ECONOMIC ANALYSIS OF LAPSI (*Choerospondias axillaris* Roxb.) PRODUCTION IN PARBAT DISTRICT, NEPAL

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ABSTRACT

A survey-based study was conducted to assess the production scenario of Lapsi in Falewash, Parbat. Purposively selected twenty-four Lapsi entrepreneurs in Falewash Municipality, Parbat district were interviewed with a well-structured questionnaire that explored Lapsi production data in the last twelve years, which were then processed and analysed with descriptive statistics using computer software MS-Excel 2010. The average landholding size of the respondent farm households was 17.6 Ropani (0.88 ha), and 1 8% of the land was occupied by Lapsi. However, 95% of the Lapsi orchard is established in Pakho/Bari (Upland). A majority (66.7%) of the Lapsi growers were trained either for cultivation, grafting and/or processing techniques. The Lapsi productivity in Falewash, Parbat (12.7 Mt/ha) is above the national average (8 Mt/ha). A Lapsi orchard in Falewash, Parbat can be established with investing NRs. 3,762.89 per Ropani. The average annual operating cost of Lapsi orchard is NRs. 2,052.19 per Ropani, whereas the average annual gross return is NRs.15,890.57 per Ropani. The benefit-cost ratio (BCR) of 2.84, net present value (NPV) of NRs. 30,146.3 and internal rate of return (IRR) of 33% signify the economic importance of Lapsi production. Pay-Back period of eight years in Lapsi production enterprise requires a long-term plan to be established as a cash-generating enterprise. The major problems in the Lapsi production are harvesting difficulty and damage by wild animals (mostly monkeys) whereas the poor transportation facility and inadequate market information are the major marketing constraints.

Keywords*: BCR, Mada, pay-back period, Titaura*

INTRODUCTION

Agriculture is a major source of Nepalese economy, which contributes about 26.98% to the Gross Domestic Product (MoF, 2019), and the sector employs about two-thirds of the total population (MoF, 2020). Nepal is a part of a biodiversity hotspot having a unique geographic position with wide altitudinal variation and diverse climate within a short horizontal span (CBD, nd). Considering wild and cultivated species, there are over 200 fruit species in Nepal (Joshi *et al*., 2017). Lapsi *(Choerospondias axillaris)* is one of the important underutilized fruits of Nepal with social, cultural, ecological and economic importance (Poudel, 2003). Lapsi belongs to family Anacardiaceae and called as Nepalese hog plum. It is called as "*lumsi*" in Bhutan "*luppsi*" in Sikkim, "*naan swan jawo*" in China and "*chanchin modoki*" in Japan. Besides Nepal, it is also found in Eastern India, Bhutan, South-Eastern part of China, Japan, Vietnam, Thailand, Hongkong, etc. (Poudel, 2003).

Lapsi is a large and deciduous edible fruit plant (Poudel, *et al.,* 2003) and popular being native to mid-hill of Nepal (Roxburgh, 1832). It can be consumed as fresh or after processing into various items such as Candy, Pickle, Mada, Titaura, Jam etc. It is recognized as a means to generate income and improve the livelihoods of the rural community (Dhakal, 2015). Lapsi can be grown in the mid-hill regions of Nepal with altitude ranges from 1,000 to 1,500 m.a.s.l. (Kaudal, 2008). Lapsi is rich in essential amino acids, vitamin C, and minerals as potassium, calcium, and magnesium (Paudel et al. 2002). Li *et al.,* (2016) reported the

presence of medicinally important phytochemicals in both the pulp and peel of Lapsi. Besides, Protease: a proteolytic enzyme can be isolated from leaf, bark, root (Upadhyay, Magar and Thapa, 2013) and fruit pulp (Prajapati, Sharma and Agrawal, 2009) of the Lapsi. Thus, it is a potential product for national as well as international market (Paudel *et al.,* 2003).

Lapsi is cultivated in 29 hilly districts of Nepal (MoAD, 2017; Paudel, 2003). The top five commercially Lapsi producing districts are Sindhupalchok, Dhankuta, Parbat, Kavre, and Kathmandu; and total Lapsi produced in the fiscal year (FY) 2016/17 was 7,885 Mt. (MoAD, 2017). Among total Lapsi produced in the country, 9.76% was from Parbat district (MoAD, 2017). The FNCCI (2012) reported that the production of Lapsi is not sufficient to meet its market demand. Only a few studies have been undertaken on opportunities, importance, production and traditional knowledge of farmers toward Lapsi fruit (Joshi, 2017; Labh & Shakya, 2016; Seber, 2016; Chhetri & Gauchan, 2007). The study aimed to analyze the production economics of Lapsi at Falewash Municipality, Parbat district.

MATERIALS AND METHODS

After consulting Agriculture Knowledge Centre (AKC), Parbat, the study was carried out in Falewash Municipality of Parbat district. Lapsi producers at Bhagara, Sirsuwa, Sankarpokhari, Madikuwa, Thapathana, Limithana, Rugdi and Kurgha villages were interviewed. A pre-tested well-structured questionnaire was used for the survey. As the survey was intended to get the response from the most experienced Lapsi growers, twenty-four commercial Lapsi producers with at least one Ropani of Lapsi orchard and minimally four years of experience were purposively interviewed. Farmer's experience and indigenous knowledge of Lapsi production were the basis for this study. Lapsi being a perennial fruit tree, the information on the production in the last twelve years from the commercial growers were collected. Other relevant information was obtained from the secondary sources as Central Bureau of Statistics (CBS), Ministry of Agriculture and Livestock Development (MoALD), Nepal Agricultural Research Council (NARC), and other relevant publications.

Production cost of Lapsi

The variable costs include expenditure on fertilizer/manure, labour, irrigation, intercultural operations and harvesting/marketing. The land rent and cost on saplings were considered as the fixed costs. The tools and equipment used in the orchard establishment phase are spades, sickle, hoe and watering can. Tools and equipment cost includes the depreciation and maintenance cost. Total cost was calculated by adding all these expenditures on variable inputs and fixed inputs.

Total Cost = Variable Cost + Fixed Cost

Gross return

Gross return was calculated by multiplying the quantity of product sold by the average price of the product. Mathematically, Gross return is calculated by the following formula;

Gross Return (NRs.) = Price of Lapsi (NRs/kg) × Total Quantity Sold (kg)

Benefit-cost ratio (BCR)

The easiest and effective method to measure the economic performance of the enterprise is Benefit-cost (B/C) ratio. Year-wise Gross Return and Total Cost were discounted by a

discount rate of 12% as an opportunity cost to estimate the present value (PV) of the future amount as:

$$\text{Present Value} = \frac{\text{Future Amount}}{(1+\text{Discount Rate})^{\text{Number of Years}}}$$

Then, the present value (PV) of benefit and cost for twelve years of business was estimated. The PV of benefit and cost from establishment year to 12th year was summed up separately. The BCR was then calculated using the formula;

$$\text{BCR} = \frac{\text{Discounted Total Benefits}}{\text{Discounted Total Costs}}$$

Net return from Lapsi enterprise

Net return (profit) is the difference between the gross return and the total cost incurred. Mathematically, it can be written as;

Net Return - Gross Return - Total Cost

Marginal return from Lapsi enterprise

Per year marginal return from Lapsi enterprise was calculated by deducing the current year's gross return by previous year's one. Mathematically, it can be written as;

Marginal Return = Nth year's Gross Return - (N-1)th year's Gross Return

Problems in the production and marketing of Lapsi

Various problems were ranked with the use of an index. Scaling techniques, which provides the direction and extremity attitude of the respondents towards any proposition (Miah, 2016), was used to construct the index. The problems were identified by using three-point scaling technique comparing extreme, moderate and slight using scores of 1, 0.5 and 0 respectively. To identify the problems in the production and marketing of Lapsi in the study sites, the respondents were confronted with a list of existing problems and asked them to provide a scale value for all of them. During the data processing, the following formula was used for the final ranking of problems:

$$I_{\text{Problem}} = \sum \frac{Si\ Fi}{N}$$

Where,

I_{Problem} = index value for intensity of the problem

S_i = Scale value of ith intensity

F_i = Frequency of ith response

N = Number of observations

RESULTS AND DISCUSSION

Landholding and land under Lapsi production

The average landholding per household was 17.6 Ropani (0.88 ha). About 18% of the total land per household was used for Lapsi production. Present scenario of Lapsi cultivation is in small scale (Figure 1) as farmers in the Falebas, Parbat are producing Lapsi in just one to ten Ropani of lands.

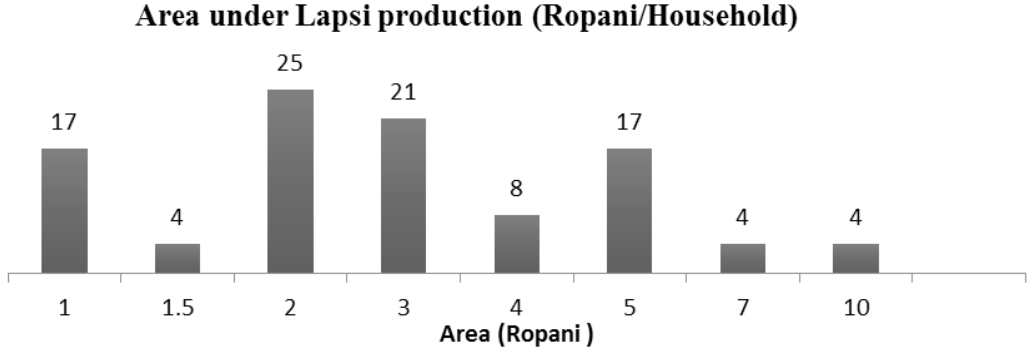

Figure 1. Area under Lapsi production in Falewash, Parbat (Ropani/Household)

About 95% of the Lapsi orchard (by area) in Falewash, Parbat is established in steepy Pakho bari (Upland), and only 37% of the orchard is under irrigation facility while lowland accounted all the irrigation facility (Table 1). The taproot of Lapsi that goes deep down, enabling the plant to be established in steep slopes even under poor irrigation facility.

Table 1. Land type under Lapsi cultivation in Falewash, Parbat

Land type	% Lapsi orchard
Khet (Lowland)	5
Pakho bari (Upland)	95
Irrigated land	37
Unirrigated land	63

Experience and training

The knowledge gets advanced with increased experience, and it is an important consideration in determining the quality and quantity of the products. Majority of the farmers have been engaged in Lapsi production since six to ten years, whereas there are a few farmers with sixteen to twenty years of engagement (Figure 2).

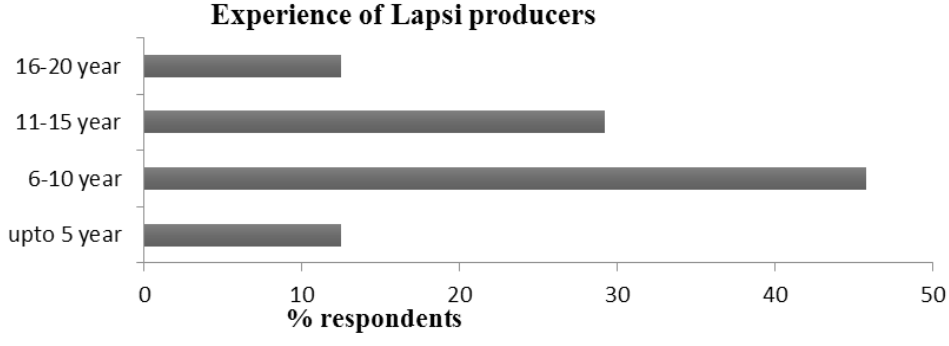

Figure 2. Experience of Lapsi producers

Most of the respondents (about 67%) obtained training on various techniques required to manage the Lapsi orchard commercially. A majority of them (33.3%) was trained for Lapsi processing technique followed by the cultivation and grafting technique in Lapsi (Figure 3).

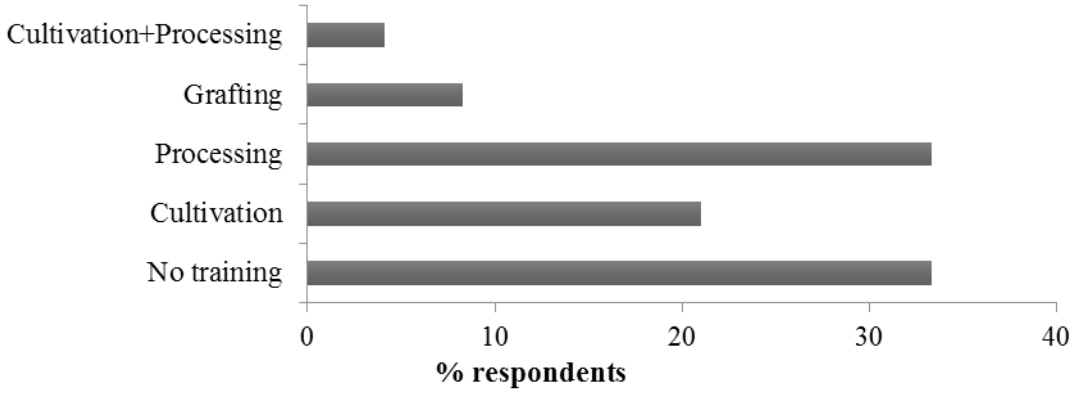

Figure 3. Types of training obtained by the Lapsi growers

Marketing of Lapsi

Lapsi from Falewash Municipality is marketed both as fresh and after processing. Growers sell fresh fruits mostly to the village traders, followed by out-district traders, district traders and individual households (Figure 4).

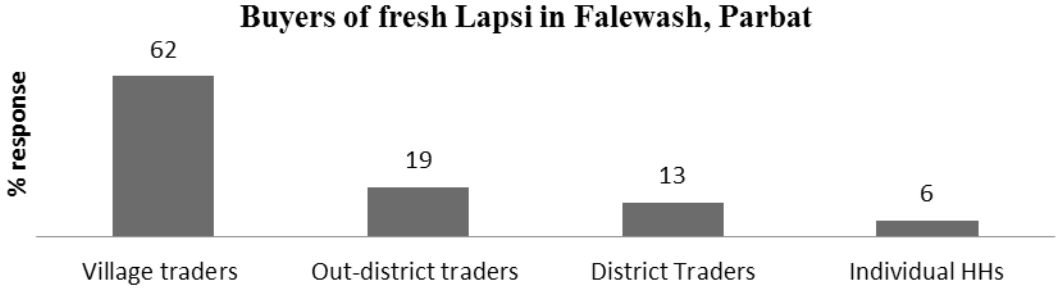

Figure 4. Buyers of fresh Lapsi in Falewash, Parbat

Map of the prevailing marketing channels (Figure 5) is made based on the information provided by Lapsi producers, collectors and wholesalers of Falewash, Parbat.

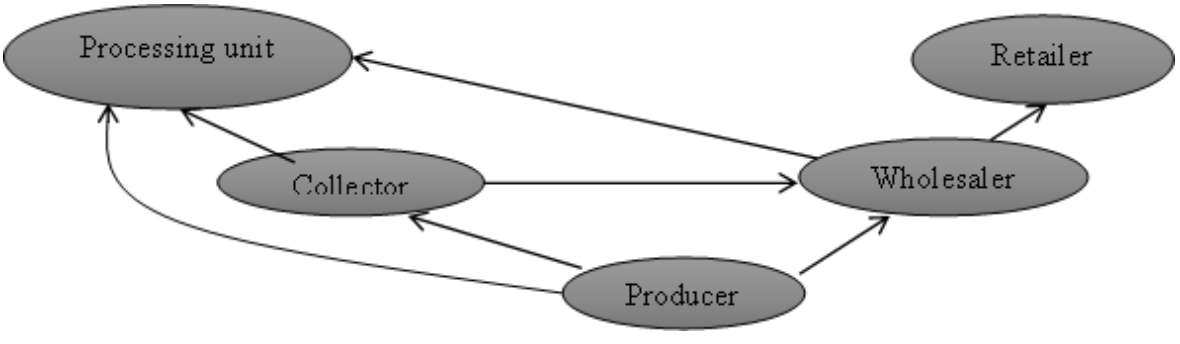

Figure 5. Marketing channel of fresh Lapsi in Falewash, Parbat

Economics of Lapsi production in Falewash, Parbat

Cost of orchard establishment

The establishment cost of Lapsi orchard was estimated. Among the various costs incurred on several items or processes, highest cost incurs in land preparation as labor for the digging to plant the Lapsi seedling (33.34%) since Lapsi is transplanted in the pit of 1.5*1.5 square feet; likewise, the lowest cost incurs in Lapsi sapling (Table 2). Out of 24, only one Lapsi orchard found fenced. So, the Lapsi orchard establishment cost is free from fencing cost, summing up into a lower total value. A high amount of investment is required in the orchard establishment, mainly for the process of pit digging. So, farm mechanization with Pit Digger possibly reduces the orchard establishment cost.

Table 2. Establishment cost of Lapsi orchard (NRs./Ropani)

Item / Process	Average cost (NRs./Ropani)	% of total costs
Labor for digging	1,277.12	33.94
Land rent	650.69	17.29
FYM/ fertilizers	566.70	15.06
Irrigation	506.03	13.45
Tools and equipment	401.00	10.66
Saplings	361.34	9.60
Total cost	3,762.89	100.00

Cost and return in Lapsi production in the long-run (12 years)

According to the similarities found, inputs used and the operations performed after the establishment of the Lapsi orchard are grouped into three groups of years (Table 3). The land rent dominates the other costs incurred in the first four years; likewise, harvesting cost is dominant for the rest of the duration. The land rent (fixed cost) and the harvesting (variable cost) only contribute to the total costs from the ninth year.

Table 3. Year-wise change in the cost of the inputs in Lapsi orchard

Years	Order of inputs and processes w.r.t. cost incurred
1-4	Land rent > Labor > FYM/fertilizer > Irrigation >Harvesting > Intercultural operation
5-8	Harvesting > Land rent > Labor > Intercultural operation > FYM/fertilizer > Irrigation
9-12	Harvesting > Land rent

The Lapsi growers increase the application of fertilizers and irrigation dose from the 4th year when the flowering is expected to occur; so, the total cost is increased from the 4th year of orchard establishment. The harvesting practice starts in operation 4th year onward, that has also found to increase the total cost from 4th year (Table 4). Lapsi has a tap root system; this feature has relieved the growers from the higher cost of irrigation. From the 7th year of establishment, the growers become successful to produce economic returns under rain-fed condition. Also, the growers stop the application of fertilizers in the Lapsi orchard 7th year onward. The avoidance of fertilizer application and irrigation operation has greatly reduced the total cost incurred. Ninth-year onward, only the harvesting operation is performed in the Lapsi orchard. This is the reason behind the reduced annual total cost from 9th to 12th years.

Table 4. Cost, Production and Return in Lapsi cultivation

Year	Production Kg/plant	Production Kg/Ropani	Gross Return NRs./Ropani	Total cost NRs./ Ropani	Net return NRs./Ropani	Marginal rate of return NRs./year
Est.	0.00	0.00	0.00	3762.89	-3,762.89	0.00
1	0.00	0.00	0.00	1,267.75	-1,267.75	0.00
2	0.00	0.00	0.00	1,618.74	-1,618.74	0.00
3	0.00	0.00	0.00	1,460.14	-1,460.14	0.00
4	4.00	40.00	1000.00	3,116.70	-2116.70	1,000.00
5	9.05	90.53	2,263.16	3,011.04	-747.88	1,263.16
6	16.18	161.82	4,045.46	2,816.89	1,228.57	1,976.45
7	28.70	286.96	7,173.91	2,298.99	4,874.92	3,646.35
8	46.04	460.43	11,510.87	2,351.34	9,159.53	4,284.61
9	69.17	691.74	17,293.48	1,671.17	15,622.31	6,462.78
10	108.96	1,089.57	27,239.13	1,671.17	25,567.96	9,945.65
11	136.48	1,364.78	34,119.57	1,671.17	32,448.39	6,880.43
12	153.48	1,534.78	38,369.57	1,671.17	36,698.39	4,250.00
Total	572.06	5,720.61	143,015.15	28,389.16	114,625.98	-
Avg.	63.56	635.62	15,890.57	2,183.78	8,817.38	-
Total operating costs in 12 years (NRs./Ropani)						NRs. 24,626.27
Average annual operating cost (NRs./Ropani)						NRs. 2,052.19

After the orchard establishment, annual orchard operating cost is NRs. 2,052.19 per Ropani. The fruiting in Lapsi takes four to six years to start, and seven to ten years for full potential production. The average productivity of Lapsi in Falewash, Parbat (635.62 Kg/ Ropani i.e., 12.7 Mt/ha) is far greater than the national average as 8 Mt/ha (MoAD, 2017). The Lapsi tree offers the economic return from the fourth year onwards. Then, the return increases by an increasing rate of return till 10th year; thereafter it increases with a decreasing rate.

Economic analysis of Lapsi production enterprise

The benefit-cost ratio (BCR) is 2.84 that suggests that one can earn NRs. 2.84 by investing NRs.1 in the Lapsi production enterprise (Table 5). Net present value (NPV) of NRs. 30,146.31 and internal rate of return (IRR) of 33% signify the economic importance of Lapsi production enterprise. The cumulative cash flow becomes positive from the 8th year of Lapsi orchard establishment suggesting the Pay Back period of 8 years. A long-term plan is needed to establish Lapsi production as a cash-generating enterprise since the Lapsi takes about eight years to pay back the investment.

Table 5. Benefit, Cost, BCR and Pay Back Period of Lapsi production enterprise in Falewash, Parbat (NRs./Ropani)

Year	Benefit (NRs)	Cost (NRs)	Discounted benefit (NRs)	Discounted cost (NRs)	Cash flow (NRs)	Cumulative cash flow (NRs)
0	0.00	3,762.89	0.00	3,762.89	-3,762.89	-3,762.89
1	0.00	1,267.75	0.00	1,131.92	-1,267.75	-5,030.64
2	0.00	1,618.74	0.00	1,290.45	-1,618.74	-6,649.38
3	0.00	1,460.14	0.00	1,039.30	-1,460.14	-8,109.52
4	1,000.00	3,116.70	635.52	1,980.72	-2,116.70	-10,226.22
5	2,263.16	3,011.04	1,284.18	1,708.55	-747.88	-10,974.10
6	4,045.45	2,816.89	2,049.55	1,427.12	1,228.56	-9,745.54
7	7,173.91	2,298.99	3,245.11	1,039.95	4,874.92	-4,870.62
8	11510.90	2351.34	4649.05	949.67	9,159.53	4,288.91
9	17293.50	1671.17	6236.2	602.64	15,622.31	19,911.22
10	27239.10	1671.17	8770.27	538.07	25,567.96	45,479.18
11	34119.60	1671.17	9808.56	480.42	32,448.40	77,927.58
12	38369.60	1671.17	9848.51	428.95	36,698.40	114,625.98
Total	-	-	46526.95	16380.65	114,625.98	-
BCR						2.84
NPV						NRs. 30,146.31
IRR						33%
Pay Back Period						8 years

Problems of production and marketing of Lapsi

The problems in Lapsi cultivation and its marketing with their intensity are identified and presented in Table 6 and Table 7 respectively.

Table 6. Problems in the Lapsi cultivation

Rank	Production problems	Index Value
1st	Harvesting difficulty	0.81
2nd	Damage by wild animals	0.66
3rd	Unavailability of labor	0.50
4th	Policy/support	0.47
5th	Fruit dropping	0.41

Lapsi plant is a large tree and has a huge canopy. At the same time, the growers do not practice any kind of training and pruning activities. That is the main cause behind the harvesting difficulty ranked first. Wild animals (mostly monkeys) ranked second. Poor transportation and inadequate market information are the major marketing constraints of Lapsi production enterprise in Falewash, Parbat (Table 7).

Table 7. Problems in the Lapsi marketing

Rank	Marketing problems	Index value
1st	Poor transportation facility	0.58
2nd	Inadequate market information	0.57
3rd	Low market price	0.42
4th	Late payment by wholesaler and processing unit	0.34
5th	Price fluctuation	0.31

CONCLUSION

Lapsi production is a profitable business in Falewash, Parbet. Lapsi production enterprise requires a long-term plan to be established as a cash-generating enterprise. Harvesting difficulty and damage by wild animals are the major production problems whereas poor transportation facility and inadequate market information are the major marketing constraints. Proper study on flowering physiology of Lapsi is a present need in developing a proper training and pruning practice for the increment of the yield as well as to reduce the harvesting difficulty.

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