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# Economic Contribution of Forestry Sector to National Economy in Nepal

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**Abstract:** Forests are major sources of energy, timber and non-timber forest products, medicinal and aromatic plants, hydrological functions, biodiversity conservation, and also fundamental sources of revenue collection to the nation. Studies indicate that forests could significantly enhance economic growth and create employment opportunities for local communities under intensive management. This paper aims to predict the contribution of the forest sector to the national economy. The economic facets of forestry considered in this paper are revenue generated from timber, non-timber forest products (NTFPs) and medicinal and aromatic plants (MAPs), and protected areas. The ARIMA model was used to forecast the economic contribution of the forestry sector. The study found that the total revenue generated from the selling of timber and fuelwood (USD 50.19 million) was higher than the total revenue collected from protected areas (USD 37.58 million) and NTFPs/MAPs (USD 6.9 million) in the past 15 years. The model projected that the mean revenue for the timber and fuelwood sale will USD 3.5 million for the next ten years. Similarly, the mean revenue will be generated about USD 0.5 million and USD 6.2 million from NTFPs/MAPs and protected areas, respectively, for the next ten years. The study limits to take account the in-kind use of forest products such as timber, fodder, fuelwood, etc., as used by community people within a forest users' groups. Thus, practicing sustainable forest management, enabling policy documents, establishing forest-based industries, establishing forestry nurseries, conducting agroforestry practices, and tenure security could enhance the forestry sector's economic aspects.

**Key words:** economy; revenue; timber; non-timber forest products

## 1 Introduction

Forestry is an all-embracing land-use system in Nepal, where forest occupies 40.36%, and shrubs cover 4.38% of Nepal's total land area (DFRS, 2015). These forest resources provide an array of essential commodities to human beings with direct and indirect benefits. The direct economic benefits include various types of forest products for different uses like timber, mainly for the construction of houses, poles for agricultural tools, fuelwood for energy; fodder, grass, and leaf litter for livestock rearing and preparation of compost fertilizer; bamboo and thatching for roofing; medicinal plants for pesticides; and other non-timber forest

products (NTFPs) for income and employment generation. The indirect benefits include serving as important ecological functions such as biodiversity conservation, water regulation functions, erosion control, providing clean air, wilderness activities, and carbon dioxide consumption and spiritual respite (FAO, 2009). Besides, forests are the natural habitat of various types of flora and fauna. So, the government has declared certain areas of the national forests as protected areas (national parks, conservation areas, buffer zones, and wildlife sanctuaries), which could play an important role in the development of eco-tourism and environmental protection. Forests, at the same time, in addition to providing a

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source of income, may contribute to alleviating the poverty of rural households' by providing safety nets in times of scarcity (Angelsen and Wunder, 2003; de Sherbinin et al., 2008; Ranjit, 2011; Rayamajhi et al., 2012).

Although Nepal's forestry sector has a high potential for the economic development of the country, the contribution to Gross Domestic Product (GDP) and the current trend of forest resource in the revenue generation is negligible (Dhungana and Bhattarai, 2008). As a result, the contribution of the forestry sector has been underestimated or poorly understood, and the forestry sector could not make its strong policy profile in Nepal. The national planning commission generally calculates forestry's contribution to GDP by combining forestry with agriculture and fisheries. The three sectors (forestry, agriculture, and fisheries) together contributed to about 39.3% of GDP during the Ninth Five-year Plan period (1997–2002) (NPC, 2002). In the Tenth Five-year Plan (2002–2007), the contribution had dropped to 34.9% (NPC, 2007). Likewise, the contribution of the agriculture, forestry, and fisheries sector in the fiscal year 2018/19 is estimated to be 26.98%, and this contribution was 27.59% in the fiscal year 2017/18 (MoF, 2019). Similarly, in the forest sector policy 2000, it is noted that the forest sector alone has contributed 15% to the GDP of nation. FAO (2004), in contrast, estimated a contribution of just 3.5% in 2000 and 4.4% for the periods from 1990 to 2000. FAO estimation includes formal forest sector activities such as logging and wood industries only, and informal activities are ignored. Again, the Department of Forest Resources and Survey (DFRS) and Nepal Foresters' Association conducted a combined study that reveals that the forest sector may contribute up to 28% of the total GDP (DFRS/NFA, 2008). Having more than 100 types of plant species harvested in Nepal being traded in international markets, especially in India, NTFP-based enterprises contribute almost one-third of the forestry GDP (AEC/FNCCI, 2012). They account for more than 90% of the total households income in rural parts of Nepal (Bista and Webb, 2006).

In Nepal, the economic contribution of forest resources is assessed on the basis of quantity produced, traded, and revenue generated out of three major types of forest products, i.e., timber and firewood, NTFPs, and Medicinal and Aromatic Plants (MAPs) (Rai and Chapagai, 2014). In rural communities, timber constitutes an important building material, and a major share of energy is derived from fuelwood. Additionally, NTFPs, including MAPs, provide both household consumption and market products (Kanel and Dahal, 2008). However, these multiple benefits have not been adequately considered in the national accounting system, despite their importance to the national economy. How these numerous benefits might be supplied in a sustainable way for economic activities and livelihood promotion is the main issue in the policy debate regarding forestry sector development of Nepal (Kanel and Dahal, 2008).

Timber and fuelwood constitute two important forest products in Nepal. They are an important source of cash earning and means to improve the livelihood of local people. Most of the timber and fuelwood production is consumed domestically. Exporting timber is expensive as there is a 200% sales tax on the royalty rate. The volume of timber collection and sale depend on various external factors such as trees uprooted through heavy winds, an illegal felling of trees, and the harvesting of trees at the construction of priority projects, etc. (Amatya, 2013). Nepal has small commercial wood production and trade compared to high-scale timber exporting countries like Malaysia and Indonesia. Accurate and complete data on total production and sale of forest product imports and exports are difficult to obtain due to poor database management by the data administrator and the existence of illegal internal markets within Nepal and neighboring India and Tibet (Satyal, 2004). So, these illicit logging of timber and trade activities should be addressed adequately on time by the authorities; otherwise, it has an adverse effect on the economic and environmental dimensions of the forestry sector in Nepal.

Realizing the importance of forest products for contribution to the national economy and having gaps in data of exact revenue collected through these products, this paper attempts to answer the following questions; what amount of revenues were generated from the major forestry sectors in the last 15 year? What will be the revenue status in the next ten years, and what factors are limiting revenue generation? The study's findings could help policymakers and forestry practitioners to make evidence-based policies in improving Nepal's forestry sector.

## 2 Methodology

This study has two main folds: 1) Illustrated the last 15 years revenue data from the timber and fuelwood sale, NTFPs/MAPs sale, and revenue generated by protected areas (PAs); 2) Forecasted the revenue generated from that categories.

### 2.1 Data source

The present study uses the data of forest products revenue and protected areas revenue, which were collected from the "*Hamro Ban*"—An annual publication of the Department of Forests and Soil Conservation (DOF) and the Department of National Parks and Wildlife Conservation (DNPWC). We gathered the last 15 years of revenue data generated from the selling of the timber and fuelwood, NTFPs/MAPs, and also 15 years of revenue collected from PAs of Nepal (Table 1). The amount of timber and fuelwood collection and selling includes the production of the Division Forest Offices (DFOs), Timber Corporation Nepal (TCN), and District Forest Product Supply Board (DFPSB). The data excluded the revenue generated from the selling of timber and fuelwood from private forests.

Table 1 Quantity of timber, fuelwood, NTFPs/MAPs sale and revenue generated from them between 2003 to 2017 in Nepal.

S.N.	Fiscal year	Revenue from timber and fuelwood sale			Revenue from NTFPs/MAPs sale		Revenue from PAs
		Timber sale (m <sup>3</sup> )	Fuelwood sale (m <sup>3</sup> )	Revenue (×10 <sup>3</sup> USD)	NTFP and MAP sale (t)	Revenue (×10 <sup>3</sup> USD)	Revenue (×10 <sup>3</sup> USD)
1	2003/2004	52127.88	32050.00	3887.63	7574.63	386.45	687.94
2	2004/2005	32538.09	27173.10	2574.46	5349.42	681.85	486.67
3	2005/2006	NA	NA	NA	NA	NA	563.73
4	2006/2007	35773.17	25762.05	2783.74	20804.20	477.57	825.39
5	2007/2008	35105.66	23400.05	2642.63	44580.33	1038.73	1029.14
6	2008/2009	36247.64	26660.14	3117.70	33294.67	869.56	1182.16
7	2009/2010	33191.42	19157.41	2855.44	32503.32	617.10	1225.41
8	2010/2011	1569.41	5090.57	213.62	6226.83	438.16	1832.71
9	2011/2012	19047.55	6186.33	3314.79	10618.59	239.67	2256.68
10	2012/2013	22309.76	9156.51	5374.51	10188.54	339.10	4114.34
11	2013/2014	19485.42	15834.18	5356.73	21153.39	746.45	4633.80
12	2014/2015	8751.18	4948.55	2599.45	3079.02	265.16	4702.43
13	2015/2016	15889.83	8993.27	4348.80	8819.88	376.50	3056.93
14	2016/2017	15105.15	79131.80	2906.12	1653.05	NA	4815.93
15	2017/2018	32357.26	25502.88	8214.32	5234.88	407.69	6161.79
Total revenue				50189.94		6913.65	37575.05

Note: Source: DOF, DNPWC 2003–2018; NA: data not available; 1 USD = 114.56 NRS on December 1, 2019.

In addition, several literature reviews were carried out through published and unpublished reports and articles of the Ministry of Forests and Environment, Forest Research and Training Center, related studies, project reports, and office records. The keywords for the review were economy, forestry sector, timber sale, protected areas, and NTFPs/MAPs. Similarly, related acts, regulations, forest policies, guidelines, and directives were also reviewed to draw relevant information. Additionally, personal interaction with forestry professionals and private sector personnel were also conducted to know their perspectives about the economic aspects of the forestry sector.

## 2.2 Data analysis

For the data analysis of revenue from the selling of timber, NTFPs/ MAPs, and PAs, we used Autoregressive Integrated Moving Average (ARIMA) model. This model was employed for forecasting the revenue, which will be generated for next ten years. Before employing the ARIMA model, we have tested serial correlation to examine the presence or absence of autocorrelation in data. We performed the Box-Ljung test using `auto.arima()` and `forest` function of the forecast package of R. The results of the `Box.test()` function shows that they were not significant at 0.05 level of significance, suggesting that there was no autocorrelation between the observations. This result assured that ARIMA model appears to fit the data well. In addition, as we used `auto.arima()` function, the ARIMA always gives the best model to forecast.

## 2.3 Model specification

The forecast has been carried in ARIMA model, which is a commonly used for time series data analysis. The ARIMA model can be classified as an “ARIMA ( $p, d, q$ )” models, where  $p$  is the number of autoregressive terms,  $d$  is the number of non-seasonal differences needed for stationarity, and  $q$  is the number of moving average terms. The forecasting equation for  $\hat{Y}_t$  can be illustrated as:

$$\hat{Y}_t = \mu + \Phi_1 Y_{t-1} + \dots + \Phi_p Y_{t-p} - \theta_1 e_{t-1} \dots - \theta_q e_{t-q} \quad (1)$$

where,  $\hat{Y}_t$  is the variable that is explained in time  $t$ ;  $\mu$  is constant;  $\Phi$  is coefficient of each parameter  $p$ ;  $\theta$  is coefficient of each parameter  $q$ ;  $e_t$  is residuals or errors in time  $t$ .

A time series ( $\hat{Y}_t$ ) generated by an ARIMA ( $p, d, q$ ) process with mean  $\mu$  of the Box-Jenkins model formulation includes four steps:

- (1) Model identification: Identification of the ARIMA ( $p, d, q$ ) structure. Use autocorrelation function (ACF) and partial autocorrelation function (PACF) to derive the tentative function.
- (2) Model estimation: Estimation of the unknown model parameter of the tentative function.
- (3) Model diagnosis: Diagnostic checks are applied with the object of uncovering possible lack of fit and diagnosing the cause.
- (4) Forecasting with the model: Forecasting for one or several periods of time from the selection model.

It is assumed that  $\alpha_t$  are independent and identically distributed as normal random variables with mean 0 and variance  $\sigma^2$ . If possible, at least 50 observations should be used in this model. In this study, however, outcomes from forests are uncertain and change rapidly, forecasting future situations was carried out by using little data in a short span of time. So, it is hard to confirm that the data is a normal distribution. So, this assumption has limitations. This model uses the concept of measurement error to deal with the difference between estimators and observations, but these data are precise values and do not include measurement errors.

Specifically, the revenue generated from the Timber and NTFPs/MAPs sale were forecasted by ARIMA (0, 0, 0) model. This model indicates there is no differential order to become stationary and also has neither AR terms nor moving average order. So, this is the general time series model.

However, for the revenue generated from the Protected Areas, random walk model was used to forecast This ARIMA (0, 1, 0) is also a special case of ARIMA model, where AR and MA term are zero and present the first difference of series, where coefficient ( $\Phi$ ) of first lagged is one. Typically,  $\Phi$  should be less than 1. However,  $\Phi$  is equal to 1 in this special random walk model. Hence, ARIMA (0, 1, 0) represents the random walk model.

$$\hat{Y}_t - Y_{t-1} = \mu \tag{2}$$

$$\hat{Y}_t = Y_{t-1} + \mu \tag{3}$$

where,  $\hat{Y}_t - Y_{t-1}$  is first difference and  $\mu$  is constant term.

In order to find the best possible ARIMA fit to the time series model, the `auto.arima()` and `forecast` function is used from the package named `forecast`. Box Ljung function: Our data sets ARIMA (0, 0, 0) best fit, R internally comparison automatically and this is the best in our model.

### 3 Results

#### 3.1 Revenue from timber and fuelwood

Volumes of timber and fuelwood production and revenue generated for the last fifteen years were not regular. The total revenue of the last 15 years has been calculated as USD 50.19 million with an annual average revenue of USD 3.3 million (Table 1). In the fiscal year 2010–2011, the revenue generated from the selling of timber and firewood was extremely low (USD 0.2 million) in comparison to the following fiscal years. The revenue from timber selling remained stable in the fiscal year 2012–2013 and 2013–2014 but sharply fluctuated in other fiscal years. This may be due to poor governance in timber collection, data management system, and trade or not accounting for all the quantity of timber and fuelwood collected and traded from the DFOs to the government accounting system.

The ten-year forecast of revenue generated from the selling of timber has been carried out in ARIMA (0, 0, 0) model (Fig. 1). The mean revenue for next ten years will be con-

stant at USD 3.5 million between USD 0.35 million (lower) and USD 7.1 million (higher) at 95% confidence interval.

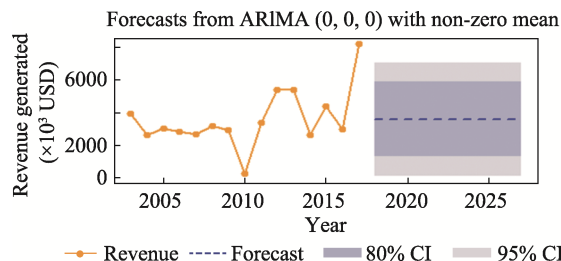


Fig. 1 Revenue forecast from timber and fuelwood for next ten years

#### 3.2 Revenue from NTFPs/MAPs

The total amount of NTFPs/MAPs traded for 15 fiscal years from DFOs in Nepal has been estimated as 211080.75 t, and the total revenue for the 15 years has been calculated as USD 6.9 million, which was considerably lower than that of revenue from timber. The production of NTFPs/MAPs was nearly stable in the fiscal year 2011–2012 to 2013–2014, getting higher in the fiscal year 2014–2015 and sharply declined in the following fiscal years. This may be due to either low production of resources or illegal collection and trade by local people and not included in the national accounting system (Table 1).

The ten-year forecast of data has been carried in the ARIMA (0, 0, 0) model (Fig. 2). The forecasting for the revenue from NTFPs/MAPs for the next ten years will remain USD 525670 for every year. The mean revenue will lie between USD 76740 (lower) and USD 974600 (higher) at 95% confidence interval.

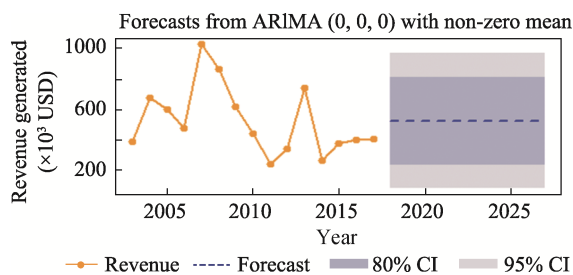


Fig. 2 Revenue forecast from NTFPs for next ten years

#### 3.3 Revenue from Protected Areas (PAs)

Nepal has been renowned in the world for its vast array of biodiversity, which is conserved in the protected areas. Nepal has 20 protected areas, among which 12 national parks, 6 conservation areas (three managed by NTNC, two by the government of Nepal, and one by the community), one wildlife reserves, one hunting reserve, and 13 Buffer zone areas, comprising the 23.39% of the total area of the country (DNPWC, 2017).

The total revenue from protected areas for the last 15 years has been calculated as USD 37.57 million with an

annual average revenue of USD 2.5 million (Table 1). This trend of revenue has been seen in steadily increasing order. According to the ARIMA, the total mean revenue for protected areas will be higher (USD 6161790) as compared to timber and fuelwood (USD 3546260) and NTFPs/MAPs (USD 575670). The ten-year forecast of data (Table 2) has been carried in the ARIMA (0, 1, 0) model (Fig. 3).

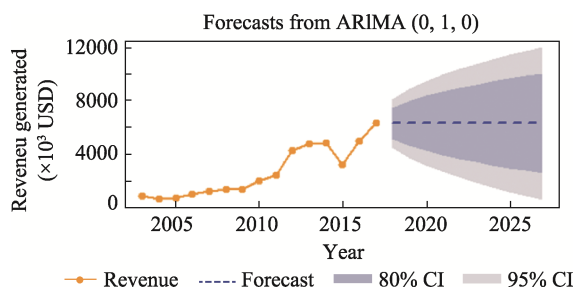


Fig. 3 Revenue forecast from PAs for next ten years

Table 2 Ten-year forecast of revenue from Protected Areas in Nepal

Year	Point Forecast ( $\times 10^3$ USD)	Lower CI* at 80%	Higher CI* at 80%	Lower CI* at 95%	Higher CI* at 95%
2018	6161.79	4971.91	7351.67	4342.02	7981.56
2019	6161.79	4479.04	7844.54	3588.25	8735.33
2020	6161.79	4100.85	8222.73	3009.86	9313.72
2021	6161.79	3782.02	8541.56	2522.25	9801.33
2022	6161.79	3501.13	8822.45	2092.66	10230.92
2023	6161.79	3247.18	9076.40	1704.28	10619.30
2024	6161.79	3013.65	9309.93	1347.13	10976.45
2025	6161.79	2796.29	9527.29	1014.70	11308.88
2026	6161.79	2592.14	9731.44	702.48	11621.10
2027	6161.79	2399.05	9924.53	407.17	11916.41

Note: \* CI means confidence interval.

## 4 Discussion

Among the three sectors of forestry, revenue generated from timber and fuelwood contributed the highest proportion to the national economy of Nepal. The production of timber and fuelwood are mainly from community-based forest management (such as Community Forestry Users' Group and Collaborative Forest Management) and only a small quantity from government-managed forests. The study shows that revenue generated from timber and fuelwood sale has been increasing in trends. However, the timber and fuelwood marketing are highly inefficient due to the low stumpage values, policy constraints on harvesting, less market value of softwood, and high transaction costs. Additionally, there were issues associated with local communities' organizational and institutional capacity for getting benefits from the forest resources (Rai, 2010). Similarly, Macqueen (2010) reported that Community Forest Users' Groups (CFUGs) in Nepal are deficient in knowledge/skill/capacity, technical know-how, financial resources, materials,

and equipment for carrying out forest management operations. Our study also found that the annual revenue generation for timber and fuelwood selling is quite less (average revenue per year is USD 3.3 million). The reason for minimal economic outcomes may be due to the issues of forest governance, conservation-oriented forest management practices, and poor involvement of the private sector in marketing and harvesting of forest products (Poudyal et al., 2013; Gritten et al., 2015; Sharma et al., 2017). Also, as forest resources are one of the fundamental means for rural livelihood, the political leaders may consider these resources as important means to impress local people that they are giving much attention to forestry issues (Poudyal et al., 2019). Furthermore, they make frequent and unpredictable changes in policies and plans in Nepal that ultimately discouraged forest government officials in timber management that, in fact, increased uncertainty and created ambiguity in the timber market (Paudel et al., 2014b).

Further, Banjade et al. (2011) pointed out that revenue from forests contributed significantly during the early years of development planning in Nepal, and the timber-based economy has been getting a smooth increment since the late 1990s. However, due to the limited capacity of government personnel to implement the forestry-related policies and regulations and also due to political instability, this sector yet to getting many benefits. Also, the illegal logging and corruption involved in the collection and trade of timber and fuelwood are not appropriately monitored due to which people are not taking advantage of forest resources.

The ten-year forecast of total mean revenue from NTFPs/MAPs in our study was calculated as USD 525670, which is significantly lower than that of the mean total revenue (USD 3.5 million) from timber and fuelwood. A similar result had been presented in a study conducted by Devkota (2006). Devkota (2006) illustrated that the contribution of timber and fuelwood in government royalty was over 80%, followed by NTFPs like sand and gravel was 16.5%, and Maps was only 3.5%. The World Bank (1994) also illustrated that community forests have promising potential through timber and NTFPs. Also, NTFPs have a significantly higher level of incremental benefits than from timber with an intensive forest management regime.

The study found that NTFPs/MAPs contributed the lowest proportion in the national economy compared to revenue from timber and revenue from protected areas. Also, the study shows that there are decreasing trends in the revenue generated by NTFPs. Due to limited research and information on NTFPs, bureaucratic hassles for its easy trade, the burden in trans-boundary trade, the nontransparent market, low technology for processing are some of the complaints with NTFPs/MAPs collection and marketing (Banjade and Paudel, 2008). Similarly, the study carried by Shackleton and Pandey (2014) found that factors such as overexploitation, illegal trade, the lack of advocates for NTFPs operating

within national policy arenas, raw extraction, unsustainable harvesting are some of the issues for not getting enough revenue.

The NTFP/MAPs sub-sector has been one of the important centers of discourse, which has been increasingly attracting the attention of both rural local people and the private sector as it has the potential for high revenue that can be fetched in the global market. It harbors several stakeholder groups ranging from collectors, local mediators, rural traders, urban traders, exporters, government agencies, private sectors, and I/NGOs. So, formulating sustainable resource use management plans, guiding local communities, collectors, and harvesters towards sustainable harvesting practices, conducting training on product development and value addition processes may add marketing opportunities for NTFPs (Laird et al., 2011).

Another most important source of revenue for the government of Nepal is protected areas. The total mean revenue from PAs has been quite higher than NTFPs and timber. PAs are not only the home for varieties of wildlife species but also the destination for tourist attractions in different geographic regions and can contribute sustainable economy to the local and national level (Nyaupane and Paudel, 2011). The entry fees charged on visitors to access PAs can be an important source of revenue for park management and local development, so the visitors are one of the most important sources of revenue in the PAs (Alpizar, 2006). The 30% to 50% of the revenue of PAs goes for community development and conservation programs in the respective Buffer Zone (BZ). Besides, they have other sources of income, too, such as ecotourism activities in the BZ areas and the sale of forest products harvested from the BZs (Dhungana and Bhattarai, 2008).

If we see the PAs based revenue generation scenario in the different fiscal year, it showed some disparity despite all these PAs having significant geographical, cultural, and other physical attractions that tourists can experience. This inequality in revenue generation may include a lack of proper transportation facilities, lack of reliable and intense infrastructural facilities for tourists, and illogical government policies. The disparity may also be due to the discrepancies in entry fees described in the National Parks and Wildlife Conservation Act 1973 and which was very nominal too. So, the policy for the entry fees to the PAs and BZ management policy should be reviewed periodically by the DNPWC for the smooth functioning of PAs and also for the improvement in the revenue generation (Pandit et al., 2015). To improve the revenue generation from PAs, several challenges like park people conflicts, poaching, overexploitation, illegal hunting, and management of human and financial resources should be overcome.

Besides the direct benefit of forest products in the national economy in terms of revenue generation presented above, there are some of the indirect benefits of forest re-

sources such as payment for environmental services (PES), forest sector enterprise development, and forest sector employment. The PES is another potential source of revenue in the forestry sector and especially connected with carbon sequestration, recreational use, biodiversity conservation, scenic beauty, watershed protection, soil formation, pollination and colonization (Swallow et al. 2005; Subedi and Singha, 2008 cited in Pandey et al., 2010). These environmental services can be counted as positive externalities as people do not directly pay for using these resources. However, biodiversity conservation and watershed protection are still considered complicated for calculating the benefits for payment (Dhungana and Bhattarai, 2008). Similarly, forest-based micro and small enterprises have contributed to the economic enhancement and upliftment of various households in Nepal (Pandit et al., 2009; Bajracharya et al., 2013) as well as for the overall community development (Timsina, 2005). After consumption at the local level, forest products can also be exported for revenue generation. A study showed that the value of forest products exports had been raised (USD 35 million in 2011) during the 1990s to 2011 (FAO, 2014). These forestry enterprises contribute significantly to employment generation in Nepal. The private sector involving in the forestry provides nearly 99000 formal full-time jobs per year, whereas Community-Based Organizations (CBOs), including CFUGs, Leasehold Forestry (LF), Buffer Zone Forest Management Committees and Collaborative Forest Management Groups (involved in production functions provide about 31000 jobs making a total of 130000 jobs (MSFP, 2014). This figure manifests that forestry has been the great potential for employment generation if it has continuous and proper management. The study's findings are based on the availability of recorded data. The data did not accompany the forestry sector contributed within the forest users' groups. It is because the government has not been collecting the royalty from the community people, those use forest product within the CFUGs (not traded in the markets). As CFUGs have not given the royalty to the government, many community people used timber, fuelwood, fodder, and other forest products that were not accounted. So that, we claim that the forestry sector's actual contribution should be more than the study's result. In addition, the study has two major constraints that limit this study's findings. First, the lack of monthly or quarterly data over the study period meant that we were unable to conduct the major tools using time series data analysis. We attempted to partially compensate for this by doing the necessary statistical analysis to validate the information. Second, revenue data was not regular because of regulatory factors (e.g., political scenario, policies), environment fluctuation (e.g., earthquake, natural hazards), and a weak data management system to record the revenue data regularly.

## 5 Conclusions and policy recommendations

The study showed that the direct contribution of the forestry sector to the national economy is minimal. However, revenue collected from timber contributed the highest proportion among the revenue from NTFPs and PAs. The study also found that revenue generated from timber sales, NTFPs, and PAs has increased in the last 15 years. Nevertheless, the mean revenue forecast for timber and NTFPs will be constant for the next ten years, but PAs revenue will be increased. To expand the forestry sector's contribution in national economy, the government should be carried out intensive forest management practices such as practicing sustainable forest management, implementing agro-forestry practices, establishment of forest-based industries, and high-tech nurseries. In addition, policymakers should create an enabling environment by updating policy documents, a rewarding mechanism for forests depending communities, and securing tenure right for the community to enhancing the forestry sector's economic aspects. For instance, current policies ban harvesting and trade of certain timber and NTFPs, and have a lengthy timber export process, which should be addressed soon. This paper leads to additional future research possibilities. Future research might include the use of more detailed and longer-term revenue data of the forestry-sector in the analysis. Also, it is important to consider the indirect benefits of forest resources in monetary terms that give a more reliable contribution to the country's economy.

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## 尼泊尔林业部门对国民经济的经济贡献

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**摘要:** 森林是能源、木材和非木材林产品、药用和芳香植物、水文功能、生物多样性保护的主要载体, 也是国家税收的基本来源之一。研究表明, 森林可以极大促进经济增长, 并在集约化管理下为当地社区创造就业机会。本文旨在预测森林部门对国民经济的贡献。本文研究的林业经济主要是指木材 (timber)、非木材林产品 (NTFP)、药用和芳香植物 (MAP) 以及保护区产生的收益。ARIMA 模型可用于预测林业部门的经济贡献。研究发现, 在过去 15 年中, 木材/薪材销售的总收入 (5019 万美元) 高于保护区 (3758 万美元) 和非木材林产品的收入 (690 万美元)。该模型预计, 未来十年木材和薪材销售的平均收入将为 350 万美元/年。同样, 在未来十年中, NTFPs/MAPs 和保护区的平均收入将分别为约 50 万美元/年和 620 万美元/年。因此, 实践可持续的森林管理, 建立林业苗圃, 实施农林业实践以及明晰林业权属, 建立以森林为基础的产业, 可以改善林业部门的经济状况。

**关键词:** 经济; 收入; 木材; 非木材林产品