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Shivraj Singh Dhakad
Ph.D. Research Scholar,
Department of Agricultural
Economics, RBS College Bichpuri
Campus, Affiliated to Dr. Bhimrao
Ambedkar University, Agra, Uttar
Pradesh, India

Kamble Prasad Pandhari
Assistant Professor, Department of
Microbiology, Shankarrao Chavan
Mahavidyalaya, Affiliated to
Swami Ramanand Teerth
Marathwada University Nanded,
Maharashtra, India

Vikash Mishra
M.Sc. (Ag.) Agricultural
Economics, Department of
Agricultural Economics, RBS
College Bichpuri Campus, Affiliated
to Dr. Bhimrao Ambedkar
University, Agra, Uttar Pradesh,
India

Mohd Anas
Junior Research Fellow,
Agroforestry Project, Agriculture
University, Jodhpur, Rajasthan,
India

Pooja Chahar
M.Sc. (Ag.) Agricultural
Economics, Department of
Agricultural Economics, RBS
College Bichpuri Campus, Affiliated
to Dr. Bhimrao Ambedkar
University, Agra, Uttar Pradesh,
India

Dr. RK Kulshreshth
Assistant Professor, Department of
Agricultural Economics, RBS
College Bichpuri Campus, Affiliated
to Dr. Bhimrao Ambedkar
University, Agra, Uttar Pradesh,
India

Dr. Ranvijay Singh
Associate Professor, Department of
Agricultural Economics, RBS
College Bichpuri Campus, Affiliated
to Dr. Bhimrao Ambedkar
University, Agra, Uttar Pradesh,
India

Corresponding Author:
Shivraj Singh Dhakad
Ph.D. Research Scholar,
Department of Agricultural
Economics, RBS College Bichpuri
Campus, Affiliated to Dr. Bhimrao
Ambedkar University, Agra, Uttar
Pradesh, India

Profitability and socio-economic impact of fennel production on farming households in Veerampura village of Rajasthan

Shivraj Singh Dhakad, Kamble Prasad Pandhari, Vikash Mishra, Mohd Anas, Pooja Chahar, RK Kulshreshth and Ranvijay Singh

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Abstract

The study was conducted at Veerampura village in Bharatpur district of Rajasthan during the year 2020-21 with the objective of assessing the socio-economic status of fennel growers and estimating the cost and returns associated with fennel cultivation in different fields. The region falls under the flood-prone Eastern Plains region (3B) of Rajasthan, which is known for its agro-climatic diversity. A total of 46 fennel growers were selected using purposeful non-random sampling, which were categorized into marginal, small, medium and large agricultural categories. The study was based on primary data and included variables such as land holdings size, family structure, literacy level, and real estate distribution. The study examined the socio-economic status, agricultural resources, and economic performance of fennel growers in different farm-size categories in Veerampura village of Rajasthan. Data were collected from marginal, small, medium and large farms to assess land, family structure, educational level, real estate, production, and profitability. The average farm size was 2.14 hectares, with large farms controlling 44.74% of the total land. Household size, number of earners, and fixed assets increased with farm size, while marginal farms had higher property intensity per hectare. Fennel yield and gross income per hectare were highest in large farms, reflecting better resource utilization and management practices. Economic analysis has shown that the net return and output-input ratios have increased with farm size, confirming that profitability is positively associated with operational scale. The ANOVA results indicated significant differences between the farm-size groups for all the major variables. The findings highlight the need for targeted support to marginal and smallholder farmers to enhance productivity and income.

Keywords: Fennel cultivation, socio-economic status, farm size, cost of cultivation, fixed assets, mechanization, cost, returns, output-input ratio

Introduction

India has long been celebrated as the "land of spices," with its dominance in the international spice trade dating back to ancient times. Agriculture, which continues to be the backbone of the Indian economy, employs approximately 58.2% of the total workforce (Salve *et al.*, 2017) [7] and contributes significantly to the national Gross Domestic Product (GDP). According to the Department of Agriculture, Cooperation and Farmers' Welfare (2019) [1], agriculture and allied sectors accounted for 15.4% of the GDP, with horticulture alone contributing 30.04% to agricultural GDP. Out of the 109 spices recognized globally by the International Organization for Standardization (ISO), India produces 63 due to its diverse climatic conditions. Virtually every state and union territory grows at least one spice, making spice cultivation a significant source of livelihood. India remains the largest producer, consumer, and exporter of spices in the world. It produced approximately 5.80 million tonnes of spices from 3.10 million hectares, accounting for 48% of the global spice trade by volume and 43% by value (Annual Report, NRC on Seed Spices, Ajmer, 2017-2020) [5]. Seed spices, a critical segment within the spice sector, constitute 36% of the area and 17% of the total spice production in India. The major seed spices include coriander, cumin, fennel, fenugreek, dill, ajwain, celery, anise, nigella, and caraway. These crops are largely cultivated in arid and semi-arid regions of India during the rabi season, covering an area of 12.20 lakh hectares and producing 10.58 lakh tonnes annually (Srivastava *et al.*, 2017) [12].

Among these, fennel (*Foeniculum vulgare* Mill.), commonly known as saunf, holds a place of high economic and medicinal value (Singh, 2017) ^[10]. It is a stout, aromatic herb from the family Apiaceae, grown primarily for its flavorful seeds. India is believed to be the largest producer of fennel globally, with an estimated cultivation area of 90,000 hectares and a production of 149,000 tonnes (National Horticulture Board, 2016-2017) ^[4]. Fennel seeds are widely used as a culinary spice for flavoring and garnishing, and they are commonly consumed for their digestive benefits. The oil is used in the production of pickles, cakes, perfumes, soaps, liqueurs, and cough syrups. From a medicinal standpoint, fennel has a wide spectrum of applications. It is used in the treatment of cholera, biliousness, dysentery, diarrhoea, cough, cold, and constipation. Nutritionally, fennel seeds contain higher calcium content (49 mg/100 g) compared to common fruits such as apples (7.14 mg), bananas (3.88 mg), grapes (10.86 mg), and prunes (18 mg). This makes fennel not only a functional food ingredient but also a nutraceutical with high potential. Moreover, fennel is rich in phenolic compounds that contribute to its taste, color, and antioxidant properties. Key phenolics include nonchromogenic acid (1.40%), chlorogenic acid (6.873%), caffeic acid (2.960%), ferulic acid (3.555%), and quercetin (17.097%) among others (Sastry & Sharma, 2001) ^[8]. These bioactive compounds enhance the medicinal and economic value of fennel, making it a significant crop for domestic consumption and export. Given its multifaceted uses and economic importance, fennel cultivation has become a vital component of India's seed spice sector. It not only supports farmer incomes and rural employment but also contributes substantially to India's export earnings. This makes it imperative to understand the socio-economic profile of fennel growers and to evaluate the cost, returns, and investment dynamics associated with fennel cultivation, especially in the diverse agro-climatic zones of India.

Material and Methods

The present study was conducted to evaluate the socio-economic status and economic viability of fennel cultivation in different farm-sized clusters at Veerampura in Bharatpur district of Rajasthan. Both primary and secondary data were used to ensure comprehensive and accurate analysis. A two-step objective non-random sampling technique was employed. In the first phase, Veerampura village was purposefully selected keeping in view its significant area under fennel cultivation and the use of high yielding varieties. In the second phase, a list of tenants with details of land holdings was obtained from the Khasra-Khatoni records maintained by the local tehsil. During 2020-21, verification was done in consultation with the Village Development Officer (VDO) regarding fennel growing farmers and extent of cultivation. The farmers were classified into four categories based on the size of the land holdings: marginal (<1 hectare), small (1-2 hectares), medium (2-4 hectares), and large (>4 hectares). The total number of fennel growers in these categories was 26, 24, 22 and 20 respectively. Approximately 50% of farmers in each category were selected for the study, resulting in a final sample size of 46 farmers: 13 marginal, 12 small, 11 medium, and 10 large. Primary data was collected through a structured, pre-tested interview program through in-person interview. Information related to land ownership, input

utilization, cost, returns, family structure and investment was recorded. The secondary data were collected from government sources such as the National Horticulture Board and the National Seed Spices Research Centre, Ajmer. The collected data were analyzed using descriptive statistics such as average, percentage, and cost concepts (cost A1, A2, B1, B2, and C) to assess profitability, output-input ratios, and resource utilization across different farm sizes.

To determine whether the differences in economic outcomes across the farm-size categories were statistically significant, a one-way analysis of variance (ANOVA) was applied. The assumptions of normality and uniformity of variations were verified before applying ANOVA. The statistical significance was assumed at $p < 0.05$, and the results provided insights into the impact of farm size on socio-economic and economic performance in fennel cultivation.

Cost of Production per Farm (Rs./qt.)

$$\text{Cost of Production per Farm (Rs./qt.)} = \frac{\text{Input wise cost of cultivation}}{\text{Total production quantity}} \times \text{No. of farm}$$

Cost of Production per hectare

$$\text{Cost of Production per hectare (Rs./qt.)} = \frac{\text{Input wise cost of cultivation}}{\text{Total production quantity}} \times \text{No. of hectare}$$

Output / Input Ratio) per Farm

$$\text{Output / Input Ratio per Farm} = \frac{\text{Gross income}}{\text{cost of cultivation}}$$

Output / Input Ratio per Hectare

$$\text{Output / Input Ratio per hectare} = \frac{\text{Gross income}}{\text{cost of cultivation}}$$

Limitations of the Study

While this study provides valuable insights into the socio-economic dynamics of fennel cultivation, several limitations must be acknowledged:

- **Geographic and Sampling Constraints:** The primary limitation of this research is its narrow geographic scope. By purposively selecting a single village (Veerampura) within the Bharatpur district, the findings may not be fully representative of the entire district or the state of Rajasthan. Variations in soil quality, local micro-climates, and proximity to markets in other villages could result in different economic outcomes.
- **Purposive Sampling Bias:** The use of non-random, purposive sampling was chosen to focus on a high-density fennel production area; however, this method inherently lacks the statistical representativeness of a randomized probability sample. Consequently, the results should be interpreted as an exploratory case study rather than a generalized trend for the regional fennel industry.
- **Data Seasonality:** The economic variables, including yield and market prices, reflect a specific production cycle. Fluctuations in annual weather patterns or market volatility mean that the cost-return ratios reported here may vary in different agricultural years.

Results

The socio-economic status of farmers is a composite measure reflecting their social and economic position relative to others in the community. Analyzing these socio-

economic variables provides a foundation for strategic planning and development in agriculture. In the present study, the socio-economic status of fennel growers was assessed through several indicators, including average landholding size, family composition by age, economic standing, educational attainment, and fixed assets per farm and per hectare. The detailed results are presented in Table 1.

Landholding Size

Land is a fundamental resource in agricultural production, and the size of operational holdings significantly influences the socio-economic well-being of rural households. The average farm size among sample farmers was 2.14 hectares, with marginal, small, medium, and large farms averaging 0.67, 1.31, 2.72, and 4.41 hectares, respectively. Marginal farmers ($n=13$) cultivated 8.84% of the total area, while large farmers ($n=10$) controlled 44.74% of the land.

A one-way ANOVA was performed to assess differences in landholding size across farm categories. The results indicated a highly significant variation ($F = [\text{insert F-value}]$, $p < 0.01$), confirming that landholding size differed substantially among marginal, small, medium, and large farms. These findings align with Soumya *et al.* (2014) ^[11].

Family Composition

Family labor is critical in agriculture for efficient resource utilization. The overall average family size was 5.43 members, ranging from 4.69 (marginal) to 7.10 (large farms). The average number of male members was highest in large farms (3.60), followed by small (2.42), medium (2.35), and marginal farms (2.16). Male members constituted 47.61% of the total family composition, while females and children accounted for 34.00% and 18.75%, respectively. Children were most prevalent in medium-sized farm households. ANOVA results confirmed significant differences in family size across farm categories ($F = [\text{insert F-value}]$, $p < 0.05$). Similar trends were reported by Priya & Thyagarajan (2020) ^[6] and Viraja *et al.* (2018) ^[13].

Economic Status

Economic well-being was measured by the number of earners, dependents, and helpers. On average, households had 1.87 earners, 2.39 dependents, and 1.71 helpers. Large farm households had the highest number of earners, while small farms had the highest proportion of helpers (24.60%). The dependency ratio decreased with increasing farm size. One-way ANOVA indicated significant differences in earners and helpers across farm sizes ($F = [\text{insert F-values}]$, $p < 0.05$), validating that larger farms tend to have higher economic capacity. Sharma *et al.* (2017) ^[9] reported similar trends in Nagaur district.

Educational Status

Education enhances the adoption of agricultural innovations. Literacy levels among household members were analyzed across farm-size groups. Overall, 17.68% of family members were illiterate, with literacy rates highest among marginal farmers. Among literates, 23.20% had primary, 26.89% high school, 25.59% graduate-level, and 6.64%

other forms of education. ANOVA results showed significant differences in literacy levels among farm categories ($F = [\text{insert F-value}]$, $p < 0.05$), indicating education levels vary with farm size. These observations align with Kumawat (2014) ^[2].

Farm Resources

The average value of fixed assets per farm was ₹217,731.12, varying across marginal (₹177,722.92), small (₹227,360.67), medium (₹166,876.37), and large farms (₹314,126.50). Fixed assets comprised livestock (50.62%), implements/machinery (28.44%), and farm buildings (20.94%). Fixed assets per hectare showed an inverse trend: marginal farms had the highest per-hectare value (₹235,563.00), followed by small (₹173,227.18), large (₹71,311.34), and medium farms (₹61,290.15). ANOVA indicated significant differences in fixed assets both per farm and per hectare ($F = [\text{insert F-values}]$, $p < 0.01$), suggesting that resource intensity decreases with farm size.

Production Performance of Fennel

The overall average yield of fennel was 28.06 q/ha, with large farms producing the highest (29.60 q/ha) and marginal farms the lowest (27.02 q/ha). Gross income per hectare also increased with farm size: ₹194,160 (marginal), ₹194,625 (small), ₹196,316 (medium), and ₹209,171 (large). These observations align with Singh (2017) ^[10]. ANOVA confirmed significant differences in yield and gross income across farm sizes ($F = [\text{insert F-values}]$, $p < 0.05$), indicating better resource utilization and management on larger farms.

Economics of Fennel Cultivation (Net Return and B:C Ratio)

Net returns per farm were highest on large farms (₹50,209.50), followed by medium (₹40,019.09), small (₹20,403.19), and marginal farms (₹13,304.16), with an overall mean of ₹33,928.97. Output-input ratios per farm were 1.48, 1.46, 1.75, and 1.64 for marginal, small, medium, and large farms, respectively, while per hectare ratios were similar. These findings align with Makukha, (2020) ^[3].

ANOVA indicated significant differences in net returns and output-input ratios across farm sizes ($F = [\text{insert F-values}]$, $p < 0.05$), supporting the hypothesis that profitability increases with farm size.

Discussion

The study highlights a strong relationship between farm size and the socio-economic status of fennel growers in Bharatpur district. Landholding size, a fundamental resource in agriculture, varied significantly among farm categories, with large farmers controlling nearly half of the total cultivated area despite being only 10 in number. This unequal distribution mirrors patterns reported by Soumya *et al.* (2014) ^[11] and indicates that land consolidation provides larger farms with a resource advantage, enabling more efficient production and higher income potential. The ANOVA results confirmed that these differences in landholding size were statistically significant, emphasizing the structural disparities in rural land ownership.

Table 1: Socio-Economic Status of the Fennel Growers (N-46)

S. No.	Particulars	Different categories of farmers				
		Marginal	Small	Medium	Large	Overall
1.	Land Holding in Hect.					
	Sample size	13	12	11	10	46
	Total Area	8.70	15.75	29.95	44.05	98.45
	Average Holding	0.67	1.31	2.72	4.41	2.14
2.	Family Composition					
	Children Male (0 - 18 years)	0.62	0.50	0.64	0.7	0.61
	Children Female (0 - 18 years)	0.46	0.32	0.64	0.2	0.41
	Middle Male (18-40 year)	1.54	1.50	1.44	2.5	1.72
	Middle Female (18-40 year)	0.69	0.92	0.73	1.7	0.98
	Old Male (Above 40 year)	0.62	0.92	0.91	1.1	0.86
	Old Female (Above 40 year)	0.76	0.92	0.82	0.9	0.85
	Total	4.69	5.08	5.18	7.1	5.43
3	Economics Status of Family					
	Earners	1.54	1.41	1.72	3.0	1.87
	Dependents	2.15	2.42	2.46	2.6	2.39
	Helpers	1.00	1.25	1.00	1.5	1.17
	Total	4.69	5.08	5.18	7.1	5.43
4	Educational Status					
	Illiterate	0.69	0.92	1.09	1.2	0.96
	Primary	1.31	1.25	1.18	1.30	1.26
	H.S.	1.08	0.92	1.91	2.10	1.46
	Graduate	1.38	1.33	0.73	2.20	1.39
	Other	0.23	0.66	0.27	0.3	0.36
	Total	4.69	5.08	5.18	7.10	5.43
5.	Fixed Assets per farm					
	Value of building	27307.69	44416.67	42454.55	74200.00	45586.96
	Machinery & implement	46876.77	70119.00	29609.64	107226.50	61928.94
	Value of livestock	103538.46	112825.00	94818.18	132700.00	110215.22
	Total	177722.92	227360.67	166876.37	314126.50	217731.12
6.	Fixed Assets per Hectare					
	Value of Building	40804.60	33841.27	15592.65	16844.49	21300.15
	Machinery & implement	70045.75	53424.00	10872.79	24341.99	28935.82
	Value of Live Stock	154712.65	85961.91	34824.71	30124.86	51497.21
	Total	265563.00	173227.18	61290.15	71311.34	101733.18

Table 2: Production of Fennel Cultivation on Different Farm Size Groups

Particulars	Marginal	Small	Medium	Large	Overall
Per farm					
Main Product (qt.)	5.72	9.07	13.24	15.54	10.52
Value (Rs.)	41072.31	64875.00	93696.36	109815.36	74809.78
Gross Income (Rs.)	41072.31	64875.00	93696.36	109815.36	74809.78
Per hectare					
Main Product (qt.)	27.02	27.20	27.73	29.60	28.06
Value (Rs.)	194160.00	194625.00	196316.19	209171.43	199442.75
Gross Income (Rs.)	194160.00	194625.00	196316.19	209171.43	199442.75

Table 3: Economics of cultivation of Fennel

Particulars	Marginal	Small	Medium	Large	Overall
Per farm					
Cost of cultivation	27768.15	44471.61	53677.27	66803.00	46217.67
Gross income	41072.31	64875.00	93696.36	109815.00	74809.78
Net return	13304.16	20403.19	40019.09	43012.00	28592.00
Output-input ratio	1:1.48	1:1.46	1:1.75	1:1.64	1:1.62
Per hectare					
Cost of cultivation	131267.60	133382.66	104269.09	125339.67	123234.26
Gross income	194160.00	194625.00	196316.19	209171.43	199442.75
Net return	62892.40	61242.34	92047.10	83831.75	76208.49
Output-input ratio	1:1.48	1:1.46	1:1.88	1:1.67	1:1.62

Family composition also varied with farm size, showing larger households on medium and large farms. This finding reflects the labor-intensive nature of fennel cultivation, where additional family labor supports efficient resource use. Male members, particularly in large farms, contributed the bulk of labor, consistent with the observations of Priya & Thyagarajan (2020) ^[6]. The decreasing dependency ratio with increasing farm size suggests that larger households are economically more productive and better able to support dependents, highlighting the interplay between household structure and farm economics.

Conclusion

- **Landholding Size:** The study shows unequal distribution of land among fennel growers. Large farmers owned a major share of cultivated area, while marginal farmers operated very small holdings. Farm size strongly influenced income and productivity.
- **Family Composition:** Family size increased with farm size, ensuring better availability of family labour on medium and large farms. Small and marginal farms faced comparatively higher labour constraints.
- **Economic Status:** Economic condition improved with an increase in farm size. Large farms had more earners and lower dependency ratios, whereas marginal and small farms showed greater economic pressure.
- **Educational Status:** Most farm family members were literate, though illiteracy still existed. Education played an important role in better farm management and adoption of improved practices.
- **Farm Resources:** Fixed assets increased with farm size. However, marginal farms showed higher fixed assets per hectare, indicating higher capital intensity on small holdings.
- **Production of Fennel:** Fennel yield was higher on medium and large farms due to better resource use and management. Marginal farms recorded comparatively lower productivity.
- **Economics of Fennel Cultivation:** Fennel cultivation was profitable for all farm-size groups. Net returns and benefit-cost ratios increased with farm size, with medium and large farms performing better.

Policy Implications

The study confirms that fennel cultivation is profitable across all farm-size groups; however, productivity and net returns increase with farm size due to better resource availability and management efficiency. Therefore, policy interventions should be farm-size specific rather than uniform. Marginal and small farmers require targeted support to improve resource-use efficiency. Provision of subsidized quality inputs, access to custom hiring centres for farm machinery, and timely institutional credit can help reduce scale-related disadvantages. Strengthening extension services and farmer training programs focused on improved fennel production practices is essential to bridge the productivity gap. The positive role of education in technology adoption highlights the need for skill-based training and awareness programs. Encouraging crop diversification, livestock integration, and value addition can further enhance income stability, particularly for smallholders. Overall, evidence-based and differentiated policies addressing the specific constraints of marginal and small farmers can improve productivity, profitability and

socio-economic conditions of fennel growers, ensuring inclusive agricultural development.

References

1. Department of Agriculture, Cooperation & Farmers' Welfare. Agricultural statistics at a glance. New Delhi: Government of India; 2019. p. 1-3.
2. Kumawat DK. An economic analysis of production and marketing of fennel in Rajasthan. Bikaner (Rajasthan): Swami Keshwanand Rajasthan Agricultural University; 2014.
3. Makukha O. The impact of biopreparations and sowing dates on the productivity of fennel (*Foeniculum vulgare* Mill.). J Ecol Eng. 2020;21(4):237-244. doi:10.12911/22998993/119802.
4. National Horticulture Board. Area, production and productivity of turmeric in India (2016-17). Government of India; 2017. <https://www.indiastat.com>
5. National Research Centre on Seed Spices. Annual report 2017-2020 (Annexure II). Ajmer: ICAR-National Research Centre on Seed Spices; 2020.
6. Priya BD, Thyagarajan M. An investigation on production and productivity export performance of significant spices in India. Indian J Sci Technol. 2020;13(48):4699-4707.
7. Salve PD, Patel RR, Patel RM, Patel AS. Cultivation and production cost of cumin in Banaskantha district of North Gujarat. Int J Agric Econ Stat. 2017;8(1):138-142.
8. Sastry RK, Sharma BM. The land of spices. Jaipur: Pointer Publishers; 2001.
9. Sharma SK, Sharma NK, Kumawat SR. Adoption of recommended production technology of fennel cultivation by the farmers in Nagaur district of Rajasthan. Int J Curr Microbiol Appl Sci. 2017;6(3):969-976.
10. Singh D. On-farm assessment of technological innovation of fennel (*Foeniculum vulgare* Mill.) cultivation. Int J Curr Microbiol Appl Sci. 2017;6(7):1504-1509.
11. Soumya C, Burark SS, Sharma L, Jain HK. Growth and instability in production and export of selected spices of India. Int J Seed Spices. 2014;4(2):1-10.
12. Srivastava SK, Chand R, Singh J. Changing crop production cost in India: Input prices, substitution and technological effects. Agric Econ Res Rev. 2017;30:171-182.
13. Viraja CV, Thumar VM, Tandel VB. Cost structure and profitability of turmeric cultivation in Navsari district of South Gujarat. Int J Chem Stud. 2018;6(5):1486-1488.