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Factors Influencing Profit Chain of Little Millet by Farmer Producer Organization Farmers, Processors and Marketers in Tamil Nadu, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Little millet, a significant part of the Indian diet known for its health benefits. The study focuses the factors influencing Profit chain of little millet by FPO farmers, processor and retailers. The research focuses on Northern Tamil Nadu, analysing profitability for producers (75), processors (10), and

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marketers (10). A total sample of 95 respondents were surveyed using structured interview schedule. Key factors influencing profit chain were identified using multiple linear regression model. For producers, Nitrogen and Potash fertilizer positively impact profits, while labour and seed exhibit negative effects. Processors benefit from positive associations with labour and transport, and marketers' profits are linked to labour, transportation, and storage. The findings stress the need for strategic interventions to enhance the millet value chain, emphasizing the importance of efficient logistics. The study recommends policy measures to increase farmers' productivity and profits through incentives, farmer support extension, and innovative technologies, promoting a balanced diet, weight maintenance, and overall well-being while addressing economic aspects of millet production and distribution.

Keywords: Profit chain; profitability; FPO; little millet; OLS regression.

1. INTRODUCTION

Millet, a nutritious group of cereal grains classified under the Poaceae family, is often referred to as "coarse cereals" or "cereals of the poor." Beyond traditional uses, millets have found their way into modern food products such as cookies, bread, health mixes, and more. Little millets, rich in dietary fiber, can be used to formulate prebiotic drinks, aiding digestion according to a study by Swarnima Dey *et al*. in 2022. The Indian Peninsula is where little millet (*Panicum sumatrense*) was initially cultivated (Weber and Fuller, 2007). Little millet (*Panicum sumatrense L.*) is grown in India under various agro ecological situations and commonly known as samai, samo, moraio, vari, kutki. Little millet is a hardy crop which can withstand drought better than most of other cereal crops and water logging to a certain degree (FAO). Hence, it can provide us with food security in unfavourable climatic conditions. Little millet is rich in vitamin B, minerals like potassium, phosphorus, iron, zinc and magnesium. Therefore, it can address nutritional sensitive agriculture, which aims at nutritional enhancement to combat the present scenario of micronutrient malnutrition [1]. In India, little millet growing states are Karnataka, Tamil Nadu, Odisha, Madhya Pradesh, Chattisgarh, Jharkhand, Andhra Pradesh, Uttarakhand, Maharashtra and Gujarat**.** There are two varieties of little millet: robusta and nana (House *et al*., 2000). It's important to the Indian diet. While minor millets had superior nutritional content, their limited availability in refined and processed forms has hindered widespread usage [2,3]. Over the last three decades, there has been a significant decline in the direct consumption of millet as food [4,5]. Despite being a leading millet producer, India faces a high malnutrition rate globally [6]. In rural areas, finger millet, small millet, and foxtail millet are commonly consumed, with foxtail millet emerging as the preferred choice [7]. Value addition in millets through collecting the produce, marketing linkages and better business plan increased the income of millet FPO in Tamil Nadu [8]. Traditional farming practices involve individual farmers, while Farmer Producer Organizations (FPOs) play a crucial role in providing inputs, guidance, procurement, and wholesale distribution of value-added millet products [9-11]. Recognizing the significance of millets, the government of India proposed to the United Nations to declare 2023 as the International Year of Millets (IYOM) (NABARD, 2023). This proposal garnered support from 72 countries, leading to the United Nations General Assembly (UNGA) officially declaring 2023 as the International Year of Millets on March 5, 2021, (NABARD). As of 2021, India holds the title of the largest millet producer, commanding a share of 41%, followed by Niger (12%) and China (8%) (FAO). Moreover, an additional significant benefit of millet is its rich nutritional composition, contributing to elevated levels of energy, proteins, dietary fiber, and vitamins. These nutritional elements have a profound impact on combating diseases such as diabetes, cancer, cardiovascular issues, and neurodegenerative conditions. There is a pressing need for a stronger emphasis on institutional support, market initiatives, and sustainability efforts to alleviate poverty levels , (NABARD, 2023).

Farmer Producer Companies (FPCs), are groups of growers organized under the Companies Act with support from the Small Farmers' Agribusiness Consortium (SFAC) (NABARD, 2021). Established in the last decade through initiatives by SFAC, state governments, and organizations like National Bank for Agriculture and Rural Development, these FPOs aim to empower farmers by eliminating intermediaries in the agricultural supply chain (Source: Directorate of Marketing and Inspection, 2020). The major

driving forces of Famer Producer Organization such as NABARD engaged in aggregation of marketing activities while SFAC engaged in processing activities and consultancy services [12]. India presently hosts around 7,000 Farmer Producer Organizations (FPOs) with approximately 70 lakh farmers, led by Maharashtra (1622 FPOs) (Source: State of India's Livelihood (SOIL) Report 2021). Initiated in the past decade through government, SFAC, State Governments, and NABARD efforts, these FPOs, in early stages and involving 100 to 1000 farmers, require support for technical, financial, and infrastructural needs, including market access. The government aims to establish 10,000 FPOs by 2024, allocating Rs. 6,865 crores for this purpose, with SFAC as the central promoting agency (NABARD, 2021). FPOs significantly benefitted the smallholder farmers in the adoption of modern agricultural technology, providing weather and advisory services, market intelligence system, access to high-quality farm inputs and services and access to credit and insurance [12,13].. Performance varies, with about 30% operating successfully, 20% facing challenges, and 50% in early stages, focusing on mobilization and business planning. Tamil Nadu, over 900 Farmer Producer Organizations (FPOs), with a notable few serving as exemplary models for the state. These FPOs, recognized by the government for their effectiveness, exemplify successful cooperation among farmers. Functioning as collective entities, FPOs manage various agricultural activities from production to marketing, providing farmers with enhanced negotiation power. The Tamil Nadu government supports FPOs through special incentives and concessions, acknowledging their crucial role. Despite challenges, FPOs have significant potential to benefit farmers by facilitating access to finance, technology, and markets, presenting untapped opportunities for growth. Encouraging the producer ecosystems into formal and informal networks and organizations can be a quick and easy approach to connect with more people [14,15]. So it is essential to examine the profitability of producers, marketers, and processors in the process.

2. METHODOLOGY

Primary and secondary data were gathered from farmers, processors, and marketers in Northern Tamil Nadu, specifically in Tiruvannamalai, Dharmapuri, and Tirupathur districts, using a structured questionnaire. The survey included a total of 95 respondents, comprising 75 little millet producers, 10 processors, and 10 marketers. To meet the minimum sample size requirement of 30, I ensured that there were 30 sample respondents for producers in each district. However, due to low production in Tirupathur district, only 15 sample respondents were included. The profitability of the sample farmers, processors, and marketers was estimated using the Ordinary Least Squares (OLS) technique with a linear regression model.The research employed a revised framework developed [16] to examine the profit levels within the value chain of producers, processors, and marketers, as depicted below. Furthermore, we integrated supplementary factors into the model.

Producer's model

$$PRV_{\text{p}} = \propto + \beta 1 LARi + \beta 2 SEDi + \beta 3 UREi + \beta 4 MOPi + \beta 5 TOCi + \varepsilon i \quad (1)$$

Where,

LAR= Labours in Numbers
SED= Seeds in Kgs
URE= Nitrogen in Kgs
MOP= Potash in Kgs
TOC= Total cost in Rupees

Processor's model

$$PRV_{\text{pr}} = \propto + \beta 1 LARi + \beta 2 TOCi + \beta 3 TRSi + \beta 4 STRi + \beta 5 OTCi + \varepsilon i \quad (2)$$

Where,

LAR= Labours in Man days
TOC= Total cost in Rupees
TRS= Transport cost in Rupees
STR= Storage cost in Rupees
OTC= Other cost in Rupees

Marketer's model

$$PRV_{mrs} = \propto + \beta 1LARi + \beta 2TOCi + \beta 3TRSi + \beta 4STRi + \beta 5OTCi + \varepsilon i \quad (3)$$

Where,

LAR= Labours in Man days
TOC= Total cost in Rupees
TRS= Transport cost in Rupees
STR= Storage cost in Rupees
OTC= Other cost in Rupees

From the equations (1, 2 and 3) PRV, LAR, SED, FER, PES, TOC, TRS, STR, OTC, AGE and EDU refers as profits, labour, seed, fertilizer, pesticides, total cost, transports, storage, other cost, age, the level of education and εi indicates the residual error in the model.

3. RESULTS AND DISCUSSION

3.1 Descriptive Analysis

3.1.1 Producer's model

The Table 1 reveal the descriptive analysis of producers that , labour hours, seed rate, nitrogen levels, potash levels, and profits. The average labour hours invested is approximately 18.95, with a standard deviation of 3.75. Seed rates average 8.84. Nitrogen levels and potash levels average 11.25 and 12.04, respectively, both displaying moderate variability. Profit averages 23,281.56, with a standard deviation of 142.27 and a minimum and maximum is about 23096 and 23532.

3.1.2 Processor's model

The Table 2 revealed the descriptive statistics of processor model that, labor, transport, and profits based on ten observations. On average, labour hours total 1880, with a standard deviation of 574.07. Transport costs average 1170, showing a standard deviation of 363.01. Profits average 3440.8, with a standard deviation of 454.99. The median values for labor, transport, and profits are 2075, 1225, and 3324.5, respectively.

3.1.3 Marketer's model

The Table 3 revealed the descriptive analysis of marketer's model that, labor, transport, storage, and profits. On average, labour hours amount to 1745, with a standard deviation of 559.99. Transport costs average 1095, showing a standard deviation of 302.26 is storage capacity averages 546, with a standard deviation of 88.47. Profits average 3469.3, with a standard deviation of 433.26. Median values for labor, transport, storage, and profits are 1700, 1175, 580, and 3308, respectively.

Table 1. Descriptive analysis of producers model

Particulars	Labour	Seed rate	Nitrogen	Potash	Profit
Mean	18.94667	8.84	11.25333	12.04	23281.56
Standard Error	0.432838	0.500104	0.243172	0.429724	16.42846
Median	19	9	12	11	23265
Mode	25	9	13	9	23173
Standard Deviation	3.748489	4.331032	2.105933	3.721523	142.2746
Range	12	13	7	13	436
Minimum	13	4	8	6	23096
Maximum	25	17	15	19	23532
Sum	1421	663	844	903	1746117
Count	75	75	75	75	75

Table 2. Descriptive analysis of Processors model

Particulars	Labour	Transport	Profit
Mean	1880	1170	3440.8
Standard Error	181.5367	114.7945	143.882
Median	2075	1225	3324.5
Standard Deviation	574.0693	363.0121	454.9947
Range	1550	1200	1436
Minimum	1050	600	3096
Maximum	2600	1800	4532
Sum	18800	11700	34408
Count	10	10	10

Table 3. Descriptive analysis of Marketer's model

Particulars	Labour	Transport	Storage	Profit
Mean	1745	1095	546	3469.3
Standard Error	177.0828	95.58301	27.97618	137.0092
Median	1700	1175	580	3308
Standard Deviation	559.9851	302.26	88.46845	433.261
Range	1400	1050	250	1434
Minimum	1100	650	400	3096
Maximum	2500	1700	650	4530
Sum	17450	10950	5460	34693
Count	10	10	10	10

3.1.4 Profit chain of producers, processors, and marketers in Northern Tamil Nadu

Table 4 provides a comprehensive overview.

3.1.5 Producer's Model

$$PRVi = 22827.58 - 9.222\text{LAR} - 9.299SED + 24.267N + 36.364P + \varepsilon i$$

In the producer's model, the study found that Nitrogen and Potash had a positive impact on the producer's profit it is exactly matched with the findings [17].. Align with the notion that the amount of fertilizer used tends to rise with an increase in the farmer's resource holdings or income, and conversely, decrease as income decreases [18]. Specifically, a one percent increase in Nitrogen and Potash led to a substantial increase in the producer's profit, by approximately 24.267 percent and 36.364 percent, respectively. Any change in Labour and Seeds had negative coefficients, indicating that a five percent increase in these factors resulted in a decrease in the producer's profit by approximately 9.222 percent and 9.299 percent, respectively. The R^2 is 0.651, adjusted R^2 is 0.631, the f value is 32.703 and the model is statistically significant (sig <.001). These results suggest that investing in Nitrogen and Potash fertilizers can significantly boost agricultural productivity, aligning with government efforts to increase production.

Processor's Model:

$$PRVi = 2867.63 - 0.30LAR + 0.967TRS + \varepsilon i$$

According to the processor's model, Labor identified as factors that negatively influence the processor's profit, and Transport were identified as factors that positively influence the profit. A ten percent increase in Labor was associated with a slight decrease in profit by .297 percent, aligning with the findings of Otunaiya and Akinleye [19]. Dramadri *et al*. (2005), Olawale *et al*. (2009), and Minot *et al*. (2000), as per Minot's observations in 'Malawi,' larger processors tend to employ more labour than smaller ones, the study suggests that processors utilize labour based on need. A one percent increase in Transport corresponds to a 0.967 percent marginal profit increase for processors, indicating a limited impact of Labor and Transport on processor profits compared to other factors. The R^2 is 0.871, adjusted R^2 is 0.764, the f value is 15.594 and the model is statistically significant (sig =0.003).

Table 4. Factors influencing the profit of producers, processors, and marketers in Northern Tamil Nadu

Variables	Producers Profit	Processors Profit	Marketers Profit
Constant	22827.58(218.010)	2867.63(7.718)	1308.252(2.560)
Labour	-9.222**(-2.222)	-.297*(-2.292)	-.344***(-3.730)
Seed	-9.299**(-2.332)	-	-
N fertilizer	24.267***(3.617)	-	-
P fertilizer	36.364***(7.078)	-	-
Transport	-	0.967***(4.720)	1.402***(7.267)
Storage	-	-	2.244**(3.351)
R^2	0.651	0.817	0.918
Adjusted R^2	0.631	0.764	0.877
f value	32.703	15.594	22.439
Sig	<.001	.003	.001

(Figures in parentheses indicates t value)
*Note: ***, ** and * illustrate 1, 5 and 10 percent significance level*

3.1.6 Marketer's Model

$$PRVi = 1308.252 - 0.344LAR + 1.402TRS + 2.244STR + \varepsilon i$$

The marketer's model revealed that transportation, and storage had a positive relationship with the profit levels of marketers. A five percent increase in transportation and storage led to corresponding increases in marketer's profit by approximately 1.402 and 2.244 percent, respectively. However, labour costs had a negative association, with a one percent increase resulting in a decrease in marketer profit by approximately 3.44 percent. These results emphasize the importance of efficient transportation and storage for marketers, while also highlighting the need to manage labour costs effectively and the R^2 is 0.918, adjusted R^2 is 0.877, the f value is 22 and the model is statistically significant (sig =.001).

4. CONCLUSION

The research investigates the millet value chain's impact on the profits of producers, processors, and marketers within a sample of 95 farmers in Northern Tamil Nadu, utilizing structured questionnaires and the linear regression model. The findings indicate that investing in Nitrogen and Potash fertilizers can significantly enhance millet productivity, aligning with government efforts to increase production. Transportation play a limited role in impacting processor profits compared to other factors. Finally, efficient transportation and storage for marketers contribute to increased profits and highlight the need to manage labour costs effectively. Enhancing profits for producers, processors, and marketers is achieved through the optimal application of fertilizers, awareness and utilization of government initiatives, the adoption of new technologies, and the implementation of effective logistics strategies. The study recommends policy measures to increase farmers' productivity and profits through incentives, farmer support extension, and innovative technologies, promoting a balanced diet, weight maintenance, and overall well-being while addressing economic aspects of millet production and distribution.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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