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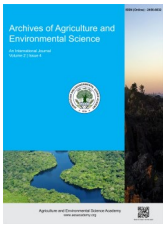

ORIGINAL RESEARCH ARTICLE

Socio-economic analysis of ginger production in Terhathum district, Province no. 1, Nepal

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ABSTRACT

Terhathum is one of the major ginger-producing districts in Nepal. This study with the objective of analyzing the socio-economic status of ginger growing farmers in the Terhathum district investigates the production economics of ginger (*Zingiber officinale* Rose.) and the socio-economic status of ginger producing farmers. The semi-structured interview schedule was administered to interview randomly selected commercial ginger-producing households in Myanglung municipality, Phedap rural municipality, and Menchhayayem rural municipality with 35, 39, and 17 respondents from each of the locations respectively. The overall productivity of ginger in the study area was found to be 19.3 MT/ha. The major cost-share for ginger production was found to be held by rhizomes used in the plantation (40.01%). The results indicated that ginger production was a profitable enterprise in the study area with an average B: C ratio of 3.77. The Cobb-Douglas production function indicated that ginger production exhibit increasing returns to scale at a decreasing rate. Rhizome quantity and amount of organic manure applied in the field played a major role in increasing the gross margin of the production. The goodness of fit was 52.3% with a return to scale of 0.714. Indexing technique identified incidence of diseases and pests and the instability of price as the major problems associated with production and trade of ginger. Overall, the study revealed that ginger production was a profitable and potential agriculture enterprise for the study area.

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INTRODUCTION

Ginger (*Zingiber officinale*) is an herbaceous tropical perennial plant belonging to the family Zingiberaceae. In cultivation, it is usually grown as an annual. The whole plant is refreshingly aromatic, but it is the underground rhizome, raw or processed, that is valued as spice (Vasala, 2012). These Zingiberene plants have strong aromatic and medicinal properties and are characterized by their tuberous or non-tuberous rhizomes (Chen *et al*., 2008). The crop performs well in a temperature range of 19°C- 28°C and a humidity of 70-90% (Ettanil *et al*., 2015). Nepal is growing ginger in an area of 22,649 ha with the production of 2,71,863 Mt and productivity of 12.34 Mt/ha (MOAD, 2018). In 2017/18, over 246396.6 tons ginger worth NRs. 248 million was exported to India (NTIP, 2020). On average, 85% of the total production is estimated to be marketed by the producers, either as a fresh rhizome or as a mother rhizome. The amount of ginger produced is higher in the eastern region of Nepal as compared to the western region (ANSAB, 2011). Of the 32 VDCs and one municipality of Terhathum district, large-scale ginger cultivation is done in 7 VDCs. Cultivar ZI 1609 represents ginger grown in Terhathum. The major ginger growing municipalities/VDCs are Myanglung, Tamphula, Jaljale, Simple, Oyakjung, Ishibu, and Morahang (Adhikari, 2016). Based on the production of the year 2014/15, the estimated quantity of this cultivar available for trade annually is 1,908 MT whereas the district produced 3,286

metric tons of ginger in 260 hectares of area with the productivity of 12.63 mt/hector (MOAD, 2018). Ginger production is basically a family farm enterprise of smallholder farmers who are facing multi-faceted challenges like increased cost of production, lack of production, sub-optimal level of resource use, lack of market information, and inefficient marketing channels (Khanal, 2018). Terhathum being one of the major gingers producing districts of the country with the humongous potential for the crop, no data and research report was being found regarding the production and socioeconomics of the crop in this district. Thus, realizing the significance of documentation, production economics, and marketing performance of ginger in a potential district, this study was conducted. This research developed a clear picture of economic, social, and market factors involved in the production, and marketing aspects of the ginger subsector in the Terhathum District.

MATERIALS AND METHODS

Description of study area

Terhathum district is one of the fourteen districts of province no. 1 of Nepal. It is one of the leading ginger producers in eastern Nepal. It extends from 300m to 3000m above sea level covering a total area of 652km^2. Terhathum district is bordered by Panchthar in the east, Shankhuwasabha in the west, Taplejung on the north, and Dhankuta on the south. The geographical coordinates of Terhathum are 27.1984° N, 87.5000° E. There is a total of 6 municipalities in Terhathum of which 2 are urban and 4 are rural. The study was conducted mainly on Myanglung municipality, Phedap rural municipality, and Menchhayayem rural municipality (Figure 1).

Types and source of data

The primary information was the main basis for this study. Secondary information also provided substantial support for data verification and enriched knowledge on the current status of ginger production in the district.

Primary data and its source

Primary data were collected through a survey questionnaire method by visiting the selected farmer's houses along with their ginger growing lands (farms). Following tools were used for the collection of primary data.

Household survey

Sets of semi-structured questionnaires were prepared to acquire the primary information from commercial ginger growing households through the face-to-face interview method. Altogether 92 commercial ginger growing farmers were interviewed.

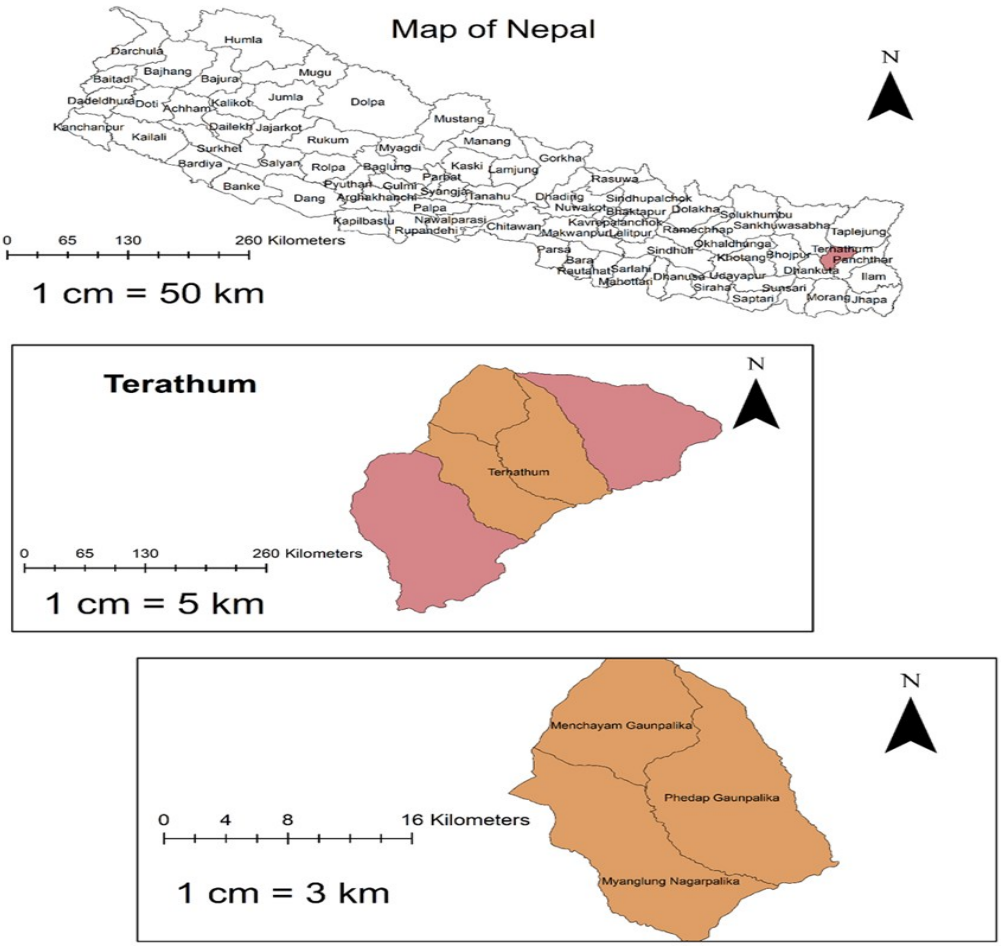

Figure 1. *Surveyed area for this study in Terhathum District*

Key informant survey (KIS)

The key informant survey was also conducted to acquire information regarding production, marketing, and price determination. Consulted personnel were major ginger exporters and village development officers. 3 municipal officers from each municipality office and one ginger exporter were interviewed. From the various data of commercial ginger growing areas and farmers were gained.

Secondary data and its source

Secondary data and information were collected from reports of Government and non-governmental organizations, district offices, journals, books, agricultural development and statistical book, and other sources. Web browsing was done to collect necessary data and figures.

Sample size and procedure

The study on ginger-producing farmers was conducted in one municipality and two rural municipalities of Terhathum district in January 2020. The study was conducted in Myanglung municipality, Phedap rural municipality, and Menchhayayem rural municipality. The study site was selected on the basis of feasibility, level of commercialization, access, and remoteness. A semi-structured questionnaire was used for data collection.

Population, sampling frame, and sample size

The ginger growing farmers who have been growing ginger on a commercial basis and are gaining economic return from their produce constituted the sampling frame from the whole population. The sampling frame was prepared with the key informants from Myanglung municipality and agriculture officers at Menchhayayem and Phedap rural municipality of Terhathum district. The sampling frame included 891 ginger-growing households from three locations. Random sampling techniques were used to select the major ginger-growing farmers. 91 samples were selected from the prepared sampling frame. The sample size consisted of about 10.21 % of the sampling frame.

Sampling procedure

Purposive sampling was used in order to select the survey area for this study. Myanglung municipality, Phedap rural municipality, and Menchhayayem rural municipality of Terhathum district were purposively selected for this study. Major pocket zone of Myanglung i.e., ward no. 10, 6, and 4 were selected, ward no 1, 3, and 4 of Phedap and ward no. 6 of Menchhayayem too were purposively selected based on the density of commercial ginger growing farmers in the area, areas under ginger farming and ease for data collection. The ginger growing farmers who have been growing ginger on a commercial basis and are gaining economic return from their produce constituted the sampling frame from the whole population. Then, simple random sampling was used for the selection of commercial ginger growers from the sampling frame.

Preparing questionnaire and pre-testing

Primary data was collected by organizing scheduled interviews. A semi-structured questionnaire consisting of necessary parameters was used. Both closed and open-ended questions were prepared. Questionnaires were pre-tested in 5 households by organizing interviews.

Method of data analysis

Descriptive analysis: Data processing was done by examining, categorizing, editing, tabulating, and recombining the evidence. Microsoft excel and statical packages for social science (IBM SPSS version 16.0) were used as computer facilities. Results were presented in charts, figures, and tables. Interpretations were made on the basis of results, which were assisted by qualitative and quantitative data/information available from both primary and secondary sources. Information was analyzed from different angles such as production, marketing, and socio-economic aspect.

Mean value: Mean values were calculated by using the formula,

Simple arithmetic mean, A.M. = $\frac{\sum X}{N}$

Where,
$\sum x$ = summation of all values
N = total number of observations or samples

Total cost: Total cost was calculated by summing up all the variable items and all the fixed items.
i.e., Total cost = $\sum$ of cost incurred in all the variable items + $\sum$ of cost incurred in all the fixed items.
Variable cost included cost of labor for ploughing, plantation, weeding, manuring and harvesting, FYM, Chemical fertilizers, Pesticides and Rhizome cost whereas fixed cost included cost of land tax and depreciated amount of fixed variable (Tools and equipment) used in the farm

Gross margin and net margin: The gross margin provides simple and quick method of farm business analysis. Seed, labor, manure, rent on land and interest on investment was taken as independent variables. Gross margin was estimated by taking gross return and the total variable cost incurred.

GM= Gross return – total variable cost

Where, GM = Gross margin

Similarly, net margin was calculated by using the formula

Net margin: Gross revenue – Total cost

Where,
Gross revenue = Total quantity of ginger produced (KG)*price per kg

Benefit-cost ratio: Benefit-cost ratio is the ratio between the gross return and total cost of any enterprise. In this study, benefit-cost ratio was calculated by using the following formula:

$$\text{B/C Ratio} = \frac{GR}{TC}$$

Where, B/C Ratio= Benefit-Cost ratio
GR=Gross return, TC= Total cost

Estimation of production function analysis

The general form of Cobb-Douglas type production function was used to determine the contribution of different factors of production. The estimating model for the coefficients of ginger production is, the following:

$$Y = a X_1^{b1} X_2^{b2} X_3^{b3} X_4^{b4} X_5^{b5} e^{u}$$

In log linear form, the above model can be expressed as follows:

$$\ln Y = \ln a + b1 \ln X_1 + b2 \ln X_2 + b3 \ln X_3$$

Where,
Y = Gross income
X_1 = Labor quantity,
X_2 = Organic manure quantity (Doko),
X_3 = Rhizome quantity.
u = Random disturbance term
b_1, b_2, b_3, b_4, b_5 are the coefficient to be estimates.

Problem ranking

Ranking of production and marketing problem was done by calculating the index of importance for each problem. The problem was ranked according to the value of index of importance in decreasing order. It was calculated using the following formula:

$$Index\ of\ importance(I)i\ t\ firm = \sum fiSi/\ N$$

Where, fi is the frequency of i^{th} index
Si is the scale value for i^{th} index
N= sample size

Table 1. Population, sampling frame and sampling unit of the location.

Location	Population (Total households in selected wards)	Sampling frame (Total ginger growing households)	Sampling unit (Selected households)
Myanglung Municipality	1965	393	35
Phedap rural municipality	1366	420	39
Menchhayayem rural municipality	388	78	17
Total	3719	891	91

Source: MoFAGA, 2020 and respective municipal offices.

Table 2. Description of Hhs based on the occupations they are involved.

Source of income	Agriculture	Service	Business	Remittance
Primary	73	10	5	3
Secondary	16	9	10	5
Tertiary		1	0	0

Source: Field survey, 2020.

Table 3. Description of Hhs practicing value addition.

Description of Hhs doing value addition	Average	S.D.
Age	48.7	13.5
Year of education	8.9	4.55
Family Size	5.2	1.03
Active members	2	0.47
Average land holding	27.9	19.82

Source: Field survey, 2020.

RESULTS AND DISCUSSION

Socioeconomic profile

Population and gender distribution of respondents: Ninety-one ginger growing household heads were interviewed among total ginger farmers of the Myanglung Municipality, Phedap rural municipality, and Menchhayayem rural municipality with the number of 35, 39, and 17 from each of them. The total population of the 91-ginger growing household was found to be 424 out of which 49.52% were male and 51.415% were females. The average family size of the study area was found to be 4.60 with an average of 2.28 males and 3.36 females in each family. Among the total respondents, 72.8% were male and 27.17 % were female. Out of which, the gender distribution of respondents among Myanglung, Phedap, and Menchhayayem were 27, 31, and 9 for males and 9, 8, and 8 for females respectively. Lesser participation of females as a respondent is directly related to them having a lesser role as a household head and this could be because of the existing patriarchal influence in the communities of the study area.

Age distribution of respondents: Out of the total respondents in the study area, 77.124% belonged to economically active population range of 16-59 out of which 6.52% were from the age group of 16-30, 70.65% of them belonged to the group of 31-59 and 22.826% of them belonged to economically inactive population (more than 60 years old). No member of a household less than 15 years of age was interviewed as a respondent. Having this, the average age of the respondents in Myanglung, Phedap, and Menchayam were 49, 45, and 50 years old, respectively. The highest age of the respondents was 80, 65, and 76, and the lowest age of the respondent was 25, 23, and 30 for Myanglung, Phedap, and Menchhayayem respectively. Overall, the mean independent population number was found to be higher than that of the mean dependent population number. This suggests that farmers engaged in ginger production were independent but older ones. Similar to our result in Terhathum, Mahat *et al.* (2019) and Ezra *et al.* (2017) also found that farmers below 50 years are actively engaged in ginger production in the Surkhet district of Nepal and in Nigeria respectively. All of these findings indicate that there is less interest in ginger farming among the younger population below 30 years of age. According to Mahat *et al.* (2019), the development of a creative training program targeting the younger population could increase their interest in ginger farming. The average number of family members working in the ginger field was found to be 2.02 which shows that ginger has provided an opportunity of employment to many households.

Ethnicity

Based on their caste namely, Brahmin and Chettri and Janajaati, Brahmin and Chhetri 77(83.696%) were the dominant caste in the study area followed by Janajaati 15(16.30%).

Education status of household heads: It was found that the average year of education of the majority of the respondents was 8.04 years. 23.9% of them were illiterate, 8.7% of them had completed their primary education, 5.4% of them had completed lower secondary level of education, 35% of them had completed secondary level of education, 13.4% of them had completed higher secondary education, 9.8% of them had completed bachelor level of education and 1.08% of them had completed master's level of education. Collier (2007) said that "A pool of educated people in a country helps to turn it into a better place". Mmasa and Mhagama (2017) state that it is an advantage on the adoption of agriculture technology if an individual has attained a secondary level of education.

Source of income of the household: The study revealed that the population that was solely involved in Agriculture for their major source of income was found to be 79.3% followed by 10.87% of the population involved in service, 5.43% involved in business, and 3.261% of them depending on Remittance as a major source of income. Many of them were also involved in agriculture plus other works like business, service, and abroad jobs. 1.087% of respondents marked agriculture as their tertiary source of income and 17.3% of the total respondents were practicing agriculture as a secondary source of income

Value addition and its demographics: Out of the total population of respondents, 9.2% of them were practicing value addition. 90% of them were above 30 years of age. All of them belonged to the Brahmin and Chhetri group or ethnical backgrounds. The average year of education was 8.9 years with a standard deviation of 4.55. 60% of them were male and 40 % of them were female. 60% of the respondents who had been practicing value addition were engaged in either services or business along with agriculture.

Ginger cultivation practices: On average, the total land holding of the respondent family was 23.72 ropani with a standard deviation of 20.10 whereas the average area of land for ginger farming was 2.39 ropani per farmer, with a standard deviation of 1. 95. 98.91% of farmers reported cultivating a local variety of ginger available in their locality whereas only 1.08% of respondents reported using an improved variety of rhizomes. This could be because of the fact that the local variety of ginger is believed to be more resistant to the diseases than other varieties in the option. 73(83.696%) of farmers were intercropping maize and ginger together and the remaining planted ginger as a sole crop. This is done to ensure higher productivity per plot. According to research done by Kandiannan *et al.* (2016), a 3m^2 plot of raised bed that is commonly followed in hilly areas for ginger production can accommodate 10 to 20 maize plants without affecting the main crop yield.

Cost of ginger production: The study revealed that the total average variable cost for ginger production was NRs. 27,412 for one ropani. Seed contributes the highest cost in average varia-

Table 4. Cost share by various variables (Nrs.).

S.N.	Particulars	Mean	Standard Deviation	Cost shared (%)
1	Seed (Rhizome)	4957.768	4017	40.51291
2	Land preparation	501.0179	337.4375	4.094119
3	Plantation	1002.04	674.8795	8.188275
4	weeding	1503.058	1012.321	12.28239
5	Mulching	1002.04	674.8795	8.188275
6	Chemical fertilizer	28.50835	170.6889	0.232959
8	FYM	2191.504	1494.473	17.90811
9	Pesticides	64.04911	121.1897	0.523384
10	Harvesting	1470.714	695.6467	12.01809
11	total average variable cost	12237.5	79314.55	
12	Total average fixed cost	241.3116	243.5357	
13	Total cost	12447.62	7952.134	

Source: Field survey, 2020.

Table 5. Estimates of Cobb-Douglas production function.

Variable	Coefficient	standard error	t value	p value
Constant	2.34	1.57	1.48	0.140307*
ln Labor used	-4.76	1.82	-2.60	0.010709**
ln FYM	4.391	1.75	2.495	0.014443*
ln Rhizome	1.085	0.13	8.070	3.33E-12**
Return to scale	0.71			
R square	0.54			
Adjusted R square	0.53			

Dependent Variable: Ln Gross margin, ** and * indicate the significant at 1% and 5% level of probability respectively.

Table 6. Problems faced by ginger farmers in the study area.

S.N.	Problem faced	Total value of priority	Myanglung	Phedap	Menchhayayem	Index value	Ranking based on index value
1	Disease and pest	383	180	192	11	0.8326	I
2	Marketing	85	0	0	85	0.18475	VI
3	Lack of technological knowledge	235	92	110	33	0.510	III
4	Price instability	355	129	158	68	0.7717	II
5	Labor unavailability	215	80	84	51	0.4673	IV
6	Drought	108	63	43	2	0.234	V

Source: Field survey, 2020.

ble cost of production. Seed cost accounted for 40.51% of average variable cost and then followed by weeding (12.20%), harvesting (12.01%), mulching, and manure transportation both contributing 8.18 %, manure (6.14%), land preparation (4.09%), Chemical fertilizer (0.23%) and pesticides (0.52%). Similar results were found in various other articles. Poudel *et al.* (2018) also found that the highest cost was incurred for rhizome in the ginger farming practice in the Surkhet district. The percentage of cost-share observed on human labor and organic manure was 15.3% and 10.5% respectively in the study area. Similarly, Neupane *et al.* (2019) found that 48.74% of cost-share is on seed and 39 % cost share on total labor. ANSAB (2011) and GOK (2011) reported up to 46 % and 30.38% cost for seed respectively. Similarly, ANSAB (2011) reported that in ginger cultivation, the major part of the cost goes into the seed with 46% of the total production cost. Similarly, seeds are being produced and preserved for the next season by the farmers themselves. Farmers keep 20 to 25 % of their ginger production as a purpose of seed (ANSAB, 2011).

Cobb Douglas production function analysis: The estimated values of the coefficients and related statistics of Cobb-Douglas production functions are shown in Table 5. The three independent variables included in regression analysis; the amount of FYM, the quantity of rhizome, and cost of labor were found significant. Poudel *et al.* (2015) also reported labor costs to be significant in ginger production. The regression coefficient of labor cost was -4.76 which indicates that by increasing 100% cost of labor, the gross returns could decrease by 4.76 times. Similarly, a 100% increase in FYM and rhizome could increase

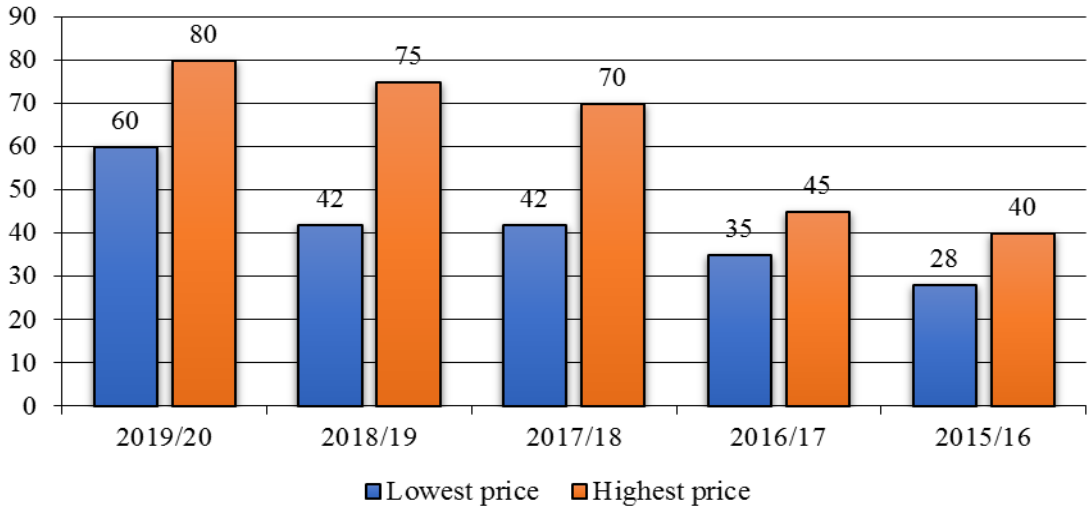

Figure 2. *Price trend of ginger in last five years. Source: Field survey, 2020.*

the gross returns by 4.39 and 1.08 times respectively. The negative effect on gross margin while increasing input on labor could be because of the higher labor cost in the study area which is closely linked to the issues of labor shortage in the hills of Nepal. Approximately 14% of the total population were working abroad in 2020 (Ghimire, 2020) and more than 4 % of the population from hills and mountains shifted to the plain of Nepal within the last 10 years (Karki, 2022). The sum of all the regression coefficients of all the inputs considered in the regression function was estimated to be 0.714 which indicates that the production function exhibited an increasing return to scale at a decreasing rate. This implies that if all the inputs specified in the production function are increased by unity, the gross return will increase by about 0.714 times. The adjusted R-square value was estimated to be 0.54% which implies that the specified variables affect gross return by 54 %. Similar research was done by Acharya *et al.* (2019) in the Salyan district in Nepal found a similar figure on regression coefficients and R-square value.

Production and productivity: The overall productivity of ginger in the study site was found to be 989.57kg/ ropani (19.3 mt/ha) while the average production of ginger per kg was 12.89 kg per kg of rhizome used. The productivity of ginger was found to be significantly higher than both the district and national records of 2018. This identifies that the study area is one of the most productive areas in the country for ginger and has huge climatic suitability for ginger production.

Estimation of cost of production, revenue, and B: C ratio of ginger: The average cost of ginger production was found to be Nrs. 23.910 per KG. and Nrs. 11469.46 per ropani. The average returns from ginger in the study area were estimated to be Nrs.38.44 per kg with an average selling price of Nrs. 63.35 per kg of that year. The average net return was found to be Nrs. 53,065.1/ropani. The overall B/C ratio of producers was calculated to be 3.77 which indicates that ginger production is a profitable enterprise in the study area. Gurung *et al.* (2021) too found ginger as a profitable farm enterprise for the Rukum district with a B/C ratio of 2.02.

Constraints

Although ginger was observed as a more profitable crop only at its own input use condition, there are several constraints to its higher production. Producers are facing several production-related problems like disease and pest, marketing, lack of technological knowledge, price instability, labor unavailability, and drought. Different production and marketing problems were given different priority by the ginger producers based on their prevalence and severity. Disease and pest received the first priority followed by price instability, lack of information, labor unavailability, drought, and marketing problems. Only farmers of Menchhayayem rural municipality reported having problems with the marketing of the product. The major disease reported were stem rot, rhizome rot, and blight whereas the major insects that were causing problems were the white grubs, red ant flies, and maggots.

Price trend of ginger in last 5 years: Price instability is the second major problem reported by the respondents. The price of ginger wasn't constant for a year or a season. In the surveyed year (2076 B.S./2020 A.D.), the price of ginger ranged from Nrs. 60 to 85, Similarly, in the year 2018/19, 2017/18, 2016/17, and 2015/16, the price range was reported to be 42-75, 42-70, 35-45, and 28-40, respectively. Similar cases of price instability were found by Dahal and Rijal (2020) who reported that the fluctuating behavior of ginger price in the Sindhuli district of Nepal was observed not over years but also within a year. Neupane *et al.* (2019) too reported that price instability is a major problem for ginger farmers of Surkhet district. Aryal (2022) reports that more than 98 percent of Nepali ginger is shipped to the Indian markets and the price of Nepali ginger is totally dependent upon Indian importers. This makes the price for exportable Nepali ginger unpredictable. There is an urgent need for the development of a proper predetermined pricing system for ginger.

Figure 3. *Value chain of fresh ginger in the study area. Source: Field survey, 2020.*

Marketing channels

It was found that the harvesting, cleaning, grading, and packaging of the ginger is done by the farming family. The major actors involved in the value chain in our study area were found to be farmers, collectors, exporters, wholesalers, retailers, and consumers. Ginger marketing includes all the activities involved in the transference of farmers' products either fresh or processed to the consumers at both domestic and international levels.

Marketing channel from Myanglung municipality and Phedap rural municipality: Ginger growers at Myanglung and Phedap were solely dependent on the exporter for the trade of their product. The exporter would weigh and collect ginger from each household, bring it to the collection center at Singha Bahini Ginger Cardamon and herbs collecting center and from there the product would directly get exported to Naxalbadi, India. In the harvesting season of 2020, Rs. 60 and Rs. 80 were the lowest and highest price per kg received by the farmers in this area. Whereas, the exporter got a price ranging from Rs. 85 (lowest) -105 (highest) per kg from the foreign traders. Late harvesters were the ones receiving higher prices per kg. (Field survey, 2020)

Marketing channel for Menchhayayem rural municipality: It was found that the farmers of Menchhayayem trade their ginger mostly to whole sellers or collectors. The collectors would again sell the product to the exporter. The farmers here received prices ranging from Rs. 40 per kg on lowest for those who sold ginger in November to Rs. 70 per kg by those who sold ginger in late December from the collector. Collectors received Rs. 45 (lowest) -75 (highest) per kg from the exporter and the exporter traded ginger on Rs. 80 (lowest)-105(Highest) per kg ginger to the foreign traders. (Field survey, 2020).

Conclusion

Based on the findings of this study, it can be concluded that ginger farming was a profitable and preferred enterprise in the study area with a B/C ratio of 3.77. Productivity of 19.3 mt/ha, which is higher than the national and district record implies that the location is most feasible for ginger farming. Seed rhizome's contribution of 40.5% on total production cost showed that the cost of seed rhizomes is an important factor for the gross return of the enterprise. Similarly, the Cobb Douglas production function analysis presented that the gross return is directly affected by the cost of labor, amount of FYM, and the quantity of the seed rhizome used in the cultivation of the crop. Almost all ginger farmers were using local rhizome variety and there was no use of chemical fertilizers and pesticides in the study area which links to the lack of technical knowledge among the farmers. While the incidence of disease and pest was reported as the major production problem for ginger farming, it was found that these didn't cause much hindrance on productivity but the major market problem; price instability was something that was disappointing farmers each year. Similarly, reports of labor unavailability and constant migration are found to be a serious potential problem. Addressing these technical and administrative constraints could, in effect, boost ginger profitability which would ultimately support the improvement of the socio-economic status of the farmers.

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Conflict of interest

The authors declare there are no conflicts of interest.

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