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Research Paper

Resource Productivity Analysis of Organic Turmeric Production in Surkhet District, Nepal

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ABSTRACT

This study was conducted in 2020 to determine the profitability and productivity of organic turmeric production in the Surkhet district of Mid-western Nepal. Face-to-face interviews were conducted with 60 farmers and two focus group discussions were held in four different communities. Turmeric is commonly utilized among Nepalese households in the preparation of curries and is considered one of Nepal's top five major spice crops. Despite being one of the top five-spice crops, Nepal's dependency on imported turmeric has been growing every year to meet domestic demand due to the gradual decline in domestic production. The simple descriptive and statistical tools including the Cobb-Douglas production function and benefit-cost analysis were used to analyze the result. The benefit-cost ratio was found to be 1.20, indicating that organic turmeric production was a low profitability sub-sector with a productivity of only 9.06 metric tons per hectare. The Cobb- Douglas production function showed that the cost on seed had a non-significant effect on gross returns and other costs like human labour cost, organic manure cost, ploughing cost, and other costs (agriculture equipment, thread, sack/doko, and rhizome treatment) were found statistically significant. Return to scale was calculated using the Cobb- Douglas production function and it was found to be 0.363, indicating that a 10% increase in the cost of production increases the rate of return by 3.63%, which is a diminishing rate of return. As a result, replacing human labour with agricultural machinery, lowering seed costs, and ensuring appropriate market prices are required to boost the productivity and profitability of organic turmeric production in the research area.

Highlights

- The benefit-cost ratio was found to be (1.20), indicating that organic turmeric production was a low profitability subsector with a productivity of only 9.06 Metric tons per hectare.
- The return to scale was found to be 0.363, indicating that a 10% increase in the cost of production increases the rate of return by 3.63%, which is a diminishing rate of return.
- The highest cost was covered by seed rhizome (50%).
- The majority of the turmeric farmers in the study area were still cultivating turmeric using traditional methods.
- All of the producers employed organic input (seed, manure) that was readily available in the area, resulting in 100% organic turmeric.

Keywords: Organic, inputs, productivity, market

Turmeric is regarded as an important spice crop among Nepalese households and is commonly used in the preparation of curries. It contains a yellow-colored matter named curcumin that is usually applied to coloring foods. Fresh turmeric Kapurkot-1 has a curcumin content of 4.89 percent and aromatic oils of 6.65 percent (NARC, 2014). The global turmeric production is 11 lakh tons per year, with India accounting for 80% of global turmeric production and 60% of global turmeric exports

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(TPCI, 2019). The main five-spice crops grown in Nepal are large cardamom, ginger, garlic, dry chili, and turmeric. Turmeric accounts for 11 percent of the area and 15.07 percent of production among the top five-spice crops (MoALD, 2019). Nepal produced 71500 metric tons of turmeric over an area of 7300 ha with a productivity of 9.79 Mt/ha (Krishi Dairy, 2074/75). Surkhet is well-known for its fertile land for turmeric cultivation, and it is one of the country's leading turmeric-producing districts. As a result, Prime Minister Agri-Modernization Project has declared it as a turmeric zone (PMAMP, 2017). Surkhet produced 2047 metric tons of turmeric over an area of 226 ha with a productivity of 9.06 Mt/ha (Krishi Dairy, 2074/75). In the fiscal year 2019, Nepal imported turmeric worth ₹ 22, 53, 93, 948 and exported turmeric worth ₹ 1, 21,650 (MOAD, 2019).

Despite the overall growth in the turmeric sector, the production and marketing situation of turmeric is miserable due to a lack of technical knowledge and insufficient supply of inputs during sowing as well as poor handling after the harvest, which has led to a lower yield of quality turmeric. Due to the traditional agricultural practice of turmeric production, farmers cannot get a good price, which has resulted in high production costs. Similarly, some government interventions, such as taxation, have discouraged farmers from producing turmeric. Farmers are discouraged from producing turmeric because of the low market price, high seed cost, and price fluctuation, resulting in a low benefit-cost ratio. Turmeric is primarily sold through a middleman on a commission basis, which has reduced the farm gate price of turmeric. The farmer's main concern is the occurrence of disease during field production as well as during storage. Turmeric growers receive a lower price due to haphazard price-fixing, and land fragmentation affects small holdings of land, resulting in lower turmeric production.

This study would be useful in focusing on collective marketing and market information systems to reduce the involvement of large intermediaries and achieve higher economic returns for farmers. Turmeric farmers would benefit from information on field preparation costs, labour costs, and input requirements for turmeric cultivation. The study's findings would help the concerned authority deal with the existing problems and develop effective solutions to mitigate these constraints, thereby promoting turmeric production and commercialization. The study's findings would also help farmers make decisions about farm planning and enterprise selection.

MATERIALS AND METHODS

Study area and sampling design

Organic turmeric production is one of the major traditional farm activities within the mid-western region, Nepal. Surkhet district is a part of Province No. 6 within the Inner-Terai valley located in the Bheri Zone of Nepal. It has a mild climate with hot summers and cold rainy winters. The district was purposefully selected because it is famous for productive land and is one of the leading turmeric-producing districts of the country. The Surkhet district of Nepal favours turmeric production in terms of physical, biological, and atmospheric conditions. Hence, four municipalities namely: Bheriganga, Barahtal, Lekbeshi, and Gurbhakot Municipality were randomly selected. A total of 60 households, 15 from each municipality were randomly selected from the study area.

Data Collection and Analysis

FGD was conducted to supplement and triangulate the information obtained from the household survey. Two FGD was organized in four municipalities. The secondary data were collected from the various web, published articles, national reports and publications, various books, reports of different NGOs and INGOs, etc. The gathered data were coded, entered, and interpreted by utilizing SPSS and MS-Excel computer software. The simple descriptive and statistical tools including the Cobb-Douglas production function and benefit-cost analysis were used to find out the result.

Cost and return analysis

The total variable cost of organic turmeric production was calculated by estimating all variable inputs such as seed, organic manure, other costs, human labour, and bullock ploughing at current market prices.

Total variable cost = C seed + C organic manure + C ploughing + C labour + C other

Where, C seed = Cost on seed (NRs. / ropani),

C organic manure = Cost on organic manure (NRs. / ropani),

C ploughing = cost on ploughing by pair of a bullock (NRs. / ropani),

C labour = cost on human labour (NRs. / ropani),

C others = cost on agriculture equipment, sack/doko, thread, and rhizome treatment (NRs. / ropani). Similarly, the gross return was calculated as the total quantity of fresh turmeric produced × average price of fresh turmeric. The undiscounted benefit-cost ratio (BCR) was calculated by the following method.

Benefit cost ratio (BCR) = Gross return (NRs. / ropani)/ Total variable cost (NRs. /ropani)

Gross margin is an estimation of the difference between gross returns and variable costs. It was calculated using the formula below:

Gross Margin (NRs. /ropani) = Gross return (NRs. / ropani) – Total variable cost (NRs. / ropani).

Cobb-Douglas production function analysis

To estimate the contribution of different variable inputs on turmeric production, the general form of Cobb-Douglas production function was used. The model used for estimating regression coefficients of turmeric production in the study area was computed by the following formula:

$$Y_t = aX_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4} X_5^{b_5} e_u$$

Where, Y_t = Gross return of turmeric (NRs. / ropani), X_1 = Cost on sources of seed (NRs. / ropani), X_2 = cost on labour (NRs. / ropani), X_3 = cost on organic manure (NRs. / ropani), X_4 = cost on other (NRs. / ropani), X_5 = cost on ploughing, e = Base of natural logarithm, u = Random disturbance term, a = constant, and b_1, b_2, b_3, b_4 and b_5 are coefficient of respective variables.

Above model can be expressed in log linear form as follows:

$$lnY_t = lna + b_1 ln X_1 + b_2 ln X_2 + b_3 ln X_3 + b_4 lnX_4 + b_5 ln X_5 + u$$

Where ln = natural logarithm, a = constant and u is random disturbance.

Return to scale analysis

The term Return to scale refers to the change in output as input change by the same proportions. It was determined by summing up the regression coefficients of respective inputs from the Cobb Douglas Production Function (CDPF) regression analysis.

RESULTS AND DISCUSSION

Cost of Production

Distribution based on turmeric cultivated area and productivity in Surkhet district, Nepal is presented in Table 1 which revealed that the average productivity of turmeric in the study area was 9.06 Mt/ha which was found to be less than that of the national average productivity of 9.79 Mt /ha (Krishi Dairy, 2074). Among 60 households interviewed, the average total landholding per farmer was found around 12.5 ropani with an average size of the plot allocated for turmeric farming was around 2.28 ropani.

Table 1: Distribution based on turmeric cultivated area and productivity in Surkhet district, Nepal

Measuring Criteria	Average Value
Total landholding (ropani)	12.5
Area under turmeric (ropani)	2.28
Productivity (Mt/ha)	9.06

Note: *1 ropani = 508.74 m²;* ***Source:*** *Authors own computation.*

Table 2: Share of different cost factors in organic turmeric production/ ropani in Surkhet district, Nepal

Particulars	Average variable cost (NRs. / ropani)	Percentage of the total cost (%)
Seed cost	5,422.67	50
Organic manure cost	1,669.27	15
Human Labour cost	2,996.48	28
Ploughing cost (by bullock)	299.33	2.8
Other costs (agriculture equipment, sack/doko, thread and rhizome treatment)	469.02	4.2
Total average variable cost	10,856.77	100.00

Source: *Authors own computation.*

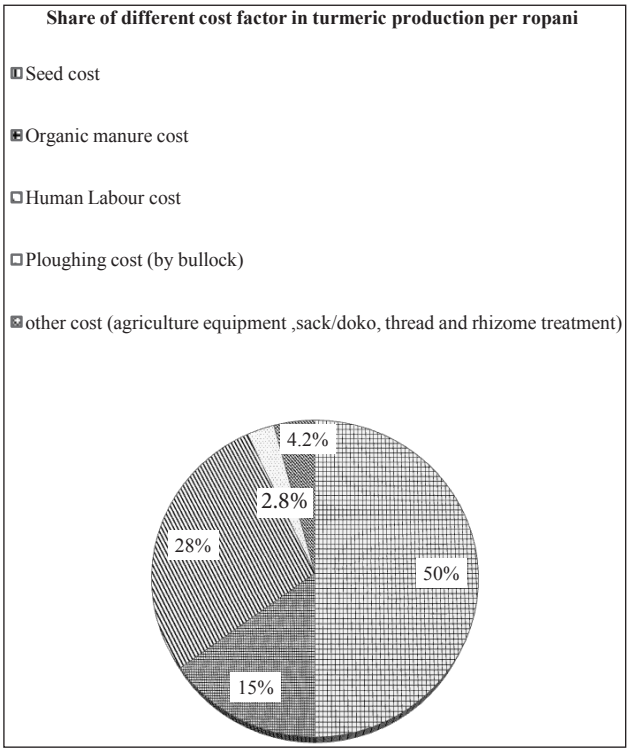

Fig. 1: Share of different cost factor in organic turmeric production per ropani in Surkhet district, Nepal

Most of the turmeric producers in the surveyed area were growing turmeric by traditional agricultural practices in which agricultural knowledge obtained from their ancestors was used. They don't use any chemical fertilizers and they don't even properly water their crops. For this study, the cost of production was calculated based on household interviews and focus group discussions done with farmers from four municipalities of the Surkhet district selected for the study.

The major cost of production included human labour, seed, manure, ploughing, and other costs. The highest cost was found to be covered by seed rhizome (50 %). However, according to studies by (Chhetri *et al.* 2019), (HVAP 2011), and (Timsina *et al*. 2011), 31.37%, 31%, and 11.17%, respectively, go to purchasing seed. The difference in seed cost may be due to the different annual seed price rates. The cost-share accounted for human labour, organic manure, other costs (doko/sack, agriculture equipment, thread, rhizome treatment), and ploughing costs were 28%, 15%, 4.2%, and 2.8% respectively in the study area. The pesticides, machinery, chemical fertilizer, and herbicides were found to be used in a negligible quantity and are not mentioned in the cost. Loss of about 2-3% of the total production during harvesting, post-harvest storage, and transportation was reported. The same loss percentage was reported in the study by (HVAP, 2011).

Labour costs include human labour costs and ploughing costs. Labour was primarily used for land preparation, ploughing, planting, organic manure application, mulch collection and application, weeding, irrigation, harvesting, cleaning, grading, and transportation/marketing. This shows that the production of turmeric in the study area is labour-intensive. Human labour was measured on man-days, that is, 8 hours of work per person per day. Generally, the average wage rate for human labour varies from ₹ 500-700 depending upon the area. Land preparation was carried out with a labour force of 0.51 persons per day. Ploughing was done by 0.27 pair bullocks per day. During ploughing, turmeric producers often use bullocks. In the case that the turmeric producers don't have their bullocks or have a deficiency of them, they often rent bullocks from others. The charge of a pair of bullocks per day is normally ₹ 1000 to 1200. FYM placement and plantation were done with a labour force of 1.45 persons per day. The collection and placement of mulching were carried out with a labour force of 1.49 persons per day. The collection of mulch is carried out from the surrounding areas, farms, or nearby forests, and the cost mainly includes the labour cost of transporting it and placing it into the field. Weeding and irrigation were done with a labour force of 0.25 persons per day. Harvesting was carried out with a labour force of 1.3 persons per day. Transportation/marketing cost is also incorporated in labour cost as farmers usually have to take their produce up to road head. Therefore, planting a turmeric plant requires 5 human labours and 0.27 pairs of bullocks per ropani. However, due to the active seasonal migration of workers overseas, there is a shortage of labour and the wage rate also is increasing day by day. As a result, efforts should be undertaken in the research area to introduce labour-saving strategies.

The study found that the use of inputs such as fertilizers and machinery is negligible. A similar result was observed by (Sahoo *et al.* 2017). They only use organic manures within the range of 30-60 doko per ropani, and the turmeric produced is purely organic. The average price of each doko manure

ranges from 30-50 rupees, depending on the region. Improved seeds are also rarely used, and most farmers rely on locally available seeds (rhizomes) in quantities ranging from 1 – 1.5 quintals per ropani. The higher rhizome requirements are due to the fact that they plant with medium-sized rhizomes. Normally the average seed price per kg varies from NRs. 45-60 depending on the region. Mulch is collected for free from the neighborhood, the farm, and the nearby forest. Thus, the entire local seed (1-1.5 quintal) and FYM (30-60 doko) were required per ropani of turmeric cultivation. Therefore, there is no need to raise awareness about the use of organic inputs among farmers, and farmers already know how to use organic inputs. However, the high cost of seeds and the inability to obtain sufficient quantities of high-quality seeds have hindered turmeric farmer's willingness to commercialize them. As a result, in promising turmeric areas, efforts should be undertaken to select and further produce enhanced rhizome seeds from native kinds with high curcumin concentration. The details of each cost are summarized above and listed in Table 2.

Table 3: Cost and Return Analysis of turmeric production based on production attributes in Surkhet district, Nepal

Average farm gate price of turmeric (NRs. /kg)	24.5
Total production cost (NRs /ropani)	10,856.77
Gross return (NRs / ropani)	13,008.50
Net profit (NRs / ropani)	2151.73
Undiscounted B/C ratio of fresh turmeric	1.20

Note: *1 ropani = 508.74 m^2;* ***Source:*** *Authors own computation.*

The study showed that gross return and profit were estimated at NRs.13008.5 and NRs.2151.73 per ropani respectively. The output-input ratio (without land rent) of fresh turmeric was 1.20. The low BC ratio was due to the high cost of the purchased seed. It implied that when 1 rupee spent on turmeric production, it would lead to the economic returns of ₹ 1.20 in turmeric cultivation.

Resource Productivity Analysis

The estimated value of the coefficients and related statistics of the Cobb-Douglas production function is shown in table 4. Out of five independent variables included in the regression analysis, the cost of human labour, organic manure, ploughing cost, and other costs were found significant at 1% and 5% level of significance, respectively. Among five independent variables input in regression analysis, seed cost was found non-significant in turmeric production in the study area.

The study revealed that a 10 % increase in seed cost decreases the rate of return by 0.21%, a 10% increase in labour cost increases the rate of return by 1.96%, a 10%increase in manure cost increases the rate of return by 0.62%, 10% increase in ploughing costs increases the rate of return by 0.62% and 10% increase in other cost increases the rate of return by 0.63%. R squared value was tabulated to be 0.56, and the return to scale was found to be 0.363. It signifies that a 10% increase in the cost of production increases the rate of return by 3.63%, which is a diminishing rate of return.

Table 4: Production function analysis of turmeric production in Surkhet district, Nepal

Factors	Coefficients	Standard Error	t Stat	P-value
Constant	6.873	0.612	11.232	0.000^{***}
Seed cost	-0.021	0.066	-0.313	0.755^{NS}
Labour cost	0.196	0.047	4.137	0.000^{***}
Manure cost	0.062	0.020	3.152	0.003^{**}
Other cost	0.063	0.024	2.640	0.011^{**}
ploughing cost	0.062	0.020	3.179	0.002^{**}
Multiple R	0.75			
R Squared	0.56			
Adjusted R Squared	0.52			
Standard Error	0.02			
F-value	13.98			
Return to scale	0.363			

Note: ****Significant @ 1%, **Significant @5% and ^{NS}Non-significant;* ***Source:*** *Authors own computation.*

Return to scale analysis

From the regression analysis of Cobb-Douglas Production Function (CDPF), the sum of the coefficient was computed to be 0.363 which signifies the decreasing return to scale in the production of turmeric in the study area.

CONCLUSION

The majority of the turmeric producers in the study area were still cultivating turmeric using traditional methods. The seed cost was found the highest contributor (50 %) to the total production cost of turmeric followed by human labour cost (28 %), organic manure cost (15 %), other costs (4.2%), and ploughing cost (2.8 %). Seed accounts for the highest share among the total costs because farmers rarely use chemical fertilizers, irrigation, and pesticides in turmeric. All the farmers used locally available organic input (seed, manure) and thus, the produced turmeric is purely organic. Organic manures are used for soil management; whereas mulching applications were integrated for weed management, moisture conservation, and nutrient retention as well. Seed, human labour, and organic manure were the three major inputs and, in most cases, are owned by the farmers themselves. The study showed that the farmers could earn an average gross margin of about NRs. 2151.73 from cultivating turmeric in 1 ropani of land area. The output-input ratio (without land rent) of fresh turmeric was 1.20. It implied that when 1 rupee was spent on turmeric production, it would lead to the returns of ₹ 1.20 in turmeric cultivation. The low BC ratio was due to the high cost of the purchased seed. It can be inferred that turmeric was a less profitable sub-sector in the study area. Several problems like the high cost of seed, the unavailability of labour, and low market price are the major bottlenecks that have deprived farmers of gaining maximum profit in turmeric farming as compared to other crops in the study area. Therefore, government intervention should be enhanced to reduce seed costs and make sure the reasonable market price of turmeric. Besides this, there is a tremendous need to introduce labour-saving techniques to maximize the productivity and profitability of organic turmeric production in the study area.

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