https://doi.org/10.48047/AFJBS.6.13.2024. 3207-3223

African Journal of Biological Sciences

Economic Analysis of Production of Finger Millet (*Eleusine coracana* L.) in Perspective of Nutritional Security in the Western Undulating Agroclimatic Zone of Odisha, India

Binmay Kumar Mandal[1]
PhD scholar, College of Agriculture, OUAT**, Bhubaneswar, Odisha-751003, India
Dr. Sarba Narayan Mishra[2]
Professor & Head,
Dept. of Agricultural Economics, College of Agriculture, OUAT, Bhubaneswar, Odisha-751003, India
Dr. Rajendra Kumar Rout[3]*
Assistant Professor,
Dept. of Agricultural Economics, College of Agriculture, OUAT, Bhawanipatna, Odisha-766001, India
Dr. Abhiram Dash[4]
Assistant Professor & Head,
Dept. of Agricultural Statistics, College of Agriculture, OUAT, Bhubaneswar, Odisha-751003, India
Dr. Sarbani Das[5]
Joint director,
Directorate of extension, OUAT, Bhubaneswar, Odisha-751003, India

* Corresponding author contact information: Dr. Rajendra Kumar Rout, College of Agriculture, OUAT, Bhawanipatna, Odisha-766001, India, Telephone: 6371799173, e-mail: rkrout@ouat.ac.in
**OUAT: Odisha University of Agriculture and Technology, Bhubaneswar

Abstract

The popular names for finger millet (*Eleusine coracana* L.) are Mandia or Ragi. "Economic Analysis of Production of Finger Millet (*Eleusine coracana* L.) in Perspective of Nutritional Security in the Western Undulating Agroclimatic zone of Odisha, India" was the main emphasis of the current study. For the purposes of the study, two districts namely Kandhamal and Koraput were purposively selected based on their potential for producing finger millet and the largest area cultivated respectively. The total sample size was 120. The major findings of the study revealed that C_2 cost and gross return of finger millet were Rs. 29835.01 and 38650.25 per hectare respectively. Cost A_2, Cost B_2 and Cost C_2 were worked out Rs. 14765.76, Rs. 19833.29, and Rs. 29835.01 per hectare respectively. The Benefit- Cost ratio in the cultivation of finger millet was estimated for cost C_2 was 1.30. The net return on replacing upland rice with finger millet, in partial budget estimate was Rs. 3414.48 and in sensitivity analysis it was found that facilitating & miscellaneous cost was the most important variable deciding the net profit positively. Compared to parboiled rice, finger millet is more nutrient-rich, ensuring the nutritional security among growers in the study area.

Key Words: Finger millet, Partial budgeting, Benefit-Cost ratio, Cost of cultivation, Sensitivity analysis, Nutritional security.

Article History

Volume 6, Issue 13, 2024

Received: 18June 2024

Accepted: 02July 2024

doi:*10.48047/AFJBS.6.13.2024*. 3207-3223

Introduction

Food and Agriculture Organization and United Nations have recognised 2023 as International Year of Millets or IYM2023 for awareness about health and nutritional benefits of millets. During 2022, world millet production was 906.50 lakh tons while India produces more than 173 lakh tons of millet, which is 80 per cent of Asia's and 19.11 per cent of global production. Global average yield of millet is 1260 kg/ha whereas the yield in India is 1364 kg/ha. India holds the highest share of millet production in whole world. Finger millet (ragi) (*Eleusine coracana L.*) accounts for about 11% of total millet production in India (as per the final estimates 2021–22). (Ministry of Consumer Affairs, Food & Public Distribution).

The nutritional advantages of finger millet are numerous; according to the Millet Network of India-Deccan Development Society-FIAN (2009), it has thirty times more calcium than rice. Straw from finger millet is used extensively in the livestock industry as feed. Finger millet may be grown all year round if moisture is available because it is not a season-specific crop (http://www.agritech.tnau.ac.in).Millets have nutritional potential comparable to common cereals like rice, wheat, or barley in terms of calorie, protein, and carbohydrate contents. Compared to rice or wheat, millets have a greater mineral content and the largest percentage of beneficial dietary fibres (Malleshi et al., 1996). According to the Deccan Development Society-FIAN, 2009,finger millet has thirty times more calcium than rice, among its many other nutritional advantages. This millet's grains are ground into flours and used to make a variety of foods, including bread, roti, puddings, pancakes, porridge, and cookies (Nidoni et al., 2021). In comparison to rice, wheat, maize, and sorghum, its proximate composition is better in terms of dietary fibre, calcium, and a few other micronutrients. The seed coat of this millet is rich source of phenolic compounds, minerals and dietary fiber (Shobana et al., 2010). Positively, because of its greater nutritional benefits, the urban population in India is consuming more millet in their diet.

Materials and methods

The present study was focused to investigate the "Economic Analysis of Production of Finger Millet (*Eleusine coracana* L.) in Perspective of Nutritional Security in the Western Undulating Agro climatic zone of Odisha, India''. Kandhamal and Koraput were purposively selected based on their potential for producing finger millet and the largest area cultivated respectively. Subsequently, GPs & farmers were selected randomly for the study. Thus, the total sample size was 120 for finger millet growers. The data of cost of cultivation of upland

rice was collected from 60 farmers among them. Primary data was collected through personal interview method with the help of pre-tested questionnaire. The production costs and returns of crop production were estimated on the basis of per hectare. The costs and returns of crop were estimated with the help of standard cost concept. The details of standard cost concept used in present study are as below.

Cost Concept

The cost concepts generally used in farm management studies viz. cost A_1, cost A_2, cost B_1, cost B_2, cost C were considered in the present study as per the Commission for Agricultural Costs and Prices (CACP).

According to CACP,

"Cost A_1 = Cost of hired human labour and attached labour

+ Cost of hired and owned bullock labour

+ Cost of hired and owned machine charges

+ Cost of pesticides, seeds, manures & fertilizers

+ Depreciation, repair and maintenance of implements and farm building

+ Irrigation charges

+ Land revenue, cesses and other taxes

+ Interest on working capital

+ Transportation charges

Cost A_2 = Cost A1 + rent paid for leased in land

Cost B_1 = Cost A1 + interest on value of owned capital assets excluding land

Cost B_2 = Cost B1 + rental value of owned land and rent paid for leased Land

Cost C_1 = Cost B1 + imputed value of family labour

Cost C_2 = Cost B2 + imputed value of family labour

Farm Business Measures

1. Net income (NI) = Gross Income – Cost C_2
2. Family labour income (FLI) = Gross Income – Cost B_2
3. Farm Business Income (FBI) = Gross Income – Cost A_1
4. Owned Farm Business Income = Gross Income – Cost A_2
5. Farm Investment Income (FII) = Net income + Imputed value of owned land+ interest on value of owned capital assets excluding land

   or

   Farm Business Income – Imputed value of family labour."

Benefit Cost Ratio (BCR)

It is the ratio of discounted cash inflows to discounted cash outflows, and for an investment to be deemed worthwhile, the ratio needs to be one or greater. The following formula was used to calculate the benefit cost ratio, or BCR.

$$\text{Benefit cost ratio (BCR)} = \frac{\sum_{t=1}^{n} \frac{B_n}{(1+i)^n}}{\sum_{t=1}^{n} \frac{C_n}{(1+i)^n}}$$

Where, B= benefit in n^{th} year

C = Cost in n^{th} year

n= number of years

i= discount rate

Partial Budgeting

The partial farm budget designed for the present study uses the criteria of Kay (1986). A planning and decision-making framework called partial budgeting is used by agricultural businesses to weigh the advantages and disadvantages of various options. It exclusively considers the adjustments to income and expenses that might arise from putting a certain alternative into practice.

The effective application of partial budget analysis as a tool for decision-making involves seven steps.

1. State the proposed change: Substituting upland rice with finger millet
2. Added returns: Compute the return gained from finger millet cultivation.
3. Reduced costs: Compute the foregone cost of cultivation of upland paddy
4. Added costs: Compute the cost incurred from finger millet cultivation
5. Reduced returns: Compute the return foregone from upland paddy cultivation
6. Summarize the net effects: In order to calculate the alternative's overall cost and benefit, we examined each of the alternative's good (steps 2 and 3) and negative (steps 4 and 5) characteristics separately. Subtracting total costs from total benefits yields the alternative's net benefit. There are certain financial benefits to such option because the net benefit is positive.
7. Take into account non-economic and additional aspects: When evaluating the alternative, non-economic factors were taken into account. Among these were the social ramifications of reducing farm labour force, as well as the requirement for specialised knowledge.

Sensitivity analysis (Tornado plot)

Several probable outcomes given a range of input parameters were estimated and then shown together with the likelihood to occur in an impact (sensitivity) analysis. In order to make the best decisions possible in the face of uncertainty, this aids the decision-maker in determining which risks taking and which to avoid. Additional variable input analysis was conducted using multiple regression analysis in order to generate the tornado plot. To do regression analysis, the following equation was used:

The data are, therefore, subjected to functional analysis by using the following form of equation:

$$Y = aX_1^{b_1} \times X_2^{b_2} \times X_3^{b_3} \times \ldots \times X_n^{b_n} \times e^u$$

This function can easily be transformed into a linear form by making logarithmic transformation, after logarithmic transformation this function is:

$$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + \ldots + b_n \ln X_n + u \ln e$$

Where, ln = Natural logarithm

a = constant

Y = Net return (Rs.)

X_1 = Gross return (Rs.)

X_2 = Paid out labour cost (Rs.)

X_3 = Imputed family labour cost (Rs.)

X_4 = seed cost (Rs.)

X_5 = Manures & $fertiliser\ cost$ (Rs.)

X_6 = Plant protection charges (Rs.)

X_7 = Facilitating/misc. cost (Rs.)

b_1 to b_7 = Regression co − efficient of respective variables

e = Error term

Result and Discussion

Cost of cultivation of finger millet

The per hectare cost of cultivation of finger millet was worked out by using standard cost concepts. The information on various items of cost of cultivation of finger millet in Koraput and Kandhamal district of Odisha is presented in table 1. It can be observed from the table that at pool level, per hectare cost of cultivation of finger millet i.e., Cost C_2 was Rs. 29835.01. Amongst the different items of cost, imputed value of family labor was the major item of cost which accounted for Rs. 10001.69 (33.52%) ,followed by rental value of land Rs.

3865.02 (12.95%), machine power Rs. 3572.07 (11.97%), hired human labour Rs. 3227.40 (10.82%), manures Rs. 2211.87 (7.41%), bullock labour Rs. 1499.95 (5.03%), interest on fixed capital Rs. 1202.51 (4.03%), phosphorus fertilizer Rs.907.23 (3.04%), potash fertilizers Rs. 844.36 (2.83%), interest on working capital Rs. 360.75 (1.21%), seeds Rs. 323.36 (1.08%), plant protection charges Rs. 283.51 (0.95%), and nitrogenous fertilizers Rs. 85.56 (0.29%). Of the total cost of cultivation of finger millet, Cost A_2 was Rs. 14765.76 (49.49%) and Cost B_2 was Rs. 19833.29 (66.48%).The per quintal total cost of cultivation at cost C_2 of Finger millet was Rs 2754.04 and Rs. 2758.42 for Koraput and Kandhamal respectively. Similarly, Tandel et al (2017) studied the cost structure and profitability of finger millet in south Gujarat region and found that Cost A1/A2, cost B1, cost B2, cost C1 and cost C2 were Rs.9334.67, Rs.9370.09, Rs.13170.44, Rs.17770.09 and Rs.21570.44 per hectare respectively. The Cost-benefit ratio in the cultivation of finger millet was estimated for cost A1/A2, cost B1, cost B2, cost C1, cost C2 and cost C3 were 2.54, 2.53, 1.80, 1.33, 1.10 and 1.001 respectively.

Cost, returns, gross income and B:C ratio of finger millet

The information on per hectare cost, returns, gross income and B:C ratio is presented in figure 1 & table 2. The per hectare gross income was received Rs. 39384.87 and Rs. 37915.62 by Koraput and Kandhamal, respectively. However gross income was Rs. 38650.25 in study area and BC ratio in the cultivation of finger millet was estimated for cost A_2, cost B_2, and cost C_2 were 2.62, 1.95 and 1.30 respectively. In similar way, the gross revenue of finger millet cultivation was significantly varied from NRs. 21608.03/ha in Begnas to NRs. 24638.23/ha in Kalabangarea respectively and also positive gross margin in his study (Raj K. Adhikari, 2012). Upreti et al. (1991) also found similar gross margin (NRs 641 - 951/ha) in Eastern and Western hills under their study.

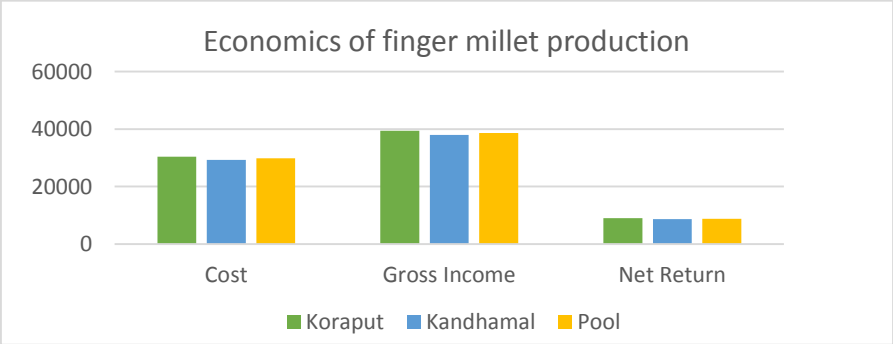


Figure 1: Economics of finger millet production

Table 1: Per hectare cost of cultivation of finger millet (in Rs.)

Sl. No		Koraput			Kandhamal			Pool		
		Qty	Value (Rs.)	%	Qty	Value (Rs.)	%	Qty	Value (Rs.)	%
I. 1	Hired Human labour (hrs)	114.78	3443.40	11.34	100.38	3011.40	10.28	107.58	3227.40	10.82
	a) Male	50.37	1511.10	4.98	37.96	1138.80	3.89	44.17	1325.10	4.44
	b) Female	64.41	1932.30	6.36	62.42	1872.60	6.39	63.41	1902.30	6.38
2	Bullock labour (hrs.)	46.36	1390.68	4.58	53.64	1609.21	5.49	50.00	1499.95	5.03
3	Machine power (hrs.)	4.61	4149.98	13.66	3.54	2994.17	10.22	4.08	3572.07	11.97
4	Manure (q)	14.20	2129.44	7.01	15.30	2294.30	7.83	14.75	2211.87	7.41
5	Seeds (Kg)	10.58	317.45	1.05	10.98	329.28	1.12	10.78	323.36	1.08
6	Fertilizers (Kg)			0.00			0.00			0.00
	i. Nitrogen	7.82	86.00	0.28	7.74	85.12	0.29	7.78	85.56	0.29
	ii. Phosphorus	23.12	901.65	2.97	23.41	912.81	3.12	23.26	907.23	3.04
	iii. Potassium	21.81	850.71	2.80	21.49	838.02	2.86	21.65	844.36	2.83
7	Irrigation Charges	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	Plant protection charges (Rs.)		265.94	0.88		301.09	1.03		283.51	0.95
9	Miscellaneous		260.36	0.86		319.75	1.09		290.05	0.97
	Working capital (Rs.)		13795.61	45.42		12695.15	43.33		13245.38	44.40
11	Interest on working capital (Rs.)		1103.64	3.63		1015.62	3.47		1059.63	3.55
12	Depreciation (Rs.)		430.54	1.42		290.97	0.99		360.75	1.21
13	Land revenue and taxes (Rs.)		100.00	0.33		100.00	0.34		100.00	0.34

	Cost ' A_1'		**15429.79**	**50.80**		**14101.74**	**48.13**		**14765.76**	**49.49**
	Rent paid for leased in land		0.00	0.00		0.00	0.00		0.00	0.00
	Cost ' A_2'		**15429.79**	**50.80**		**14101.74**	**48.13**		**14765.76**	**49.49**
14	Rental value of land		3938.49	12.97		3791.56	12.94		3865.02	12.95
15	Int. on fixed capital@ 10 %		1435.14	4.73		969.89	3.31		1202.51	4.03
	Cost ' B_2'		**20803.42**	**68.50**		**18863.19**	**64.38**		**19833.29**	**66.48**
16	**Family labour(ih hrs.)**	318.91	9567.30	31.50	347.87	10436.10	35.62	333.39	10001.69	33.52
	a) Male	145.83	4374.90	14.41	140.54	4216.20	14.39	143.18	4295.40	14.40
	b) Female	173.08	5192.40	17.10	207.33	6219.90	21.23	190.21	5706.30	19.13
	Cost ' C_2'		**30370.72**	**100.00**		**29299.29**	**100.00**		**29835.01**	**100.00**
II	Output (q)									
	a. Main produce	10.96	39198.38		10.53	37662.44		10.74	38430.41	
	b. By-produce	1.24	186.49		1.69	253.17		1.47	219.83	
	Gross income		**39384.87**			**37915.62**			**38650.25**	
	Net income		**9014.15**			**8616.33**			**8815.24**	
III	Cost ' C_2' net off by produce		30184.23			29046.12			29615.18	
IV	Per quintal cost		2754.04			2758.42			2757.47	

Table 2: Cost, returns, gross income and B: C ratio of finger millet

Sl. No	Particulars	Koraput	Kandhamal	Pool
1	Total cost (Rs.)			
	i) Cost 'A_2'	15429.79	14101.74	14765.76
	ii) Cost 'B_2'	20803.42	18863.19	19833.29
	iii) Cost 'C_2'	30370.72	29299.29	29835.01
2	Profit at (Rs.)			
	i) Cost 'A_2'	23955.08	23813.88	23884.49
	ii) Cost 'B_2'	18581.45	19052.43	18816.96
	iii) Cost 'C_2'	9014.15	8616.33	8815.24
3	Production (qtl.)	10.96	10.53	10.74
4	Gross income (Rs.)	**39384.87**	**37915.62**	**38650.25**
5	B:C ratio			
	i) Cost 'A_2'	2.55	2.69	2.62
	ii) Cost 'B_2'	1.89	2.01	1.95
	iii) Cost 'C_2'	1.30	1.29	1.30

Cost of cultivation of upland paddy

Table 3 shows the cost of cultivation of upland paddy in Koraput and Kandhamal district of Odisha. The table shows that the cost of cultivating upland paddy, or Cost C_2, was Rs. 29324.25 per hectare.

Table 3: Per hectare cost of cultivation of upland paddy (in Rs)

SL NO	Particulars	Rs.	%
1	Hired Human Labour	2285.41	7.79
2	Animal Labour	1415.65	4.83
3	Machine Labour	3200.88	10.92
4	Seed	1915.17	6.53
5	Fertilizer	4355.86	14.85
6	Manure	2353.40	8.03
7	Plant Protection Chemicals	854.67	2.91
8	Irrigation Charge	0.00	0.00
9	Miscellaneous	436.03	1.49
10	**Working capital (Rs.)**	**16817.07**	**57.35**
11	Interest On Working Capital	1345.37	4.59
12	Depreciation	371.25	1.27
13	Land revenue	100.00	0.34
14	**COST A_1**	**18633.69**	**63.54**
15	Rent paid for leased in land	0.00	0.00
16	**COST A_2**	**18633.69**	**63.54**
17	Rental value of owned land	3472.50	11.84
18	Interest on fixed capital	1237.50	4.22
19	**COST B_2**	**23343.69**	**79.61**
20	Imputed value of family labor	5980.56	20.39
21	**COST C_2**	**29324.25**	**100.00**
22	**RETURN**		
23	Main Product (Qtl.)	14.40	
24	Main Product (Value)	29382.74	
25	By Product (Value)	5342.27	
26	**Gross Return**	**34725.01**	
27	**Net Return**	**5400.76**	

Among the various cost components, imputed value of family labor accounted for the majority at Rs. 5980.56 (20.39%), followed by fertilizer Rs. 4355.86 (14.85%), rental value of owned land Rs. 3472.50 (11.84%), machine labour Rs. 3200.88 (10.92%), manures at Rs. 2353.40 (8.03%) and so on. Upland paddy cultivation came at a total cost of Rs. 18633.69 (63.54%) at cost A_2 and Rs. 23343.69 (79.61%) for cost B_2, respectively. In a similar way, K. Marikannan and G. Srinivasan (2022) studied "The economic analysis on cost and returns of paddy in jawadhu hills of Tamil Nadu" and discovered that the net yield on an acre was Rs. 16,726 and the gross return was Rs. 50,500. Therefore, the cost of production per kilogramme of paddy was 18.15. Consequently, the calculated return on investment per rupee was 1.49.

Partial budgeting analysis for substituting upland rice with finger millet

Now, we analyzed data of table 2 & 3 through Partial Budgeting (PB) in table 4. The result from table 4 reveals that due to the addition of finger millet in the cropping system the added return was found to be Rs. 67974.50 and the added cost incurred was Rs. 64560.02 per ha. which ultimately gives rise to a total net return of Rs. 3414.48 per hectare. The added cost incurred is due to the increased cost of finger millet cultivation over rice.

Added return gained from finger millet was Rs. 38650.25. Reduced costs are associated with the cost of rice production which was Rs. 29324.25. The Added return & reduced costs represent the credit(left) side of the change and amount to Rs. 67974.50.The debit side of the change includes the reduced income from rice of Rs. 34725.01,along with increased costs for the finger millet production of Rs. 29835.01. When we subtract the debit side from the credit side in the PB, there is an increase in net income of Rs. 3414.48 to the operation. In short, the net gain of growing finger millet is Rs.4224.95 per hectare in comparison to the upland rice in the study area. With this substantial increase in income, we should make the change as long as risk and other non-monetary factors are negligible at present context. In the same line Bandumula, N. et. al., (2017) conducted the partial budgeting analysis technique for adoption cultivation of paddy in SRI method over traditional method and they found "SRI adoption would bring net gain to the tune of Rs.19420/ha. The BC ratio of SRI (1.75) was found to be higher than transplanting method (1.3)" & also Ahmed, H. et al. (2021) adopted partial budgeting approach "to examine the relationship between contribution margins and improvements in FAW in terms of increased space allowance for a typical Swedish cow-calf operation, as compared to current practices. In the current practice, a cow should be given at least 5 m^2 & the calf 2.2 m2. We found that

a 0.5 m2 increase in space allowance per calf (achieved by a reduction of herd size) was associated with a 6.9 to 18.7% reduction in contribution margins in the short term".

Net return= Added return - Added cost

= (Increased income + Reduced costs) – (Increased costs + Reduced income)

= Rs. (38650.25+ 29324.25) – Rs. (29835.01+34725.01)

= Rs. 67974.50– Rs. 64560.02

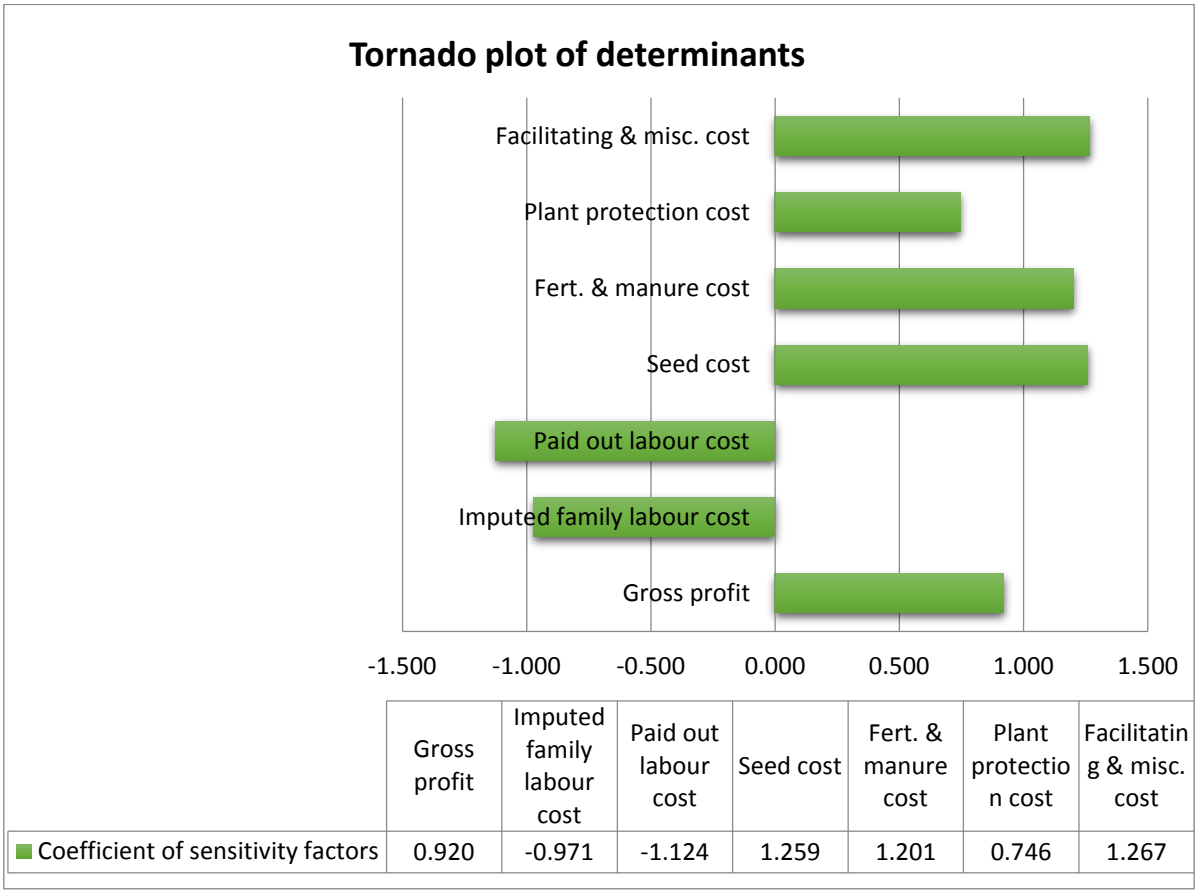
= Rs. 3414.48

Table 4: Partial budgeting analysis for substituting upland rice with finger millet

Credit (Added return)	**Value in Rs.**	**Debit (Added cost)**	**Value in Rs.**
Increased income	38650.25	Reduced income	34725.01
Reduced costs	29324.25	Increased costs	29835.01
Total	67974.50		64560.02
		Net return	**3414.48**

Sensitivity analysis

The sensitivity analysis was made on partial budgeting of finger millets over upland paddy and a tornado plot was plotted for better clarifications of the study. Figure 2 revealed that facilitating & miscellaneous cost was the most important variable driving the net benefit. Apart from that seed cost, manure & fertilizer cost, gross profit, and plant protection charges were positive drivers for the resulted net return. These aforesaid drivers were contributing towards the net profit according to their respective positions. The paid-out labour cost was the most important variable that reduced revenue and negatively affected the contribution margin in the sensitivity analysis. Similarly imputed family labour cost also acts as a negative contributor towards net profit. In a similar line, Ahmed, H. et al. (2021) adopted sensitivity analysis technique through tornado plot and suggested "DWG was the most important variable driving the contribution margin".



	Gross profit	Imputed family labour cost	Paid out labour cost	Seed cost	Fert. & manure cost	Plant protection cost	Facilitating & misc. cost
Coefficient of sensitivity factors	0.920	-0.971	-1.124	1.259	1.201	0.746	1.267

Figure 2: Tornado plot of regression coefficients for determinants of a change in net income

Nutritional analysis of finger millet and upland paddy

Finger millet is high in phenolics such as protocatechuic acid (45.0 mg) and ferulic acid (18.6 mg) in addition to these nutrients. Nutritional proximate composition of finger millet and par-boiled rice per 100 g (Table-5) indicates that the finger millet is a good source of nutrients especially of calcium (364 mg), iron (4.62 mg), phosphorus (250 mg), zinc (2.3 mg), magnesium (130 mg), other minerals and fibre (11.18g). In contrast, rice contains several nutrients, including calcium (8.11 mg), iron (0.72 mg), phosphorus (160 mg), zinc (1.2 mg), magnesium (32 mg), and fibre (3.74g).In addition to these nutrients finger millet is rich in phenolics like Ferulic acid (18.6 mg) and Protocatechuic acid (45.0 mg). Based on the data above, we can say that finger millet has more beneficial elements than parboiled rice. So, it definitely ensures the nutritional security among the growers of finger millets. Accordingly, several studies have discussed the nutrient contents and potential health advantages of finger millet. For example, Dykes and Rooney (2007) have shown that finger millet is an excellent provider of a range of phenolic compounds.

Table 5: Nutritional proximate composition of finger millet and par-boiled rice per 100 g

Crops	Protein (g)	Fat (g)	Carbohydrate (g)	Crude fiber (g)	Ash (g)	Calcium (mg)	Iron (mg)	Zinc (mg)	Phosphorus (mg)/*	Manganese (mg)*	Magnesium (mg)*	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Ferulic acid (mg)	Protocatechuic acid (mg)
Finger millet	7.16	1.92	66.82	11.18	2.04	364	4.62	2.3	250	3.5	130	0.37	0.17	1.34	18.6	45.0
Rice	7.89	0.55	77.16	3.74	0.65	8.11	0.72	1.2	160	1	32	0.17	0.06	2.51		

Source: National Institute of Nutrition (NIN), Hyderabad and ***USDA Nutrient database**

Phenolic acid and tannins are the primary polyphenols (Shobana et al., 2013), with trace amounts of flavonoids (Subba Rao and Muralikrishna, 2002). 1.85–2.10% of total lipids are found in finger millets, of which 70–72% are neutral lipids, mostly triglycerides, 10–12% are glycolipids, and 5–6% are phospholipids. The fat from finger millet contains traces of linolenic acid along with oleic, linoleic, and palmitic acids. When compared to all other cereals and millets, finger millet has the highest calcium content (344 mg), according to Gopalan et al. (1989).

Additionally, finger millet has 3.9 mg of iron and 283 mg of phosphorus. Since finger millets are gluten-free, they're a great choice for those with celiac disease and other gluten sensitivity issues who are frequently bothered by the gluten in wheat and other more popular cereal grains (Saleh et al., 2013). Chethan et al. (2008) demonstrated that phenolics included in the finger millet seed coat, including gallic, vanillic, syringic, ferulic, quercetin, trans-cinnamic, p-coumaric, protocatechuic, and p-hydroxybenzoic, were shown to inhibit aldose reductase sniger reversibly in cataract formation of the eye lens. In addition to delaying nutrient absorption and increasing faecal bulk and lowering blood lipids and colon cancer prevention, eating foods high in fibre also acts as a barrier to digestion, increases intestinal mobility, lengthens the transit time of faeces, and has fermentability properties (Tharanathan and Mahadevamma, 2003). In hyperlipidemic rats, Lee et al. (2010) looked into the possibility that finger millet could prevent cardiovascular disease by lowering plasma triglycerides. Finger millet lowers serum triglyceride level. Antioxidants and phenolics found in millet grains have a significant role in ageing, health, and metabolic syndrome. It has been discovered that finger millets prevent collagen from glycating and cross-linking, which gives protection against aeging (Kumar et. al., 2021).

Conclusion

The average total cost of cultivation of finger millet per hectare was Rs. 29835.01. From which the total working capital coming to Rs. 13245.38. The calculated costs for A_2, B_2, and C_2 were Rs. 14765.76, Rs. 19833.29, and Rs. 29835.01 per hectare, respectively. The finger millet primary product yield on average was 10.74 quintals. On an average total yield of main product of finger millet was 10.74 quintals. Total cost of production obtained Rs. 2757.47per quintal. In the finger millet cultivation, the benefit-to-cost ratios for costs A2, B2, and C2 were 2.62, 1.95, and 1.30, respectively. The benefit cost ratios of finger millet production showed more than oneand is earning more profit over upland paddy. So, upland

paddy can be diverted towards finger millet production which is climate smart & nutri-cereal to maintain diversity. Since disguised employment in paddy cultivation can be adjusted in finger millet as there is a high labor requirement in finger millet cultivation. So, encouragement for finger millet production should be continued in the study area. The current study examines the partial budgeting strategy for switching from upland rice to finger millet, which is nutrient-rich and climate-resilient and has significant health benefits and shields against serious illnesses. Partial budget analysis for switching from upland rice to finger millet found that the net return is Rs. 3414.48. It was also concluded through sensitivity analysis that facilitating & miscellaneous cost was the most important variable driving the contribution margin. Finger millet is enriched with valuable nutrients as compared to parboiled rice which ensures the nutritional security and shields against serious illnesses among the growers of finger millets and in the study area.

References

1. Adhikari, R.K. (2012). Economics of finger millet (Elecusine coracana G.) production and marketing in peri urban area of Pokhara valley of Nepal. *Journal of Development and Agricultural Economics*. 4(6), 151-157.
2. Ahmed, H., Alvåsen, K., Berg, C., Hansson, H., Hultgren, J., Röcklinsberg, H., and Emanuelson, U. (2021). Assessing animal welfare and farm profitability in cow-calf operations with stochastic partial budgeting. *Animals*. 11(2), 382.
3. Chethan, S. (2008). *Finger millet (Eleusine coracana) polyphenols and their nutraceutical potential* (Doctoral dissertation, University of Mysore).
4. Contribution of Agricultural Sector in GDP, Ministry of Agriculture & Farmers Welfare. Retrieved from https://www.pib.gov.in/PressReleasePage.aspx?PRID=1909213
5. Dykes, L. and Rooney, L.W. (2007). Phenolic Compounds in Cereal Grains and their Health Benefits. Cereal Foods World, 52(3):105-111.
6. Gopalan, C., Rama Sastri, B. V. and Balasubramanian, S. C. (1989). Nutritive value of Indian foods.
7. Indian Millets. Retrieved from https://apeda.gov.in/apedawebsite/SubHead_Products/Indian_Millets.htm
8. Kumar, A., Rani, M., Mani, S., Shah, P., Singh, D. B., Kudapa, H., and Varshney, R. K. (2021). Nutritional significance and antioxidant-mediated antiaging effects of

finger millet: Molecular insights and prospects. *Frontiers in Sustainable Food Systems*. 5, 684318.

9. Lee, S. H., Chung, I. M., Cha, Y. S., and Park, Y. (2010). Millet consumption decreased serum concentration of triglyceride and C-reactive protein but not oxidative status in hyperlipidemic rats. *Nutrition Research*. 30(4), 290-296.
10. Malleshi, N. G., Hadimani, N. A., Chinnaswamy, R., and Klopfenstein, C. F. (1996). Physical and nutritional qualities of extruded weaning foods containing sorghum, pearl millet, or finger millet blended with mung beans and nonfat dried milk. *Plant Foods for Human Nutrition*. 49, 181-189.
11. Marikannan, K., and Srinivasan, G. (2022). AN ECONOMIC ANALYSIS ON COST AND RETURNS OF PADDY IN JAWADHU HILLS OF TAMIL NADU. *Seeds*. 1140, 3-38.
12. Mathanghi, S.K. and Sudha, K. (2012). Functional and Phytochemical Properties of Finger Millet (Eleusina corana L.) for Health. *Intern. J Pharma Chem and Bio Sci*.. 2(4), 413-438.
13. Nidoni, U., Mouneshwari, K., Ambrish, G., Mathad, P. F., Shruthi, V. H., and Anupama, C. (2021). An Insight to Entrepreneurial Opportunities in Millet Processing. In *Entrepreneurship Development in Food Processing* (pp. 119-140). CRC Press.
14. Bandumula, N., Kumar, M., Waris, A., and Muthuraman, P. (2017). System of Rice Intensification: A Partial budget analysis. *Bulletin of Environment, Pharmacology and Life Sciences*. 6(2), 361-365.
15. Nutritional and Health Benefits of Nutri Cereals, ICAR – INDIAN INSTITUTE OF MILLETS RESEARCH (IIMR). Retrieved from https://nutricereals.dac.gov.in/ Publication/ Pub_ HealthyBenfits_Sep2018.pdf
16. Ragi. Retrieved from https://agritech.tnau.ac.in/agriculture/millets_ragi.html
17. Subba Rao, M. V. S. S. T., and Muralikrishna, G. (2002). Evaluation of the antioxidant properties of free and bound phenolic acids from native and malted finger millet (Ragi, Eleusine coracana Indaf-15). *Journal of Agricultural and Food Chemistry*. 50(4), 889-892.

18. Saleh, A.S.M., Zhang, Q., Chen, J. and Shen, Q. (2013). Millet Grains: Nutritional Quality, Processing, and Potential Health Benifits. *Comprehensive Reviews in Food Science and Food Safety*. 12, 281-295
19. Shobana, S., Krishnaswami, K., Sudha, V., Malleshi, N.G., Anjana, R.M., Palaniappan, L. and Mohan, V. (2013). Finger Millet (Ragi, *Eleusine Coracana L*.): A Review of Its Nutritional Properties, Processing, and Plausible Health Benifits. *Advance in Food and Nutrition Research*. 69, 1-3.
20. Shobana, S., Harsha, M. R., Platel, K., Srinivasan, K., and Malleshi, N. G. (2010). Amelioration of hyperglycaemia and its associated complications by finger millet (Eleusine coracana L.) seed coat matter in streptozotocin-induced diabetic rats. *British journal of nutrition*, *104*(12), 1787-1795.
21. Tandel V.B. et al. (2018). Cost structure and Profitability of Finger Millet in south Gujarat Region. International journal Of Agriculture Science, ISSN: 0975-3710 & E-ISSN: 0975- 9107, 10(4).
22. Tharanathan, R. N. and Mahadevamma, S. (2003). Grain legumes—a boon to human nutrition. *Trends in Food Science & Technology*. 14(12), 507-518.
23. Upreti, R.P., Shakya, P.B., Vaidya, S. and Riley, K.W. (1991). A study on finger millet in Nepal: Importance, nutrition, utilization and farming system in a socio economic and ecological context. Paper presented at the second international small millet workshop Zimbabwe. April 8-12, 1991.
24. Viswanath, V., Urooj, A. and Malleshi, N.G. (2009). Evaluation of Antioxidant and Antimicrobial Properties of Finger Millet Polyphenols (Eleusine Coracana). *Food Chem*. 114(1), 340-346.