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Production economics and marketing of finger millet in Mugu district

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Abstract— *Mugu district in Nepal, despite facing geographical constraints, hold immense potential for finger millet production, which can improve the living standard of its residents. A study conducted in Mugu district evaluated economics of production and marketing which includes cost return analysis, marketing dynamics, constraints and recommendations associated with finger millet cultivation. Drawing from the sample of 120 farmers from Khatyad Rural Municipality and Chayanath Rara Municipality, where finger millet is extensively grown. Household survey was carried out to collect primary information from growers conducting interviews supplemented by secondary data from various sources. The cost-return analysis underscores the profitability of finger millet cultivation, with a per-hectare cost estimated at NPR 43,127.71, gross returns reaching NPR 50,790, resulting in net returns of NPR 7,662.29 with NPR 28.80 of cost per kg of production. The productivity was 1497 Kg/Ha and benefit cost ratio of 1.18. Factors such as labor cost and cost of fertilizer were statistically significant coefficients suggesting change in labor cost and cost of fertilizer influence annual finger millet income. Direct marketing of finger millet from producers to consumers was most frequent, for which the producer receives NPR 0.98 out of NPR 1.00 paid by consumer. Attack of pests such as rats and blast disease followed by lack of infrastructures and market intelligence were the major production problems. Growers highly suggests to have technical support for producing beverages along with availability of modern production technology.*

Keywords— ***Finger millet, linear regression, Benefit-Cost ratio, Marketing channel, Garett ranking***

I. INTRODUCTION

The Poaceae family's finger millet (Eleusine coracana (L.) Gaertn.), commonly referred to as Kodo in Nepal, is a significant crop used for food, fodder, and industrial goods. The Nepalese mid-hills have a high diversity of finger millet (Kandel et al., 2019). In terms of acreage and productivity, finger millet, ranks fourth among the major crops grown in Nepal, behind rice, maize, and wheat. According to Ghimire et al. (2017), the main districts in Nepal that produce this crop are Khotang, Sindhupalchok, Baglung, Syangja, Kaski, Gorkha, and Sindhuli. Finger millet (*Eleusine coracana* (L.) Gaertn.) is one of the important crops of Nepal with area of production of 265,401 hectares. In the fiscal year 2020/2021, 326,443 tons of finger millet were produced with a productivity of 1.23 Mt/Ha. Of this, 207,52 tons were produced in Karnali province with a production of 1.09 Mt/Ha, and 4196 tons were produced in Mugu district alone with a productivity of 0.98 Mt/Ha (MoALD, 2022). In Nepal's hills and mountains, millet plays a significant role in providing smallholder farmers and marginalized populations with food and nutrition security. In terms of acreage and productivity, finger millet is the most important crop in the districts of Humla and Mugu, although it ranks second in

Jumla, Khotang, and Sindhupalchok. The largest area and production of finger millet in Nepal is found in the Baglung district of Gandaki Province (Gairhe et al., 2021).

Finger millet is usually converted into flour and made into Roti (cakes), Dhindo (puddings) and Khole (thin porridge). It is also popular for making fermented beverages among certain communities of the country which is needed for their religious and cultural rituals. The straw of finger millet is an important animal fodder particularly, during the feed deficit months and helps to sustain animal management, improved compost application, soil fertility and yield (Adhikari, 2012). Health benefit of millet includes, helps to protect against heart diseases, and lowers bad cholesterol levels, beneficial in detoxifying the body, prevents type II diabetes, prevents onset of breast cancer, beneficial in lowering blood pressure and enhancing the function of the kidneys, liver, and immune system (Devika, 2017). As members of the Poaceae family, millets are considered to be ancient staple foods that originated in the tropical regions of Asia and Africa. With a 41 percent global share, India is the world's top producer of millet, with Africa coming in second. Millets are sometimes called "super foods," and growing them is a way to practice sustainable agriculture (Rawat, 2022). The economics of production and profitability of finger millet cultivation in Mugu district remains largely unexplored. There is insufficient information and analysis regarding the economic aspects of Finger millet. Due to lack of informed strategies and interventions aimed at improving farmer livelihoods it is difficult in promoting sustainable agricultural practices, enhancing market integration and overall economic development in the region. In recent times, because of nutritive value of finger millet hype is increased and different nations have implemented policies to promote the cultivation of finger millet. Exploring the present socio-economic situation and analyzing the profitability of finger millet in Nepal is highly required. By examining the economics of finger millet cultivation, this research aims to provide valuable insights into the viability and profitability at the farm level and exploration of market dynamics at the market level. Finger millet holds a pivot role as a staple crop in Mugu district, contributing significantly to local food security and survival. Understanding its economic aspects is essential for enhancing agricultural productivity, improving rural livelihoods and ensuring sustainable food production. The study aims at pinpointing the production and marketing aspects such as cost of inputs, cost of production, returns, marketing practices, problems of production and marketing, etc. Therefore, the objective of this study is to access the economic prospects of finger millet production and marketing in Mugu district in Nepal.

II. METHODOLOGY

Mugu district was purposively selected for this study based on coverage area of Finger millet production, marketing value and demand of consumers. The study was conducted in Khatyad Rural Municipality and Chayanath Rara Municipality based on the farmers and traders involved in Finger millet production and marketing. A total of 120 farmers and traders were selected as samples for enumeration. Simple random sampling method was used in choosing the sample. Consequently, 60 households from both Khatyad Rural Municipality and Chayanath Rara Municipality were selected.

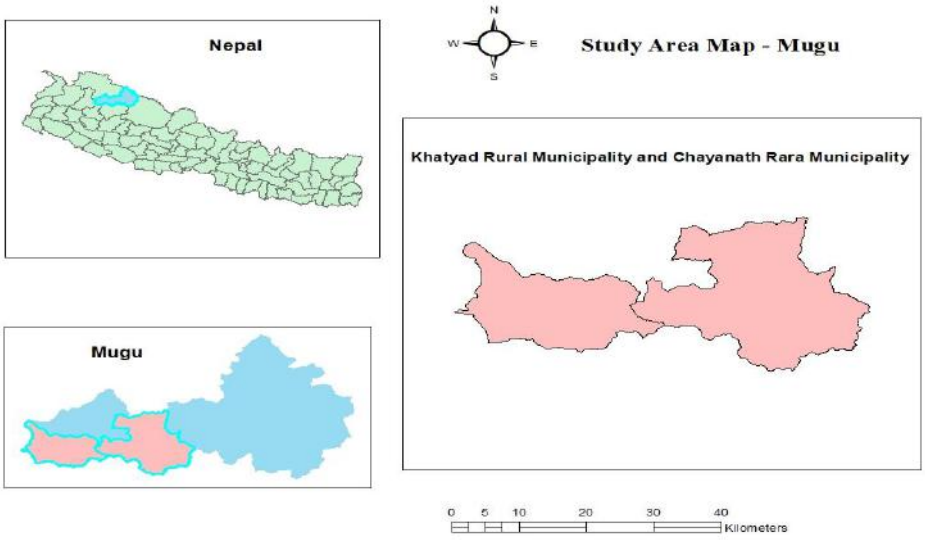

Fig.1. Map depicting the location of the study area

Primary information was collected by using pre-tested interview schedule by applying face–to–face interview method. The collected information was first tabulated, coded and entered into the computer. Data analyses were done by using the computer software packages like Microsoft Excel and Statistical Package for Social Science (SPSS).

2.1. Operational cost: Operational costs in agriculture include the value of hired and family labor, animal and machine labor (both hired and owned), seeds, manures, fertilizers, depreciation, irrigation charges, land revenue, interest on working capital, and miscellaneous expenses.

2.2. Cost of production: The cost of production is calculated by using following formula:

$$\text{Average cost of production} = \frac{\text{Cost of cultivation}}{\text{Total production}}$$

2.3. Income measures:

Following income measures were used.

2.4. Gross income: It is the total value of main product.

$GI = \{Qm \times Pm\}$

Where;

GI = Gross Income

Qm = Quantity of main product

Pm = Price of main product

2.5. Farm business income (FBI):

FBI = Gross income – Cost A

Where:

Cost A = Operational cost – value of owned labor

2.6. Family labor income (FLI) and management:

FLI = Gross income – Cost B

Where:

Cost B = Cost A + interest on FC + depreciation

2.7. Net income (NI):

NI = Gross income – Cost of cultivation

2.8. Returns per rupee (RPR):

RPR=Gross Income/Cost of cultivation

2.9. Return on investment (ROI)

Return on investment is a technique to evaluate the profitability or efficiency of an investment relative to its cost. The ROI formula calculates the ratio of the net return or gain from an investment to the initial cost of investments.

$$\text{ROI} = \left(\frac{\text{Net return}}{\text{Initial cost}}\right) \times 100\%$$

2.10. Return on labor

Return on labor is a measure of the efficiency and effectiveness of labor input in generating output or income. It evaluates the return or value generated per unit of labor cost.

$$\text{Return on labor (ROL)} = \left(\frac{\text{Net profit+value of family labor}}{\text{Total income}}\right) \times 100\%$$

2.11. Net Profit

It is the net earnings after subtracting all the expenses not included in the calculation of gross margin. It was calculated by deducting fixed cost and marketing cost from gross margin as shown in equation:

Net profit = gross margin –marketing cost- total fixed cost

2.12. B: C ratio

It is the benefit of the farm business relative to inputs cost, expressed both in monetary value. The benefit-cost ratio is calculated by taking the ratio of total revenue and total cost. It is calculated by using the following formula:

$$\text{B/C ratio} = \frac{\text{Gross return}}{\text{Total cost}}$$

If the B/C ratio is greater than 1, the farm business is profitable.

If the B/C ratio is less than 1, the farm business is unprofitable.

If the B/C ratio is equals to 1, the farm business can neither be considered profitable nor unprofitable.

2.13. Gross margin analysis

The gross margin provides simple and quick method for analyzing farm business which is the difference between the gross return and the total variable cost incurred that is:

Gross margin = Gross return - total variable cost

Where, Gross return = $\sum Gross\ return$ = return from main product + return from by products

Total variable cost = $\sum$ cost of all variable inputs used for the production.

2.14. Linear regression

Linear regression is a statistical method used to model the relationship between a dependent variable (often denoted as Y) and one or more independent variables (often denoted as X). Linear regression was used to estimate the factors of share to total income. The equation for the model is represented by:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon$$

Where:

Y is Annual finger millet income

X_1, X_2, X_3, X_4 are the independent variables, cost of labor, cost of seeds, cost of ploughing, cost of fertilizers

β_0 is the intercept, representing the income when all costs are zero.

$\beta_1, \beta_2, \beta_3, \beta_4$ are the coefficients, representing the change in income for a one unit change in each respective cost variable, holding other variable constant.

ϵ is the error term, representing the difference between the observed and predicted income values.

2.15. Marketing Channel

The path or route followed by the commodity which connects the producer with the final consumer is known as marketing channel. Marketing channel consists of various market middleman who perform the various marketing activities in sequence as the produce moves from the producers to ultimate consumers.

2.16. Price spread

Price spread is calculated by the difference between net price paid by the consumer and price received by the producer for an equivalent quantity of farm product.

$$P_s = C_f - P_f$$

Where:

C_f = Consumers price

P_f = Price received by farmer

2.17. Producers share

$$P_s = \left(\frac{\text{Price received by producer}}{\text{Price paid by consumer}}\right) \times 100\%$$

2.18. Marketing margin

The marketing margin at any stages of marketing has been calculated as follows:

$$MM_i = SP_i - (PP_i + MC_i)$$

Where:

MM_i = Marketing margin of the i-th middleman

SP_i = Selling price of the i-th middleman

PP_i = Purchasing price of the i-th middleman

MC_i = Marketing cost incurred by the i-th middleman

2.19. Garrett's ranking technique

Garrett's ranking technique was used to rank the constraints and recommendation indicated by the respondents on different factors. As per this method, respondents have been asked to assign the rank for all factors and the outcomes of such ranking have been converted into score value. This technique was used for analyzing constraints in production and marketing of finger millet, and recommendation for speeding up the growth of finger millet production and these ranks were converted to scores by referring to Garrett's table.

$$\text{Percent position} = \frac{100*(Rij-0.50)}{N}$$

Where:

Rij = Rank given for ith item by a jth individual

Nj = Number of items ranked by jth individual

The per cent position of each rank was converted to scores by referring to tables given by Henry Garrett. Then for each factor, the scores of individual respondents were added together and divided by the total number of respondents for whom the scores were added. These mean scores for all the factors were arranged in the order of their ranks and inferences were drawn.

III. RESULTS AND DISCUSSIONS

3.1. Socio - demographic characteristics of respondents

The study revealed that the sample of 120 farmers had an equal gender distribution, with 50% female and 50% male farmers. The age distribution showed that 62.5% of farmers were within the age group of 36-55, representing the middle-aged demographic, while a significant proportion were aged 56 and above, indicating the presence of experienced farmers. Regarding family size, 69.1% of households had up to 5 members, 23.4% were medium-sized families with 6-9 members, and a smaller proportion had larger households with 10 or more members. Educational status revealed that 43.4% of respondents were illiterate, 13.3% were literate, 21.6% had completed primary education, 12.5% had attained secondary education, 8.4% had higher secondary education, and only 0.8% had a university education. Agriculture emerged as the primary occupation for 72.5% of respondents, while a smaller proportion engaged in dual occupations combining agriculture with business, government jobs, private jobs, or social employment. In terms of household income, 90.8% of farmers earned an annual income above NPR 200,000, while 9.2% earned between NPR 100,000 and NPR 200,000. Regarding finger millet production, 78.3% of farmers produced over 200 kg annually, 20.8% produced between 50 and 200 kg, and only 0.8% produced less than 50 kg.

Table 1. Socio - demographic characteristics of respondents

Demographics	Number of respondents (N=120)	Percentage
Gender		
Male	60	50
Female	60	50
Age group		
Below 25	3	2.5
26 – 35	25	20.8
36 – 55	75	62.5
56 and above	17	14.2
Family type (no. of members)		
Small size (up to 5)	83	69.1
Medium size (6 - 9)	28	23.4
large size (above 10)	9	7.5
Education		
Illiterate	52	43.4
Primary education	26	21.6
Secondary education	15	12.5
Higher secondary education	10	8.4
University	1	0.8
Literate	16	13.3
Occupation		
Agriculture as main occupation	87	72.5
Agriculture as subsidiary occupation	33	27.5
Household income		
Less than NPR 200000	11	9.2
More than NPR 200000	109	90.8
Annual finger millet production (Kg)		
Less than 50	1	0.8
50 – 200	25	20.8
More than 200	94	78.3

Table 2. Reasons for selecting finger millet production among respondents

Reason for finger millet farming	**Frequency**	**Percent**
Highly nutritive plant	120	100
Drought tolerance	14	11.7
Easy cultivation,	1	.8
Other	2	1.7

The table 2 shows that 100% of farmers in Mugu district cultivate finger millet primarily because of its highly nutritive value. Drought tolerance was mentioned by 11.7% of respondents, while only a small percentage cited easy cultivation and other reasons. This indicates that nutrition is the main driver for finger millet farming in the region

3.2. Marketing channel preferences

The finger millet sample farmers' preferences for marketing channels, accounting for 92.5% of respondents, prefer "Direct selling," indicating a preference for selling their produce directly to consumers or end-users. Only a small proportion, 6.7%, opt for selling through "Retailers and wholesalers," suggesting limited reliance on intermediaries in the marketing process. Additionally, a negligible percentage (0.8%) chooses "Middlemen and local traders" as their preferred marketing channel. These findings emphasize farmers' inclination towards direct engagement with consumers.

Table 3. Preferences for marketing channels among respondents

Preferences for marketing channel	Frequency	Percent
Direct selling	111	92.5
Middlemen and local traders	1	.8
Retailers and wholesalers	8	6.7
Total	**120**	**100.0**

Key aspects of finger millet farming

Table 4. Production and distribution of finger millet among respondents

Particular	N	Minimum	Maximum	Mean	Std. Deviation
Area for finger millet farming (Gada)	120	2	12	6.69	1.931
Household consumption (Kg)	120	50	700	195.96	72.649
Selling amount (Kg)	120	0	300	90.83	53.837

The descriptive statistics highlight key aspects of finger millet farming respondents in Mugu District. Farmers allocate an average area of approximately 6.69 Gada for cultivation, each gada representing at least 300m^2 in area with variations ranging from 2 to 12 Gada. Household consumption of finger millet varies widely, with households consuming an average of 195.96 Kg annually, ranging from 50 to 700 Kg. Similarly, the amount of finger millet sold by farmers varies, with an average of 90.83 Kg sold, ranging from 0 to 300 Kg.

3.3. Cost structure in finger millet production

The total cost of cultivation per hectare was found to be NPR 43127.71. The breakup of total cost into operational and fixed costs indicated that the operational costs were NPR 38232.71 (88.65%) and fixed costs were NPR 4895.00 (11.35%).

Table 5. Cost (NPR /Ha) of finger millet production in the study area

S. N	Particulars	Value (NPR)	%Total cost
1	Operational costs		
a.	Human labor	12,951.43	30.03
	Owned	7,770.6	18.01
	Hired	5,180.83	12.01
b.	Seeds	747.20	1.73
c.	Ploughing	9,921.13	23.00
d.	Farm Yard Manure	11,311.75	26.23
e.	Miscellaneous Cost	800.00	1.85

f.	Total working capital (Σ a to e)	35,731.51	82.85
g.	Interest on working capital @7%	2,501.21	5.80
	Total operational costs (Cost A)	38,232.71	88.65
2	Fixed costs		
a.	Land revenue	-	-
b.	Rental value of owned land	4,000.00	9.27
C	Interest on fixed capital @10%	445.00	1.03
d.	Depreciation	450.00	1.04
	Total fixed costs	4,895.00	11.35
	Total costs	**43,127.71**	**100.00**

The majority of the operational cost are attributed to human labor, ploughing, farm yard manure, seeds, miscellaneous cost and interest on working capital constituting 88.65% of the total costs. Fixed cost that contains rental value of owned land, interest on fixed capital and depreciation contribute 11.35% to the total cost.

3.4. Cost breakdown of agricultural activities in finger millet cultivation

The pie chart illustrates that human labor is required to perform various cultural practices viz., land preparation, transplantation, application of manures and fertilizers, weeding, irrigation and harvesting. Of the total costs, human labor was the highest item of cost in the cultivation of finger millet. The expenditure incurred towards human labor was NPR 12951.43 per hectare accounting for 30.03 per cent of the total costs. The expenditure towards ploughing was NPR 9921.13 (23.00%). Seedlings of finger millet were transplanted. The seed cost was NPR 747.20 accounting for 1.73 per cent of total cost.

Plant nutrient management is an important factor for getting good crop yields. The balanced supply of plant nutrients would also help to maintain disease free conditions to a larger extent. The farmers had spent NPR 11311.75 on organic fertilizers such as farm yard manure for 26.23 percent of the total cost and inorganic fertilizers were not incorporated as Karnali province being organic province. Among the fixed costs, rental value of owned land was the major item, it was NPR 4000 per hectare.

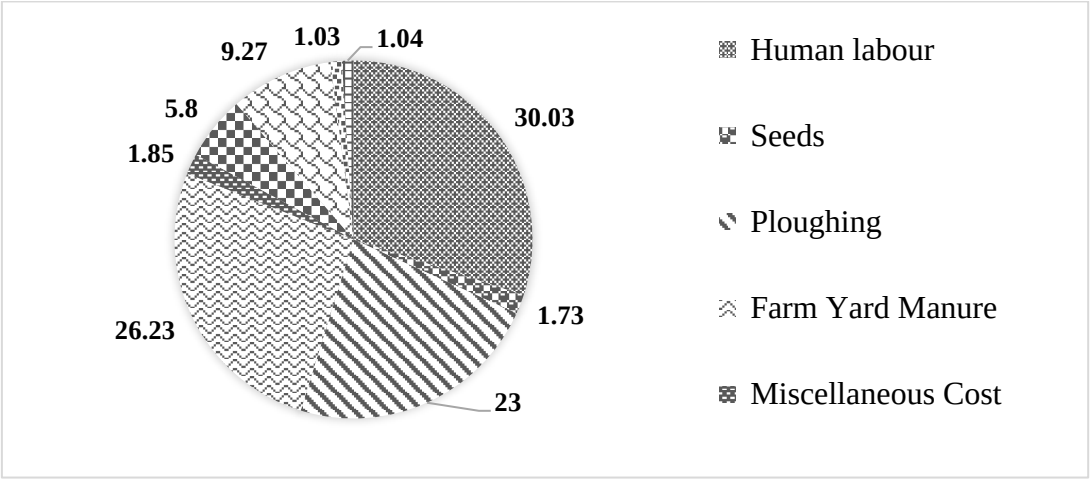

Figure 2. Percentage distribution of expenditure on finger millet production

3.5. Yield and revenue of finger millet production

The details of physical output and returns per hectare from the production of finger millet are presented in Table 10. On an average, the yield of main product was 1.49 Mt, while that of by-product was 1 Mt. To produce value added product wine average amount of 0.48 Mt of finger

millet is used, which in return produces 48 liter of beverage The monetary yield for main product having NPR 30/Kg results in return of NPR 44910. 1 Mt by product straw gives return of NPR 1000 and 48 liters of value-added product wine gives return of NPR 4880. The sample farmers, on an average realized a total income of NPR 50790 per hectare. The net returns were estimated at NPR 7662.29 per hectare. The Benefit Cost ratio in the cultivation of finger millet was estimated to be 1.18.

Table 6. Output and return per hectare of finger millet cultivation

S. N	Particulars	Units	Output and returns
1	Yield in physical units		
A	Main product	Mt	1.49
B	By product (Straw)	Mt	1
C	For value added product (wine)	Mt	0.48
2	Yield in monetary terms		
A	Main product	NPR	44910
B	By product (Straw)	NPR	1000
C	Value added product (wine)	NPR	4880
3	Gross return	NPR	50790
4	Cost of cultivation	NPR	43127.71
5	Net returns	NPR	7662.29
6	B:C ratio		1.18

3.6. Income from finger millet production

Various farm efficiency measures such as farm business income, family labor income, net income and farm investment income and returns per rupee of expenditure were worked out.

The gross income realized in the cultivation of finger millet was estimated at NPR 50790 per hectare. Though the gross income is a measure to analyze the efficiency of farm business, but it alone does not help us to judge the success of farm business. Therefore, another measure namely net income which represents surplus over the total costs was estimated. Higher net income reflects the degree of success of farm business. Finger millet farmers in the study area realized a net income of NPR 7662.29 per hectare.

Farm business income is a measure which indicates return for owned resources like land, labor and capital and this amounted to NPR 19877.89 per hectare. Family labor income is another measure of farm efficiency which represents the returns to farmers owned labor and family labor and this amounted to NPR 15432.89 per hectare. Farmers were able to secure a net income of 1.18 per every rupee spent in finger millet cultivation. Return on investment is 17.76% which indicates the investment has yielded a profit of 17.76% relative to initial investment amount. The return on labor is 30.38% which indicates for every unit of labor cost there is a return of approximately 30.38% in profit.

Table 7. Farm income per hectare of finger millet production

S. N	Particulars	Farm income (NPR)
1	Gross income (GI)	50,790.00
2	Farm business income (FBI)	19,877.89
3	Family labor income (FLI)	15,432.89
4	Return on investment (ROI)	17.76%
5	Gross margin	12,557.29
6	Return on labor (ROL)	30.38%
7	Net income (NI)	7,662.29
8	Cost of production per Kg	28.80
9	Average price per Kg	30
10	B: C ratio	1.18

In our study we found that the cost of production per hectare of finger millet NPR 43127.71 was significantly closer compared to previous research by Kaushal and Choudhary, (2020) which was INR 33336.02 and higher than Adhikari, (2012) which was NPR 23847.65 at Kalabang site and NPR 21005.57 at Begans. Our cost of production was slightly higher compared to Tandel, (2017)

in the study economic analysis of south Gujrat revealed to be INR 23752.15. The productivity of finger millet according to research of Adhikari, (2012) was 1.15 Mt/Ha in Kalabang and 0.98 Mt/Ha in begnas similarly 1.09 Mt/Ha was in the study of Tandel, (2017) which is quite significant with our result of 1.4 Mt/Ha.

The research (Tandel, 2017) estimated net return of INR 2181.71 and B:C ratio of 1.10 and the study (Adhikari, 2012) estimated B:C ratio of 1.04 at Kalabang and 1.05 at Begnas which aligns with our findings of net return of NPR 7662.29 and B:C ratio of 1.18.

3.7. Factors of annual income from finger millet production

The model summary provides statistical information about the regression model used to analyze the relationship between various predictors (cost of fertilizer, labor cost, cost of seeds, cost of ploughing) and the dependent variable, annual finger millet income (NPR), in the context of research on finger millet production in Mugu district. The R Square value (coefficient of determination) of 0.347 indicates that approximately 34.7% of the variability in annual finger millet income can be explained by the predictors included in the model. The F Change value of 15.292 is associated with a significant p-value of .000 (Sig. F Change), indicating that the overall regression model is statistically significant at the 0.05 level.

Table 8. Model summary for annual finger millet income prediction

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics		
					R Square Change	F Change	Sig. F Change
1	.589[a]	.347	.325	.379	.347	15.292	.000
a. Predictors: (Constant), cost of fertilizer, labor cost, cost of seeds, cost of ploughing							
b. Dependent Variable: annual finger millet income (NPR)							

The table 9 presents the coefficients for the predictors (labor cost, cost of seeds, cost of ploughing, cost of fertilizer) in the regression model predicting Annual finger millet income (NPR) in Mugu district. Among the predictors, only "Labor cost" and "Cost of fertilizer" have statistically significant coefficients. "Labor cost" has a coefficient of 0.211 with a significance level of 0.034, and "Cost of fertilizer" has a coefficient of 0.374 with a significance level of 0.000. This suggests that changes in labor cost and cost of fertilizer significantly influence annual finger millet income in Mugu district. However, "Cost of seeds" and "Cost of ploughing" do not show significant effects on annual finger millet income at the 0.05 significance level. Here the regression coefficient is less than 1, it indicates decreasing returns to scale, meaning that increasing the amount of capital invested results in proportionately less output.

Table 9. Model summary for annual finger millet income prediction

Model	Standardized Coefficients		T	Sig.
	Std. Error	Beta		
(Constant)	.142		5.512	.000
Labor cost	.000	.211	2.146	.034
Cost of seeds	.000	.135	1.648	.102
Cost of ploughing	.000	.176	1.780	.078
Cost of fertilizer	.000	.374	4.409	.000
a. Dependent Variable: Annual finger millet income (NPR) b. Return to scale (∑ bi): .896				

3.8. Marketing channel of finger millet

The finger millets are non-perishable commodity that can be sold throughout the year. Farmers were found selling-out finger millets mainly through three channels in the

study area. The study revealed that majority of finger millet were marketed directly from producers to consumers. Consumers were local buyers of finger millet. Little amount of finger millet was traded through middleman. Most of the finger millet produced in study sites was consumed at the same production site. Direct selling of finger millet from producers to consumers was observed as the strongest marketing channel having 47.80 percent finger millet marketed solely. 10.35 percent of finger millet was marketed through local trader or miller solely. However, medium amount was found to be taken by Neighbor farmer/local traders (millers) and consumer combined. 11.95 percent of finger millet were channeled through consumer, local trader and collector combined.

Table 10. Major channels, based on no. of households engaged and the volume channelized, of finger millet marketing in the study area

Marketing channel	No. of respondents	Frequency	Sold quantity (Kg)	Percent of total sold quantity
Channel I	65 (54.2%)	103	6000	47.80
Channel II	14 (11.6%)	52	1300	10.35
Channel III	3(2.5%)	9	650	5.17
Channel I, Channel II	32 (26.7%)	38	3750	29.88
Channel I, Channel II, Channel III	6 (5%)	120	850	6.77
Grand Total	**120**	**322**	**12550**	**100**

The marketing of finger millet through major channel have been presented based on the data collected from farmers and market functionaries. The channels identified in the study area were:

Channel-I: Producer → Consumer

Channel-II: Producer → Neighbor farmer/Local trader/Miller → Consumer

Channel-III: Producer → Collector → Wholesaler → Retailer → Consumer

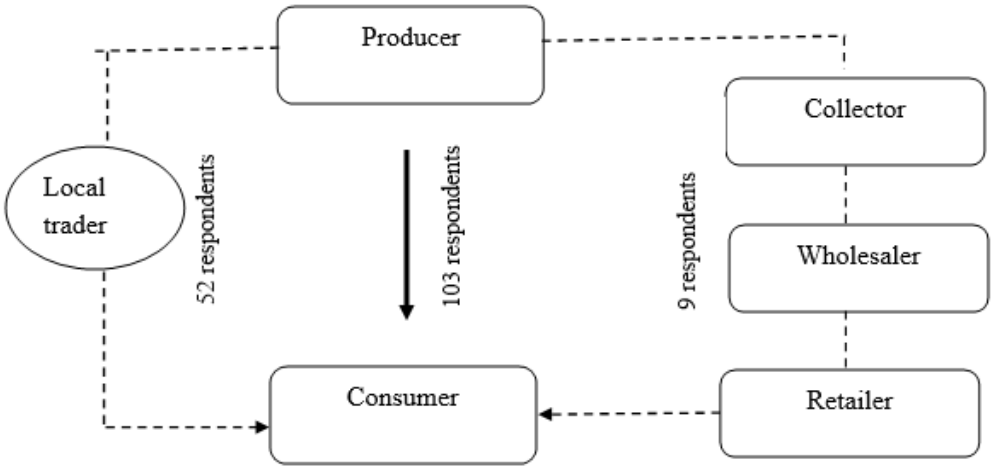

Fig.3. Marketing channel of finger millet in Mugu district

Reddy *et al*. (2015) and Tandel (2017) insights about having 3 important marketing channels of finger millet first being producer to consumer followed by producer to retailer to consumer and producer to local trader or local mandi to retailer to consumer. These findings align with our findings which is more similar to the marketing channel findings of Adhikari (2012) majority of growers channeling produce directly to the consumer and then through local trader or miller to the consumer and by collector to wholesaler to retailer and finally to the consumers.

Marketing costs, marketing margin and price spread of finger millet

The channel of marketing of finger millet from producer to consumer varies from area to area. The average price

spread was worked out on per quintal basis. Marketing cost, margin and price spread were calculated for three channels separately.

Marketing cost, margin and price spread of finger millet in channel – I

The producer received the price of NPR 3000 per quintal which is 98.16 percent of consumer's rupee. The cost incurred by producer on transportation, loading, unloading, weighing, and miscellaneous charges etc. was NPR 56 per quintal which is 1.83 percent of consumer's rupee.

Marketing cost, margins and price spread of finger millet in channel – II

The producer received the price of NPR 3000 per quintal which is 91.01 percent of consumer's rupee. The cost incurred by producer on transportation, loading, unloading weighing and miscellaneous charges etc. was NPR 56 per quintal which is 1.69 percent of consumer's rupee. Producer sold the produce to the local trader or miller at NPR 3056 which is 92.71 percent of consumer's rupee. The local trader sold directly to the consumer at NPR 3296 per quintal. The cost incurred by local trader was NPR 40 per quintal which is 1.21 percent of consumer's rupee. Thus, the margin retained by the local trader amounted to NPR 200 per quintal which is 6.06 percent of consumers rupee. The price spread was NPR 296 per quintal.

Marketing cost, margin and price spread of finger millet in channel – III

The producer received the price of NPR 3000 per quintal which is 66.56 percent of consumer's rupee. The major cost incurred by the producers are loading, unloading, weighing a32nd miscellaneous charges accounted to NPR 35.5 per quintal. The price at which the producer sold to the collector is NPR 3035.5 which is 67.34 percent of consumer's rupee. The cost incurred by collector is NPR 38 which accounted for 0.84 percent of consumer's rupee. The collector selling price to wholesaler was NPR 3373.5 with profit margin of NPR 300. The cost incurred by wholesaler was NPR 41 and the wholesaler selling price to retailer was NPR 3914.5 with margin of NPR 500 which is 11.09 percent of consumer's rupee. The cost incurred by retailer was NPR 43. The margin that retailer received is NPR 550 per quintal which is 12.20 percent of consumer's rupee. The price that the ultimate consumer pays is NPR 4507.5 per quintal. The price spread was NPR 1507.5 per quintal.

Table 11. Marketing cost, margin and price spread of finger millet in different marketing channels of study area

(NPR/qtl)

S. N	Particulars	Channel – I	Channel – II	Channel - III
1	Producer's net price	3000 (98.16)	3000 (91.01)	3000 (66.56)
2	Cost incurred by			
A	Producer	56 (1.83)	56 (1.69)	35.5 (0.79)
B	Local trader or miller		40 (1.21)	
C	Collector			38 (0.84)
D	Wholesaler			41 (0.91)
E	Retailer			43 (0.95)
	Total cost	56 (1.83)	96 (2.90)	157.5 (3.49)
3	Margin earned by			
A	Local trader or miller		200 (6.06)	
B	Collector			300 (6.66)
C	Wholesaler			500 (11.09)
D	Retailer			550 (12.20)
	Total margin		200 (6.06)	1350 (29.95)
4	Consumer's price	3056 (100.00)	3296 (100.00)	4507.5 (100.00)
5	Price spread	56	296	1507.5
6	Producer's share	98.16 %	91.01 %	66.56 %

Note: Figures in parentheses indicate percent share in consumer's price

3.9. Analyzing constraints in production and marketing of finger millet and suggestion from growers

Garrett's ranking technique was used to rank the constraints identified in finger millet production and marketing. By using Garrett's formula, the per cent position was obtained. These were converted into scores by relating to Garrett's table. The mean score values were obtained and the constraint having the highest score value was identified as the most important.

Table 12. Percentage positions and their corresponding Garett table values

Rank	% position 100(R-0.5)/120	Garett Value
1	100(R-0.5)/120 =0.42	96
2	100(R-0.5)/120 =1.25	92
3	100(R-0.5)/120 =2.08	88
4	100(R-0.5)/120 =2.91	86
5	100(R-0.5)/120 =3.75	84

Above table 12 includes the rank assigned to each item, the Garett value calculated for each rank, the percentage position of each item, and the final Garett value assigned to each item. Lower Garett values indicate higher ranks, and the percentage position offers context on each item's relative position within the total set of items being ranked.

Table 13. Ranking problems associated to finger millet production and marketing in study area

Problems	**F1**	**F2**	**F3**	**F4**	**F5**	**Total respondents**	**Total score**	**Average score**	**Rank**
Low level of education and training	18	3	17	34	48	120	10456	87.13	5
Problems due to pests	21	65	17	11	6	120	10942	91.18	1
Lack of market intelligence	8	35	61	15	1	120	10730	89.41	3
Lack of quality seeds	19	13	5	57	26	120	10546	87.88	4
Lack of infrastructures	54	4	20	3	39	120	10846	90.38	2

Problems due to pests was the most severe production constraint in finger millet, with Garrett score of 91.18. Similarly, the second severe most constraint was found to be lack of infrastructures having a Garrett score of 90.38. In finger millet production lack of market intelligence were ranked third (89.41) and fourth (87.88) most severe constraints faced by the farmers were lack of quality seeds and low level of education and training having 87.13 ranking fifth were the constraints of finger millet production and marketing.

From the study, attack of pests such as rat to the standing crop was the most serious production problem followed by lack of infrastructures. Lack of infrastructure such as transportation was one of the major constraints followed by low quality seeds and low level of education and training. Adhikari, (2012) also came out with same constraint. Still majority of the finger millet growers using own farm local varieties for seed purpose and unavailability of good quality seed and lack of improved variety was major constraints for little millet growers in compare with finger millet growers. This is in line with the research (Kaushal and Choudhary, 2020).

Suggestions given by finger millet growers

Table 14. Ranking suggestions associated to finger millet production and marketing in study area

Suggestions	**F1**	**F2**	**F3**	**F4**	**F5**	**Total responders**	**Total scores**	**Average score**	**Rank**
Technical education should be made available	45	1	1	6	67	120	10644	88.7	4
Availability of timely inputs	7	27	22	63	1	120	10594	88.28	5

Modern production technology should be easily adaptable in the field	10	21	75	13	1	120	10694	89.11	2
Technical support for brewery industry	14	69	19	17	1	120	10910	90.91	1
Program for increasing nutritional awareness	44	2	3	21	50	120	10678	88.98	3

The suggestions were ranked with the help of Garett ranking method. Brewery management was the major problem in cultivation of finger millet; hence to mitigate this with 90.91 score growers gives a suggestion to provide technical support for brewery industry and to provide modern production technology easily adaptable in the field with 89.11 score from growers to rank second followed by providing program for increasing nutritional awareness to the farmers of Mugu district so that they could engage in production and marketing of finger millet actively. The next important problem was unavailability of technical education for farm operation therefore 88.7 score from growers was suggested to provide technical education available. The next constraint was lack of timely inputs of manures and quality seeds. Therefore with 88.28 scores growers suggested facilitating availability of timely inputs made available to the growers. More research and development activities suggested to release good quality seeds and varieties.

IV. CONCLUSION

This study conducted in Mugu district shed light on the economic dynamics, demographic characteristics, and marketing strategies associated with finger millet cultivation. Through a comprehensive cost-return analysis, it became evident that while the cultivation of finger millet entails significant costs, it also yielded favorable returns, indicating its potential as a profitable venture for farmers in the region. The regression analysis for factor share to total output of production found labour cost and fertilizer cost significantly impact income. However, challenges such as damage from pests, lack of market intelligence, and inadequate infrastructure were constraints to both production and marketing processes. Furthermore, the demographic profile of finger millet growers revealed a predominantly middle-aged population with limited formal education, highlighting the need for targeted interventions to enhance agricultural knowledge and skills. The identification of three primary marketing channels underscores the importance of understanding local trade dynamics for optimizing market access. Grower's recommendations, including support for the brewery industry, adoption of modern technologies, and improved access to education and inputs, offer valuable insights for enhancing productivity and market competitiveness. Addressing the challenges and leveraging the opportunities identified in the study can contribute to the sustainable development of finger millet cultivation in Mugu district, benefiting both farmers and the wider community.

Technical support for the brewery industry should be provided as some of the farmers or growers from Mugu district mainly rely on income generated from brewery produced from finger millet. Cost-return analysis of this study revealed that finger millet cultivation involves substantial cost yet yields favorable returns, highlighting its viability as a profitable venture, so providing more favorable conditions to attract more farmers towards finger millet cultivation should be done. Regression analysis suggests improving labor cost efficiency through better training, skill development, and adoption of labor-saving technologies could optimize the cost-effectiveness of labor inputs. Promoting effective fertilizer use is crucial, as its significant effect on income highlights the importance of timely access and proper application. Re-evaluating investments in seeds and ploughing could help reduce unnecessary costs without affecting output. The regression coefficient being less than 1 indicates decreasing returns to scale, suggesting the need for improved management practices and strategic investments to ensure additional inputs yield proportionate increases in output. Supporting innovation and technology adoption, such as introducing advanced farming techniques and improved technologies for seed and ploughing, is also important. Policymakers should consider these findings when developing agricultural support programs, providing subsidies for fertilizers and labor-saving tools along with technical assistance to significantly improve farmers' incomes in Mugu district. Finger millet, being a highly nutritive crop, necessitates programs for increasing nutritional awareness in the Mugu district. Growers suggest that technical education should be provided to the growers and the upcoming generation of the study area. Being a remote area of the country deprived of timely inputs, growers suggest providing inputs on time. Urban consumers in Nepal are willing to pay a premium price for local finger

millets, so strengthening marketing channels for finger millet can help connect producers with urban consumers, indicating a potential market for this crop, which will improve the smallholder livelihoods of growers in the Mugu district.

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