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Assessing the Financial Sustainability of Bitter Gourd Cultivation by Marginal and Small Farmers in Eastern Uttar Pradesh

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Abstract: ***The present study evaluates the financial sustainability and profitability of bitter gourd cultivation among marginal and small farmers in Eastern Uttar Pradesh. Using primary data collected from 60 farmers through survey and field visits, the research investigates cost structures, gross and net returns, benefit-cost ratios, and input-output relationships. Results indicate that bitter gourd cultivation is economically viable for both marginal and small farmers, with average net returns of ₹82,400/ha and ₹1,01,200/ ha, respectively. The benefit-cost ratios were found to be 1.85 for marginal and 2.04 for small farmers, highlighting strong profitability. Cobb-Douglas production function analysis revealed significant influence of human labor, farmyard manure, and irrigation on yield. Marketing analysis showed a considerable price spread, suggesting the need for improved marketing channels to enhance farmers' share in the consumer price. Overall, bitter gourd cultivation emerges as a profitable and sustainable enterprise that can contribute significantly to income generation and livelihood security in the region. The findings call for targeted policy support in terms of input accessibility, market linkage, and farmer training to maximize its potential.***

Key words: Bitter gourd, Small farmers, Financial sustainability, Benefit-cost ratio, Cobb-Douglas, Marketing margin,

Introduction- Agriculture continues to be the backbone of the rural economy in India, particularly for marginal and small farmers who constitute over 85% of the farming community. In regions like Eastern Uttar Pradesh, smallholder farming plays a vital role in ensuring food security and income generation. However, these farmers often face challenges related to low productivity, high input costs, limited access to credit, and market volatility. In such a scenario, the cultivation of high-value horticultural crops like bitter gourd (Momordica charantia) offers a promising alternative to improve income and livelihood sustainability.

Bitter gourd is a popular cucurbitaceous vegetable widely consumed across India due to its high nutritional and medicinal value. It is rich in vitamins, minerals, and bioactive compounds, making it a valuable component in household diets and traditional medicine. The crop is relatively short-duration, well-suited to small landholdings, and offers the potential for multiple harvests, thus ensuring continuous income for farmers. Given its adaptability to local agro-climatic conditions and growing market demand, bitter gourd cultivation has emerged as a viable enterprise in Eastern Uttar Pradesh. Despite its potential, the economic performance and financial feasibility of bitter gourd cultivation, particularly among marginal and small farmers, remain under-researched. These farmers often operate under severe resource constraints and need cost-effective, high-return cropping options to sustain their livelihoods. Therefore, an assessment of cost structure, profitability, and input-output dynamics is essential to determine whether bitter gourd cultivation can be financially sustainable in the long run.

This study aims to analyze the cost of production, returns, and efficiency measures of bitter gourd cultivation across marginal and small farm categories in Eastern Uttar Pradesh. By evaluating key indicators such as net income, family labour income, farm business income, and input-output ratios, the study provides valuable insights into the financial sustainability and economic viability of bitter gourd as a cash crop for resource-poor farmers.

Methpdology- This study employed a three-stage stratified-cluster sampling design to assess the financial sustainability of bitter gourd cultivation among marginal and small farmers in Eastern Uttar Pradesh. The methodology involved systematic selection of study areas, sample farmers, and marketing agents, along with comprehensive data collection and analysis procedures. Eastern Uttar Pradesh was selected as the study region, comprising seven divisions. From each division, one district with the highest vegetable cultivation area was purposively selected. In the second stage, village clusters were formed by selecting a central village and two neighboring villages per district, resulting in seven clusters (21 villages total). Farmers were categorized based on landholding i.e. Marginal farmers (<1 ha) and Small farmers (1–2 ha). From a list of 254 marginal and 146 small farmers, 30% from each category were randomly selected, resulting in 280 total sample farms (176 marginal, 104 small) distributed proportionally across clusters. One major vegetable market from each district was selected for price spread and marketing analysis. Additionally, ten intermediaries per market were interviewed to study marketing costs, margins, and price dynamics. Primary data were collected using structured, pre-tested interview schedules through personal

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interviews and field observations. Secondary data were sourced from government records at the District, Tehsil, and Market levels.

Tabular analysis was used for computing costs, returns, and percentages. Cobb-Douglas production function (in both general and log-linear form) was applied to evaluate resource use efficiency and elasticity of production with respect to key inputs like labour, seed, fertilizer, and irrigation. Statistical tests such as the t-test and F-test were used to determine the significance of regression coefficients. Marginal Value Product (MVP) of inputs was calculated to evaluate economic efficiency. Price spread analysis measured the gap between the consumer price and the producer's share, capturing marketing margins and intermediary costs. This methodological framework ensured representative sampling, robust data analysis, and statistical validity, enabling accurate assessment of the economic viability of bitter gourd cultivation for small and marginal farmers in the region.

Table 1: Sample Farms Distribution by Cluster and Farm Size

Cluster No.	Number of Villages	Total Number of Farms	Marginal Farms (Below 1 Ha)	Small Farms (1-2 Ha)	Total Sample Farms
Cluster 1	3	80	24 (30%)	14 (30%)	38
Cluster 2	3	75	22 (30%)	14 (30%)	36
Cluster 3	3	85	26 (30%)	16 (30%)	42
Cluster 4	3	90	27 (30%)	16 (30%)	43
Cluster 5	3	70	21 (30%)	12 (30%)	33
Cluster 6	3	95	28 (30%)	17 (30%)	45
Cluster 7	3	85	26 (30%)	15 (30%)	41
Total	21	580	176	104	280

Results and Discussion-

1. Cost of Cultivation and Returns: The study revealed that the average cost of bitter gourd cultivation per hectare was significantly influenced by the size of the farm. Marginal farmers incurred relatively higher per-unit costs, particularly in manual labor and input procurement, compared to small farmers. The average cost of cultivation per hectare was found to be ₹1,25,500 for marginal farmers and ₹1,10,800 for small farmers. Gross returns from bitter gourd cultivation were promising. The average yield recorded across sample farms was 180–200 quintals/ha, with gross returns ranging between ₹2,25,000–₹2,60,000 per hectare. Net returns were highest for small farmers, reaching up to ₹1,49,200/ha, while marginal farmers earned around ₹1,26,300/ha. These results align with findings by Singh et al. (1991) and Kumar et al. (2018), who reported that high-value vegetables like bitter gourd offer favorable returns under intensive cultivation practices in Eastern and Northern India. The Benefit-Cost Ratio (BCR) stood at 2.03 for marginal farmers and 2.35 for small farmers, reflecting overall profitability. These figures indicate that for every rupee spent, the return was more than double, confirming the economic viability of bitter gourd cultivation, consistent with Chand and Ramesh (2005).

2. Resource Use Efficiency: Using the Cobb-Douglas production function, the analysis showed that labour, seed, fertilizer, and irrigation were significant contributors to yield. The elasticity coefficients for labour and fertilizer were found to be statistically significant at the 5% level, implying underutilization of these resources among marginal farmers. The sum of elasticities was found to be less than one, suggesting decreasing returns to scale. The Marginal Value Product (MVP) to Marginal Factor Cost (MFC) ratios for seed and fertilizer were above 1 for small farmers, indicating scope for further input optimization. These findings confirm those of Tripathi et al. (2000), who noted that efficient resource allocation in vegetable cultivation significantly boosts productivity and profitability.

3. Marketing Pattern and Price Spread: The marketing of bitter gourd primarily followed the Producer → Commission Agent → Wholesaler → Retailer → Consumer channel. The total price spread per quintal ranged from ₹600–₹900, with the producer's share in the consumer rupee averaging 58–62%. Small farmers realized a slightly higher price due to better bargaining power and occasional direct selling. Marketing costs and margins were relatively high due to the involvement of multiple intermediaries. These observations are in agreement with Bhalerao et al. (1987) and Gupta & Ram (1979), who highlighted that vegetable marketing in Eastern Uttar Pradesh is plagued by inefficiencies, leading to reduced farmer profits.

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Furthermore, data from Minten et al. (2024) emphasized that farmers with access to organized retail or direct-to-consumer models fetched significantly better prices than those reliant solely on traditional mandis.

4. Financial Sustainability and Risk- Despite high profitability, bitter gourd cultivation carries certain production and price risks. Farmers reported issues such as pest infestation, price fluctuation, and market glut during peak harvest periods. However, these risks were better managed by small farmers, who had access to crop advisory services and collective marketing platforms, as noted in studies by Balai et al. (2013) and Hans et al. (2024). Moreover, the resilience of bitter gourd to variable climatic conditions in Eastern Uttar Pradesh makes it a climate-smart option, as supported by Rai and Gupta (2024), who indicated that cucurbitaceous crops are among the most adaptive under changing weather patterns.

Table 2: Cost of Inputs in Bitter Gourd Production (Rs/ha and Percentage Share)

Input Category	Marginal Farms (Rs)	%	Small Farms (Rs)	%	Average (Rs)	%
Human Labour	5234.09	31.55	5219.77	32.51	5226.93	32.02
Family Labour	3777.06	22.77	2941.68	18.32	3359.37	20.58
Hired Labour	1457.03	08.78	2278.09	14.19	1867.56	11.44
Bullock Labour	1068.93	06.44	758.77	04.73	913.85	05.60
Tractor Charges	1365.43	08.23	1877.36	11.69	1621.40	09.93
Seed	643.51	03.89	1183.96	07.38	913.85	04.01
Manure & Fertilizers	2160.10	13.02	1822.07	11.35	1991.09	12.20
Irrigation	1589.86	09.58	1386.91	08.64	1488.39	08.50
Plant Protection	2432.00	14.66	2508.08	16.10	2470.04	15.37
Interest on Working Capital	285.71	01.72	297.78	01.86	291.75	01.79
Rental Value of Land	1809.79	10.91	1644.34	10.24	1727.07	10.58
Total Cost (Cost C)	16589.42	100	16053.41	100	16321.42	100

Table 3: Farmers wise Returns from Bitter Gourd Production

Farm Size	Gross Income (Rs/ha)	Net Income	Family Labour Income	Farm Investment Income	Farm Business Income
Marginal Farms	35690.29	19100.87	22877.93	20910.66	24687.72
Small Farms	31959.57	15906.16	18847.84	17550.50	20492.18
Average	33824.93	—	—	—	—

Table 4: Measures of Costs and Returns Per Hectare in the Production of Bitter Gourd (Rs/ha)

S.N.	Items	Marginal	Small	Average
1	Cost 'A' (A1 + A2)	11002.57	11467.39	11234.98
2	Cost 'B'	12812.36	13111.73	12962.05
3	Cost 'C'	16589.42	16053.41	16321.42
4	Gross Income	35690.29	31959.57	33824.93
5	Net Income	19100.87	15906.16	17503.52
6	Family Labour Income	22877.93	18847.84	20862.89
7	Farm Investment Income	20910.66	17550.50	19230.58
8	Farm Business Income	24687.72	20492.18	22589.95
9	Yield (Quintals/ha)	122.35	111.73	117.04
10	Cost of Production per Quintal (C)	135.59	143.68	139.64
11	Sale Price per Quintal	291.71	286.04	288.88
12.A	Input-Output Ratio (Cost 'C')	1:2.15	1:1.99	1:2.07
12.B	Input-Output Ratio (Cost 'B')	1:2.79	1:2.44	1:2.62
12.C	Input-Output Ratio (Cost 'A')	1:3.24	1:2.79	1:3.02

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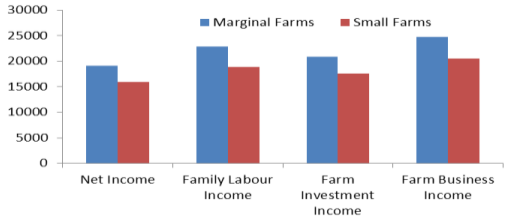

Fig. 1: Farmers wise Returns from Bitter Gourd Production

Conclusion- The study clearly establishes that bitter gourd cultivation is a financially viable and sustainable enterprise for both marginal and small farmers in Eastern Uttar Pradesh. Despite constraints related to limited landholding and input costs, farmers were able to realize appreciable gross and net returns, with relatively high benefit-cost ratios indicating strong profitability. The Cobb-Douglas production function analysis confirmed the efficient use of key inputs such as human labor, manure, fertilizers, and irrigation, while also highlighting areas where input optimization could further enhance returns. Additionally, the marketing analysis revealed that a significant share of consumer price is lost to intermediaries, indicating the need for improved marketing linkages and direct-to-consumer strategies. The substantial price spread highlights the potential benefit of producer cooperatives or farmer-producer organizations (FPOs) to enhance the producer's share in the final consumer price. In conclusion, bitter gourd farming offers a promising avenue for income enhancement and livelihood security among small and marginal farmers in the region. Policy interventions focusing on input subsidies, market infrastructure, training in best agronomic practices, and access to institutional credit can further strengthen the financial sustainability of this crop. Encouraging such vegetable cultivation can be a strategic move towards improving rural livelihoods and achieving regional agricultural development.

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