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ORIGINAL RESEARCH ARTICLE

Profitability, marketing, and resource use efficiency of ginger production in Rukum west, Nepal

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ABSTRACT

The study was designed to investigate the profitability, marketing, and resource use efficiency of ginger production in Rukum west. The sample size of 62 ginger-growing farmers out of 187 farmers was determined using slovin's formula. In addition, 20 traders from two major market hubs Simrutu and Jhulneta were interviewed. The pre-tested semi-structured interview schedule was administered to interview a randomly selected sample size. Data were analyzed using descriptive and statistical tools, including the Cobb-Douglas production function. Result showed that the average area under ginger cultivation was 0.14 ha. A major portion (46.56%) of the cost was found to be incurred by the seed alone in ginger cultivation. The benefit-cost ratio (2.02) indicates that ginger production enterprise was profitable. The productivity of ginger in the study area was estimated to be 11.39 Mt/ha, while per kg cost of production was found to be (NRs 35.67 = USD 0.30). Most of the gross income (78.85%) was found to be contributed by fresh ginger. Similarly, gross margin, market margin, and producer's share were found to be 21.16, 33.33, and 62.97%, respectively, for 1 kg of ginger. The indexing technique identified high-cost with low-quality seed and price instability as the major problems associated with the production and marketing of ginger, respectively. Cobb-Douglas production function estimated the value of return to scale at 0.889, implying that ginger production exhibited decreasing returns to scale. A study on resource allocative efficiency revealed that farm yard manure and total labor were underutilized resources while seed rhizome was overutilized resource. Thus, for optimal allocation of resources, expenditure on farm yard manure and total labor need to be increased by 87.374% and 39.908%, respectively. The study concluded that an effort should be made to bridge the gap between optimal resource utilization and current practices. For this, it is prime important to interconnect the combined efforts of ginger growers, provincial government, or any developing partners.

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INTRODUCTION

Ginger (*Zingiber officinale* Rose., family Zingiberaceae) is herbaceous perennial plant having an underground modified stem known as "rhizome". It is broadly adapted to the growing conditions ranging from the low-lying plains of the "Terai" up to altitudes of 2,000 meters (FAO, 2014). Nepal is the world's largest ginger producer after India, China, and Indonesia, producing approximately 245 thousand metric tons per year (FAOSTAT, 2018). This spice crop has been regarded as one of the nineteen commodities of Nepal, having significant export potential (NTIS, 2017). In the Financial year 2019/20, the total

area under ginger cultivation in Nepal was 22132 ha and production were 284427 Mt with the productivity of 12.85 Mt /ha (AITC, 2020). More than 75% of the total quantity of ginger produced in Nepal is exported and almost about 99% of the total export goes to India (ITC, 2010). In addition, about 75% of Nepalese ginger is traded in fresh form while the remaining 25% is in processed form, primarily as sutho (traditionally dried form of ginger) and powdered ginger (Zoder, 2017). Ginger is one of the significant spice crops traditionally grown in the mid-hill areas of Nepal having a good potential for employment creation and income generation (HVAP, 2011).

Rukum west is also popular in ginger production despite being known as vegetable seed production hub of Nepal (VSPC, 2017). According to TEPC (2017), total area and production under ginger cultivation in Karnali province was 2936 ha and 36,691 Mt, respectively with a productivity of 12.82 Mt/ha. Similarly, the productivity of the ginger in Rukum west was 9.04 Mt/ha with 150 ha of cultivation area and 1356 Mt production (MoALD, 2016/17).

APP has recognized ginger as a high value spice crop in Nepal. In developing countries like Nepal, ginger as a high-value spice crop, has a significant role in uplifting the socio-economic status of rural people by raising their income (NSCDP, 2007). Despite this significant potential of ginger to alleviate rural poverty; low productivity, traditional cultivation practices, low quality of product, and lack of technical knowledge are the major bottleneck of domestic ginger production in Nepal (HVAP, 2011). Preliminary field visits and interaction in the study area revealed lower productivity and limited research and development as major prevailing problems. Moreover, most of the farmers producing ginger are unaware of resource optimization. Thus, for commercialization of ginger sub-sector and directing the efforts of developing stakeholders into considerable effects, it is critical to understand production planning and resource allocation to maximize the return, minimize the cost and improve overall efficiency (Bhandari and Aryal, 2014/15). However, no any past scientific studies have been done so far to investigate the profitability, level of resource use optimization, and their interrelationship with the gross revenue. The presence of shortfall in resource use efficiency, absence of scientific research to back up the efforts of the ginger growers, and the fact that majority of ginger production is undertaken by medium category and traditional farmers with rudimentary production techniques are the driving force for this research. Keeping this in view, the study was conducted to estimate and analyze profitability and resource use efficiency in ginger production in Rukum west. Results drawn from this study will serve as a bench-mark to policy makers.

MATERIALS AND METHODS

Study area

The study was conducted at Rukum west district in Nepal. Rukum west district lies in Karnali province of mid-west Nepal, covering an area of 121349 ha of which 19.5% is agricultural land. The climatic situation of the district varies from sub-tropical to temperate, allowing favorable conditions for diverse crop species. The study was conducted at Tribeni rural municipality, which was assigned as a ginger block by PMAMP, as shown in (Figure 1). It is located at 28°63' N latitude and 82° 49' E longitude. (Muru) Tribeni-6, (Lasikot, Bhurtibang) Tribeni-7 and (Totke) Tribeni-9 of Tribeni rural municipality were selected purposively based on area and the production of ginger.

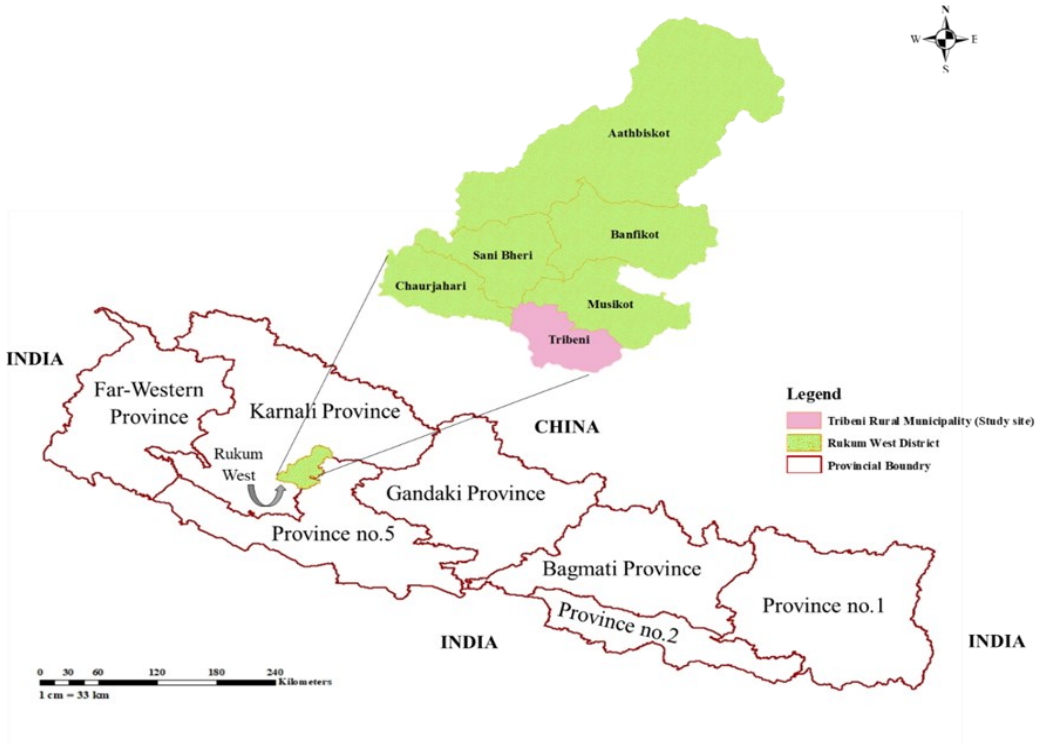

Figure 1. *Map of Nepal showing the study area located at Tribeni rural municipality, Rukum west, Nepal (Source: Authors archive, 2020).*

Table 1. Sample distribution in the study area.

S.N.	Municipality	Site-ward	Population size (N)/ Sampling frame	Sample size (n)
1	Tribeni	Muru-6	62	24(39%)
2	Tribeni	Lasikot, Bhurtibang-7	63	17(27%)
3	Tribeni	Totke-9	62	21(34%)
Total			187	62(100%)

Sampling design

- Sampling method: Two-step sampling techniques were used. In the first step, three wards (6, 7, and 9) of ginger block Tribeni rural municipality were selected purposively based on the area and production of ginger. Later on, simple random sampling was employed to the sampling frame constituting the list of ginger farmers.
- Sampling frame: Ginger farmers with a landholding of ≥2 ropani under ginger cultivation constituted the sampling frame. (DoA, 2019)
- Sample size determination: When nothing is known about the nature of the population, Slovin's formula allows a researcher to determine sample size with the desired degree of accuracy (Stephanie, 2021). The sample size was determined by using following slovin's formula as also used by (Rono, 2018) (Table 1).

$$n = \frac{N}{(1 + N \times e2)}$$

Where,
n= Sample size ; N= Number of ginger farmer (≥2 ropani); e= Margin of error (=0.10 for this study)

- Selection of trader: 20 traders were selected for interview from two primary market hub Simrutu and Jhulneta.

Data collection procedure

Before the actual survey, interview schedule was pre-tested in Khara-3-Tribeni rural municipality with 10 respondents. After pre-testing, necessary corrections were made and it was finally administered to the actual respondent. Structured interview schedules using face-to-face interview techniques were employed to collect primary data in May 2020. It was further confirmed by the data collected through Focus group discussion (FGD) and Key informant interview (KII). The Secondary information was collected from various sources like research articles, ADO report, Central Bureau of Statistics (CBS), annual report of KUBK, and various proceedings.

Techniques of data analysis

Information collected from the field survey was coded first and entered in Microsoft Excel 2013 worksheet, SPSS 16 data entry sheet, and then analyzed using STATA 14.2.

Cost and return analysis: The total variable cost incurred in ginger production was estimated considering variable inputs like seed rhizome, FYM, and total labor costs. They were valued at a current market price of the year 2020 to calculate the cost of production.

Total variable cost= $C_{rhizome} + C_{FYM} + C_{total\ labour}$
Where, $C_{rhizome}$= Cost on seed rhizome used (NRs./ha)
C_{FYM} = Cost on farm yard manure used (NRs./ha)
$C_{total\ labour}$= Land preparation (bullock) cost (NRs./ha) + Planting cost (NRs./ha) + mulching cost (NRs./ha) + Weeding cost (NRs./ha) + Harvesting, cleaning and grading cost (NRs./ha)
Gross return was calculated by multiplying the total volume of fresh ginger and mother rhizome by their respective current average price in 2020.
Gross return (NRs./ha) ={total quantity of fresh ginger produced (kg/ha) × price of fresh ginger (NRs./kg)} + {(total quantity of mother rhizome produced (kg/ha) × price of mother rhizome (NRs./kg)}
Various studies like (Esekhade *et al.*, 2014) and (Mehmood *et al.*, 2011) used this formula to estimate gross margin, which can be expressed as:
Gross margin (NRs./ha) = Gross return (NRs./ha) - Total variable cost (NRs./ha)
Producers' share is the proportion of the farmer's price that the consumer pays. It was calculated as;

$$\text{Producers' Share (Ps)} = \frac{\text{farm gate price (Pf)}}{\text{retailer'price (Pr)}} \times 100$$

Similarly, average cost per kg of ginger production was calculated as the ratio of total variable cost (NRs.) to total production (kg). Furthermore, Undiscounted benefit-cost ratio was estimated using the following formula as used by (Begum *et al.*, 2019).

$$\text{Undiscounted Benefit} - \text{Cost Ratio (BCR)} = \frac{\text{Gross return}}{\text{total variable cost}}$$

Resource use analysis

The Cobb-Douglas production function was used to determine the contribution and efficiency of different variable production inputs on a ginger production system. Gross income was used as a dependent variable and cost of variable input as an independent variable in this study. Cobb-Douglas production function was considered to determine the resource productivity, efficiency, and return to scale. The input-output relationship was established applying the Cobb-Douglas production function, which has been used by (Mathew *et al.*, 2017) and (Holida *et al.*, 2019). It can be expressed as;

$Y=aX_1^{b1}X_2^{b3}X_3^{b3}e^u$

Where,

Y= Gross return (NRs./ha),

X_1= Cost on seed rhizome used (NRs./ha),

X_2= Cost on farm yard manure used (NRs./ha),

X_3= Total labour cost (NRs./ha) = {Land preparation (bullock) cost (NRs./ha) + Planting cost (NRs./ha) + Mulching cost (NRs./ha) + Weeding cost (NRs./ha) + Harvesting, cleaning and grading cost (NRs./ha)}

e = Base of natural logarithm,

u = Random disturbance term,

a = constant and b1, b2 and b3 are coefficient of respective variables.

Linearization of above Cobb-Douglas production function into logarithmic function was carried out as expressed below;

lnY = lna + b1lnX1 + b2lnX2 + b3lnX3 + e

The summation of the value of coefficient for each variable inputs included in the Cobb-Douglas production function gives return to scale as illustrated below;

b1+b2+b3>1, meaning an increasing return to scale,

b1+b2+b3=1, meaning a constant return to scale,

b1+b2+b3<1, meaning a decreasing return to scale.

Marginal value product-Marginal factor cost (MVP-MFC) analysis approach was employed in the study to determine resource use efficiency of ginger production as also used by (Aneani *et al.*, 2011). The allocative efficiency of a resource used was calculated as a ratio of marginal value product of given variable input to the marginal factor cost of the same variable input. Mathematically;

$$r = \frac{MVP}{MFC}$$

Where,

r = Efficiency ratio,

MFC=Marginal Factor Cost and MVP= Marginal Value Product of variable input

Marginal value product of variable input was calculated using the following formula;

$$MVP = \beta i \times \frac{\text{geometric mean of gross income(Y)}}{\text{geometric mean of level of use of ith input(Xi)}}$$

Where, βi = regression coefficient of given variable input

Decision criteria: r>1, indicates underutilization of input

r=1, indicates optimum utilization of input

r<1, indicates overutilization of input

Similarly, adjustment percentage change in MVP necessary to achieve optimal resource allocation, i.e., r=1 or MVP=MFC, was determined using the following formula;

$$D = (1 - \frac{MFC}{MVP}) \times 100$$

Where D = absolute value of percentage change in MVP of each resource and r= efficiency ratio.

Forced rank scaling

Forced rank scaling technique was used to rank ginger's production and marketing problems, prevailing in the study area. The intensity of problem was scaled as strongly agree = 1, fairly agree = 0.8, neutral = 0.6, fairly disagree = 0.4 and strongly disagree = 0.2. The following formula was used to calculate the index value based on the severity as perceived by the farmers:

I= Σ coefficient * frequency/ N,

Where,

I =Index value for intensity of problem

Σ = Summation

N= Sample size

The problems were ranked according to the index score.

RESULTS AND DISCUSSION

Socio-economic and demographic information of household

The socio-economic and demographic information regarding age, gender of household head, family size, ethnicity, economically active members, years of schooling, primary occupation, total land, food security, and total income are presented in (Table 2). The information on age, years of schooling, and gender were taken on a household head basis since the household head is presumed to be the major decision taker in the family. His/her information could be pivotal in making several economic inferences.

The mean age of the household head in the study site was 43.25. The average family size of the study area was 5.67, which was more than the average family size of the Tribeni rural municipality 5.38 and the national average 4.32 (CBS, 2011). More than half (61.47%) of the total population of sampled households had an economically active group, which was higher than that of Tribeni rural municipality (51.18%) and the national average of 56.98% (CBS, 2011). It shows that there is a sufficient potential number of human resources available for the production of economic goods. The average landholding was 0.71 ha, higher than the national average of 0.68 ha (CBS, 2011). KUBK (2016) also reported that the majority of farmers are categorized as medium farmers in West Rukum. Moreover, the average years of schooling of household head was found to be 7.8 years. According to CBS (2011), the literacy rate of Tribeni rural municipality was 61.69%.

Cost of production

The study revealed that the total average cost of ginger production per ha was (NRs. 3,48,210 = USD 2946.04). The largest portion of the cost of ginger production was found to be covered by seed alone. The cost per hectare on seed rhizome was estimated at (NRs. 1, 62,112.5 = USD 1371.56), which accounted 46.56% of the total variable cost of production (Figure 2). This was supported by the findings of (Upadhyaya *et al.*, 2020), who reported 47.61% contribution of seed rhizome cost for ginger production in Salyan district. Moreover, according to HVAP (2011), the cost of seed rhizome is usually higher than the fresh ginger; thus, a significant part of the cost goes into seed rhizome

Table 2. Socio-economic and demographic description of the study area.

Variables	N	Mean	Minimum	Maximum	SD
Age in years	62	43.25	23	72	11.44
Years of schooling	62	7.8	0	18	4.86
Household member	62	5.67	3	12	1.88
Below 15	62	1.73	0	6	1.18
Economically active (15-59)	62	3.48	2	9	1.57
Above 60	62	0.45	0	2	0.7
Total land holding (ha)	62	0.71	0.15	2.04	0.47
land under ginger cultivation (ha)	62	0.14	0.05	0.46	0.075
Annual income	62	222333	80000	600000	78375.82

Table 3. Average cost of ginger production in the study area (NRs./ha).

S.N.	Variables	Average Cost Nrs/ha (US $)	Contribution to total (%)
1	Seed rhizome	162112.5 (1371.56)	46.56
2	FYM	34905.55 (295.32)	10.02
3	Land preparation (Bullock)	40532.59 (342.93)	11.64
4	Planting	27283.73 (230.83)	7.84
5	Mulching	25777.23 (218.09)	7.40
6	Weeding	31743.68 (268.57)	9.12
7	Harvesting, cleaning, and grading	25854.64 (218.74)	7.42
Total		348210 (2946.04)	100

Figure in parenthesis indicates value in US $ (1 USD = 118.196 NRs).

Table 4. Per kg cost of ginger production in the study area (NRs./kg).

Particulars	Total variable cost (NRs.)	Total production (kg)	per kg production (NRs.)
value	2950150 (24959.81)	82700	35.67 (0.30)

Table 5. Production and productivity of ginger in the study area (Mt/ha).

Particulars	Mean	S.D.	Minimum	Maximum
Fresh Rhizome (kg/ha)	9628.50	3684.18	5895	23580
Mother Rhizome (kg/ha)	1509.59	492.72	0.00	2947.50
Productivity (Mt/ha)	11.39			

with 46 percent of the total production cost. Similarly, cost on land preparation constituted (11.64%) followed by cost on FYM (10.02%), cost on Weeding (9.12%), cost on Planting (7.84%), cost on Harvesting, cleaning and grading (7.42%), and cost on Mulching (7.40%) (Table 3).

Per kg production cost

The total variable cost and production in the study area were estimated to be (NRs 2950150 = USD 24959.81) and 82700 kg, respectively (Table 4). Thus, per kg cost of ginger production in the study area was found to be 35.67 NRs/kg. According to Chalise *et al.* (2019), per kg cost of ginger production in Sunsari district was (NRs. 48.685 = USD 0.41). The lower per-kilogram cost of production could be attributable to the fact that ginger production in the region is organic by default, which means that the use of chemical fertilizers and pesticides is not permitted in Karnali province.

Production and productivity of ginger

The total production of ginger in the study site was estimated to be 95650 kg. The productivity of ginger in the study site was found to be 11.39 MT/ha (Table 5). It was recorded higher than district productivity 9.04 Mt/ha (MoALD, 2016/17) but lower than the average provincial (Karnali) productivity of ginger, i.e., 12.82 Mt/ha (TEPC, 2017) and as well lower than national productivity 12.85 MT/ha (AITC, 2020). Mediocre productivity can be because of complete use of organic fertilizer only, lack of management practices for rhizome rot disease, rhizome fly, and poor-quality seed rhizome.

Return from ginger production

The study revealed that the gross return from the ginger cultivation in the study area was (Nrs 709936.64 = USD 6006.44) per ha. 78.85% of gross income was contributed by fresh rhizome, whereas mother rhizome contributed only 21.15%. Despite the fact that the price of mother rhizome was more than that of fresh ginger, the majority of gross income was found to be generated from fresh ginger due to its higher productivity. The Gross margin per kg of ginger in the study area was estimated to be (NRs 21.16 = USD 0.18). It was observed that the overall undiscounted BCR considering total variable cost was 2.02, as shown in (Table 6). According to (Acharya *et al.*, 2019), B-C ratio of fresh ginger was 1.55 in Salyan district. The B-C ratio examined in our study was found to be relatively high in comparison to their findings. This is owing to ginger growers' engagement in the sale of other forms of ginger, such as "sutho" and "Bruni." The on-season price of fresh ginger is comparatively lower than its other forms.

Table 6. Economic statement of ginger production in the study area.

Measuring criteria	
Estimation of gross return (NRs/ha)	Value/Contribution%
Gross return per ha (Fresh ginger)	559751.09 (4735.79)/78.85%
Gross return per ha (Mother rhizome)	150185.55 (1270.65)/21.15%
Gross return	709936.64 (6006.44)
Estimation of gross margin (NRs/kg)	Value
Gross return	4700200 (39766.15)
Total variable cost (NRs)	2950150 (24959.81)
Gross margin (NRs)	1750050 (14806.34)
Gross margin per kg	21.16 (0.18)
Estimation of Benefit-cost ratio (BCR)	Value
Gross return (NRs)	5961300 (50435.72)
Total variable cost (NRs)	2950150 (24959.81)
B-C ratio	2.02

Figure in parenthesis indicates value in US $ (1 USD = 118.196 NRs).

Table 7. Cobb-Douglas production function analysis of ginger production in the study area.

Variables	Coefficient	Standard error	t-value	p-value
(Constant)	0.052	0.047	1.108	0.273
Rhizome cost	0.298**	0.148	2.018	0.049
FYM cost	0.268**	0.124	2.166	0.035
Total labor cost	0.324**	0.147	2.201	0.032
F-value	36.471***			
R square	0.67			
Adjusted R-square	0.651			
Return to scale	0.889			
Note: ***,** indicates level of significance at 1% and 5%, respectively				

Table 8. Resource use efficiency analysis of ginger production in the study area.

Input	G.M	Coeff.	MVP	MFC	MVP/MFC	efficiency	% Adjustment req.
Rhizome cost	55839.09	0.298**	0.928	1	0.928	over utilized	-7.753
FYM cost	5884.04	0.268**	7.920	1	7.920	under utilized	87.374
Total labor cost	33857.29	0.324**	1.664	1	1.664	under utilized	39.908

Cobb-Douglas regression analysis of ginger production

The Cobb-Douglas production function model for ginger production in the study site was found to be best fit as F-ratio was highly significant (*P<0.001*). The estimated values of the coefficients and related statistics of Cobb-Douglas production functions are shown in (Table 7). Three explanatory variables, namely seed rhizome cost, FYM cost, and total labor cost, were found to have an impact on the production of ginger in the study area. These all three explanatory variables are found to be significant at 5% level.

From the result the production model formed is:

$$Y = 0.052 * X_1^{0.298} * X_2^{0.268} * X_1^{0.324}$$

where,

Y= Gross return (ginger)

X_1 = seed rhizome cost

X_2= FYM cost

X_3= Total labor cost

The regression coefficient of seed rhizome cost was 0.298, which indicates that 100% increase in seed rhizome cost keeping all other variables constant, the gross returns could be increased by 29.8%. Similarly, with an increase in FYM cost by 100%, keeping all other variables constant, income could be increased by 26.8% as the coefficient is 0.268. Total labor cost if increased by 100%, *ceteris paribus*, the income could be increased by 32.4%. Similar to this, Poudel *et al.* (2018) using production function, reported seed rhizome cost and labor cost as significant factors on ginger production in a selected location of Palpa district in Nepal. The coefficient of multiple determination R^2 of the model was 0.67 for ginger production. It indicates that about 67% of variations in gross return have been explained by the explanatory variables included in the model. The value of adjusted R^2 was estimated to be 0.651. It depicts that, after taking an account of the degree of freedom, the explanatory factors in the model explained 65.1 % of the variation in the dependent variable.

Return to scale indicates the proportionate change in output as a result of proportionate change in input. The summation of all the coefficients of explanatory variables included in the regression model gives the value of return to scale. The value of return to scale was 0.889. Thus, ginger production function in the study area exhibited decreasing return to scale and 88.9% increase in the gross return could be realized if all the inputs specified in the function are increased by 100%. Similar to this, the finding of (Poudel *et al.*, 2018), (Acharya *et al.*, 2019), and (Acharya *et al.*, 2021) have reported a decreasing return to scale on ginger and turmeric crop production, respectively.

Table 9. Profit margin and market margin of 1 kg fresh ginger in the study area.

Particulars	Producer NRs.	Local collector NRs.	Retailer NRs.
Purchase price		56.67 (0.48)	65 (0.55)
Production cost	35.67 (0.30)		
Transportation cost		2 (0.01692206)	1.5 (0.01269155)
Loading cost		0.5 (0.00423052)	0.5 (0.00423052)
Packaging cost		1.8 (0.01522946)	2 (0.01692206)
Unloading cost		0.5 (0.00423052)	0.5 (0.00423052)
Total cost	35.67 (0.30)	61.47 (0.52)	69.5 (0.59)
Sales price	56.67 (0.48)	65 (0.55)	90 (0.76)
Market margin	21 (0.18)	8.33 (0.07)	25 (0.21)
Profit margin	21 (0.18)	3.53 (0.03)	20.5 (0.17)
Market margin%	38.65	15.33	46.02
Profit margin%	46.64	7.84	45.53
		Market margin between Farmer and retailer	
Farmgate price (P_f)		56.67 (0.48)	
Retailer price (P_r)		90 (0.76)	
Market margin ($Pr-P_f$)		33.33 (0.28)	
Producer's share (P_s)		62.97 (0.53)	

Figure in parenthesis indicates value in US $ (1 USD = 118.196 NRs).

Table 10. Production problems of ginger in the study area.

Production problems	Score					Weight	Indexing	Ranking
	1	0.8	0.6	0.4	0.2			
High cost and low quality seed	39	15	6	0	0	54.6	0.91	I
Disease/insect	18	37	5	0	0	52.6	0.88	II
Lack of technical services	3	3	46	8	0	36.2	0.6	III
Institutional/Organizational support	0	5	3	51	1	26.4	0.44	IV
Irrigation facility	0	0	1	2	57	12.8	0.21	V

Table 11. Marketing problems of ginger in the study area.

Marketing problems	Score					Weight	Indexing	Ranking
	1	0.8	0.6	0.4	0.2			
Price instability	44	14	2	0	0	56.4	0.94	I
Access to limited trader and market center	12	42	6	0	0	49.2	0.82	II
Poor bargaining power	4	5	46	5	0	37.6	0.63	III
Lack of transportation facility	0	2	5	47	8	25	0.42	IV
Lack of storage facility	0	0	0	11	49	14.2	0.24	V

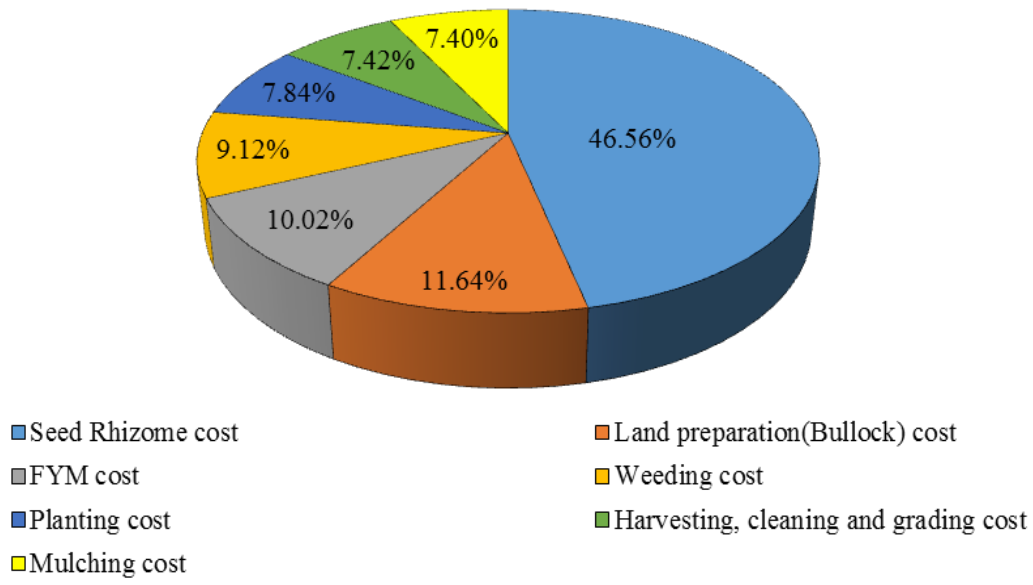

Figure 2. *Contribution (%) of variable resources to total variable cost of ginger production.*

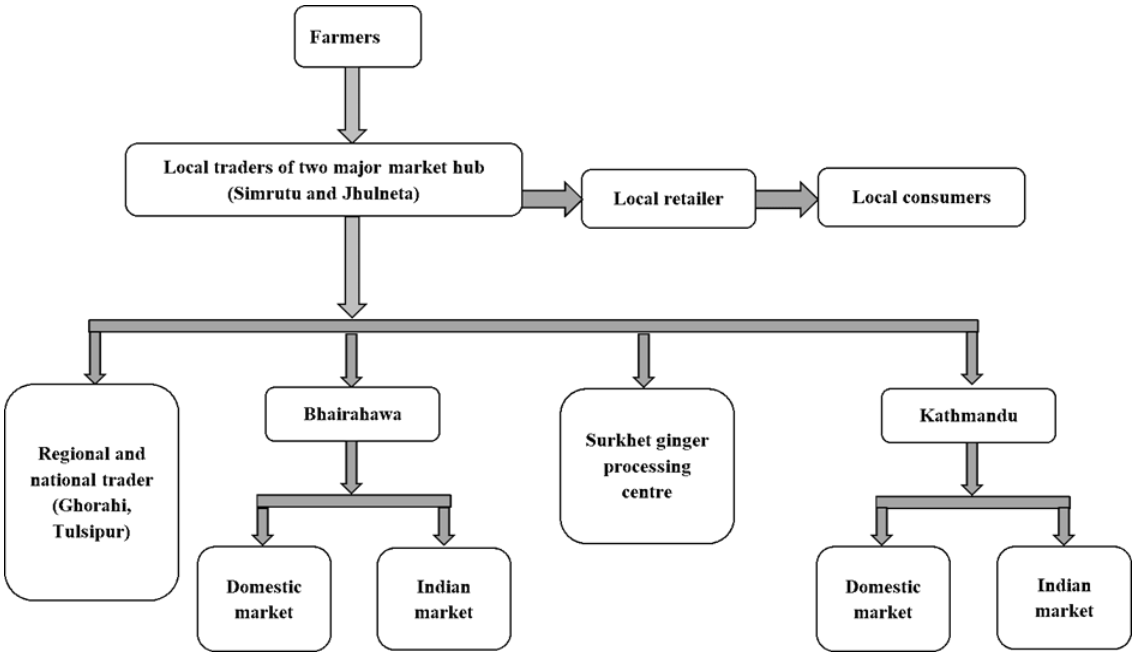

Figure 3. *Marketing channel of ginger in the study area.*

Resource allocative efficiency

The estimated MVP of the three major inputs used in the ginger production are presented in (Table 8). The ratio of the MVP to MFC of the rhizome cost was positive and less than one, which indicated the overuse of this resource. Similarly, ratios of MVP to MFC for FYM cost and total labor cost were positive and greater than one, indicating their under-utilization. The resource use efficiency ratio was highest for FYM costs (7.920), followed by total labor cost (1.664) and seed rhizome cost (0.928). This implied that spending more on FYM cost and total labor cost would yield more returns. For instance, every additional rupee spent on FYM and total labor would result in the returns of NRs. 7.920 and NRs. 1.664, respectively. Study result showed that the efficiency ratio for seed rhizome cost was near to 1, implying that it has been utilized to optimum economic advantage. According to a study on resource allocative efficiency, expenditure on FYM and total labor must be increased by 87.374 % and 39.908 %, respectively, to achieve optimal resource allocation. These results are in conformity with the earlier reports by (Anamayi and Anamayi, 2018), who assessed the underutilization of seed rhizome and FYM in the Jaba local government area of Kaduna state.

Profit margin and market margin

The Profit and market margin of 1 kg of ginger was calculated from the marketing channel prevailing in the study area, i.e. (Producer - local trader - retailer channel) as shown in (Table 9). The actual cost of 1 kg ginger production at the farmer level was found to be (NRs. 35.67 = USD 0.30). The selling price of 1 kg ginger was (NRs. 56.67 = USD 0.48), allowing him a profit margin of (NRs. 21= USD 0.18) per kg ginger. The total cost incurred by the local trader was estimated to be (NRs. 61.47 = USD 0.52) per kg ginger. The increment in per kg value of ginger is due to the transaction cost associated with it. The average value of transportation, loading, unloading, and packaging cost for 1 kg ginger at local trader level was reported to be NRs 2, 0.5, 0.5, and 1.8, respectively. The selling price of 1 kg ginger at local trader level was (NRs. 65 = USD 0.55). Thus, the profit margin and market margin at local trader level were estimated to be NRs 3.53 and 8.53, respectively.

The purchasing price, total cost, and selling price of 1 kg ginger at retailer level were (NRs. 65 = USD 0.55), (NRs.69.5 = USD 0.59), and (NRs. 90 = USD 0.76), respectively. The per kg transportation, loading, unloading, and packaging costs incurred by the retailer during the transaction were NRs. 1.5, 0.5, 0.5, and 2, respectively. Similarly, the profit margin and market margin at the retailer level were (NRs. 20.5 = USD 0.17) and (NRs. 25 = USD 0.21), respectively. The overall market margin of the marketing channel (Producer - local trader - retailer channel) was reported to be (NRs. 33.33 = USD 0.28) per kg of ginger. Likewise, the study revealed the producer's share of 62.97% in the study area. The findings are consistent with those of (Upadhyaya *et al.*, 2020), who reported a market margin of (NRs. 25.66 =USD 0.22) per kg of ginger in Salyan district, Nepal. However, this study's result was contrary to the producer's share, which was estimated at 53.34% in Salyan district Nepal.

Problems in ginger production and marketing

Production problems: Five points scaling technique was applied to rank ginger production problems based on the farmers' perception. The intensity of each problem was scaled as strongly agree = 1, fairly agree = 0.8, neutral = 0.6, fairly disagree = 0.4 and strongly disagree = 0.2. All 62 ginger farmers were asked to rank problems on a scale of one to five, as specified in the interview schedule. The frequency was calculated and then multiplied by their corresponding intensity/weightage. The obtained results were then added. This value was divided by the total

number of respondents, i.e., 62, yielding an index value. Finally, ranks were assigned to each problem according to the obtained index value. The result showed that high-cost and low-quality seed (0.91) was the most problematic while irrigation facility (0.21) was perceived as least problematic (Table 10).

Marketing problems: A similar technique of five-point problem ranking was also applied in case of ginger marketing problems, as shown in (Table 11). Five different major problems were enlisted in the interview schedule. All 62 ginger growing farmers were asked to rank each problem with their respective intensity/weightage ranging from 0.2 to 1. The result revealed that price instability (0.94) and access to limited trader and market center (0.82) were the major prevailing problems while storage facility (0.24) was ranked last. Also (Timsina, 2009) identified lower price and market price fluctuations as two key challenges faced by the ginger grower in Jante and Bhogateni VDC of Morang district.

Marketing channel: The marketing system for ginger of Tribeni was entirely private, with no involvement from co-operatives or other institutions. The key players in the marketing system were producers and traders. Producers were compelled to sell mostly at the prices set by a local trader at the production locations and in the market hub. In addition, almost all farmers were found selling their products directly to the assembly trader in the local market without any intermediaries. As a whole, ginger growers at Tribeni were completely reliant on local traders for their product delivery. A similar marketing system was also observed by (Khanal, 2018) at Tharmare of Salyan district, where local traders were only the option for distribution of ginger in the market. The marketing channel of ginger in Rukum west, Nepal, is as shown in (Figure 3).

Conclusion

The study concluded that the ginger production enterprise is reasonably profitable in the study area as the benefit-cost ratio is 2.02. However, mediocre productivity suggested that there is ample scope to get higher production from ginger farming. In the same way, Cost return analysis concluded that the majority of the variable cost is contributed by the seed rhizome alone which accounts 46.55 percent of total variable cost. The Cobb-Douglas production function analysis revealed that Cost on seed rhizome, farmyard manure, and total labor are significant positive predictors of gross revenue collected from ginger cultivation. The output elasticity of the Cobb-Douglas production function was 0.889, which is near to unity; implies that ginger production exhibited decreasing return to scale. On the other hand, resource use analysis has revealed that all the inputs applied in ginger production are inefficiently utilized. Marginal value product-Marginal factor cost ratio for farm yard manure and total labor cost was found greater than one (>1), implying its underutilization, while it was found less than one (<1) for seed rhizome cost indicating its overutilization. Thus, to derive economic advantage, farmers are encouraged to decrease the level of seed rhizome and increase the level of farm yard manure and labor input. Furthermore, the marketing system of ginger are poorly organized. Producers and local traders are the main actors in the marketing system. In addition, Low-quality seed, price instability, and limited access to traders and market centers are the major hindrance to ginger production and marketing. As a result, despite the fact that ginger is grown in almost every family, it is still considered a subsistence crop. From a holistic view, we can say there is still a yield gap between the actual and the potential yield of ginger production in the study area. Without a doubt, addressing these technical constraints and allocative inefficiencies could, in effect, boost ginger p reduction with the concomitant multiplier effect of increasing the profitability of ginger production enterprise and upliftment of the socio-economic living condition of the farmers.

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ABBREVIATIONS

FYM	:	Farm yard manure
MT/ha	:	Metric tons per hectare
MT	:	Metric tons
Ha	:	Hectare
APP	:	Agriculture Perspective Plan
PMAMP	:	Prime Minister Agriculture Modernization Project
ADO	:	Agriculture Development office
CBS	:	Central Bureau of Statistics
KUBK	:	Kisan Ka Lagi Unnat Biubijan Karyakram
Kg	:	Kilogram
MVP	:	Marginal Value Product
MFC	:	Marginal Value Cost
G.M	:	Geometric Mean
FAO	:	Food and Agriculture Organization
NTIS	:	Nepal Trade Integration Strategy
GoN	:	Government of Nepal
AITC	:	Agriculture Information and Training Center
ITC	:	International Trade Centre
HVAP	:	High Value Agriculture Project
VSPC	:	Vegetable Seed Production Centre
TEPC	:	Trade and Export Promotion Center
MoALD	:	Ministry of Agriculture and Livestock Development
NSCDP	:	National Spice Crop Development Program
NRs./ha	:	Nepalese Rupee per hectare
Kg/ha	:	Kilogram per hectare
NRs./kg	:	Nepalese Rupee per kilogram
S.D	:	Standard Deviation
VDC	:	Village Development Committees

REFERENCES

Acharya, N., Acharya, B., Dhungana, S. M., & Bist, V. (2019). Production economics of Ginger (Zingiber officinale Rose.) in Salyan district of Nepal. *Archives of Agriculture and Environmental Science*, *4*(4), 424–448, https://doi.org/10.26832/24566632.2019.040408

Acharya, S., Dhital, P. R., Bista, B., Ghimire, A. R., & Airee, S. (2021). Resource Productivity Analysis of Organic Turmeric Production in Surkhet District, Nepal. *Economic Affairs*, *66*(2), 189–194, https://doi.org/10.46852/0424-2513.2.2021.2

AITC. (2020). Krishi Diary. Hariharbhawan, Lalitpur: Ministry of Agriculture and Livestock Development.

Anamayi, & Anamayi, R. M. (2018). Resource Use Efficiency in Ginger Production in Jaba Local Government Area of Kaduna State. *Journal Of Humanities And Social Science (IOSR-JHSS)*, *23*(7), 14–21.

Aneani, F., Anchirinah, V., Asamoah, M., & Owusu-Ansah, F. (2011). Economic efficiency of cocoa production in Ghana. *Journal of Agriculture, Forestry and the Social Sciences*, *7*(2), 4507–4526, https://doi.org/10.4314/joafss.v7i2.64326

Begum, M. E. ., Miah, M. ., Rashid, M. ., Islam, M. ., & Hossain, M. . (2019). Economic analysis of turmeric cultivation: evidence from khagrachari district m. e. a. b. *Bangladesh Journal of Agricultural Research*, *44*(1), 43–58, https://www.banglajol.info/index.php/BJAR/article/view/40902

Bhandari, N. B., & Aryal, M. (2014/15). *Average Cost of Production and Gross Profit of Fruit Farming in Nepal*. Hariharbhawan, Lalitpur: Agribusiness Promotion and Marketing Development Directorate.

CBS. (2011). National Population and Housing Census (National report). Kathmandu, Nepal: National planning commission secretariat, Government of Nepal. Retrieved from https://cbs.gov.np

DoA. (2019). *Information on ginger/turmeric commercial farmer*. Simrutu-2, Tribeni rural municipality: Department of agriculture, Tribeni, Karnali province, Nepal.

Esekhade, T. U., Mesike, C. S., Idoko, S. O., & Okore, I. K. (2014). Gross margin analysis of rubber based cropping systems in Nigeria. *African Journal of Agricultural Research*, *9*(37), 2834–2840, https://doi.org/10.5897/ajar2014.8942

FAO. (2014). Ginger Competitiveness Project: Enhancing Sanitary and Phytosanitary Capacity of Nepalese Ginger Exports through Public Private Partnerships. Kathmandu, Nepal: MOAC.

FAOSTAT. (2018). *Food and agriculture organization of the united nation*. Retrieved from www.fao.org: http://www.fao.org/faostat/en/#data/QC

Holida, L., Wardhani, N. W. S., & Mitakda, M. B. (2019). Optimization of Cobb-Douglas production functions. *IOP* Conference Series: *Materials Science and Engineering*, *546*(5), https://doi.org/10.1088/1757-899X/546/5/052030

HVAP. (2011). Value chain analysis of ginger subsector in Nepal. Kathmandu: Ministry of agriculture and co-operatives, GON.

ITC. (2010). Export potential assessment in Nepal: Ginger, Market section analysis. Kathmandu: International trade centre.

Khanal, K. (2018). Factors Affecting and Marketing Chain of Ginger in Salyan District, Nepal. *International Journal of Applied Sciences and Biotechnology*, *6* (2), 127–131, https://doi.org/10.3126/ijasbt.v6i2.20420

KUBK. (2016). *Vegetable seed Value chain report*. Kathmandu: Kishanka laagi unnat Biu-Bijan karyaram: Ministry of Agriculture Development, Government of Nepal.

Mathew, M., Vani, N., Aparna, B., & Reddy, B. R. (2017). Resource Use and Allocative Efficiency in Ginger Production in Wayanad District of Kerala. *Agricultural Economics Research Review*, *30*(2), 299, https://doi.org/10.5958/0974-0279.2017.00051.9

Mehmood, Y., Anjum, B., & Sabir, M. (2011). Benefit cost ratio analysis of organic and inorganic rice crop production: Evidence from district Sheikhupura in Punjab Pakistan. *Pakistan Journal of Science*, *63*(3), 174–177.

MoALD. (2016/17). Statistical Information On Nepalese Agriculture. Kathmandu: Ministry of Agriculture and Livestock Development (MoALD).

NSCDP. (2007). Spice crop, An Annual Report for 2007. Khumaltar, Lalitpur: National Spice Crops Development Program.

NTIS. (2017). *Nepal Trade Integration Strategy Factsheet*. Kathmandu: Trade promotion programme.

Poudel, R., Regmi, P., Thapa, R., Gc, Y., & Kc, D. (2018). Economic analysis of ginger cultivation in selected locations of Nepal. *Bangladesh Journal of Agricultural Research*, *42*(4), 681–691, https://doi.org/10.3329/bjar.v42i4.35795

Prasad Chalise, D., Ghimire, S., Neupane, J., & Devkota, K. (2019). Economics of Production and Marketing of Ginger in Sunsari District, Nepal. *Acta Scientific Agriculture*, *3*(11), 193–198, https://doi.org/10.31080/asag.2019.03.0707

Rono, L. (2018). Microcredit and Its Relationship To the Growth of Small and Medium Enterprises in Konoin Subcounty, Kenya. *International Journal of Advanced Research*, *6*(4), 961–968, https://doi.org/10.21474/ijar01/6935

Stephanie. (2021, August 26). Slovin's Formula Sampling Techniques. *sciencing.com*. Retrieved from https://sciencing.com/slovins-formula-sampling-techniques-5475547.html

TEPC. (2017). Karnali Provincial product profile. Lalitpur: Ministry of Industry, commerce, and supplies, Government of Nepal.

Timsina, T. N. (2009). Marketing of the Ginger in Morang District (Issue April).

Upadhyaya, S., Adhikari, R. K., Karki, L. B., & Singh, O. P. (2020). Production and Marketing of Ginger: A Case Study in Salyan District, Nepal. *International Journal of Environment, Agriculture and Biotechnology*, *5*(4). https://doi.org/10.22161/ijeab.54.38

VSPC. (2017). *Yearly program and the progressive report*. Chapa, Rukum west.

Zoder, L. S. (2017). *Ginger sector in Nepal*. Germany: Duetsche Gessalchaft fur Internationale Zusammenarbeit(GIZ).