Original Research Article

Economic Analysis of Pearl millet cultivation in Rainfed ecosystem of Thoothukudi district

Comment [U1]: Economic analysis usually mostly focus on comprehensive economic evaluation such as domestic resource cost. The current article mainly works with financial investigation. Title should be starts with "Financial analysis" instead of Economic

ABSTRACT

The Pearl millet is the stable and nutritive diet of the farm households in developing and underdeveloped countries. It is grown as dual-purpose; grain and forage in drylands, marginal lands, and unirrigated lands of the Indian subcontinent. This study analysed the cost and returns, profitability, and resource productivity of the pearl millet growing farmers in a rainfed ecosystem of Thoothukudi District. The results revealed that Cost-A, Cost-B, and Cost-C were found as Rs. 32,588.68, Rs. 38569.26, and Rs. 41115.65 respectively. The Depreciation of farm assets, Hired Human Labour and Threshing has the highest proportionate expenditure that was found to be 28.44, 19.05, and 12.85 per cent respectively. On average, the farm business income, farm labour income, and net income were estimated as Rs. 11, 741.44, Rs. 5,132.40 and Rs. 2,216.18 respectively. It revealed that the Benefit-cost ratio was 1.12 on average and 1.13 in small farms, 1.12 in medium farms, and 1.11 in large farms. It was found that the Benefit-cost ratio was higher in small followed by medium and large farms. The partial regression coefficient of hired labour, and fertilizers was 0.103, and 0.793 respectively, which were positive and highly significant. It indicated that gross return was increased by 0.793 per cent by increasing one per cent of expenses on fertilizers. The summation of all partial coefficients was 0.656 which indicated a decreasing return to scale.

Comment [U2]: Shortly the method of data collection and analytical model should be mentioned

Keywords: Economic analysis, Costs, Returns, Resource productivity, and Pearl millet.

1. INTRODUCTION

Rainfed agriculture accounts for 60.9 per cent of the net sown area in India. It supports nearly half of the total food production of India. Rainfed agriculture describes as complex, diverse, low productive, and highly risk-prone. The characteristics of rainfed agriculture are low productivity and irregular pattern of Input usage due to the vagaries of monsoon. The subnormal and abnormal rainfall during the monsoon drastically affects total food production followed by the country's wealth. Monsoon in India is erratic and irregular. It hits the predominant working population in India, contributes 3.0 per cent of the Real Gross value-added Growth in 2020 and only one sector showed that positive growth[1].The global millet production accounted for 27.80 million tons. India, Nigeria, and China are the leading producers in millet, where India shares about 41.00 per cent of total millet production, and African countries are the largest consumers of millets globally. Rajasthan, Uttar Pradesh, Gujarat, Madhya Pradesh, Haryana, Maharashtra, Karnataka, Tamil Nadu, Odisha, and Kerala are the top ten millet producers in India[2]. In India, millet is used as staples because of increased awareness about nutritional values such as rich sources of minerals like Iron, Calcium, Phosphorus, Zinc, and Magnesium and increased income. Food and Agriculture Organisation announced the year 2023 as "International Year of Millets". Indian policymakers have had a special view on millets to make our nation self-sufficient on coarse cereals. The pearl millet is the major growing millet in the world. It is the stable and nutritive diet of the farm households in developing and underdeveloped countries and among the poorest people. They are grown in a wide range of climatic conditions and stressed conditions. They are cultivated in the farms where maize and wheat are not grown[3].The pearl millet is grown as dual-purpose grain and forage in drylands, marginal lands, and unirrigated lands of the Indian subcontinent[4]. It is tolerant to difficult situations such as moisture stress, low soil fertility, and high temperature. By the distribution of cheaper rice through the Public Distribution System (PDS), the consumption of pearl millet grain was reduced. In case of the demand for millet grains in dairy and poultry enterprises, alcohol, food, and starch industries was increased. It was cultivated about 0.50 lakh of hectares of area with an annual production of 1.00 lakh tonnes with the productivity of 2085 kg/ha of grains in Tamil Nadu[5, 6]. Thoothukudi district is categorized under the southern zone of the Seven Agro-climatic zones in Tamil Nadu. Majority of area under cultivation in the Thoothukudi district follows rainfed agriculture which depends predominantly on north east monsoon. The farmers used to

Comment [U3]: Climate and weather is not main issue in this article. The introduction should highlight on major issue with most relevant references

cultivate pearl millet (Cumbu), sorghum (Solam), maize (Makkasolam), and pulses as major crops in rainfed areas. The potential income generation through rainfed crops is questionable. Hence it is imperative to study the profitability and resource productivity of crops in rainfed areas. Therefore, the current study was undertaken with the following objectives,

1. To analyses the cost and returns of the pearl millet growing farmers in the rainfed ecosystem of Thoothukudi district, and
2. Resource productivity of the pearl millet cultivation.

Comment [U4]: Problem statement should be more specific

2. METHODOLOGY

Data was collected using Purposive random sampling in Thoothukudi District. Vilathikulam and Pudur blocks were selected using area wise maximum pearl millet growing blocks in Thoothukudi District. Totally 61 farmers were personally interviewed using a well-structured questionnaire. Farmers were categorized into small (Less than 1 ha), medium (Between 1 and 2 ha), and large (Greater than 2 ha). Cost concept includes Cost-A, cost –B, and Cost-C were used to analyze the data investigation. Cost-A covers the working capital includes hired labour, machine labour, costs of seeds, fertilizers, plant protection chemicals, depreciation of farm assets, and Interest on Working Capital. Cost-B includes Cost-plus land revenue, rental value of land, and interest on fixed capital. Cost-C includes Cost-B plus imputed value of family labour. Farm business income includes Cost-A subtracted from gross revenue, Farm labour income includes Cost-B subtracted from gross revenue and net income includes Cost-C subtracted from gross revenue was analyzed. Cobb-Douglas production function was used for estimating Resource productivity. The fitted equation was as followed,

Comment [U5]: Study area needs detail description

Comment [U6]: Model selection needs more clarification

$$Y = AX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}X_6^{b_6}.e^a$$

Where, Y = Gross revenue of pearl millet cultivation in rupees per ha, X_1= costs of Family labour in rupees per ha, X_2 = costs of Hired labour in rupees per ha, X_3 = costs of machine labour in rupees per ha, X_4= costs of seeds in rupees per ha, X_5= costs of fertilizer in rupees per ha, X_6= Plant protection chemicals in rupees per ha. The equation was transformed into log-linear as

$$\log Y = \log A + b_1 \log X_1 + b_2 \log X_2 + b_3 \log X_3 + b_4 \log X_4 + b_5 \log X_5 + b_6 \log X_6 + a \log e$$

The Cobb- Douglas Production function allows us to estimate the elasticity of production of selected independent variables and returns to scale i.e., summation of elasticity of all the variables.

3. RESULTS AND DISCUSSION

The findings of the present study were given below,

3.1. Cost of cultivation of Pearl millet

Per hectare, input-wise expenditure of rainfed pearl millet growing farmers was estimated and given as Table 1. The results revealed that Cost-A, Cost-B, and Cost-C were found as Rs. 32,588.68, Rs. 38,569.26, and Rs. 41,115.65 respectively. Working capital was highest at Rs. 21,069.06 on small farms followed by Rs. 20,767.46 on large farms and Rs. 20,225.95 on medium farms. Depreciation of farm assets, hired human labour, and threshing has the highest proportionate expenditure was found to be 28.44, 19.05, and 12.85 per cent respectively. The expenditure on hired labour was increased with farm size. Hired labour, threshing, plant protection chemicals have higher proportionate to total costs. Expenditure on machine labour was estimated highest as Rs. 4,132.23 in small farms followed by Rs. 1,285.71 in medium and Rs. 456.93 in large farms. It was due to the own machinery and implements. It was revealed that the predominant proportionate expenditure was the rental value of the land and its share was 15.20 per cent. It was found that the rental value of land was increased with farm size. Deshmukh[7] reported that cost concepts of pearl millet as Rs. 11,629.35 of Cost-A, Rs. 14,673.26 of cost-B, Rs. 15,990.13 of Cost-C. Sundar [8] was reported that cost-A, cost-B, and cost-C was Rs. 10,255.00, Rs. 22,961.13 and Rs. 26,361.13 respectively. [7] The results are in line with findings of previous works [8], [9] and [10].

Comment [U7]: Many term was suddenly used. Those should be properly and clearly defined in short.

Comment [U8]: Clarification about farm category and definition should clearly be given

Table 1. Cost of cultivation of rainfed pearl millet per ha

(In Rupees)

Sr. No.	Particulars	Size of Farm Group			Average	Per cent to Total
		Small	Medium	Large		

A	**Working Capital**					
1.	Seeds	780.99	931.25	877.13	863.12	2.10
2.	Fertilizers	271.69	221.90	307.13	266.91	0.65
3.	Plant protection chemicals	1426.03	1285.71	1467.03	1392.92	3.39
4.	Threshing	5245.99	5268.57	5335.94	5283.5	12.85
5.	Hired Labour	7586.78	7788.39	8128.22	7834.46	19.05
6.	Machine Labour	4132.23	1285.71	459.93	1959.29	4.77
	Sub Total	**21069.06**	**20225.95**	**20767.46**	**20687.49**	**50.32**
7.	Interest on Working Capital @ 10 per cent	229.66	195.17	194.12	206.32	0.50
8.	Depreciation on farm asset	8289.70	13582.39755	13210.67	11694.26	28.44
B	**Cost A**	**29569.45**	**34010.61**	**34185.80**	**32588.62**	**79.26**
1.	Land tax	25.34	32.38	36.89	31.54	0.08
2.	Rental value of land	4752.07	6071.43	6918.55	5914.02	14.38
3.	Interest on fixed capital	49.06	41.37	14.82	35.08	0.09
C	**Cost B**	**34395.92**	**40155.79**	**41156.07**	**38569.26**	**93.81**
1.	Family labour	2297.52	2111.61	3229.97	2546.37	6.19
D	**Cost C**	**36693.44**	**42267.48**	**44386.04**	**41115.65**	**100.00**

Comment [U9]: Author should arrange considering main head and sub-head in order

Comment [U10]: Legend should be biger front and readable

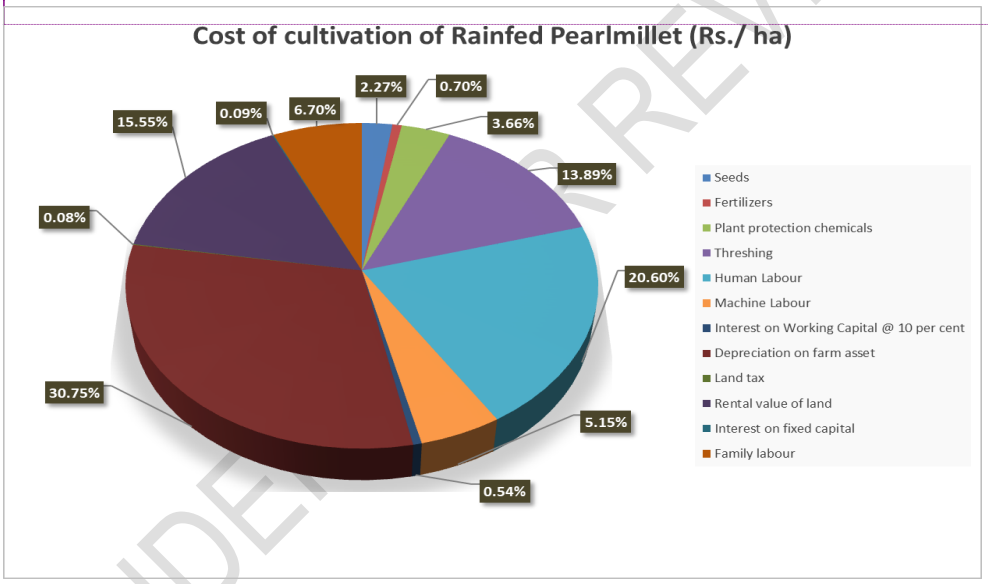

Fig. 1. Average Cost of cultivation of rainfed pearl millet (Rupees. per ha)

3.2. Profitability of the Pearl millet growing farmers in the Rainfed ecosystem.

In Table 2, Profitability per hectare of rainfed pearl millet cultivation was estimated. The gross revenue per hectare was found to be Rs. 49,398.41 in large farms followed by Rs. 47,357.00 in medium farms, Rs. 41,514.15 in small farms. It showed that gross revenue was increased with farm size. The farm business income was estimated to be Rs. 11,944.70 in small farms, Rs. 13,158.67 in medium farms, Rs. 15,212.60 in large farms and on average, Rs. 13,501.23 per hectare. It was found that the larger the farm size, the higher the farm business income. The farm labour income was found to be Rs. 7,118.23 in small farms followed by Rs. 7,013.49 in medium farms and Rs. 8,242.33 in large farms. It showed that farm labour income was increasing with an increase in farm size. On average, it was estimated as Rs. 7,520.59 per hectare. The net income was estimated as Rs. 4,820.71 in small farms, Rs. 4,901.88 in medium farms and Rs. 5,012.37 in large farms. It was found that the larger the farm size, the higher the net income. The present study revealed that the Benefit-cost ratio (BCR) was 1.12 on average and 1.13 in small farms, 1.12 in medium farms, and 1.11 in large farms. It was found that

higher in small followed by medium and large farms. This result was in line with [7] (Deshmukh, Pawar, Landge, & Yeware, 2010) who was reported that the Benefit-cost ratio was 1.18 in small followed by 1.17 in medium and 1.16 in large farms. The results were accordance with results of [11], [12] (Ayalew & Sekar, 2015; Malik, 2020) and .

Table 2: Cost and returns of the Pearl millet per ha

Sr. No.	Particulars	Units	Size of Farm Group			Average
			Small	Medium	Large	
1.	Cost A	Rupees	29569.45	34010.61	34185.80	32588.62
2.	Cost B	Rupees	34395.92	40155.79	41156.07	38569.26
3.	Cost C	Rupees	36693.44	42267.48	44386.04	41115.65
6.	Gross Revenue	Rupees	41514.15	47357.00	49398.41	46089.85
7.	Farm business income	Rupees	11944.70	13158.67	15212.60	13501.23
8.	Farm labour income	Rupees	7118.23	7013.49	8242.33	7520.59
9.	Net Income	Rupees	4820.71	4901.88	5012.37	4974.2
10.	Benefit cost Ratio	Ratio	1.13	1.12	1.11	1.12

Comment [U11]: Bigger front needs

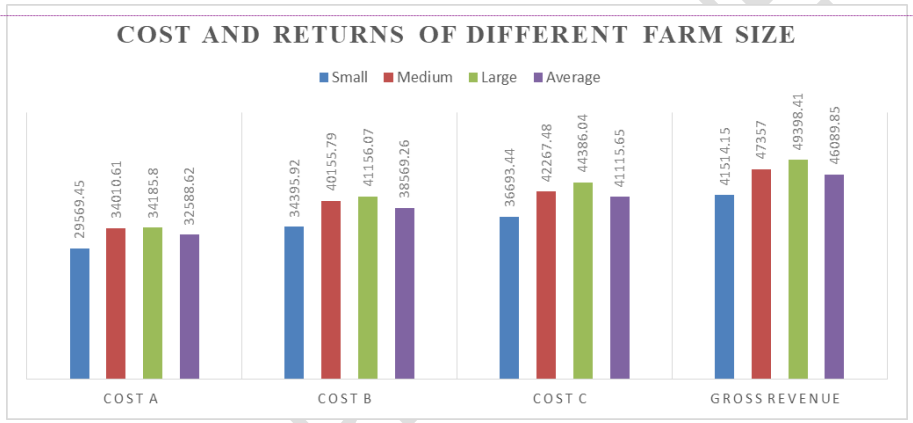

Fig. 2. Cost and returns of Different farm sizes in Rupees per hectare.

3.3. Resource productivity of the pearl millet cultivation.

Table 3 revealed the resource productivity of inputs utilized in pearl millet cultivation. It was found that the partial regression coefficient of hired labour was 0.103 which was positive and significant at a 5 per cent level of significance. (t-value = 2.430). This showed that gross return was increased by 0.103 per cent by increasing one per cent of the expenses on hired labour. The partial regression coefficient of seed was -0.187 was negative and significant with a 10 per cent level of significance. (t-value = 3.075). It could be inferred that the gross return would be decreased by 0.187 per cent if we increase one per cent of the expenditure in seeds. The partial regression coefficients of family labour, machine labour and plant protection chemicals were not significant. It was estimated that regression coefficient of fertilizers was 0.793 which were positive and highly significant with 1 (t-value = 9.274) per cent level of significance. It indicated that gross return was increased by 0.793 per cent by increasing one per cent of expenses on fertilizers.

Comment [U12]: What type variety was used is not mentioned. Derivation of conclusion based on the result will be misleading.

Table 3: Resource Productivity of Pearl millet cultivation.

Sr. No.	Particulars	Coefficients	Standard Error	at Stat
1	Family labour	-0.026	0.016	1.639

2	Hired labour	0.103**	0.043	2.430
3	Machine labour	0.004	0.015	0.240
4	Seeds	-0.187***	0.061	3.075
5	Fertilizers	0.793***	0.085	9.274
6	Plant protection chemicals	-0.031	0.028	1.099

Intercept (log a) – 6.953
R2 value – 0.829
F value – 43.78***
N – 61
Note: ***, ** and * indicate significance of value *P* = 0.01, *P* = 0.05 and, *P* = 0.10 respectively.

Comment [U13]: Intercept negative needs a clear explanation.

Comment [U14]: Adjusted R-square should be given since the multiple regression was used here

The coefficient of multiple determinations (R2) was 0.829 which indicated that 82.9 per cent of the variation in dependent variables was explained by variation in independent variables. The F-value of R2 was 43.78 that were highly significant. It was explained that all the independent variables together involved significantly in variation pearl millet production. The summation of all partial coefficients was 0.656 which indicated a decreasing return to scale. The findings are in accordance with [13], [14], [15] who found that regression coefficients of inputs in pearl millet cultivation were 0.330 for the area and 0.112 for family labour which were positive and significant. The previous studies also reported that return to scale was 0.80 which indicated a decreasing return to scale.

Comment [U15]: Only result was given but in-depth discussion needs to give.

4. CONCLUSION

In conclusion, the study showed that gross revenue per hectare of pearl millet cultivation was found to be Rs. 49,398.41 in large farms followed by Rs. 47,357.00 in medium farms, Rs. 41,514.15 in small farms. It showed that gross revenue was increased with farm size. The net income was estimated to be Rs. 4,820.71 in small farms, Rs. 4,901.88 in medium farms and Rs. 5,012.37 in large farms. The profitability was higher in larger farms followed by medium farms and small farms. The BCR~~Benefit-cost ratio~~ was higher in small than that of medium and large farms. On average, the BCR~~Benefit-cost ratio~~ was 1.12 which was lower because of rainfed cultivating practices. The partial regression coefficient of fertilizers was 0.793 which was positive and significant and indicating that gross return was increased by 0.793 per cent by increasing one per cent of expenses on fertilizers. The pearl millet cultivation in the rainfed condition showed the decreasing returns to scale (Σbi=0.656). Thus, cultivating the pearl millet as specialized crop serves normal profit which will lead to a loss for the farmers in long run. The farmers should pick mixed farming such as crops and dairy enterprises at the same time in a particular season to earn profit in long run.

Comment [U16]: Scope of further research and limitation should clearly be given

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Comment [U17]: Reference should again be match and if possible, more reference should be incorporated in introduction, methodology, and result section