International Journal of Horticulture, 2024, Vol.14, No.2, 44-52
http://hortherbpublisher.com/index.php/ijh

Research Article Open Access

Economic Analysis of Apple Production and Marketing in Raskot Municipality of Kalikot District, Nepal

Arati Chapai [1] ✉, Susma Adhikari [1] ✉, Kiran Prasad Upadhayaya [2], Shova Shrestha [1], Nisha Bhandari [1], Prativa Acharya [1], Shasi Kumar Keshari [1]

1 College of Natural Resource Management, Bardibas, Agriculture and Forestry University, 44800, Nepal

2 Agriculture Section, Madi Municipality, Chitwan, 44209, Nepal

✉ Co-Corresponding email: chapaiarati100@gmail.com; adksushma01@gmail.com

International Journal of Horticulture, 2024, Vol.14, No.2 doi: 10.5376/ijh.2024.14.0006

Received: 21 Feb., 2024

Accepted: 20 Mar., 2024

Published: 06 Apr., 2024

Preferred citation for this article:

Chapai A., Adhikari S., Upadhayaya K.P., Shrestha S., Bhandari N., Acharya P., and Keshari S.K., 2024, Economic analysis of apple production and marketing in raskot municipality of Kalikot District, Nepal, International Journal of Horticulture, 14(2): 44-52 (doi: 10.5376/ijh.2024.14.0006)

Abstract A survey research study on the economic analysis of apple production and marketing was undertaken in the Raskot municipalities of Kalikot district. The study aimed to analyze the past economics of apple production, including its marketing aspects, and identify the problems associated with apple production and marketing. A total of 78 farmers were selected through simple random sampling, while snowball sampling was utilized to choose 10 traders for the survey. A pretested semi-structured questionnaire was employed to collect data from the respondents. Data analysis was carried out using SPSS and MS Excel. The majority of the respondents were Brahmin and literate. Agriculture had been the primary source of income for 55.12% of households. On average, surveyed households had 6.28 ropani of land under apple production, with an average of 136.47 bearing fruits and 33.28 non-bearing trees, including newly planted ones. Economic analysis over a 20-year period revealed a benefit-cost ratio of 1.90, a net present value of Rs 2,111,002.92, an internal rate of return of 33.3%, and a payback period of 7.3 years. During the study, it was found that the majority of farmers (94%) had sold their produce to contractors through hedging practices, with a marketing margin and producer share of Rs 172 and 21.81%, respectively. The primary problem identified for apple production had been the incidence of insect pests and diseases. Similarly, price variation had been a major issue associated with the marketing of apples in the study area. The study concluded that apple production in Kalikot had been financially feasible, emphasizing the need for further development in alternate pest and disease management strategies and intervention in the development of a marketing system to control higher price variation.

Keywords Economic analysis; Production; Marketing; Net present value; Payback period; Internal rate of return

Introduction

Nepal, primarily an agricultural country, is geographically divided into three distinct regions: mountains, hills, and terai, each offering a diverse array of climatic conditions. These regions provide extensive opportunities for cultivating various crops such as vegetables, fruits, spices, flowers, and other plantation crops, holding immense potential for the production and improvement of agricultural subsectors. Agriculture has played a vital role in the livelihoods of the Nepalese people, and any efforts directed toward the development of the agricultural sector contribute significantly to the country's economic growth. It constitutes 36% of the GDP and employs 65.5% of the total Nepalese population (Nepal's Agricultural Landscape, n.d.), making agriculture the backbone of the nation. Despite the vast agro-ecological zone in the country, conducive to the production of diverse agricultural commodities, only 21% of the total land is available for cultivation (MoALD, 2020, n.d.). Out of the total cultivated area of 3,091,000 hectares in Nepal, the area dedicated to fruit production is 164,623 hectares (Agriculture & Livestock Diary, 2079, n.d.). Over the years, there has been a continuous increase in the area covered by horticultural crops and their production. The area covered and the production of fruits increased by 123% and 142%, respectively, in FY 2018\19 compared to 2000\1; however, productivity still hovers around 9-10 MT\ha (STATISTICAL-INFORMATION-ON-NEPALESE-AGRICULTURE-2077-78.Pdf, n.d.). The increase in area and production is more pronounced for summer fruits, followed by citrus and then winter fruits. For vegetables, potatoes, and spices during the same period (FY2000\1 to FY 2018\19), the increase is 89%, 158%, and 37% for vegetables; 50%, 137%, and 58% for potatoes; and 151%, 337%, and 74%, respectively (MoALD,

2020\21, n.d.). Analyzing the increase in the area and production of plantation crops in the same period, there is a 139% increase for tea and a 280% increase for coffee, with a remarkable 551% and 498% increase, respectively (Atreya and Manandhar, 2016). Despite the increasing trend in the area under horticultural crops, the rate of increase remains considerably lower than its potential. Research, education, and development partners must collaborate at all levels (federal, provincial, and local) for the optimal development of horticultural crops in the country. Horticulture contributes to 15% of the Agricultural Gross Domestic Product (AGDP), comprising 7.04% of the fruit and spice crop, with apples specifically contributing 0.42% (Atreya and Manandhar, 2016). With the rising levels of education, Nepalese citizens are becoming more conscious of their nutritional requirements, leading to an increased demand for vegetables and fruits.

Apples (*Malus domestica*) are a significant temperate fruit produced in the mountainous regions of Nepal (Gayak et al., 2020). Originating in southwest Asia, east Europe, and southwest Siberia, the history of apples is nearly as ancient as that of Western civilization. The apple is native to central Asia, tropical America, and various parts of Africa and America. Apple farming in Nepal commenced in the Kaligandaki Valley before 1960. However, the first commercial apple farming venture took root in 1965 at Marpha, Mustang, when a Horticultural Farm was established, introducing new apple varieties and production methods (Commercial Apple Farming in Nepal, 2013). According to official statistics from the Ministry of Agriculture and Livestock Development in 2020, apples are cultivated in 55 out of the 77 districts in Nepal, with a production of 31,386 tons and a yield of 7.22 tons per hectare. Major apple-growing districts include Mustang, Darchula, Solukhumbu, Kalikot, Humla, and Jumla (Shrestha et al., 2017). Despite recent increases in the acreage under apple cultivation and overall production, the domestic demand has not been met, leading to a rise in imports.

Kalikot, located in the remote Karnali province of Nepal, is a secluded district surrounded by hills and mountains to the east, Achham to the west, Bajura and Mugu to the north, and Jajarkot and Dailekh to the south. Positioned at 290° 5' 12" north latitude and 810° 35' 23" east longitude, Kalikot spans elevations ranging from 738 m to 4,790 m above sea level. Serving as the district headquarters, Manma Bazaar is situated at an elevation between 1,500 m and 84,790 m (Kalikot: An Epitome of Karnali Region, n.d.). Approximately 90% of the population in Kalikot is engaged in agriculture. The climatic conditions vary from subtropical to alpine, with the elevated hills proving to be climatically suitable for apple production. Kalikot is administratively divided into three municipalities and six rural municipalities. Notably, Raskot Municipality, situated in Siuna and equipped with nine wards, is well-suited for apple cultivation. It earned the designation of an apple zone in the fiscal years 2075-76. Subsequently, in 2077, it merged with PMAMP and PIU Jumla to enhance apple production. Productivity in Kalikot for apple cultivation falls below the global average but surpasses the national average. To comprehensively understand the strengths and weaknesses associated with this situation, an investigation into the production and marketing of apples in Kalikot was conducted.

1 Materials and Methods

1.1 Selection of the study area

This study was conducted in the Kalikot district of Nepal. Raskot Municipality was purposively selected because it was the major area of apple production. Similarly, it was also the command area of Prime Minister Agriculture Modernization Project (PMAMP), Project Implementation Unit, Apple Zone, Jumla/Kalikot.

1.2 Sample size and sampling procedure

Respondents include two categories: farmers and traders. Altogether, 78 farmers were selected from the study site using simple random sampling techniques out of 400 registered farmers. Similarly, to collect information related to marketing practices, 10 traders were selected through the snowball sampling techniques. Traders are the contractors, middlemen, wholesalers, and retailers who acquire apples directly or indirectly from the procedures.

The sample size was calculated by using Raosoft software at a confidence level of 95% and a margin of error 10%, sample size 78 was calculated.

1.3 Research design\Instruments

1.3.1 Preliminary field study

Preliminary survey field visits were conducted to gather information regarding the geographical, institutional, and socio-economic characteristics of the study area.

1.3.2 Household survey

A household survey was conducted with the help of a pre-tested and structured interview schedule. Both qualitative and quantitative in-depth information regarding the various aspects of apple cultivation was collected using the face-to-face interview technique. A total of 78 samples were taken for the household survey using the personal interview schedule (PIS).

1.3.3 Key informant survey (KIS)

Key informants such as experienced leaders of the village who have lived in the village for years, the zoning officer, the rural municipality's technicians, and the zoning officer were asked a series of questions about the present scenario of apple cultivation and its economics of production.

1.3.4 Focus group discussion

A focus group discussion was conducted among farmers, local leaders, the head of PIU, Kalikot, and all ethnic groups, including both male and female, to verify the results obtained from the household survey with the help of a checklist. They provided valuable information about challenges faced by farmers and discussions on the benefits of apple farming that helped to create awareness among farmers and helped develop strategies for solving problems.

1.4 Data and data types

1.4.1 Primary data

The primary data for this research was collected from farmers who were engaged in apple farming for years. The primary method was used to collect information and take actual information on apples and figure out the problem faced by apple growers in a real scenario. Household surveys through interview schedules, key informant interviews, and focus group discussions were conducted to collect the primary data.

1.4.2 Secondary data

The secondary data were obtained through different publications of the Prime Minister Agriculture Modernization Project (MAMP), Department of Agriculture, Ministry of Agriculture and Livestock Development (MOALD), Central Bureau of Statistics (CBS), Statistical Information on Nepalese Agriculture, Annual Report of Program Implementation Unit, Jumla, relevant articles, etc.

2 Analysis Techniques

The necessary data obtained from both the primary and secondary sources were coded and entered into the computer for analysis. The data analysis was done by using MS-Excel and SPSS.

SPSS was used for both the qualitative and quantitative data analysis. Different analytical tools like descriptive statistics and inferential statistics such as frequency distribution, trend analysis, etc are used. The following analysis was performed.

2.1 Descriptive analysis

For descriptive analysis of the study area, the socioeconomic and farm characteristics of the respondents like age group, gender distribution, educational level, family size, total land holding, years of farming, etc. were described using statistics like frequency, percentage, mean, standard deviation, etc.

2.2 Analysis of economic data

2.2.1 Cost of production

Cost of production was categorized into; cost of initial investment (cost incurred during the gestation period of 4 years) and operating cost (cost from 5^{th} - 20^{th} year; period of realization of output). Both the variable cost and

fixed cost were taken into account for the calculation of the cost of production. Cost was calculated for one hectare of land from years 1st to 20th. The time value of money was considered during the calculation procedure.

Total cost (TC) = Total fixed cost (TFC) + Total Variable cost (TVC)

Where, Variable cost includes cost that is incurred on variable inputs such as labor, fertilizers (FYM), plant protection measures (Roger, Servo oil and Bordeaux paste) and tiller use. All variable costs are calculated on per year per hectare basis; Fixed cost is the cost of input that has life of more than one year. The fixed cost for land preparation and layout, pit digging and sampling establishment, fencing, irrigation canal installation and tools and equipment were included. Similarly cost incurred for land rent, land tax and water charge was calculated for every year.

2.2.2 Return per hectare

To calculate the return per ha, the average production per tree was first determined. Then it was multiplied by 426 to obtain the production for 1ha of land because 1 ha of land would accumulate about 426 trees following the farmer's practice in the study site.

Mathematically, Return per hectare = Quantity of apples produced per ha (kg) x Farm gate price (NRs). For the study purpose farm gate price was kept Rs 40 per kg as it was the most common price received by apple growers.

2.2.3 Cost-benefit analysis

The data obtained from the survey were analyzed using cost-benefit analysis. Economic performance indicators such as the BC ratio, NPV, IRR, and payback period were calculated in the Cost-benefit analysis.

The B: C Ratio (BC ratio) comprises the present value of all benefits generated to the present value of all costs incurred during the apple production period of 20 years. The formula for the benefit-cost ratio is outlined below:

$$\text{Benefit-Cost Ratio} = \sum_{t=1}^{n} \frac{Bt}{(1+i)^t} \Big/ \sum_{t=1}^{n} Ct/(1+i)^t$$

Where, Bt = Benefit in each year; Ct = Cost in each year; n = Number of years; i=Discount rate

The net present value (NPV) indicates the present value of expected returns of the project or net cash flow over the life period of a project when discounted at the opportunity cost of capital. In this study, the opportunity cost of capital was considered 12.00 percent per annum. The positive NV indicates the worthiness of investment in an apple orchard. It is simply the net present worth of the cash flow stream.

$$\text{NPV} = \sum_{t}^{n} Bt - Ct/(1+i))^t$$

Where, Bt = Benefits from each year; C = Costs in each year; t = Numbers of years; i = Discount rate

Internal Rate of Return (IRR) represents the average earning capacity of an investment over the economic life period of the project. It is that discount rate that makes the net present value of the project benefits equal to zero. The trial and error method is usually used to determine IRR, and the same was used to compute in this study too. When the calculated IRR is greater than the market rate of interest, then the investment is considered viable. For the calculation of IRR, the formula given below was used:

IRR = LDR + NPV at LDR /Sum of NPV at LDR and UDR

Where, LDR = Lower discount rate; UDR = Upper discount rate

2.3 Payback period

The payback period of the apple production indicates the number of years required to recover the investment made in establishing and maintaining the orchard. An Un-discounting technique was used to determine the PBP. The

method followed is to successively add the net returns from each production year until the investments are completely recovered. Since the cash flows are not uniform, the payback period was calculated by successively reducing the net cash flows from outstanding investments.

2.4 Analysis of market margin and producer share

Prevailing marketing practices and marketing channels were studied for estimating the marketing margin and producer share of apple produced in the study area. Marketing margin was calculated as follows:

Marketing margin = Retail price (Pr) - Farm gate price (Pf)
Producer share (Ps) = (Pf + Pr) × 100%

2.5 Indexing

Problems related to production and marketing alone were ranked with the use of the index. Scaling techniques, which provide the direction and extremity attitude of the respondent towards any preposition (Miah, 1993) were used to construct an index. The intensity of production and marketing problems being faced by apple producers was identified by using five five-point scaling techniques comparing the most severe, most serious, moderate problems, low problem, and least problems using scores of 1.0, 0.8, 0.6, 0.4, and 0.2. The index for the intensity of production and marketing problems faced by respondents was computed by using the formula:

$$IS = \sum SiFi/N$$

Where, IS = index value for intensity of problems; S = Scale value for i^{th} intensity; Fi = frequency of i^{th} response; N = total number of respondents

2.6 SWOT analysis of apple production in Kalikot district

SWOT stands for Strength, Weakness, Opportunity, and Threat. Strength and weakness are the internal factors, whereas opportunity and threats are the external factors affecting Apple production. The strength, weaknesses, opportunities, and threats of apple production in Kalikot districts were analyzed to track the potentiality of adopting an apple production system in the Kalikot district.

3 Results and Discussion

3.1 Socio-economic and demographic characteristics of the respondents

3.1.1 Gender distribution of respondents of the surveyed area

The total sampled population was 78. Out of the total sample, 83.3% of the respondents were male and only 16.7% were female (Table 1). This revealed that most of the households had males as decision-makers. Moreover, it also shows that most of the males are involved in apple farming compared to females.

Table 1 Distribution of respondents of the sampled household by gender in Kalikot

Gender of Respondent	Frequency	Percentage (%)
Male	65	83.3
Female	13	16.6
Total	78	100

Source: Field survey, 2023

3.1.2 Age of respondents

The mean and standard deviation of the age of the respondents in the surveyed area were found to be 47.5 and 11.805, 51 respectively. The respondents were within the range of 27 to 72 years (Table 2). The age of respondents was categorized into three categories: < 40 years, 40 to 60 years, and > 60 years (Figure 1). The age distribution of respondents revealed that the majority of the respondents (53.8) were between the age ranges of 40 to 60 years, 33.3% of the respondents were below 40 years of age and 12.8 % were above 60 years of age.

Table 2 Age of respondents across the study area in Kalikot

Variable	Minimum	Maximum	Mean	S.D
Age of respondent	27	72	47.5	11.80551

Source: Field survey, 2023

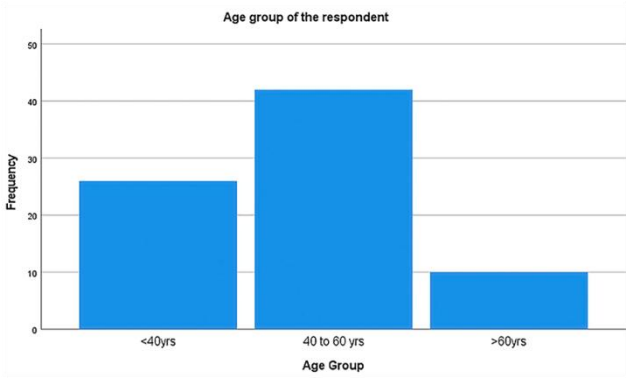

Figure 1 Age group of the respondent

3.1.3 Education status of the respondent

Education is the pillar of development. The educational status of farmers would play a significant role in socio-cultural and economic change in a society aiding the adoption of modern technology in the agriculture sector. For the study, the educational status of the respondents has been grouped into five categories: illiterate, primary, and lower secondary, secondary, higher secondary, and graduate. From the study, it was found (Table 3; Figure 2) that most of the respondents had a primary level of education (48.7%) followed by illiterate (24.4%), secondary (15.4%), higher secondary (9%), and graduate (2.6%). It shows that the majority of the apple growers in the study area were educated.

Table 3 Educational status of the respondent

Education level	Frequency	Percent (%)
Illiterate	19	24.3
Primary and lower secondary level	38	48.7
Secondary level	12	15.4
Higher secondary level	7	9
Graduate	2	2.6
Total	78	100

Source: Field survey, 2023

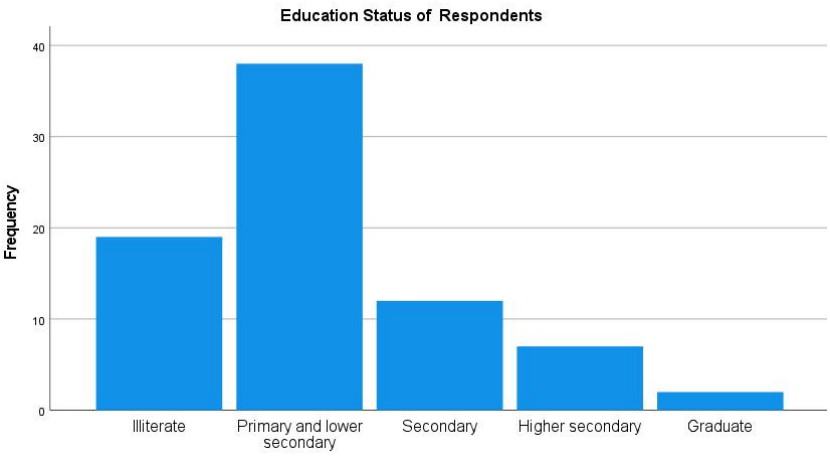

Figure 2 Educational status of the respondents

3.1.4 Ethnicity of the respondent's household

Caste is regarded as an important social structure in Nepalese society with its long historical and religious roots. Ethnic groups were categorized as Janjati, Dalit, Chhetri, Brahmin and others. In the study area, the majority of the respondents were Brahmin (55.1%) followed by Chhetri (38.5%) and Dalit (6.4%) (Table 4).

Table 4 Ethnicity of the respondent's household

Ethnic group	Frequency	Percent (%)
Brahmin	43	55.1
Chhetri	30	38.1
Dalit	5	6.4
Janjati	0	0
Total	78	100

Source: Field survey, 2023

3.2 Distribution of economically active population

The total population of sampled households was categorized into three classes, namely, less than 15 years, 15 to 59 years, and more than 59 years as considered by the government of Nepal. Whereas, the age group of less than 15 and greater than 60 were considered as an economically inactive group who depend on economically active groups for their living. The distribution of the economically active population in the household is presented below in Table. It indicated that 58.77% of the population was economically active whereas, 41.21% of the total population lies in the economically inactive age group (Table 5).

Table 5 Distribution of economically active population

Age groups	Frequency	Percent (%)
< 15 years	207	31.60
15 to 59 years	385	58.77
>59 years	63	9.61
Total	78	100

Source: Field survey, 2023

3.3 Primary occupation of the household

Primary source of household income was categorized as agriculture, services and business and others. Study revealed that, Agriculture (55.12) was the major source of household income followed by service (23.07) (Table 6; Figure 3).Thus making it clear that, economy of Kalikot's household mainly depends on agriculture.

Table 6 Primary occupation of the household

Occupation	Frequency	Percent (%)
Agriculture	43	55.12
Service	18	23.07
Business	17	21.79
Others	0	0
Total	78	100

Source: Field survey, 2023

3.4 Source of credit

The study revealed that the majority of the respondent were pretty much reliant on their fund (75.64%) for farming operations (Table 7). However, 15.38% of the respondents reported banks as the sources of credit while 8.97% of the respondents reported local moneylenders as their major source of credit.

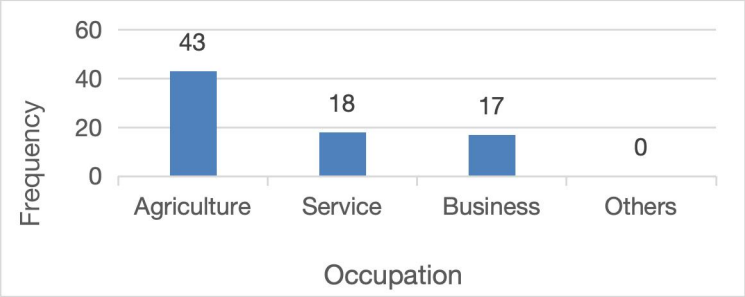

Figure 3 Primary source of household income

Table 7 Respondent's source of credit

Source of credit	Percent (%)
Own fund	75.64
Banks	15.38
Local moneylender's	8.97

Source: Field survey, 2023

3.5 Years of apple farming

Apple farming in the study area was done for many years. Years of apple farming were categorized into four categories (Table 8). The majority of respondents have done apple farming for 1 to 10 years (44.9%) followed by 10 to 20 years (42.3%), 20 to 30 years (11.5%), and 30 to 40 years (1.3%). It revealed that apple farming in the study area was carried out for decades and has been passed down from one generation to another.

Table 8 Respondent's experience in apple farming

Years of apple farming	Frequency	Percent (%)
1-10	35	44.9
10-20	33	42.3
20-30	9	11.5
30-40	1	1.3

Source: Field survey, 2023

3.6 Farm characteristics

3.6.1 Landholding of the respondents

According to the data obtained from the surveyed area, the average land holding of the respondent's household was found to be 12.15 ropani out of which 6.28 ropani of land was found on an average was used for apple cultivation (Table 9). Maximum apple cultivation was done in 20 ropani and a minimum of 1 ropani was used for apple cultivation. Hence it indicates that a major portion of agricultural land in the surveyed area is occupied by apple orchards.

Table 9 Total land holding and apple cultivated area

Description	Minimum	Maximum	Average	Total	Std.Deviation
Total land holdings (ropani)	2	30	12.1535	947.97	6.31907
Total land of apple cultivation (ropani)	1	20	6.28	490.20	3.94003

Source: Field survey, 2023

3.6.2 Bearing and nonbearing trees in the study area

The total number of bearing and nonbearing trees in the studied area was found to be 10,645 and 2,596, respectively (Table 10). Households having 550 bearing trees were noted to be the maximum in the figure. In the study area total number of maximum trees was 900.

Table 10 Total number of trees and bearing trees

Description	Minimum	Maximum	Sum	Mean
Total number of trees including recently planted	44	550	13241	169.75
Total number of bearing trees	0	900	10645	136.47

Source: Field survey, 2023

3.7 Household access to various service

3.7.1 Involvement in cooperatives

Respondent's involvement in any agriculture-related cooperatives is presented below (Table 11). The study revealed that 83.3% of the respondents were members of agriculture cooperatives.

Table 11 Distribution of respondents based on involvement in agriculture cooperatives in the study

Involvement in cooperatives	Frequency	Percent (%)
Yes	65	83.3
NO	13	16.7
Total	78	100

Source: Field survey, 2023

3.7.2 Training status

The study revealed that only 55.1% of the respondents had received training related to apple production and management practices in the study area (Table 12).

Table 12 Distribution of respondents based on training status in the study area of Kalikot

Training status	Frequency	Percent (%)
Yes	43	55.1
No	35	44.9
Total	78	100

Source: Field survey, 2023

3.7.3 Subsidy status

The majority of the respondents (64.1%) had received subsidies on apple production from service providers like PMAMP, PIU, AKC, Municipality, etc (Table 13). These subsidies were mainly related to the nursery plants, tools and equipment, and plant protection measures.

Table 13 Distribution of respondents based on subsidy status in the study area of Kalikot

Subsidy status	Frequency	Percent (%)
Yes	50	64.1
No	28	35.9
Total	78	100

Source: Field survey, 2023

3.8 Economics of production

In the study area, apple cultivation was mostly conducted traditionally. For this study, production cost was calculated based on interviews and FGD.

3.8.1 Cost of production

Initial investment cost: Based on our findings, the cost of initial investment for the years 1st - 4th is summarized (Table 14). The cost was calculated by taking the account of both variable and fixed cost. From the study, it was found that apple cultivation required high investment for the very first year (Rs 501049/ha) as compared to the following years of the gestation period (Figure 4). The cost of fencing, irrigation canal installation, tools and equipment, sapling, land preparation, and pit digging that accounts for the major share in the cost of initial investment was incurred in 1st year of apple cultivation resulting in a high establishment cost of apple orchard. Farmer perceive that their orchards will bear fruit only after 5th year of operation.

Table 14 The initial investment cost for years 1st to 4th

SN	Particulars (Variable cost)	1st year	2nd year	3rd year	4th year
A	Variable cost	Amount (Rs)	Amount (Rs)	Amount (Rs)	Amount (Rs)
1	Human labor				
	Weeding and manuring	30000	8545	9560	10790
	Training and pruning	0	1900	5360	5834
	Irrigation and maintenance	13610	4570	6245	5834
2	Organic manure	14000	2100	4830	14200
3	Plant protection measures				
	Roger	0	0	0	0
	Servo	0	0	0	0
	Bordeaux paste	15000	5528	6720	11813
4	Tiller use	18500	4545	5080	5108
	Total variable cost	91110	27197	37795	53578
B	Fixed cost	-	-	-	-
1	Land preparation and layout	60000	1026	727	2134
2	Sapling	40000	620	760	2000
3	Pit digging and sapling establishment	80000	2722	2460	2640
4	Fencing	80000	1443	0	0
5	Irrigation canal installation	126397	1877	320	0
6	Tools and equipment	20000	1161	1488	0
7	Land lease	0	0	0	0
8	Land tax	1995	1995	1995	1995
9	Water charge	1565	1565	1563	1563
	Total fixed cost	409957	12409	9273	10332
	Total cost (Fixed +Variable cost)	501067	39606	47068	63910.858

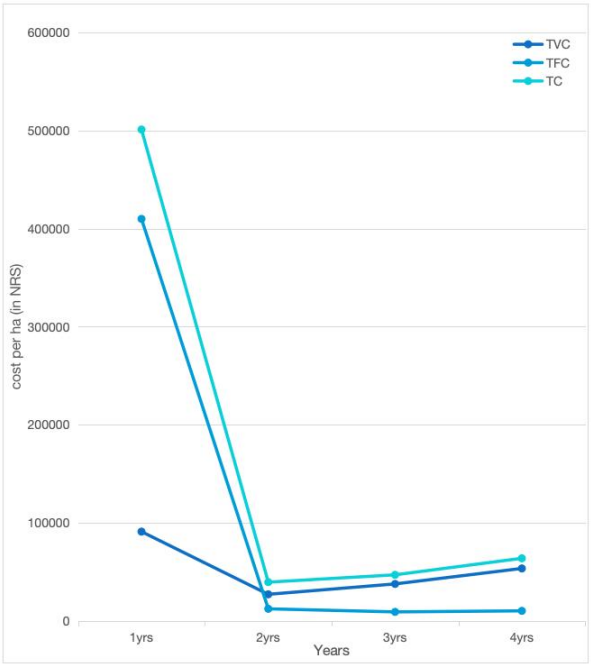

Figure 4 Cost of initial investment

Operating cost: The average cost of production was Rs 112122.1211 /ha, Rs 113303.757/ha, and Rs 50657.60626/ha for operating years 5th to 9th, 10th to 14th, and 15th to 20th, respectively (Table 15). The operating cost goes on increasing till the 15th year and then decreases from the 15th to the 20th (Figure 5).

Table 15 Operating cost from 5th to 20th year

Years	Fixed cost	Variable cost	Total cost
5 to 9 yrs	9007.64	103114.47	112122.1211
10 to 14 yrs	9007.64	104296.11	113303.757
15 to 20 yrs	9007.64	41649.95	50657.60626

Source: Field study, 2023

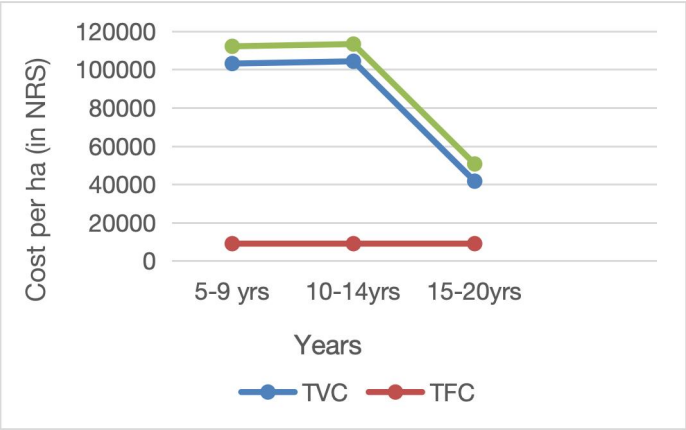

Figure 5 Operating cost for apple production

3.8.2 Returns from apple

The study revealed that apples started fruiting from the fourth year, however, the economic returns from the apple were witnessed only from the 5th year of orchard establishment (Table 16). According to the findings, the returns from the apple increased with increasing years and were highest in the 13th, 14th, and 15th years. It was reported that 15th year onwards the production decreased.

Table 16 Returns from the apple from 5th to 20th year

Years	Kg of fruits per ha	Benefit per ha
1	0	0
2	0	0
3	0	0
4	0	0
5	2982	7559
6	7668	194999
7	10650	314279
8	17040	569879
9	20448	706199
10	25560	909096
11	28968	1045416
12	31950	1164696
13	36636	1352136
14	38340	1420296
15	42600	1590696
16	38340	1482942.4
17	31950	1227342.4
18	27690	1056942.4
19	21300	801342.4
20	12780	460542.4

Source: Field survey, 2023

Similarly, the line graph below shows the trend of apple production per plant up to the 20th year. The production per plant increased up to 15 years and was found to be decreased after 15 years (Figure 6).

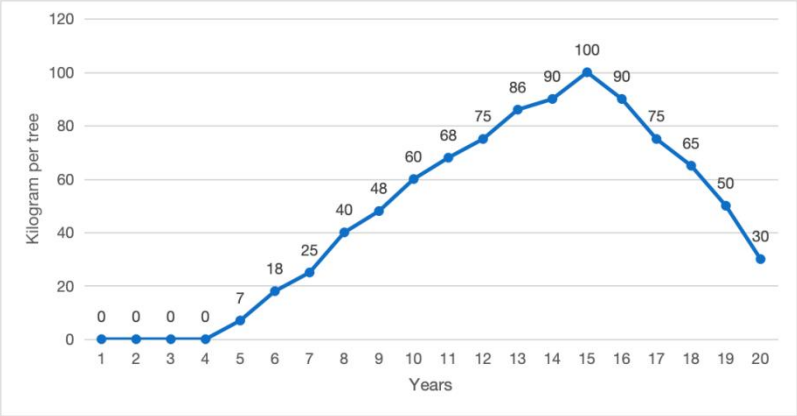

Figure 6 Per kg of apple production for years 5th to 20th years

3.9 Cost-benefit analysis

The cost and benefit for apple production were calculated for 20 years and the benefit-cost ratio for an overall period of 20 years was found to be 1.90.BC ratio observed within the different years of apple cultivation is shown in the figure. The benefit-cost ratio showed that apple cultivation was profitable with the B: C ratio being greater than 1 i.e.1.90. A similar result was found by Kafle (2017) in Jumla with a B: C ratio of 1.96. Detailed information on cost and benefit for the estimation of the benefit-cost ratio is shown in the Appendix (Figure 7).

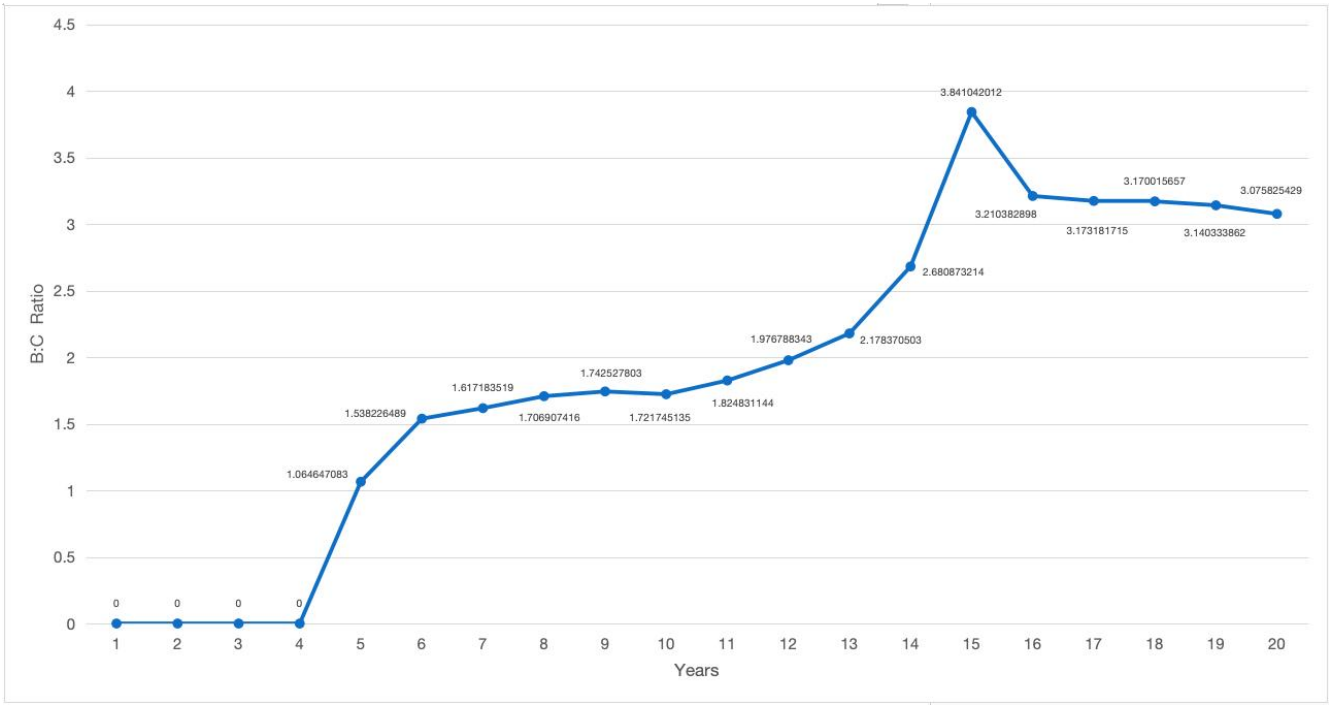

Figure 7 BC ratio of apple production from 5th to 20th year

3.10 Financial evaluation techniques

Apple plant once established, continues to give production for up to twenty years. The plant starts giving returns economically only from the 5th year onwards. It needs large resources, and income spread over a period. Hence, costs and returns have to be analyzed carefully to assess the worthiness of the investment in the Apple enterprise. Therefore, techniques of project evaluation such as net present value, benefit-cost ratio, payback period, and internal rate of returns are employed in assessing the feasibility of apple orchard. In an analysis of the financial feasibility, the cost and returns from the sweet orange production were estimated using a 12% discount rate.

3.11 Net present value

Net Present Value gives an idea about surplus money that would be generated from Apple at a given discount rate. It varies with the discount rates and the level of investment. In the study, NPV, calculated by discounting the net cash flow at a 12% discount rate for 20 years of apple production was 2,111,002. A positive NPV represents that the apple cultivation in the study area was profitable.

3.12 Internal rate of returns

IRR for apple production was calculated to be 33.3% which was greater than the discount factor of 12%.IRR being greater than the discount factor/opportunity cost indicates that apple cultivation is a profitable business in the study area.

3.13 Payback period

The time value of money was not considered for the calculation payback period. The payback period for the apple production was calculated to be 7.3 years in the study area.

3.14 Marketing system

Agricultural marketing involves several activities and processes through which harvested products from widely scattered products move to the ultimate consumers. Producers, traders, wholesalers, retailers, and consumers are the main agents involved in the production-consumption chain in the marketing system. The marketing system of Apple was studied in the study area of Kalikot district.

The majority of the respondents reported selling their produce directly to the contractor/middleman while few of them were found to sell their produce on their own to the retailers. Kalikot apples were mostly collected by middlemen who could be village traders or individual large contractors who make contracts with farmers before harvesting time. As the majority of the farmers sell their produce directly to contractors, postharvest practices like grading and packaging were rare in the study area. However, 2% of the respondents reported following grading practices before selling their apples to the retailers and stated getting higher prices for their produce through grading.

3.15 Marketing channel

In the marketing of Apple, major intermediaries involved were contractors, wholesalers, and retailers. The apple produced in the study area ultimately reached the consumers through these intermediaries. Primarily two types of marketing channels were identified in the study area. Channel-1: Producer > Middlemen > Wholesalers> Retailer >Consumer; Channel-2: Producer > Retailer > Consumer.

Channel-1 was involved in the marketing of apples in bulk to the distance market (Kathmandu, Pokhara, Chitwan, etc) while channel-2 was used to sell produce in smaller quantities within the local market. Out of these two channels, Channel -1 was found to be most prevalent in the study area as 94% sell their produce in bulk to the contractors.

3.16 Market margin and producer share

Market margin and producer share reflect the efficiency of the marketing system. Out of the two marketing channels, Channel-1 had a greater percentage of producer share (37.5%) and farm gate price of Rs 60 /kg. Higher retail of 220/ kg accounts for a greater market margin in Channel-1(Table 17).

Table 17 Market margin and producer share of the two marketing channels

Marketing channel	Farm gate price (NRs /kg)	Retail price (NRs/Kg)	Market margin (NRs/kg)	Producer share (%)
Channel-1	48	220	172	21.81
Channel-2	40	150	110	26.67

Source: Field survey, 2023

3.17 The major problem associated with apple production

3.17.1 Problems in apple production

Five different problems were identified based preliminary study and included in the interview schedule (Table 18). The farmers were asked to rank these problems based on their perceptions. Most of the farmers responded that the problem of insect pests and disease was the major problem associated with apple production. The index value of this problem was highest (0.946) and was ranked as the most serious problem of the study site. Scab and papery bark were the major diseases while wooly aphid and tent caterpillar were the most problematic insect pests hampering the production in apple farming. The second major problem was the environmental constraints mainly erratic rainfall, with the index value of 0.638. Lack of extension services was the third most serious problem with an index value of 0.607. Lack of irrigation was ranked fourth and lack of unavailability of inputs was ranked fifth with the index value of 0.458 and 0.333, respectively.

Table 18 Ranking of market problems

SN	Problems	Index	Ranking
1	Insect pests and disease	0.946	I
2	Unavailability of inputs	0.638	II
3	Environmental constraints	0.607	III
4	Lack of extension services	0.458	IV
5	Lack of irrigation	0.333	V

Source: Field study, 2023

3.17.2 Problems in the marketing of apple

Responses regarding various constraints in the marketing of apple were recorded and analyzed (Table 19). Respondents were asked to rank the problems associated with the marketing of apple. From the study, it was found that price variation (0.74) was the major problem faced by the actors involved in marketing Lack of cold storage which accounts for higher postharvest loss was ranked second most important problem with an index value of 0.70. Similarly, difficulty in transportation and lack of grading facilities were ranked 3rd and 4th most severe problems respectively. The low volume of production was the least problematic factor associated with marketing's Apple.

Table 19 Ranking of marketing problems of apple

Problems	Index	Ranking
Price variation	0.74	I
Lack of cold storage facilities	0.70	II
Difficulty in transportation	0.66	III
Lack of grading	0.64	IV
Low volume of production	0.26	V

Source: Field survey, 2023

4 Conclusion

Some conclusions are made based on the study conducted on the economics of the production of apples in the Kalikot district of Nepal. A higher benefit-cost ratio, shorter payback period, positive NPV, and IRR greater than opportunity cost ascertain the feasibility of Apple enterprise in Kalikot, Nepal. Insect pests and diseases are ranked as the major problems for the production of apples in the study area of Kalikot district, while price variation and lack of storage and transportation facilities are the major problems for apple marketing.

Authors' contributions

AC: Contribution to design and implementation of the survey, data collection, interpretation and analysis of the results, writing the manuscript. SA, KPU: analysis of data, interpretation of the results, writing the manuscript. PA, NB, SS, SKK: data collection and manuscript preparation. All authors read and approved the final manuscript.

Acknowledgements

We would like to acknowledgement Agriculture and Forestry University, Rampur, Chitwan, Nepal and Prime Minister Agriculture Modernization Project, Project Implementation Unit, Apple Zone, Jumla/Kalikot for this constant support and guidance during the research period.

References

References

Agriculture & Livestock Diary, 2079. (n.d.), Retrieved March 6, 2024, from https://molmac.lumbini.gov.np/publications/46.

Atreya P., and Manandhar R., 2016, Fruit crop development in Nepal: Achievements and Future strategy, In Proceedings of the First International Horticulture Conference, Kathmandu, Nepal, pp.36-49.

Commercial Apple farming in Nepal, 2013, Agriculture in Nepal - Himalayan Organic Farm Nepal, http://www.agricultureinnepal.com/apple-farm.

Gayak B., Pandey S.R., and Bhatta S., 2020, Economics of production and marketing of apple (*Malus domestica*) in Mustang, Nepal, International Journal of Agriculture Environment and Food Sciences, 4(4): 483-492.
https://doi.org/10.31015/jaefs.2020.4.12

Kalikot: An Epitome Of Karnali Region. (n.d.). HolidayPasal.Com. Retrieved March 29, 2024, from https://holidaypasal.com

MoALD, 2020, (n.d.). Retrieved March 8, 2024, from https://moald.gov.np/wp-content/uploads/2022/04/STATISTICAL-INFORMATION-ON-NEPALESE-AGRICULTURE-2076-77-2019-20.pdf

Nepal's Agricultural Landscape: Accessing the Government's Stance. (n.d.). Retrieved March 29, 2024, from https://nepaleconomicforum.org/nepals-agricultural-landscape-accessing-the-governments-stance/

Shrestha G., Gautam D.M., Gurung C.R., Subedi G., Poudel K., and Acharya A., 2017, Diversity and prospect of temperate fruit crop development in Nepal, In Conservation and Utilization of Agricultural Plant Genetic Resources in Nepal, Proceedings of 2nd National Workshop May, pp. 22-23.

STATISTICAL-INFORMATION-ON-NEPALESE-AGRICULTURE-2077-78.pdf. (n.d.). Retrieved March 28, 2024, from https://moald.gov.np/wp-content/uploads/2022/07/STATISTICAL-INFORMATION-ON-NEPALESE-AGRICULTURE-2077-78.pdf