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Original article

Economic Potential of Timber Production from Yargey Community Forest under Tsirang District in Bhutan

Tshering Gem

Faculty of Forestry, Kasetsart University, Chatuchak, Bangkok, 10900, Thailand
E-mail: gem.40@hotmail.com

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ABSTRACT

A field survey was conducted during the spring of 2010 to study timber production and investigate the financial return of timber sales from Yargey community forest in the Tsirang dzongkhag (district) in Bhutan. In total, 71 respondents were randomly selected for interviews using stratified random sampling by target groups namely, the community forest management group, household furniture/sawmill owners, general timber consumers and contractors. Data were gathered by employing semi structured interviews.

Demand and prediction functions were determined and the Durbin-Watson statistical test was employed for testing serial correlation in the demand function. The results showed that demand for timber was dependent on the timber price with an R^2 value of 93.73. The timber price coefficient (60.3036) was significant at the 0.01 level. Analysis of the marketing channels of the timber products indicated that 89% was used for domestic consumption and 11% for marketing purposes. The financial analysis revealed a profit of Nu 151.92/m^3 and 1,581.37/m^3 from = 7.56 m^3 of timber and lumber production, respectively (Nu 44.45 = USD 1). Profit from sale of a sofa set was the highest at Nu. 3931.30.

Keywords: economic potential, community forest, Tsirang, Bhutan

INTRODUCTION

In Bhutan, some community forest management groups, including Yargey community forest, have already started selling timber from their community forests. In this context, there have been limited studies done in the past with very few involving financial analysis, which was a major problem. Without any background on this aspect, the community forest management groups might even sell their timber and incur losses. Thus, this study was considered to be important as its research findings would provide timely help to community forest management groups and guide them in achieving better timber production and marketing opportunities in the long run. In addition, there was undoubtedly great interest at the community level in selling timber where the management plan allowed for this, leading to maximizing benefit to the community. In spite of this opportunity, timber sales have been very low. Further, no any financial analysis has been conducted in other districts where timber has been sold in the past.

Income generation was one of their main objectives of a community forest management plan (Social Forestry Division, 2008). Two main underlying principles of the community forest program were that the community forest management groups would be able to fulfill their timber requirements and to generate income through the sale of excess timber (Department of Forest, 2004). The experience gained from the community forest program confirmed that rural communities were indeed effective forest managers (Social Forestry Division, 2010).

The price elasticity of demand is a measure of the sensitivity or responsiveness of the quantity of the good or service demanded to changes in its price (Wessels and Walter, 2000). The formula for the price elasticity of demand (Ed) for goods can be expressed by Equation 1:

$$Ed = \frac{P}{Q} \times \frac{dQ}{dP} \quad (1)$$

where: P = price of lumber, and Q = quantity demand for lumber.

The demand equation is a mathematical expression of the relationship between the quantity of a good demanded and those factors that affect the willingness and ability of a consumer to buy the good. The demand equation can be expressed by Equation 2:

$$Qd = f(P;\ P_{rg},\ Y) \quad (2)$$

where: Qd = quantity of a good demanded, P = price of the good, Prg = price of a related good, and Y = income.

Fight and Youngday (1977) studied the effect of changes in the price of logs and income on the percentage of expenditure for logs to the total expenditure of low and high income consumers. They concluded that when the price of consumer goods and services changes, the effect on the consumer was equivalent to a change in income, which may be distributed differentially to the high and low income consumers.

Dorji and Phuntsho (2007) studied timber sales from community forests in Mongar and Bumthang in Bhutan. The study revealed that there were several options for timber sale, such as auction and direct sale, which would benefit the community forest management groups. Furthermore, based on the present timber market demand and price, the community forest management groups had a good opportunity to earn cash income from the sale of surplus timber and thus enhancing the livelihood of the community.

The objectives of the present research were to assess the supply of timber from the community forest, as well as to assess the demand of timber from the community forest management group and other stake-holders, such as, household furniture/sawmill owners, general timber consumers and contractors. The study aimed to undertake financial analysis of timber and furniture production from the community forest. As reflected in the community forest management plan, the community forest management group's own low demand for timber from their community forest and the huge excess of timber stock within the community forest for income generation motivated this study.

MATERIALS AND METHODS

A field survey was conducted in the spring of 2010 in Yargey community forest, Patshaling village in the Tsirang district. The community forest lies at an altitude ranging from 600 to 1900 m above sea level. Soil types in Patshaling village are mainly sandy clay and loam. The area is well

drained and has moderate to low fertility (Yargey Community Forest Management Group, 2008).

The information used in the present study was obtained from various secondary sources - namely, the Yargey Community Forest Management Plan, the Tsirang Dzongkhag, and the Gyeltshen furniture house, Gelephu, Bhutan. The timber production from the community forest was computed from the timber resource assessment data compiled from the Yargey Community Forest Management Plan. The total average timber volume production was calculated with the help of a volume table from the Forest Resource Development Division in Bhutan.

A semi structured interview was employed with community forest management group members, contractors and general timber consumers to collect information on their perceptions of annual timber demand from the community forest. A questionnaire survey was undertaken with the Lucas mill and furniture house owners to gather information on financial analysis from timber and furniture sales.

The data gathered from the study were computed with the help of tables and further analyzed using both descriptive and quantitative statistical tools such as percentages and regression analysis.

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RESULTS AND DISCUSSION

Demand and Supply of Timber

Demand theory states that the quantity of a good demanded is a function of its price, the price of substitutes, population and income. The quantity of a good supplied is also a function of its price and the price of inputs in the production process (Hoamuangkaew, 1978). Based on the field survey, the study indicated a timber volume supply of 204.47 m^3 in 2009 based on the demand from various stakeholders (Table 1) and timber volume production of 26,547.78 m^3 in standing form within the community forest (Table 2).

Table 1 Potential timber production from the community forest by type of purchaser in 2010.

Timber purchaser	Quantity of timber (m^3)	Percent
Community forest management group	131.98	88.65
Contractor	10.95	7.36
General timber consumer	5.94	3.99
Total	148.87	100

Table 2 Standing volume of individual timber species in the community forest in 2010.

Timber species	Quantity of timber (m^3)	Percent
Castonopsis spp.	10 711.30	40.34
Michelia cathcartii	3 637.79	13.70
Nyssa javanica	1 331.62	5.02
Daphnephyllum- himalayense	965.92	3.64
Others	9 901.16	37.30
Total	26 547.79	100

Estimated Regression Coefficient of Demand Function for Quantity of Demand for Timber in Favor of Furniture House

Wangchuk and Marina (2008) studied the area size required for each forest type in order to fulfill the basic timber requirements of a community forest management group and the income generation from the sale of excess timber. The present area ceiling of 2.50 ha per household in accordance with government standards (Royal Government of Bhutan (2006)) was a limiting factor for income generation opportunities in the near future. Wangdi (2009) provided evidence in support of the arguments of Wangchuk and Marina (2008) that the ceiling of 2.50 ha per household limited the ability of community forest management groups to manage their forests for income generation. The participants of the National Community Forest Workshop held in April 2009 and the National Community Forest Strategy (Gilmour, 2009) recommended removing the cap on the area of community forest per household for allocation, and using possible, traditional and natural boundaries for the community forest.

The demand for timber for household furniture is a function of price for timber. The coefficient of the timber price was significant at the 1 percent level. The Pt variable showed that the relation between price and demand for timber was positive (Figure 1) which means that when the timber price increased, the demand for timber also increased because demand for timber had not met the market's true demand or furniture was an essential product for the market and the price was not a factor that influenced consumption in the market.

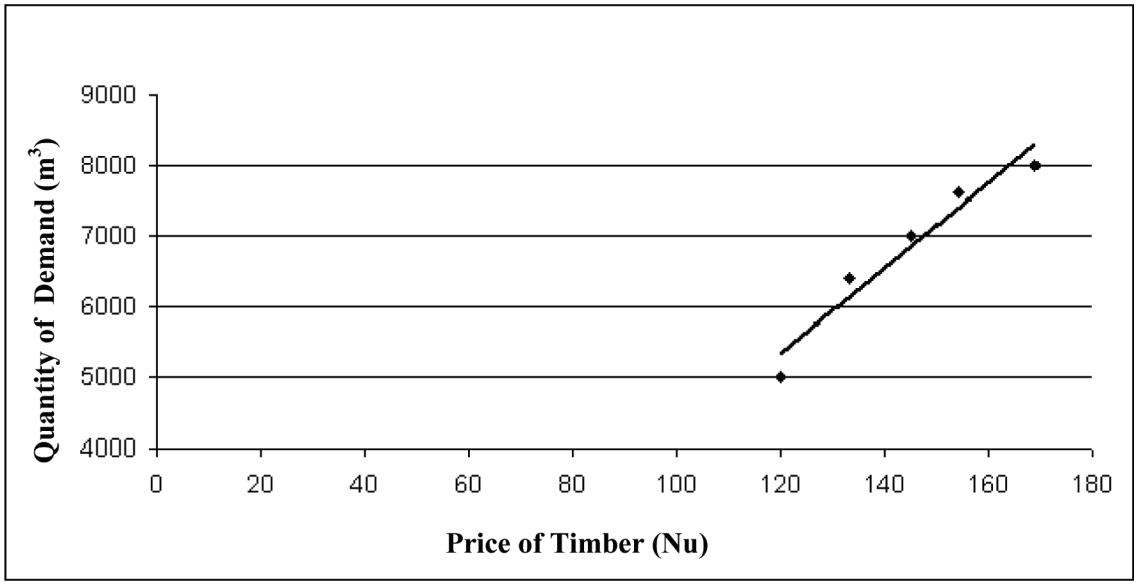


Figure 1 Relation between the quantity of demand and price for timber.

The R^2 value for this equation was 0.9373 which indicates that about 93.73% of the deviation of the dependent variable (Dt) could be explained by the explanatory variable (Pt). The Durbin - Watson test for serial correlation computed a value of 1.8866

(Table 3). Based on table for Durbin - Watson, it indicated that the critical value of 5 observations, which was almost equilibrium to 6, was the smallest number of observation. This value could be interpreted as indicating there were no problems with serial correlation in the demand function.

As there was no critical upper- and lower bound for five observations at k = 1 (intercept excluded), the study had to consider the suitability of r_a (autocorrelation coefficient) when it was near 0. The value of r_a for this equation was -0.4197, which was near 0. This indicated the suitability of equation such as F - value, P - value and standard error for estimation and visual fitness of line to plot on the graph.

Table 3 Estimated regression parameters of the demand function for timber for household furniture production.

Independent variable	Constant term	Coefficient	SE	t-ratio	R^2	DW	r_a
	-1895.783		1307.0438	-1.4504^{ns}	0.9373	1.8866	
Pt		60.3036	9.0027	6.6984**			-0.4197

Remark: ** = Significant at P< 0.01; ns = Not significant at 0.05 level; R^2 = Coefficient of determination; SE = Standard error of estimate; DW = Durbin-Watson statistical test value; r_a = Autocorrelation coefficient

Calculated by matchmatic software, the relation between the demand and price for timber was expressed as a linear equation (Equation 3):

$$Dt = -1895.7830 + (60.3036Pt) \quad (3)$$

where: Dt = Quantity of demand for timber for household furniture, and
Pt = Price of timber.

Price elasticity of demand can be calculated using Equation 4:

$$Ed = \frac{PQt}{dPt} \times \frac{\overline{Pt}}{\overline{Qt}} \quad (4)$$

Thus, Ed = 60.3036 × (144.2/6800) = 1.2787

These results indicate that a one percent change in the price for timber would increase the demand for timber by 1.2787%, that is, if price for timber was increased by Nu. 1, demand for timber would be increased by 0.0362 m^3. Similarly, if the price for timber was decreased by Nu. 1, demand for timber would be decreased by 0.0362 m^3.

Using the computer package, the relation between timber price and time was determined (Equation 5):

$$Log\ (Pt) = 2.0711 + (0.2041(logT)) \quad (5)$$

where: Pt = Price for timber, and T = Time (n=1, 2, 3,…; start year was 2005).

Table 4 Current quantity of demand for timber for household furniture, 2005 - 2009.

Year	Dt (m^3)	Pt (Nu)
2005	141.50	120
2006	181.12	133
2007	198.10	145
2008	215.08	154
2009	226.40	169
Sum	962.20	721
Annual average	192.44	144.2

Prediction of Future Price and Demand for Timber

Hoamuangkaew (1978) studied the supply and demand of the lumber market in the Philippines and tried to determine the demand and supply relationship, and prepared models for projecting consumption, production and price of lumber using time series data covering the period 1957 - 1972. From Table 4, a time trend equation of the timber price was created to predict the future timber demand (Table 5). Furthermore, from Equations 4 and 5, the price and demand of timber for the next five-year period of 2010 - 2014 was predicted (Figure 2).

Table 5 Price and quantity of demand for timber for household furniture in the five-year period 2010 - 2014.

Year	Price for timber (Nu)	Demand for timber (m^3)
2010	169.7883	236.11
2011	175.2150	245.37
2012	180.0557	253.63
2013	184.4365	261.11
2014	188.4454	267.95

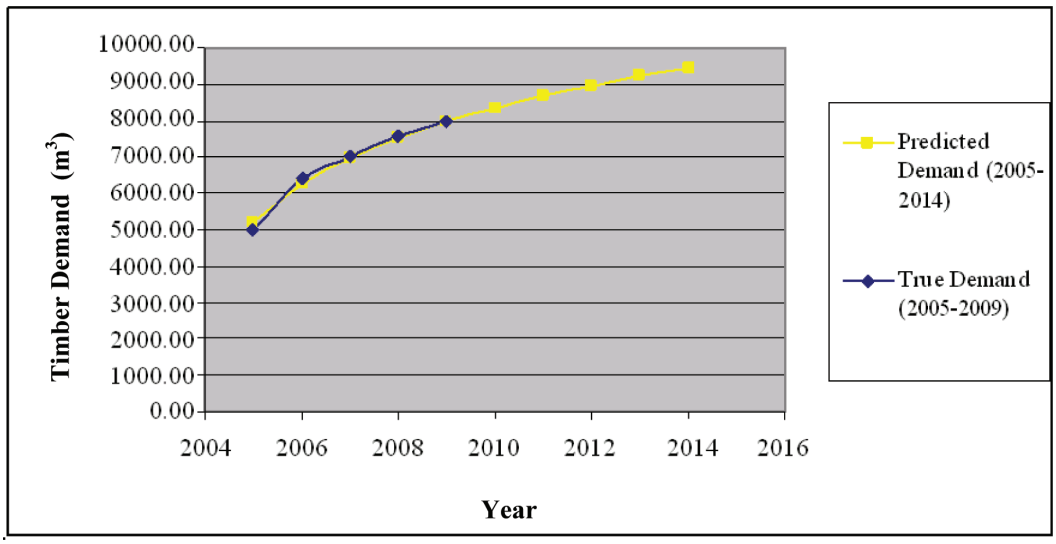


Figure 2 Prediction of demand for timber compared with the current quantity of demand for timber.

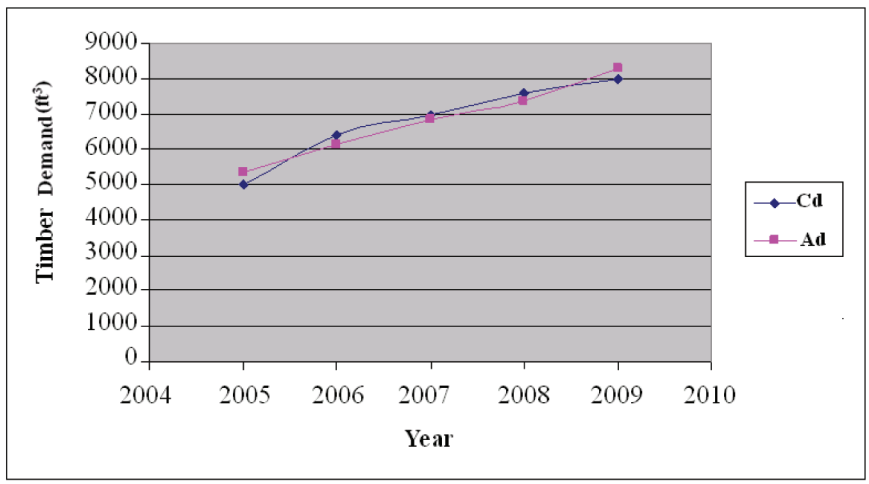
Analysis of Demand Function for Timber

Based on demand theory, when there is an increase in the price of any commodity, there is a decrease in the demand for that particular commodity. However, in the present study, it was revealed that as the price increased, the demand also increased. This was mainly attributable to the trend in timber demand, timber price and furniture price, as all three of these parameters had increased in the preceding years.

Accordingly, current and adjusted quantity of timber demand for furniture house was also determined (Table 6 and Figure 3).

Table 6 Current and adjusted quantity of timber demand for household furniture, 2005 - 2009.

Year	Current demand for timber (m^3)	Adjusted demand for timber (m^3)	Price of timber (Nu)
2005	141.50	151.15	120
2006	181.12	173.34	133
2007	198.10	193.80	145
2008	215.08	209.17	154
2009	226.40	234.78	169



Remarks: Cd = Current quantity of demand for timber

Ad = Adjusted quantity of demand for timber

Figure 3 Current and adjusted quantity of demand for timber in favor of house hold furniture, 2005 - 2009.

Potential Timber Purchasers

The field survey revealed that the annual demand of timber by sawmillers was the highest (79%) followed by contractors (21%) equivalent to amounts of 4 245 m^3 and 1 155.25 m^3, respectively (Table 7). Thus, they could be considered as potential buyers.

Table 7 Potential timber consumer by type of timber demanded in 2009.

Type of timber demander	Quantity of timber demand (m^3)	Percent
Saw miller	7 245.00	79.00
Contractor	1 155.23	21.00
General Timber Consumer	5.94	0
Total	5 406.17	100

Marketing Channel Analysis

Marketing channel analysis is a tool for understanding the benefits from natural resources and how the patterns of benefit distribution might be changed (Ribot, 1998). The study indicated that out of 148.88 m^3 of timber produced from the community forest, 131.98 m^3 (89%) was consumed by community forest management group members for their domestic use, 10.95 m^3 (7%) was consumed by contractors and 5.94 m^3 (4%) was used by general timber consumers (Figure 4).

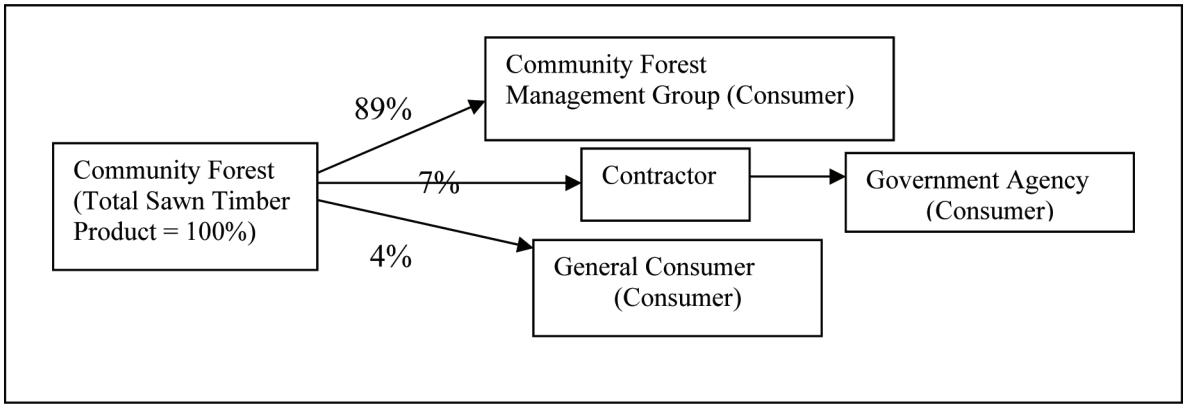


Figure 4 Marketing channels of sawn timber.

Analysis of Financial Return from Timber and Furniture Sale

Financial analysis of the costs and returns from timber sold in 2009 determined the profit using the sum of the individual costs of labor, machinery (depreciation cost), materials and transportation which were subtracted from the revenue collected from the sale of timber (Total Revenue - Total Cost = Profit). The study found that profit obtained from the sale of 16.90 m^3 of timber was Nu 50,166.07, which was relatively high, in spite of large expenses for timber harvesting and sawing. The costs were met directly from the total revenue collected from timber sales (Table 8).

Financial analysis of the costs and returns from furniture sold in 2009, computed the profit using the sum of the costs of labor, machinery (depreciation cost), materials, electricity, and transportation which were subtracted from the revenue collected from the sale of various types of furniture (Total Revenue - Total Cost = Profit). The study found that the profit obtained from the sale of sofa sets was the highest at Nu. 2,712.98 (Table 9).

Table 8 Financial analysis for costs and returns from timber and lumber production in 2009.

Item	Workday*	Wage (Nu/workday)	Value (Nu)
1. Timber production			
1.1 Labour cost for felling, debranching and crosscutting	17	120	2 040.00
Item	Quantity	Price (Nu)	Value (Nu)
1.2 Material Cost for power chainsaw			
1.2.1. Petrol (liter)			
1.2.2. Mobil (liter)	40	43.39	1 735.60
1.2.3. 2 T** (liter)	10	145	1 450.00
	2	174	348.00
Total			3 533.60
Item	No. of machine	Nu/day	Value (Nu)
1.3 Machinery cost/day			
1.3.1. Power chain saw	2	40	160.00
1.3.2. Saw chain sharpener (pieces)	2	0.66	2.64
1.3.3. Spare chain (piece)			
	1	7.70	15.40
Total			178.04
A. Total cost of timber production			5 751.64
Item	Quantity (m^3)	Price (Nu)	Value (Nu)
1.4 Total revenue from timber production			
1.4.1 Total cost of timber production × 20% of profit	7.56	25.85	6 901.96
B. Profit for timber production = (1.4 – A)			1 150.32
2. Lumber production			
2.1 Labour cost for timber sawing	90	150	13 500.00
Item	Quantity	Price (Nu)	Value (Nu)
2.2 Material Cost for Lucas mill			
2.2.1. Timber (m^3)	7.56	21.54	5 751.18
2.2.2. Petrol (liter)	160	43.39	6 942.40
2.2.3. Mobil (liter)	16	145	2 320.00
2.2.4. Saw chain sharpener (piece)	2	120	240.00
Total			28 753.58
Item	No. of machine	Nu/day	Value (Nu)
2.3 Machinery cost/day			
2.3.1. Lucas mill cost	1	450	3 600.00
2.3.2. Saw chain sharpener (pieces)	2	0.66	10.56
Total			3 610.56
Item	No. of trip	Price (Nu/TL***)	Value (Nu)
3. Lucas mill transport to site	1	3 500	3 500.00
B. Total cost of lumber production			35 864.14
Item	Quantity (m^3)	Price (Nu)	Value (Nu)
1.4 Total revenue from lumber production			
1.4.1 Total cost of lumber production × 20% of profit	160.20 x 0.03	268.64	43 036.12
Profit for lumber production (1.4 – B)	= 4.80		7 172.98

Remark: * = Eight hours in a working day
** = Lubricant used for power chainsaw operation
** = Truck load

Table 9 Financial analysis on cost and return for sofa set production from lumber in 2009.

Item	**Quantity of lumber (m^3)**	**Workdays (unit)**	**Wage (Nu/workday)**	**Value (Nu)**
1. Labour Cost				
1.1 Furniture making (sofa set):				
1.2 Sofa set making cost for carpenter	0.91	24	300	7 200.00
1.3 Sofa set making cost for helper	0.91	24	200	4 800.00
Total				12 000.00
Item	Quantity		Price (Nu/unit)	Value (Nu)
2. **Lumber cost**	0.91		250	8 827.50
3. Electricity cost	30 kW·hr		0.85	25.50
4. Lumber transportation cost	0.91		10	353.10
5. Total sofa set production cost				21 206.10
6. Total revenue from sofa set	3		11 000	33 000.00
Profit = (6 – 5)				11 793.90

Supply and Demand of Timber

The majority of the timber consumers, such as sawmillers and producers of household furniture, general timber consumers and contractors, demanded timber in sawn form, while a few wanted additional timber in log form. Considering all these facts, a direct sale could be negotiated with the relevant timber buyers. Furthermore, an auction could also be arranged based on the prevailing market demand to obtain a higher profit. Therefore, there were two options available to the community forest management group for selling timber in the near future.

Timber from Michelia cathcartii commanded the maximum demand and preference from the consumers and subsequently, the supply was comparatively high compared to other timber species. However, there was not a high abundance of standing volume of this particular species compared to other species. Therefore, the establishment of forest plantations of Michelia cathcartii on suitable open and barren areas inside the community forest should be initiated and encouraged for the future sustainability of this species in particular.

Timber Marketing Channel

Currently, the transportation of sawn timber from the processing site to the main road and loading have been carried out manually by the community members at no charge, while the transportation cost amounted to Nu. 2,100.60 at the rate of Nu. 353.36/m^3. For the timber marketing, only transportation to the main road point had to be borne by the community forest management group and then it was taken to its destination by the purchaser.

However, some of activities, like cartage and loading of the sawn timber, were not considered to be necessary, as

they were undertaken as an extra burden on the community in order to attract timber consumers in the long run. It was not seen as a healthy practice. The community forest management group was willing to ban change this strategy immediately to one of charging the loading and transportation costs as a means of earning some additional cash income. This would reduce their marketing cost and result in the best marketing performance for the community forest management group.

Financial Analysis of Cost and Return

The Yargey Community Forest Management Group members had never been involved in producing and selling timber. They lacked the necessary organizational and technical skills, and knowledge in marketing. However, the study indicated a higher profit could be obtained from lumber production than timber production with profits of Nu. 1,581.63/m^3 and Nu. 151.94/m^3, respectively. This was mainly attributable to the low cost of and high benefit from the added value of lumber production. Nevertheless, the household furniture producers could make maximum profit from the production of sofa sets, showcases and bookshelves. However, consumers demand for these goods needs to be studied.

The lack of skills and knowledge have led to some loss of profit to the contractors hired to operate the Lucas mill, to use power chainsaws, and to process the timber. This was clearly revealed from the financial analysis for 2009. Thus, it was felt important to build community forest management group capacity in market analysis and the development process to gain marketing knowledge (Thoma and Camara, 2005) and understand the production and value chains of their products. Furthermore, they should strengthen their capacity in negotiation skills; this would bring them a bigger portion of the profit benefiting the community forest management group and enhancing employment.

CONCLUSION

Based on the present timber demand and prevailing market price, Yargey community forest has good potential to generate income from the sale of excess timber in the future. The investigation of the supply and demand of timber from the community forest revealed a total standing timber volume of 26,547.78 m^3. Castanopsis species had the highest timber volume with 10,711.30 m3 (40.34%) and Daphnephyllum himalayense had the lowest timber volume with 965.92 m3 (3.64%).

The Durbin - Watson test for serial correlation produced a value of 1.8866. This indicated that, based on the table for Durbin - Watson critical value of 5 observations equilibrium to 6, that was the smallest number of observation, appeared in the Durbin - Watson table. Hence, it could be interpreted that there was no problem with serial correlation for the obtained demand function.

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