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Economics of Apple Production in High Density and Traditional Orchard in Manang, Nepal

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ABSTRACT: This study was carried out in Manang district of Nepal to investigate and compare the economics of traditional and high density apple farming. Fifty farmers were selected by census survey method and interviewed with pre-tested semi-structured questionnaire. While ten progressive traditional apple farmers were selected purposively. The cost of production of high density and traditional apple farming in one ropani land for single year was NRs. 48,404 and NRs.51,015 respectively. Similarly, the benefit-cost ratio for high density apple farming was found in the range of 1.8 in the 4th year to 3.47 in the 7th year. The study revealed that high density system was more profitable than traditional system with the satisfactory value of B:C ratio and shorter payback period (3.44 years) while it was 9.002 years for traditional system. The findings suggest that production and income can be further maximized if the problems of transportation, disease and insect pest and marketing are solved and inputs are made available in time.

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KEYWORDS: B:C ratio,Cost of production, payback period, profitable

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INTRODUCTION

'Agriculture is playing dominant role in Nepalese economy engaging 2/3rd of labor force and contributing more than one-third(37%) to National GDP. Nepal has total cultivated area of around 3 million hectares of which 4.79% is covered by fruit crops. Horticulture sector contributes to 15% of AGDP of which almost half is constituted by fruits' (Atreya and Manandhar, 2016). Among deciduous fruits, apple is the most important fruit in terms of area, production and household economy in mountainous districts of Nepal (Atreya and Kafle, 2016). Apple contributes about 4.2 % of the total fruit production and occupies 5.08% of the total fruit area in Nepal (ABPSD, 2017). It is commercially cultivated in 44 districts of Nepal and is 9th most exported and 2nd most imported fruit in Nepal (Figure 1) (MOALD, 2014). In present context, total domestic production and supply of apple is unable to meet the total demand. However, there appears to be tremendous potential for further development of deciduous fruits in Nepal which has also been mentioned in the Agricultural Perspective Plan (APP) and the first Three Years Interim Development Plan. Apple has been recognized as an engine of growth for rural economy and poverty alleviation in ADS (2015AD-2035AD). Although the production and area under apple cultivation has increased in recent years, Nepal has not not able to meet the domestic demand and the import is ever increasing. Shifting to high density plantation can be better option to increase the overall productivity. With the existing traditional system, not only the yield per unit area is low but also the gestation period of the plantation is long and the plant being vigorous poses more problem in management (Singh, 2012). High density planting(HDP) makes the optimum utilization of available space to achieve the maximum level of production per unit area. Through high density technique, apple growers across the globe are getting 5-6 times more production per unit area than traditional apple orchard (TAO)(Sharma, 2019).

Manang, situated at Gandaki province is a potential district for apple production.Agriculture is the major source of income for people of Manang after tourism involving 52.3% of population in agriculture (CBS, 2013). Apple farming in Manang has both comparative and competitive advantage in term of climatic suitability and export potentiality. In the year 2015/16 the production of apple in Manang district was 750 MT from 75 hectare areawith average productivity of 10 MT/Ha (MOALD, 2019). High density apple farming is becoming popular as aincome generation activity for farmers in Manang district.The present study was conducted to estimate the profitability of both high density and traditional system of apple farming.

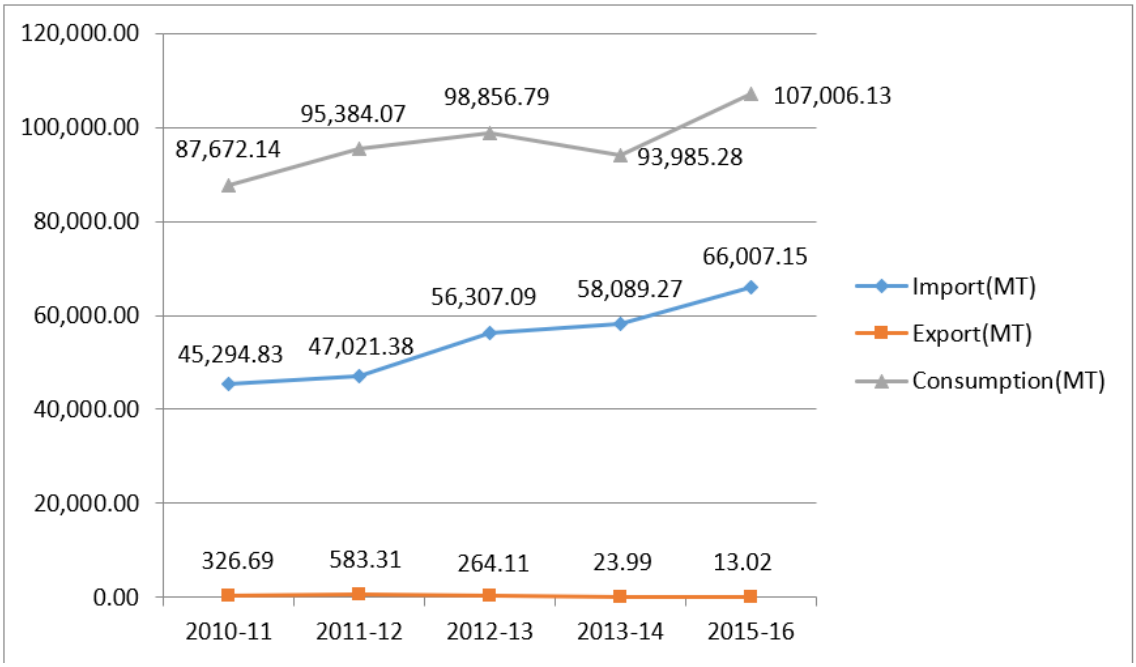
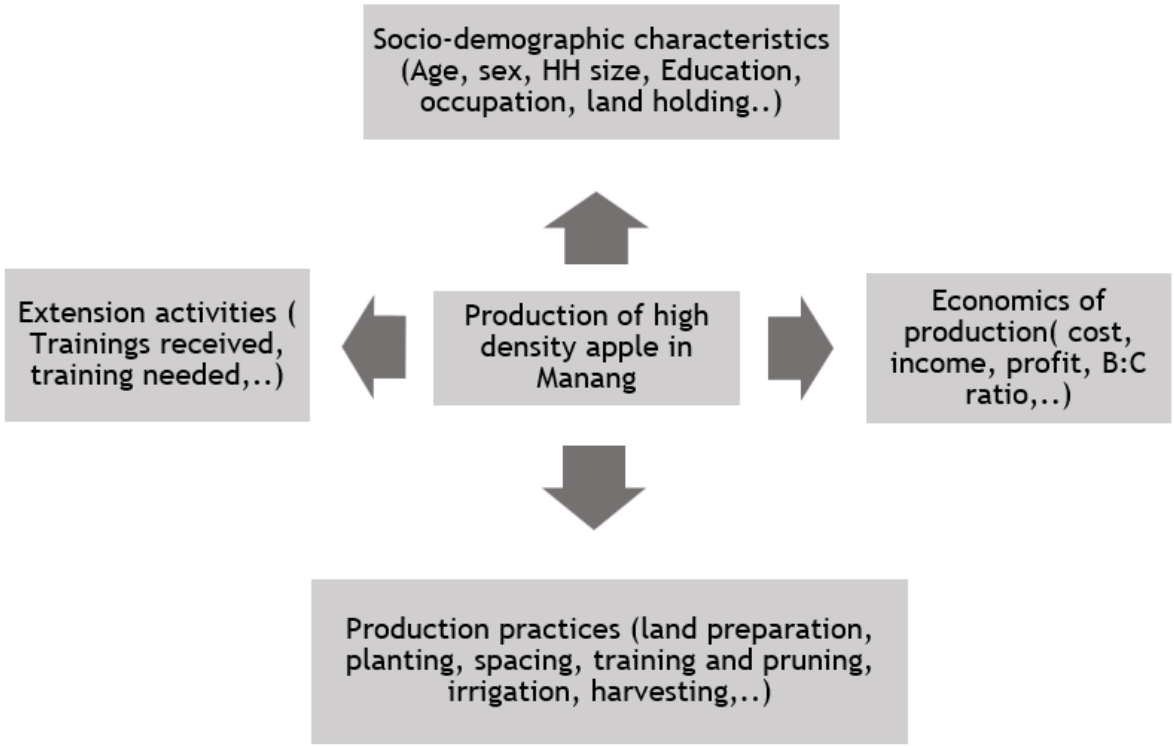


Figure 1: Status of apple import, export and consumption during 2010-11 to 2016-17. Source: (Ministry of Agriculture Development Annual Report, 2017)

CONCEPTUAL FRAMEWORK



METHODOLOGY

SITE SELECTION

This study was conducted in Manang district of Nepal which lies in Gandaki province. The study was carried out in three local bodies of Manang namely Chame rural municipality, Nashong rural municipality, Neshyang rural municipality. These places were purposively selected as these are the major apple growing areas of the district and come under the command area of PMAMP apple zone, Manang (Figure 2).

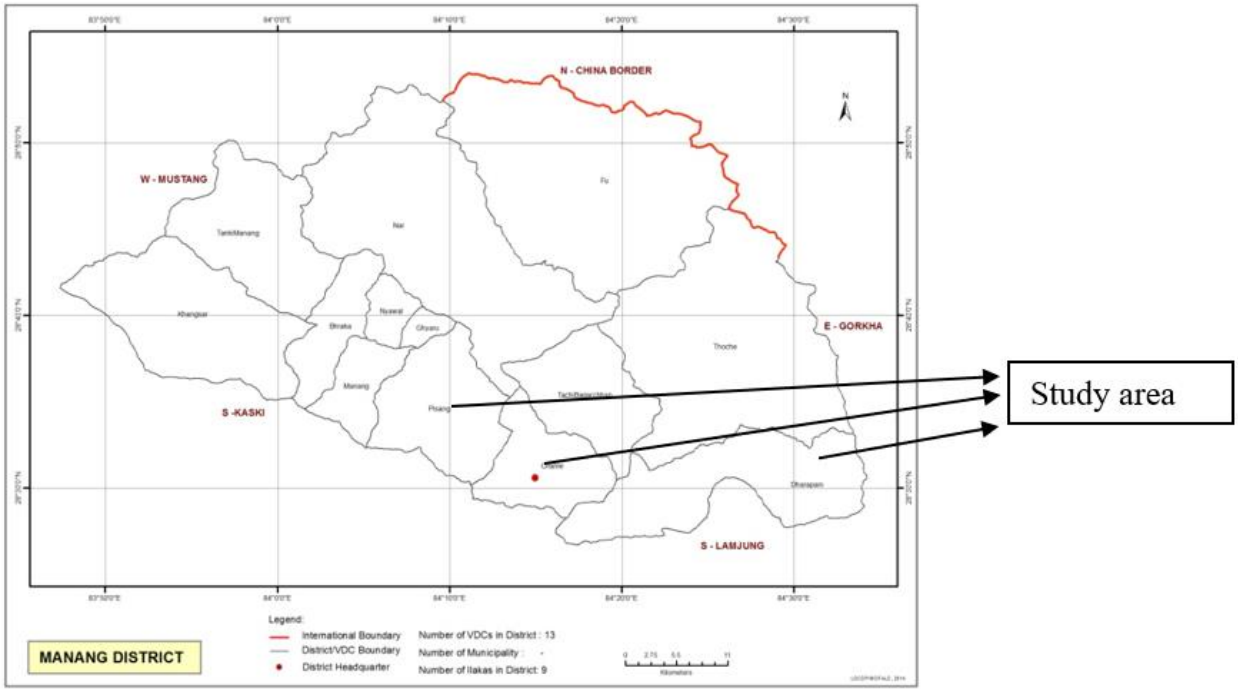


Figure2: Map of Manang showing study area

SELECTION OF POPULATION AND SAMPLE:

All the apple growing farmers registered in Apple zone office of Manang were the study population.Since the major focus of the study was concentrated on high density apple, separate list of high density apple growers and traditional apple growers were made. 50 farmers of high density apple growers were selected by census survey. Similarly, ten traditional growers were selected purposively for the study.

SOURCES OF INFORMATION

In this study, both the primary and secondary data were collected and analyzed.Small and large apple producers were the major source of primary data.Field survey was conducted in each selected rural municipality to collect the information from selected respondent. The pre-tested interview schedule was administered to the respondent to collect the primary data. The in-depth information regarding the various aspect of production was collected through face to face interview. Besides this, information obtained through observation, Focus Group Discussion, and Key Informant Interview were also used.Similarly, the secondary data were collected through different publications about apple production, processing, marketing and export to overseas countries from different institutions and organizations such as PMAMP profile, Ministry of Agriculture and Cooperatives(MoAC), Central Bureau of Statistics (CBS), Agro Enterprise Center (AEC), the then District Agriculture Development Office (DADO), Trade and Export Promotion Centre (TEPC), etc.

DATA AND DATA TYPES

Socio-economic data

Variables like age of respondent, religion, ethnicity, total land holding, education status, gender, etc were analyzed by using simple descriptive statistics such as frequencies, percentage, mean, standard deviation, etc.

Cost of production

For analyzing the cost of production both, fixed cost and variable cost were considered and analyzed. Total cost of production was calculated by summing up all the expenses made on variable inputs and the cost incurred for fixed items. Fixed cost include the cost of inputs that have life of more than one year and are purchased only once during the life of orchard i.e. during initial phase. The cost incurred on fixed items such as sapling cost, trellising cost, fencing cost, irrigation installation cost, land preparation cost were included under fixed cost. Per year fixed cost for fencing, trellising, irrigation were determined by using straight line depreciation method and was calculated by dividing the total fixed cost per ropani by useful life of the equipment. The cost incurred on variable inputs such as labour cost, fertilizer cost, land rent, etc were included under variable cost. Variable costs were calculated on per year per ropani basis. The cost for training, pruning, weeding, spraying, etc were included under labour cost.

Mathematically, TC= TFC+TVC

Where, TC= Total Cost, TFC= Total Fixed Cost, TVC= Total Variable Cost

Benefit cost ratio analysis

Benefit cost ratio indicates the return on per rupee investment. A project with benefit cost ratio greater than unity is considered viable. Benefit-cost ratio was calculated by using following formula.

Benefit-cost ratio = Gross Return/Total cost

Payback period

Payback period is the length of the time to recover the cost of an investment. Shorter payback period means more reliable investment, while longer payback periods are less desirable.

DATA ANALYSIS

The information collected from both primary and secondary sources were coded, edited and analyzed and entered into the computer using SPSS and Microsoft Excel. The SPSS was used for qualitative and quantitative data analysis. The data was analyzed by using tools like descriptive statistics and inferential statistics such as frequency distribution, trend analysis, etc. The findings were represented by tables, figures, bar-diagrams, pie-charts, etc.

RESULT AND DISCUSSION

POPULATION CHARACTERISTICS OF SAMPLED HOUSEHOLD

In the present study, 78% respondents were male and 22% were female. The average age of the respondent was 44.34 years. In the study area, 38% of the respondents were between the age of 28 to 41, 28% between the age of 42-49 and 34% between the age of 50-61. 92% of the respondent were Janajati, 6% were Chhetri and 2% were Brahmin, whereas 88% of the total respondent were Buddhist and rest were Hindu.

The higher percentage of the respondents i.e. 44% were SLC passed. Similarly, 30% respondent had secondary level education, 14% had primary level education and 4% had bachelor level and plus 2 certificate and 4% had no access to education.

SOCIOECONOMIC CHARACTERS

Land holding size and Land under apple

The average land holding of the respondent was 26.83 ropani. The size of the smallest farm was 1.5 ropani and the largest farm had an area of 735 ropani. Similarly, the average farm size under apple production was 21.8 ropani with minimum 1.5 ropani and maximum 550 ropani which is greater than national average farm size under apple.

Primary Occupation

Among 50 sampled household, 30% mentioned apple farming as their primary occupation. This showed majority of people in Manang were engaged in apple farming as their main source of income. Similarly, 30% respondents were engaged in hotel and restaurants as their primary occupation followed by government job (12%) and teaching (10 %). Four percent were dependent on foreign income source and rest 24% were engaged in other profession like health sector, social service, politics and other agriculture activities (Figure 3).

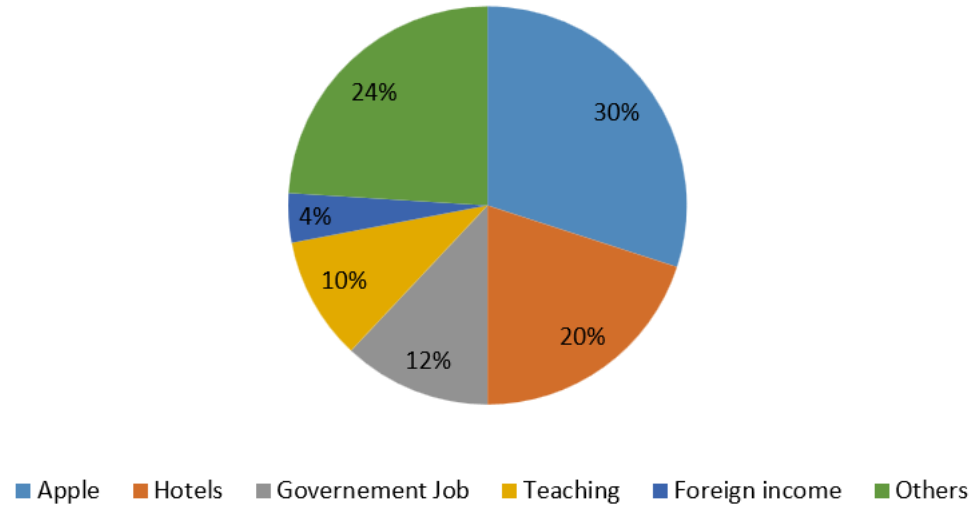


Figure 3: Primary occupation of respondents in the study site

Varieties used by the Respondents

The study revealed that Golden delicious was most widely used variety in the study area followed by Fuji, Gala, and Jonathan respectively (Table 1). Other varieties like King Red delicious, Royal Delicious, etc were also used by few respondents in their Orchard.

Table 1: Major varieties used by farmers in Manang

Varieties	Frequency	Percent
Golden Delicious	49	31.01
Fuji	42	26.58
Gala	42	26.58
Jonathan	25	15.82
Total	158	100

Rootstock used

Dwarfing rootstock M9 with strain T337 was grafted to different scion varieties (Golden delicious, Fuji, Gala, Jonathan, Royal delicious, Red delicious). The rootstock M9-337 was very precocious that come to bearing within 2 years of planting, virus free and tolerant to wide range of soil and climatic condition which requires support.

ECONOMICS OF HDP AND TAO

Cost of establishment in HDP and TAO

The cost structure of HDP was different than the TAO. Generally, in HDP produced fruit after one year of plantation while traditional apple took 5 to 8 years to come to bearing. So, the TAO was in loss up to 5 to 8 years due to no production. The establishment cost of HDP was significantly higher as compared to TAO due to the high cost incurred for planting materials and extra investment on trellising (Table 2). Trellising was not required in traditional plantation. Per ropani cost of planting materials for HDP was found to be 29 times higher than cost of planting material for TAO. This was because of two reasons, one was more number of saplingsrequired per unit area for high density system and the other was more cost of planting materials. The major reason behind higher cost of planting materials was that supply is completely dependent on import from Italy and Serbia. Land rent and cost for fencing material was almost same for both systems. Labour cost was slightly more in TAO. Land preparation cost for HDP was high because machines were used for land leveling, while in TAO only labour were used for digging and planting saplings. Due to this reason, the land preparation cost for traditional orchard was included under the labour cost.

Table 2: Establishment cost of high density and traditional apple orchard

Particulars	Establishment Cost per Ropani(NRs/Ropani)		
	High density System		Traditional System
	With subsidy	Without subsidy	
Land Preparation	5,500	5500	0
Irrigation Installation cost	7,234	28936	6,000
Fencing cost	35,259	141036	35,500
Trellising cost	5,290	21160	0
Sapling Cost	41,927	83854	1,442
Labour cost	29,414	29414	31,500
Fertilizer Cost	10,824	10824	4,940
Land rent	2,500	2500	2,500
Total	1,37,948	3,23,224	81,882

Cost of Production in HDP and TAO

There was a significant difference in cost of production between HDP and TAO. Cost of production varied depending on scale of production, technology adoption, etc. From the survey it was found that high density apple in Manang was highly subsidized and prioritized which has contributed to reduce the cost of production. 50% subsidy was provided for saplings and 75% subsidy was provided for drip irrigation and trellising materials. The highest cost among fixed cost was incurred for fencing (NRs. 9400) without subsidy (Table 3). Similarly, farmers had to spend large amount for laborin both planting system.Lamichhane and Sharma (2019) also reported human labor incurred largest portion of the total cost.

Table 3: Average cost of production of apple in high density planting per ropani

Particulars	Production cost (NRs/Ropani)		
	High density orchard		Traditional orchard
	Average cost in NRS (with subsidy)	Average cost in NRs (without subsidy)	
Fixed Cost			
Sapling	2,096	4192	1500

Trellising	353	1412	0
Fencing	2,350	9400	2400
Land preparation	275	275	0
Irrigation installation	592	2368	600
Total Average Fixed Cost (A)	5666	17,647	4500
Variable Cost			
LaborCost including family labor	29,414	29414	31,500
Fertilizer Cost	10,824	10824	4,940
Land rent	2500	2500	2500
Total Average Variable Cost (B)	42,738	42, 738	47,940
Total Cost (A+B)	48,404	60,385	51,015

Cost of production was also affected by the level of inputs used. Most of the growers relied on FYM and compost for nutrient except few large farms where they were using chemical fertilizers. Surprisingly, most of the growers almost 90% were not using pesticides and fungicides for pest and disease control. Petrol, kerosene, wood ash, etc were used for controlling pest and disease. The cost of Bordeaux paste is not included as it was provided by apple zone office for free to all the apple growers.

Benefit Cost ratio of HDP

The benefit-cost ratio up to 7 years was calculated and positive benefit-cost ratio was obtained after 4 years of planting (Table 4). It was zero in the first year due to no production and was highest (3.47) in 7th year when full production was obtained.After 7th year B:C ratio was assumed to remain constant till the economic life of Orchard(20 years). The satisfactory B:C ratio revealed the profitability of HDP in the study area.

Table 4: B:C ratio of high density apple up to 7years

Year	1	2	3	4	5	6	7
Production (Kg/plant)	0	2	3.5	6	10	15	18
Production(kg/ropani)	0	228	399	684	1140	1 710	2052
Total Income	0	37620	56430	112860	150480	188100	282150
Variable cost	42,738	47011.8	51712.98	56884.28	62572.71	68829.98	75712.98
Fixed cost	5,666	5,666	5,666	5,666	5,666	5,666	5,666
Total cost	48,404	52,678	57,379	62,550	68,239	74,496	81,379
Profit/Loss	-48,404.0	-15,058	-949	50,310	82,241	113,604	200,771
B:C Ratio	0	0.71	0.98	1.80	2.21	2.52	3.47

Note: Cost increases by 10% each year and after 7th year B:C ratio remains constant

Benefit Cost ratio of TAO

The production was obtained only after 5 years of planting in traditional system and the B:C ratio was found to be negative up to 9 years (Table 5). B:C ratio of 1.02 was obtained in 10th year and 1.16 in 11th year and remains constant onwards.Bhandari, and Aryal(2017) found similar results in their study. They found B:C ratio of apple orchard in Manang ranging from 1.07 to 2.01 with a decreasing ratio after 8 years.

Table5: B:C ratio of TAO up to 11 years

Year	Production (Kg/plant)	Production (Kg/ropani)	Total Income	Variable cost	Fixed cost	Total cost	profit/loss	B:C ratio
1	0	0	0	47940.00	4500	52440.00	-52440.00	0.00
2	0	0	0	52734.00	4500	57234.00	-57234.00	0.00
3	0	0	0	58007.00	4500	62507.00	-62507.00	0.00
4	0	0	0	63808.10	4500	68308.10	-68308.10	0.00
5	0	0	0	70188.91	4500	74688.91	-74688.90	0.00
6	10	250	30000	77207.80	4500	81707.80	-51707.80	0.37
7	20	500	60000	84928.58	4500	89428.58	-29428.50	0.67

8	30	750	90000	93421.38	4500	97921.381	-7921.38	0.92
9	35	875	105000	102763.50	4500	107263.51	-2263.51	0.97
10	40	1000	120000	113039.00	4500	117539.00	2461.00	1.02
11	50	1250	150000	124343.80	4500	128843.76	21156.23	1.16

Note: cost increases by 10% each year

The profit was made from fourth year in HDP (NRs. 50,310) while TAO was in loss for nine years and profit was made from tenth year (NRs. 2461) which was far below than HDP. This might be because of the two main reasons, one the fruits produced from high density system being of superior quality fetched more price and the other was because of more number of trees per unit area, the production per ropani was more in high density system than traditional system (although the production per tree was more in traditional system). The findings from the study showed that HDP was more profitable than TAO because of early return on investment due to shorter payback period and higher B:C ratio in high density system.

Payback period of HDP and TAO

Payback period is the time in which initial investment is expected to recover through the cash inflow generated by the investment. Discounted cash inflow and outflow was calculated at 10% discount factor. In this study, the payback period was estimated for HDP (3.44 years) and TAO (9.002 years). The study showed that the recovery of initial investment in HDP was in short time period as compared to TAO. Similar result was obtained by Majid et al. (2020). They reported early pay back period in HDP as compared to conventional orchards. Farmers in the study area started harvesting apple from second year of planting in case of HDP. Similar observation was made by Cahn and Goedegebure (2012)in their study. They found payback period of 4 years for HDP. The shorter payback period in the study site was due to sufficient subsidy provided by government to high density apple growers which helped in reducing the investment cost.

PRODUCTION PROBLEMS FACED BY HIGH DENSITY APPLE GROWERS

Agricultural production process is always confronted with several problems. The result showed that there were several production related problems in the study area. Among various problems majority of the farmers reported transportation as major problem followed by lack of extension services and had significantly affected the production of high density apple in Manang (Table 6). The roadway to Manangis seasonal which remains blocked during winter due to heavy snowfall and avalanche and in monsoon due to landslide which adversely affects the supply of major agriculture inputs required for production. Similarly, it also affects the market of harvested fruit. The farmers ranked lack of easy access to market at 3rd position as problem of high density apple production. Similarly, unavailability of major inputs in time and incidence of disease and insect pest were ranked at 4th and 5th position respectively. Gayak et al. (2020) also reported, unavailability of inputs, lack of storage facilities, insect pest damage, poor technical knowledge and infrastructure as the major production problems.

Table 6: Major Production problems faced by apple growers

Problems	Index	Rank
Transportation	0.925	I
Lack of extension services	0.883	II
Lack of easy access to market	0.816	III
Unavailability of major inputs in time	0.75	IV
Disease and insect pest	0.70	V

Note: Scale, value range from 1 to 0, where 1= strongly agree, 0.75 = agree, 0.5 = neither, 0.25 = disagree, and 0 = strongly disagree

CONCLUSION

The study showed that high density apple production is the profitable enterprise in the study area with B:C ratio of 3.47 which indicates 1 rupee investment on high density apple will give 3.47 rupees in return, while in Traditional system the B:C ratio obtained was 1.16 in 11th year which is comparatively very low. The shorter payback period of high density apple (3.44 years) also proves the feasibility of High density system over traditional system which has longer payback period (9.002 years). High density system was found to be more profitable than traditional system. For improving the production of high density apple in Manang district there should be adequate extension services like training and workshops to enhance the farmer's knowledge and skills on advanced production and management practices. Cold storage and processing industries should be established. Nursery for high density apple should be established in the district that will solve the problem of importing saplings of high cost from overseas. Output based incentives should be provided from government level to encourage the farmers.

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