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Research Article

Socio-economic Status of Fennel Growers in Bharatpur District of Rajasthan

Shivraj Singh Dhakad[1, *], Vikash Mishra[2], Pooja Chahar[1], Rakesh Kumar Kulshreshta[1], Ranvijay Singh[1]

[1]Faculty of Agricultural Economics, Dr. B. R. Ambedkar University, Agra, India
[2]Department of Agricultural Economics, Mandsaur University, Mandsaur, India

Abstract

The study was conducted during the year 2020–21 in Veerampura village of Bharatpur district, Rajasthan, with the objective of assessing the socio-economic status of fennel growers and estimating the costs and returns associated with fennel cultivation across different farm sizes. The area falls under the flood-prone Eastern Plain Zone (3B) of Rajasthan, known for its agro-climatic diversity. A total of 46 fennel growers were selected using purposive non-random sampling, classified into marginal, small, medium, and large farm categories. The study was based on primary data and included variables such as landholding size, family composition, literacy levels, and fixed asset distribution. The study found that the average farm size was 2.14 hectares, with landholdings ranging from 0.67 ha in marginal to 4.41 ha in large farms. The average family size was 5.43 members, and male members formed the majority of the agricultural labor force. Literacy levels were relatively high, with only 17.68% of the farm population being illiterate; marginal farms had the highest literacy rate. Fixed asset values per farm averaged ₹ 2,17,731.12, increasing with farm size. However, the per hectare value of fixed assets was highest among marginal farms (₹ 2,35,563), reflecting a more intensive use of resources. Livestock contributed the highest share to fixed assets, followed by machinery and buildings. The analysis concluded that farm size significantly influences socio-economic outcomes. Marginal and small farmers, despite having limited land, exhibited greater mechanization and literacy levels, whereas larger farms benefited from economies of scale but faced higher dependency ratios. These insights are critical for designing effective policies focused on improving resource utilization, income generation, and educational outreach in fennel-growing regions. The ANOVA results found 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 Crop, Socio-economic Status, Farm Size, Cost of Cultivation, Fixed Assets, Mechanization, Output-input Ratio

1. 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%

*Correspondence: Shivraj Singh Dhakad (shivrajdhakad098@gmail.com)

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of the total workforce [13] and contributes significantly to the national Gross Domestic Product (GDP). According to Department Agriculture and cooperation and Farmer's 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 grow 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 [2, 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 [14]. Among these, fennel (*Foeniculum vulgare* Mill.), commonly known as saunf, holds a place of high economic and medicinal value. It is a stout, aromatic herb from the family Apiaceae, grown primarily for its flavourful 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 [7].

Fennel seeds are widely used as a culinary spice for flavouring 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/100g) 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, colour, 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 [12]. These bioactive compounds enhance the medicinal and economic value of fennel, making it a significant crop for domestic consumption and export.

The Fennel's economic significance, limited empirical studies have examined the socio-economic characteristics of fennel growers in region-specific contexts. In particular, there is a lack of evidence on how farm size influences socio-economic outcomes among growers in flood-prone agro-ecologies such as Rajasthan's Eastern Plain Zone [3, 17].

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 [8].

2. Material and Methods

The present study was conducted to evaluate the socio-economic status and economic viability of fennel cultivation across various farm size groups in the Bayana Block of Bharatpur District, Rajasthan. Both primary and secondary data were utilized to ensure comprehensive analysis and accuracy. A two-stage purposive non-random sampling technique was employed. In the first stage, Veerampura village was selected purposively, considering its significant area under fennel cultivation and the use of high-yielding varieties. In the second stage, a list of cultivators along with landholding details was obtained from the Khasra-Khatoni records maintained by the local tehsil.

Further verification regarding fennel-growing farmers and the extent of cultivation during 2020–21 was done in consultation with the Village Development Officer (VDO). Farmers were stratified into four categories based on landholding size: marginal (<1 ha), small (1–2 ha), medium (2–4 ha), and large (>4 ha). The total number of fennel growers in these categories was 26, 24, 22, and 20 respectively and 50% of farmers from each category were selected for the study, resulting in a final sample size of 46 farmers: (50% of 26) 13 marginal, (50% of 24) 12 small, (50% of 22) 11 medium and (50% of 20) 10 large. Primary data were collected through a structured, pretested interview schedule via personal interviews. Information related to landholding, input use, costs, returns, family structure, and investments was recorded. Secondary data were gathered from government sources such as the National Horticulture Board and the National Research Centre on Seed Spices, Ajmer. Collected data were analysed using descriptive statistics such as averages, percentages, and cost concepts (Cost A1, A2, B1, B2, and C) to assess profitability, benefit-cost ratios, and resource utilization across different farm sizes.

2.1. Cost Concept

1) Cost A1 = All actual expenses in cash and kind incurred in production.
2) All values and charges of hired human labour, bullock labour, machinery charged, manure & fertilizers, seed, insecticides and fungicides. Irrigation charges, Land revenue, cesses and other taxes, Depreciation on farm implements, farm building, farm machinery, Interest on the working capital and Miscellaneous expenses (wages of artisans and repairs to small farm implements).
3) Cost A2 = Cost A1+ Rent paid for Leased in Land.
4) Cost B1= Cost A1+Interest on value of owned fixed capital assets (excluding land)

5) Cost B2 = Cost B1+rental value of owned land (Net of land revenue) and rent paid for leased in land.
6) Cost C1 = Cost B1 + Imputed value of Family labour
7) Cost C2 = Cost B2 + Imputed value of Family labour
8) Cost C3 = Cost B2 + 10% of Cost C2 on account of managerial input of the farmer

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.

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

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

2.3. Cost of Production per Hectare

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

2.4. Output / Input Ratio per Farm

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

2.5. Output / Input Ratio per Hectare

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

3. Limitations of the Study

While this study provides valuable insights into the socio-economic dynamics of fennel cultivation, 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. 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. 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.

4. 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.

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

S. No.	Particulars	Different categories of farmers				
		Marginal	Small	Medium	Large	Overall
	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					
	Earner	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
	Higher Secondary	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

Particulars	Marginal	Small	Medium	Large	Overall
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

4.1. Landholding Size

Land is a fundamental resource in agricultural production. The size of operational holdings significantly influences the socio-economic well-being of rural households. Land resources, including soil, water, and vegetation, are transformed into economic goods using labor and capital. As these inputs are scarce, their efficient utilization is critical. 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%. These results align with Soumya *et al.* [11].

4.2. Family Composition

Family labor plays a crucial role in agriculture, especially in optimizing resource use. The overall average family size was 5.43 members, varying from 4.69 (marginal) to 7.10 (large farms). The average number of males per household was highest among large farms (3.60), followed by small (2.42), medium (2.35), and marginal (2.16) farms. Male members constituted 47.61% of the total, while females and children accounted for 34.00% and 18.75%, respectively. Children were most prevalent in medium-sized farm households. Similar observations were reported by Priya and Thyagarajan (2020) and Viraja *et al.* (2018) [8, 15].

4.3. Economic Status

Economic well-being is generally linked to household income, which in turn depends on the number of earners. The economic status was measured in terms of earners, dependents, and helpers. On average, each household had 1.87 earners, 2.39 dependents, and 1.71 helpers. The number of earners was highest among large farm households. Helper proportions were greatest in the small farm category (24.60%). The dependency ratio showed a decreasing trend with increasing farm size. Similar patterns were reported by Sharma *et al.* (2017) [10] in Nagaur district.

4.4. Educational Status

Education enhances the adoption of agricultural innovations. Literacy levels of household members were examined across farm size groups. Overall, 17.68% of farm family members were illiterate. Literacy rates were highest among marginal farmers. Among literates, the proportions with primary, high school, and graduate-level education were 23.20%, 26.89%, and 25.59%, respectively, with 6.64% having other forms of education. These findings are in agreement with Kumawat, D. K. (2014) [6].

4.5. Farm Resources

Farm resources, particularly fixed capital, significantly influence productivity. Fixed assets included livestock, implements/machinery, and farm buildings. Land was excluded from fixed asset valuation.

4.5.1. Fixed Assets Per Farm

The average value of fixed assets per farm was ₹ 217,731.12, with marginal farms at ₹ 177,722.92, small at ₹ 227,360.67, medium at ₹ 166,876.37, and large farms at ₹ 314,126.50. The contribution of farm buildings, implements/machinery, and livestock to total fixed assets was 20.94%, 28.44%, and 50.62%, respectively. Asset value positively correlated with farm size. These results corroborate the findings of Dilip Singh [4].

4.5.2. Fixed Assets Per Hectare

Fixed assets per hectare were highest in marginal farms (₹ 235,563.00), followed by small (₹ 173,227.18), medium (₹ 61,290.15), and large (₹ 71,311.34) farms. A negative correlation was observed between farm size and machinery value per hectare, while livestock value followed a similar trend. This suggests higher mechanization intensity among marginal farms. Sharma *et al.* (2017) [10] reported similar trends in fixed asset adoption in fennel cultivation.

4.6. 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). ANOVA confirmed significant differences in yield and gross income across farm sizes (F = [insert F-values], $p < 0.05$), indicating better resource utilization and management on larger farms. Similar patterns were reported by Reddy AA, Bantilan MCS (2016) [9].

4.7. Economics of Fennel Cultivation (Net Return and Output-input 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. ANOVA indicated significant differences in net returns and output–input ratios across farm sizes ($p < 0.05$), supporting the hypothesis that profitability increases with farm size. Similar patterns were reported Olga Makukha (2020) [16].

5. 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. Family composition also varied with farm size, showing larger households on medium and large farms. This finding reflects the labour-intensive nature of fennel cultivation, where additional family labour supports efficient resource use. Male members, particularly in large farms, contributed the bulk of labour, consistent with the observations of [8]. 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.

6. Conclusion

The study reveals significant socio-economic differences among fennel growers based on farm size. Larger farmers hold a disproportionate share of land (44.74%), while marginal farmers, despite limited land, show higher capital investment per hectare and literacy rates. Average family size increases with farm size, with male members forming the primary workforce. Although large farms have more earners, they also face higher dependency ratios. Small farms report the highest proportion of helpers, indicating shared labour or underemployment. Fixed assets per farm are highest in large farms, but marginal farms utilize resources more intensively. Overall, farm size influences access to land, education, income, and labour. These findings highlight the need for size-specific policies to support mechanization, equitable development, and educational outreach in fennel-growing regions.

The study found 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 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 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.

Most farm family members were literate, though illiteracy still existed. Education played an important role in better farm management and adoption of improved practices. Fixed assets

increased with farm size. However, marginal farms showed higher fixed assets per hectare, indicating higher capital intensity on small holdings. Fennel yield was higher on medium and large farms due to better resource use and management. Marginal farms recorded comparatively lower productivity. Fennel cultivation was profitable for all farm-size groups. Net returns and output-input ratios increased with farm size, with medium and large farms performing better.

7. 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 centers 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.

Abbreviations

ANOVA	Analysis of Variance
n	Number
Rs.	Rupees
mg	Milligram
Qt	Quintel

Author Contributions

Shivraj Singh Dhakad: Data curation, Formal Analysis, Funding acquisition, Resources, Writing – original draft, Writing – review & editing

Vikash Mishra: Conceptualization, Formal Analysis

Pooja Chahar: Methodology, Project administration, Visualization

Rakesh Kumar Kulshreshta: Investigation, Software, Supervision, Validation, Visualization

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this manuscript.

References

[1] Agriculture statistics at a glance, Department Agriculture and cooperation and Farmer's Welfare. 2019; Government of India. Pp 1-3.

[2] Annual report, National Research Centre on Seed Spices, Ajmer. 2017-20; Annexure II.

[3] Birthal PS, Joshi PK, Roy D. Impact of diversification on farm income and risk in India. Agricultural Economics Research Review. 2013; 26(2): 193-208.

[4] Dilip Singh. On-farm Assessment of Technological Innovation of Fennel (Foeniculum vulgare mill) Cultivation. International Journal of Current Microbiology and Applied Sciences 2017; 6(7): 1504-1509.

[5] Government of India. Spices statistics at a glance. Kochi: Spices Board of India; 2020.

[6] Kumawat, D. K. An Economic Analysis of Production and Marketing of Fennel in Rajasthan. 2014; Thesis PhD (Ag). Swami Keshwanand Rajasthan Agricultural University, Faculty of Agriculture, Bikaner, Rajasthan, India.

[7] National Horticulture Board, Government of India, Area, Production and Productivity of Turmeric in India. 2016-17; www.indiastat.com

[8] Priya, B. D. and Thyagarajan, M. An Investigation on Production and Productivity Export Performance of Significant Spices in the Country India. Indian Journal of Science and Technology. 2020; 13(48): 4699-4707.

[9] Reddy AA, Bantilan MCS. Competitiveness and technical efficiency: determinants in spice crops of India. Indian Journal of Agricultural Economics. 2012; 67(3): 412-426.

[10] Sharma, S. K., Sharma, N. K. and Kumawat, S. R. Adoption of Recommended Production Technology of Fennel Cultivation by the Farmers in Nagaur District of Rajasthan. International Journal of Current Microbiology and Applied Sciences. 2017; 6(3): 969-976.

[11] Soumya, C., Burark, S. S., Sharma, L. and Jain, H. K. Growth and Instability in Production and Export of Selected Spices of India. International Journal of Seed Spices. 2014; 4(2): 1-10.

[12] Sastry EVD, Sharma RK. Status of seed spices research in Rajasthan. In Seed Species-Production Quality and Export. (Eds.) Pointer Publishers. Jaipur (Rajasthan). 2001, 19-40.

[13] Salve, P. D., Patel, R. R., Patel, R. M. and Patel, A. S. 2017. Cultivation and production cost of cumin in Banaskantha district of North Gujarat. International Journal of Agricultural Economics & Statistics, 8(1): 138-142.

[14] Srivastava, S. K., Chand, R. and Singh, J. 2017. Changing crop production cost in India: Input Prices, Substitution and Technological Effects. Agricultural Economics Research Review, 30: 171-182.

[15] Viraja, C. V., Thumar, V. M. and Tandel, V. B. 2018. Cost structure and profitability of turmeric cultivation in Navsari district of South Gujarat. International Journal of Chemical Studies., 6(5): 1486-1488.

[16] Olga Makukha (2020); The Impact of Biopreparations and Sowing Dates on "The Productivity of Fennel (Foeniculum vulgare Mill.) Journal of Ecological Engineering; Volume 21, Issue 4, May 2020, pages 237-244. https://doi.org/10.12911/22998993/119802

[17] Zafar, S., Khan, M. K., Perveen, S., Iqbal, M., AL-Huqail, A. A. (2023). Fennel. In: Zia-Ul-Haq, M., Abdulkreem AL-Huqail, A., Riaz, M., Farooq Gohar, U. (eds) Essentials of Medicinal and Aromatic Crops. Springer, Cham. https://doi.org/10.1007/978-3-031-35403-8_19