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Economics of production of Sunkagati-1 variety of acid lime in Nepal

Sanjiv Subedi[@] and Krishna Prasad Timsina

Nepal Agricultural Research Council, National Agricultural Policy Research Centre, Khumaltar, Lalitpur, Nepal: @sanjiv.subedi@gmail.com : https://orcid.org/0000-0002-8084-008X; KPT: krishnatimsina2000@gmail.com, https://orcid.org/0000-0003-4005-7039

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ABSTRACT

There is a huge opportunity for acid lime farming in Nepal. The demand is much higher than domestic production resulting voluminous import from abroad. This research aimed to assess the economics of production of Sunkagati-1 variety of acid lime in Nepal. Morang, Sunsari, Chitwan and Nawalparasi districts were selected for this study after consultation with the concerned agricultural experts and nursery entrepreneurs producing Sunkagati-1 saplings. The primary information was collected through the field survey whereas secondary information was obtained reviewing the relevant literatures. All total 70 farmers were selected as the samples through simple random sampling for the field survey. Financial analysis of farms with plant age between 3 to 7 years, was carried out which estimated the NPV (12% discount rate) NRs.4,48,672/ha, BCR 1.09, IRR 19% and the Pay-back period of 5 years, 5 months and 26 days. The value of BCR being greater than one, IRR higher than discount rate, positive NPV and short payback period indicated that commercial acid lime farming cultivating Sunkagati-1 variety is a profitable enterprise in Nepal. The unpaired t-test showed that there is no significant difference in productivity of Sunkagati-1 across eastern (Sunsari and Morang) and central (Chitwan and Nawalpur) regions; however, the price of acid lime in central region (NRs.102/kg) was significantly higher (1 % level of significance) than that of in eastern (NRs.93.8/kg). Moreover, this study revealed that porous border and unorganized market (I= 0.81) was the most severe problem followed by infestation of disease and insect pests (I= 0.76), inadequate quality seedlings (I= 0.68), inadequate technical knowledge and trainings (I=0.41) and inadequate storage and processing facilities (0.34). There is need of government intervention which would assure access to quality inputs & technology, marketing & value chain development and appropriate plant protection measures for the promotion of commercial acid lime farming in Nepal.

Keywords: acid lime farming; financial analysis; profitable enterprise; Sunkagati-1

सारांश

कागती व्यावसायिक महत्व भएको फलफूल हो । स्वदेशी उत्पादनको तुलनामा माग धेरै भएकाले विदेशबाट ठूलो मात्रामा आयात हुने गरेको हुँदा नेपालमा कागती खेतीको ठूलो अवसर छ । नेपालमा सुन कागती-१ प्रजातिको कागती उत्पादनको आर्थिक विश्लेषण गर्न यो अनुसन्धान गरिएको थियो । सुन कागती-१ सम्बन्धित कृषि विज्ञ र नर्सरी व्यवसायीसँग आवश्यक परामर्श गरी मोरङ, सुनसरी, चितवन र नवलपरासी जिल्लालाई यस अध्ययनका लागि छनोट गरियो । प्रारम्भिक जानकारी सर्वेक्षण मार्फत सङ्कलन गरिएको थियो भने अन्य जानकारी सम्बन्धित प्रकाशित कृतिहरु र पुस्तिकाहरुबाट प्राप्त गरिएको थियो । कुल ७० कृषकहरू (नमूना लिने जनसंख्याको १९%) लाई क्षेत्र सर्वेक्षणको लागि सरल अक्रमत नमूना छनोट विधिबाट छानियो । व्यावसायिक कागती फार्महरूको वित्तीय विश्लेषण (देखि ७ वर्ष उमेर भएका सुनकागती-१ का बोटहरु भएका फार्म) गरिएको थियो जसमा कुल वर्तमान मूल्य (१२% डिस्काउंट रेट) ने.रु. ४,४८,६७२/हे, मुनाफा-लागत अनुपात १.०९, आन्तरिक प्रतिफल दर १९% र फिर्ता अवधि ५ वर्ष, ५ महिना र २६ दिन रहेको पाइयो । मुनाफा-लागत अनुपात एक भन्दा बढी, आन्तरिक प्रतिफल दर डिस्काउंट रेट भन्दा उच्च, सकारात्मक कुल वर्तमान मूल्य र छोटो फिर्ता अवधि हुनाले नेपालमा व्यवसायिक कागती खेती मुनाफमुलक रहेको पाइएको छ । नेपालको पूर्वी (सुनसरी र मोरङ) र मध्य (चितवन र नवलपुर) क्षेत्रहरूमा सुनकागती-१ को उत्पादकत्वमा खासै भिन्नता नरहेको कुरा यस अनुसन्धानले देखाएको छ । यद्यपि, मध्य क्षेत्र (ने.रु. १०२/के.जी.) मा कागतीको मूल्य पूर्वी (ने.रु. ९३.८/के.जी.) भन्दा उल्लेखनीय रूपमा उच्च रहेको पाइएको छ । यस बाहेक, यस अध्ययनले खुल्ला

सीमाना र अव्यवस्थित बजार पछि रोग-कीराको प्रकोप, अपर्याप्त गुणस्तर बिरुवाहरु, अपर्याप्त प्राविधिक ज्ञान/प्रशिक्षण र अपर्याप्त भण्डारण/प्रशोधन सुविधाहरू व्यवसायिक कागती खेतीसंग सम्बन्धित मुख्य समस्याहरु रहेको देखाएको छ। गुणस्तरीय उत्पादन सामग्री र प्रविधिमा किसानहरुको पहुँच सुनिश्चित गर्न, बजारीकरण र मूल्य शृंखलालाई व्यवस्थित गर्न र रोग-कीरा व्यवस्थापन गर्न सरकारले आवश्यक कदम चाली नेपालमा व्यवसायिक कागती खेतीलाई प्रवर्द्धन गर्न जरुरी देखिन्छ।

INTRODUCTION

Acid lime (Citrus aurantifolia), an important horticultural fruit crop of commercial value in Nepal, belongs to the genus Citrus of family Rutaceae. The acid lime has been found to be grown in an area of 5,638 ha where the production and productivity has been reported 39,580 mt and 7.02 mt/ha respectively (MOALD 2020). The acid lime fruit is rich source of vitamin C, which helps in increasing the resistance to diseases. Lime improves the digestion and helps in reducing acidity problem, constipation and peptic ulcers. Moreover, the oil extracted from fruit rind is used in cosmetics and perfume industry (Mohanapriya et al 2013, Ganguly 2013). The lime farming in Nepal has been found to be grown more extensively throughout the length of the mid hills. However, the potential of cultivating range could be much wider from 125 masl to 1400 masl in Nepal with high yielding varieties. The acid lime cultivation practice is attributed to marginal land with poor yielding varieties. After the release of high yielding two acid lime varieties viz. Sunkagati-1(34.5 mt/ha) and Sunkagati-2 (26.9 mt/ha) suitable for upland terai, inner terai, foothills areas in 2015 A.D., the cultivation area of acid lime has increased significantly (Gotame 2020). Though both varieties are becoming popular among acid lime cultivating farmers; Sunkagati-1 has been found to be highly preferred by the farmers (NCRP 2018). Despite development of these two high yielding varieties: Sunkagati-1 and Sunkagati-2 in 2015, the national yield of acid lime in Nepal in the year 2018/19 was only 7 mt/ha (MoALD 2020).

The increasing demand of lime and lemon is mainly due to the increase in population, enhanced food habit of the people, tourist influx, establishment of small and medium agro-processing units in the country and knowledge among the people on multifarious use of the fruits. This increased demand of acid lime and lemon in Nepal is mainly fulfilled though import. As per report of MoICS (2020), 1,07,050 mt limes and lemons were imported from India; the prevailing domestic production of acid lime is unable to meet the national demand; more than 90% of demand has been met through the import. It has been reported that there is a great potentiality for acid lime farming in Nepal. The domestic market opportunities exist for both main as well as off season productions (Dhakal et al 2002). 70% of fruits are harvested in four months (July- October) and rest 30% is harvested round the year. The commercial productive period of the acid lime plant has been reported to be nearly 20 years (NFDC 2021). However, the citrus growing farmers of Nepal are subjected to high cost of production, low yield, poor technical knowledge and unorganized market (Parajulee et al 2021). There is a need of encouragement to the farmers for commercial acid lime farming in Nepal. Past studies mainly focused on production economics of other citrus fruits such as mandarin (Regmi et al. 2020) and sweet orange (Parajulee et al 2021). Dhakal et al (2005) had conducted a study which assessed the marketing system, demand and supply situation and price behavior of acid lime and hill lemon in Nepal. However, there is no scientific documentation of cost and benefits associated with acid lime farming; also, assessment of problems associated with production and marketing is also lacking. Moreover, the assessment of productivity of the acid lime with the increasing plant age has not been assessed yet through empirical field survey. Thus, this research intends to assess the profitability of farmers cultivating Sunkagati-1 variety of lime through discounted appraisal tools. It also, identifies the major problems related to production and marketing. The acid lime farming in Nepal could be made more productive, profitable and sustainable enterprise through the findings revealed from this research.

MATERIALS AND METHODS

Selection of the study area

Morang, Sunsari, Chitwan and Nawalparasi districts of Nepal were selected as the study area. These districts were selected having consultation with the technical experts (researchers and extension workers)

engaged in the field of citrus research and technology dissemination. Participatory Varietal Selection on acid lime had been carried out by NCRP, NARC in farmers' fields of Morang, Sunsari and Chitwan districts during 2005/06 to 2009/10. Based on in situ germplasm evaluation, and participatory varietal selection, two varieties of acid lime 'Sunkagati-1' and 'Sunkagati-2' were released (NCRP et al 2018 and Gotame et al 2020). Moreover, the views of agri-entrepreneurs having commercial nursery of Sunkagati-1 were also taken into consideration while selecting the study area.

Sampling procedure and data collection

The sampling frame of the commercial farmers cultivating Sunkagati-1 was prepared in the study area consulting the horticultural experts of local and federal government, entrepreneurs producing Sunkagati-1 saplings. Altogether, 70 respondent farmers (19% of the sampling population) from the study districts. Sunsari (20), Morang (20), Chitwan (20) and Nawalpur (10) were selected from their respective sampling frame applying simple random sampling technique. The pre-tested interview schedule was used to collect the primary information from the sampled respondents during the field survey. For secondary information, relevant literature from scientific research articles published in journals and related institutional reports were reviewed.

Methods and techniques of data analysis

The data entry was done in MS-Excel. The computer software package, Statistical Package for Social Sciences (SPSS) was mainly used for data analysis. The following analyses were performed.

Cost of production

The total cost of Sunkagati-1 production was calculated by adding the investment costs, fixed costs and variable costs. Layout cost, sapling cost and equipment cost were included in the investment cost; Land rent and taxes, interest were included in the fixed cost; while the costs of variable inputs such as, fertilizers, manures, nutrients, labor, herbicides and pesticides costs were included in the variable costs.

Gross margin and net profit

Gross margin was estimated deducting the total variable cost from the gross returns while on deducting the fixed cost from gross margin, the net margin was calculated.

Financial analysis of Sunkagati-1 production

The discounted appraisal tools were used for financial analysis of Sunkagati-1 production as these tools consider the time value of money. Time value of money is the concept that money today is worth more than money tomorrow. The appraisal tools used were: Net Present Value/Worth (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR) and Pay Back Period (PBP). These tools have been used in the study conducted by NFDC (2021) for benefit cost analysis of major fruit crops.

Net Present Value (NPV)

The NPV is the numeric value that is obtained on deducting the present value of cost stream from present value of benefit stream at a certain discount rate. The positive value of NPV shows the financial viability. The formula used to calculate the NPV was,

$$NPV = \sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t}$$

Where,

Ct = Incremental cost of the year/ cash outflows
Bt = Incremental benefit of the year/cash inflows
t = the time of the cash flow (number of years)
n = total time of the project (total productive years)
i= interest rate/discount rate

Benefit cost ratio (BCR)

Benefit cost ratio is defined as the ratio of present worth of cash inflows (incremental benefit stream) to present worth of cash outflows (incremental cost stream) due to the enterprise. The following formula was used to calculate the BCR.

$$BCR = \frac{\sum_{t=1}^{n} \frac{B_t}{(1+i)^t}}{\sum_{t=1}^{n} \frac{C_t}{(1+i)^t}}$$

Where,
Ct = Incremental cost in the tth period
Bt = Incremental benefit in the tth period
n = total time of the project (total productive years)
t = the time of the cash flow (number of years)
i= interest rate/discount rate

Internal rate of return (IRR)

Internal rate of return (IRR) is the discount rate which equates the present worth of benefits to present worth of costs. Moreover, IRR is the rate at which the net present value of the project is equal to zero. It is simply the rate of return which equates the discounted benefits with the discounted costs. IRR indicates the average earning capacity of an investment from the project. Thus, it can be said that it is that value of 'i' which makes.

$$\sum_{t=1}^{n} \frac{B_t - C_t}{(1+i)^t} = 0$$

The method used for interpolating the value of IRR lying between the two discount rates, too high on one side and too low on the other (between a spread of five percentage points) as mentioned below:

$$IRR = L_i + \frac{(H_i - L_i)\ NPV \text{ at } L_i}{NPV \text{ at } L_i - NPV \text{ at } H_i)}$$

Where,
Li= Lower discount rate
Hi= Higher discount rate

Pay-back period (PBP)

Payback period (PBP) was estimated by successively deducting the initial investment from the net returns until the initial investment is fully recovered. Payback period is the time required for the stream of cash proceeds produced by the investment to be equal to the original cash outlay. It is simply the time period required for the project to pay for itself. For any project, the shortest payback period is the best.

Scope and Limitation of the Study

This study assessed the financial status of the commercial acid lime growers cultivating Sunkagati-1 variety in eastern and central regions of Nepal. The districts from central and eastern regions were selected after having consultation with concerned researchers, extension workers and agri-entrepreneurs having commercial nursery of Sunkagati-1. During the field survey, it was found that the highest age of Sunkagati-1 plant giving production was 7 years and the lowest was 3 years including the gestation period 2 years. Thus, the farmers selected were having the acid lime production from the plants of age 3 to 7 years while the first two years were the gestation period. However, this study has not projected the costs and benefits during the entire productive period of acid lime plants.

RESULTS

The Study Sites

Sunsari and Morang are the two Terai districts which lie on eastern region of Nepal; both the districts come under Koshi Province. The length (north-south) of Morang district is about 54 km, whereas the breadth (east-west) is about 46 km. 'Biratnagar' the headquarters lies 24 km south from Itahari on the East-West Highway whereas 506 km east from Kathmandu. In Morang, Sub-tropical climate is found. There are more

than half dozen collection centers, nearly a hundred Haat Bazar, more than one dozen retail markets, one wholesale market and two cold storages in Morang district. Sunsari district is situated in about 152 m to1430 m from the sea level and at the foot of Mahabharat Hill. The plain land occupies a major part of the district. It is very fertile and so suitable for cultivation of major agricultural crops. Except for the northern part, the climate in almost all area is tropical monsoon. During the summer, the north is cold whereas Terai and Bhawar are hotter. More than 90% rainfall occurs from April to September. There are more than one dozen collection centers, more than hundred Haat Bazar, more than one dozen retail markets, one wholesale market and one cold storage in Sunsari district (BPRC 2017). The total Population of Morang has been reported 9,65,370 out of which 51.64% is female and 48.4% male of total population, 70.63% are literate. The total population of Sunsari has been reported 7,63,487 out of which 51.4% is female and 48.6% male; moreover, of total population, 68.46% are literate. Chitwan district, popularly known as Rapti valley or Chitwan Doon valley, covers an area of approximately 2,238.39 sq.km. The geographical location of Chitwan district is between 27o 21' 45'' to 270 52'30'' north latitude and 830 54' 45'' to 840 48' 15'' east longitude, about 139 km southwest of capital Kathmandu. Furthermore, the total population of Chitwan district was 5,79,984 of which 2,79,087 (48.12 %) were male and 3, 00, 897 (51.88%) were female (CBS, 2011). Nawalpur (Nawalparasi east of Bardaghat Susta) is a district located in Gandaki Pradesh of Nepal. It is 1 out of 11 districts of Gandaki Pradesh. The headquarter of the district is Kawasoti. Formally Nawalpur District was part of Nawalparasi District, which split into two districts Nawalpur District and Parasi District after the state's reconstruction of administrative divisions as of 20 September 2015. According to CBS (2011), Nawalpur district has a total area of 1043.1 square kilometres and a population of 310864 people. The major market areas for Chitwan and Nawalpur were Narayangadh, Bhandara, Kawasoti, Kathamdu, Pokhara. Producers, collectors, commission agents, wholesalers, retailers and consumers were found to be the major actors involved in the marketing of acid lime (Dhakal et al 2005, Upreti 2022).

Cost of acid lime production cultivating Sunkagati-1 variety

The average total cost incurred in Sunkagati-1 production was NRs. 34,60,086 when surveyed among the farmers whose orchard has 3-7-years old acid lime plants; moreover, the share of investment cost, variable cost and fixed cost in was 4.3, 57.3 and 38.4 percent respectively. The investment cost comprises layout, cost, sapling cost and equipment cost while the fixed cost comprises the cost for bank interest and land rent. The variable cost items were incurred in production process were: Farm Yard manure (FYM), Chemical fertilizers, Human labor, Disease-pest management, Micronutrients and Irrigation. Among the variable cost items, the share of human labor was highest (19.3%) followed by FYM (15.9%). (**Table 1**).

Table 1. Cost items in acid lime production

S.N.	Costs items	Total cost incurred from Year 1 to Year 7 (NRs./ha))	Percentage of total cost
1.	Layout	9,655.0	0.28
2.	Sapling	1,04,875.0	3.03
3	Equipment	34,171.0	0.99
	Investment Cost Total	1,48,701.0	4.30
4	Farm Yard Manure	5,49,505.8	15.88
5	Chemical Fertilizers	3,16,995.5	9.16
6	Human labour	6,65,993.0	19.25
7	Disease/pest management	1,84,392.8	5.33
8	Micronutrients	1,42,328.3	4.11
9	Irrigation	1,23,170.7	3.56
	Variable cost total	19,82,386.0	57.29
10	Land rent	8,06,587.5	23.31
11	Bank Interest	5,22,411.5	15.10
	Fixed cost total	13,28,999.0	38.41
	Total cost	**34,60,086.0**	**100**

Financial analysis of acid lime production

The discounted (considering time value of money) appraisal tool such as: Net Present Value (NPV), Benefit Cost Ratio (BCR) and Internal Rate of Return (IRR) along with Pay-back Period (undiscounted) were used for the analysis of cost and returns in acid lime production (**Table 2**). The farmers were having the acid lime production from the plants of age 3 to 7 years while the first two years were the gestation period. The financial analysis of acid lime production performed per hectare of land estimated the Pay-back Period of 5 years, 5 months and 26 days which showed the breakeven point. Moreover, using discounted method (at 12%discount rate) the NPV (NRs. 4,48,672), BCR (1.09) and IRR (19%) were estimated (**Table** 3).

Table 2. Financial analysis of acid lime production among the farmers in the study area

Year	Total income (Bt)	Total cost (Ct)	Incremental benefit (INB)	Discount factor (12%)	Present value of Bt	Present value of Ct	Present value of INB
Base year 1	0	4,13,165.4	-4,13,165	1.973823	0	8,15,515.2	-8,15,515
2	0	4,35,269.9	-4,35,270	1.762342	0	7,67,094.3	-7,67,094
3	447,768.8	4,75,933.9	-2,81,65.1	1.573519	7,04,572.8	7,48,891.2	-44,318.4
4	687,633.3	4,95,789.2	1,91,844.1	1.404928	9,66,075.2	6,96,548.1	2,69,527.1
5	944,058.8	5,14,254.3	4,29,804.5	1.2544	11,84,227	6,45,080.6	5,39,146.8
6	107,3057	5,45,204.6	5,27,852.6	1.12	12,01,824	6,10,629.1	5,91,194.9
7	125,6200	5,80,469.1	6,75,730.9	1	12,56,200	5,80,469.1	6,75,730.9
Total	44,08,718	34,60,086	9,48,631.6	10.08901	53,12,899	48,64,228	4,48,671.7

Table 3. Financial indicators of acid lime production estimated from the field survey

Financial indicators	Value
Payback period	5 years 5 months 26 days
Net present value at 12%	4,48,672
Internal rate of return	19 %
Discounted benefit cost ratio	1.09
Return on investment	9.2 %

Description of the major socio economic variables

The average age of the respondents in the study area was 49 years, family size was 5 and number of family members involved in agricultural activities was 2. Moreover, the average cultivated land, productivity and price of acid lime was 0.8 ha, 6998 kg/ha and Rs.97/kg respectively. Furthermore, the average lime cultivated years among the farmers in the study area was 4.7 (**Table** 4).

Table 4. Statistical description of the major socio-economic continuous variables

Variables	Mean	Standard decviation
Age	49.3143	9.96449
Fam size	5.0857	1.89387
Family involved in agriculture	2.2571	1.25900
lime cultivated land area	.8093	.96048
Lime cultivated years	4.7429	.86285
Productivity (kg/ha)	6998	1967.6
Price (NRs/kg)	97.3238	12.89079

Productivity and price of acid lime across the regions

The mean productivity of acid lime in eastern region districts (7019 kg/ha) was found to be higher than that of central (6969 kg/ha). However, the difference was not statistically significant (**Table** 5). Unlike this, the significant difference (at 1% level of significance) was found in the price of acid lime across eastern (NRs.93.8/kg) and central (NRs.103/kg) (**Table** 6).

Table 5. Mean comparison of productivity of acid lime across the regions

Statistics	Productivity of acid lime in eastern region districts (kg/ha)	Productivity of acid lime in central region districts(kg/ha)	Difference
Obs.	40	30	
Mean	7019	6969	49.66
Std. err. mean	405.41	110.82	478.66
Std. dev.	2564.05	606.97	
t-value	.104 (.918)		

Table 6. Mean comparison of price of acid lime across the regions

Statistics	Price of acid lime in eastern region districts (NRs./kg)	Price of acid lime in central region districts(NRs./kg)	Difference
Obs.	40	30	
Mean	93.78	102	8.28
Std. err. mean	2.07	2.04	2.97
Std. dev.	13.08	11.17	
t-value	-2.787*** (.007)		

Productivity of acid lime in different productive years in the study area

The acid lime variety, Sunkagati-1was found to productive after 2 years of planting with appropriate farming practices. In the first productive year, the average yield of lime was found to be 4850 kg/ha, while the yield was found to be increasing, being 6816, 6901, 8419 and 8910 kg/ha in the second, third, fourth and fifth productive years respectively (**Figure** 1).

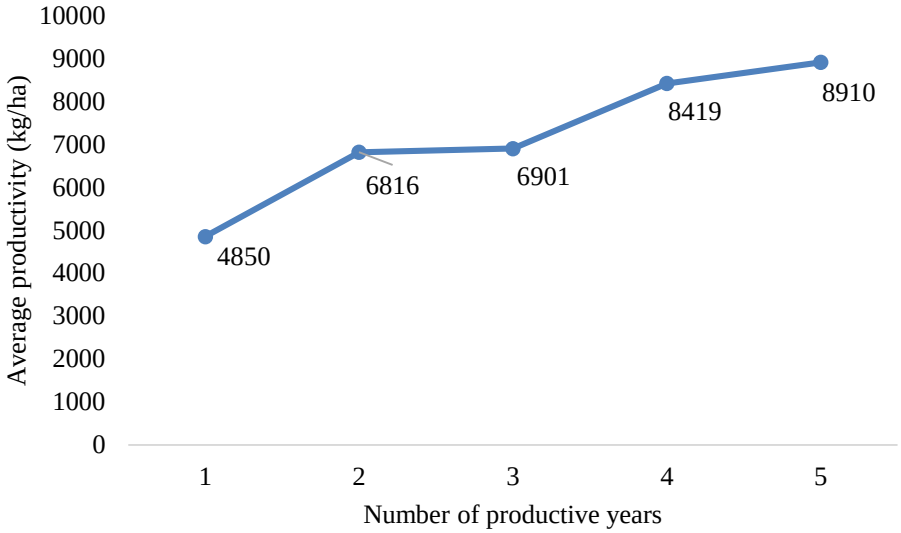

Figure 1. Average productivity of acid lime in productive years

Problems associated with production and marketing of acid lime

There were various problems associated with the production and marketing of acid lime in Nepal. The farmers' perceptions on those problems were taken during the field survey and scaling technique (indexing) was applied to rank the problems. The study revealed that, porous border and unorganized market (I= 0.81) was the most severe problem followed by Infestation of disease and insect pests (I= 0.76), Inadequate quality seedlings (I= 0.68), Inadequate technical knowledge and trainings (I=0.41) and Inadequate storage and processing facilities (0.34) (**Table 7**).

Table 7. Assessment of the major problems associated with acid lime production and marketing

Problems	Index value	Rank
Porous border and unorganized market	0.81	I
Infestation of disease and insect pests	0.76	II
Inadequate quality seedlings	0.68	III
Inadequate technical knowledge and trainings	0.41	IV
Inadequate storage and processing facilities	0.34	V

DISCUSSION

The study showed that the share of human labor in the variable cost was the highest followed by FYM (**Table 1**). Similar findings have been reported by Sundar et al (2019) and Abhilash (2018) human labor cost was found to have the highest followed by manuring cost. The value of NPV indicated that the acid lime farmers had earned NRs.4,48,672/ha in these seven years taking account of time value of money. Moreover, BCR value showed that their investment of rupee 1 had returned 1.09 rupees; return on investment was 9 percent. In addition, the estimated IRR (19%) indicated that acid lime farming has earned 19% of the investment in these seven years. The financial indicators revealed the financial viability of acid lime production in the study area (**Table 3**). In a like manner, Abhilash et al (2018) reported BCR 2.83, Payback Period 5.17 years and IRR 28 per cent in Indi taluk of Vijayapura district of India. Also, the undiscounted BCR for other citrus fruits such as mandarin in Dailekh, Nepal has been reported 1.62 (Regmi et al 2020) and 2.81 for sweet orange in Sindhuli, Nepal (Parajulee et al 2021). Moreover, it has been reported that exploring the potentiality of fruit production in Nepal would substitute import and promote export which will ultimately contribute to enhance the living standard of the farmers (Bhandari and Aryal 2017). These findings could motivate the farmers for commercial acid lime farming which will contribute to increase the national production and income.

The Sunkagati-1 variety has been recommended for terai to foothills; as the study districts lie in terai and inner terai belts of eastern and western regions, it is obvious to have nearby productivity values. Moreover, the slight difference in productivity is due to the difference in the farming practices. Unlike productivity, the significant difference in price of acid lime across the regions is due to the impact of consumer's demand and market access. The higher price of acid lime in the central region districts as compared to eastern must be due to the short market distance to highly urbanized cities such as Kathmandu, Bharatpur and Pokhara. With the increasing age of the plants, productivity was also found to be increasing, this must be happening up to certain productive age. The average productivity of the acid lime (plants of productive age 1 to 5 years) in the study area was estimated 6,998 kg/ha. In line of this finding, the productivity of acid lime in Nepal has been reported 7.02 mt/ha respectively (MoALD 2020).

This study revealed that porous border and unorganized market was the most severe problem followed by infestation of disease and insect pests, Inadequate quality seedlings, Inadequate technical knowledge and trainings and Inadequate storage and processing facilities that were associated with the production and marketing of acid lime. Sundar et al (2019) also reported price fluctuation in the market price as first major problem followed by infestation of disease and pests in acid lime farming in Tamil Nadu, India. In other citrus fruits such as, mandarin in Lamjung, Nepal, infestation of disease and pests, inadequate irrigation

facilities, inefficient technical knowledge and the high price of input were reported as the major problems associated with the production (Pokhrel, 2011). Research conducted in Jambu, India also had revealed-inadequate technical knowledge, infestation of citrus diseases, timely unavailability of FYM, inadequate good quality seedlings and improper irrigation facilities as the major problems associated with the production of citrus fruits (Bhat et al 2015).

CONCLUSION

The discounted appraisal technique applied for financial analysis of the commercial acid lime farms cultivating Sunkagati-1 showed the financial viability of the farms. The value of BCR being greater than 1, IRR higher than discount rate, positive NPV and short payback period indicated that the commercial cultivation of Sunkagati-1 variety of acid lime is profitable agricultural production in Nepal. There was no significant difference in productivity of Sunkagati-1 across eastern and central region; however, the price of acid lime in central region was significantly higher than that of in eastern. Moreover, this study revealed that porous border and unorganized market was the most severe problem associated with the acid lime marketing in Nepal; relating to production problems, Infestation of disease and insect pest was found to be the most severe. There is need of government intervention which would assure access to quality inputs & technology, marketing & value chain development and appropriate plant protection measures for promotion of commercial acid lime farming in Nepal. Moreover, the price of acid lime in eastern region could be made higher as central through proper management of border security to check illegal trade and extension of organized agricultural markets in accessible areas.

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