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Cropping Decisions, Cost-Benefit Dynamics and Income Stability of Farmers in Semi-Arid Shevgaon Tehsil of Ahilyanagar district, Maharashtra

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Abstract

Agriculture in semi-arid regions is increasingly challenged by climatic uncertainty, rising input costs, and market volatility, all of which significantly influence farmers' cropping decisions and income stability. This study examines the relationship between cropping decisions, cost–benefit dynamics, and income stability in Shevgaon tehsil of Ahilyanagar district, Maharashtra. The analysis is based on both primary data collected through field surveys and secondary data obtained from official agricultural records. Crop concentration patterns were analyzed using the Bhatia's (1965) Location Quotient method to assess spatial specialization, while cost–benefit dynamics were evaluated through estimation of production costs, gross returns, net returns, and Benefit–Cost Ratios. An Income Stability Index (ISI) was used to assess variability in farm income across crops and revenue circles.

The results reveal significant spatial variation in cropping patterns, with irrigated revenue circles favoring sugarcane, wheat, and onion, and drought-prone circles relying more on jowar and bajra. While onion and sugarcane generate high net returns, they are associated with higher income instability due to market and input risks. In contrast, wheat and coarse cereals provide moderate but more stable returns, enhancing income stability. The study concludes that income stability in semi-arid agriculture depends not merely on maximizing returns but on adopting region-specific cropping strategies that balance profitability, cost structure, and risk exposure. The findings provide valuable policy insights for promoting sustainable and resilient agricultural systems in semi-arid regions of Maharashtra.

Keywords: *Cropping pattern; Cost–benefit analysis; Income stability index; Crop suitability; Semi-arid agriculture.*

Introduction

Agriculture in semi-arid regions of Maharashtra is characterized by climatic uncertainty, resource constraints, and increasing market volatility, all of which significantly influence farmers' cropping decisions and economic well-being. Shevgaon tehsil of Ahilyanagar district represents a typical semi-arid agrarian landscape where rainfall variability, uneven irrigation facilities, and medium to shallow black soils shape agricultural practices. In this context, farmers continuously adjust their crop choices to balance production risks, input costs, and expected returns in order to sustain farm incomes.

Cropping decisions in Shevgaon tehsil are closely linked to the degree of crop diversification and spatial concentration of specific crops. Traditional rain-fed cereals such as jowar and bajra coexist with commercial crops like onion and an increasing area under fodder crops, particularly due to the growing importance of dairy farming. While diversified cropping systems are generally associated with risk reduction and income stability, crop specialization in high-value crops often involves higher input costs and greater exposure to market and climatic fluctuations. These contrasting strategies have direct implications for the cost–benefit dynamics of farming systems.

The cost–benefit structure of agriculture, reflected through production costs, gross returns, and benefit–cost ratios, provides a crucial basis for understanding farmers' income stability. In semi-arid areas, where production risks are high, economic outcomes depend not only on the profitability of individual crops but also on the overall cropping pattern adopted by farmers. This study examines the interrelationship between cropping decisions, cost–benefit dynamics, and income stability of farmers in Shevgaon tehsil. By integrating spatial cropping patterns with economic evaluation, the research aims to generate insights into the sustainability and resilience of farming systems and to inform agricultural planning and policy interventions in semi-arid regions of Maharashtra.

Study Area:

Shevgaon tehsil is located at the south of Ahmednagar district between $19^0$13'18'' North to $19^0$33'57'' North Latitude and from $75^0$01'48'' to $75^0$32'44" East Longitude. The total number of villages in the tehsil is 112.

Total area of tehsil is 1031.85sq/km. The area under agriculture is 913.19 sq/km (88.5 %), under forest 11.57 sq/km (1.12 %), and remaining 107.09 sq/km (10.38 %) is used for other purpose. Average rainfall in Shevgaon tehsil is 501.7 mm.

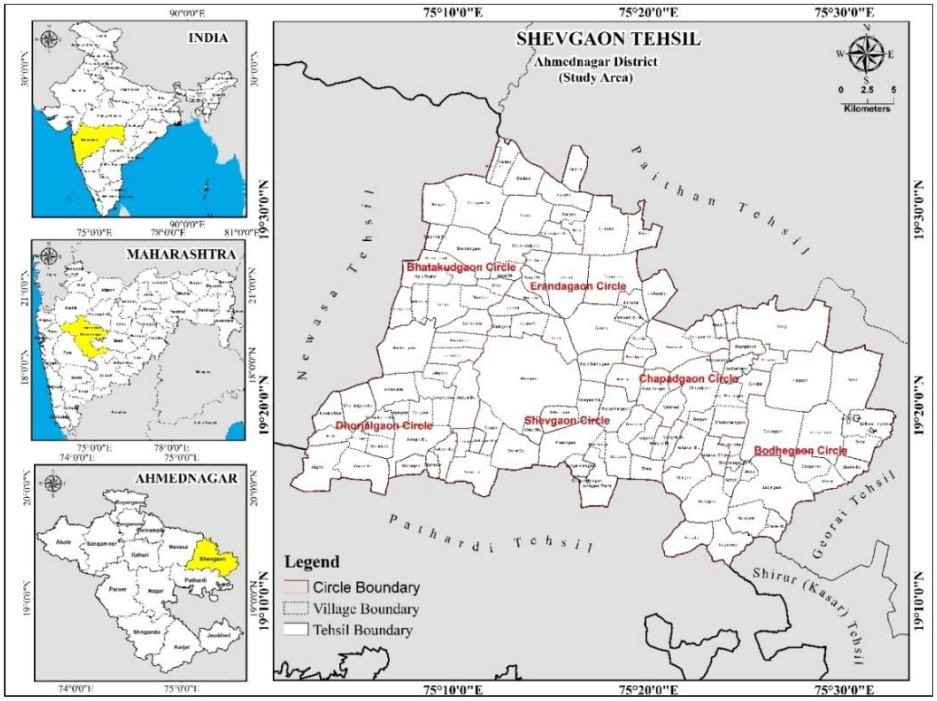

Fig. No. 1 Location map of Study Area

Objectives:

1. To examine cropping decisions in Shevgaon tehsil using crop concentration measures.
2. To analyse the cost–benefit dynamics of major cropping patterns across farming systems.
3. To assess the impact of cropping decisions and cost–benefit structure on farmers' income stability.

Methodology:

The study is based on both primary and secondary data collected for Shevgaon tehsil of Ahilyanagar district, Maharashtra. Primary data were obtained through a structured field survey of selected villages and farm households, covering information on cropping patterns, area under different crops, input use, production costs, yields, and farm income. Secondary data were collected from government records, agricultural reports, and published literature. Crop concentration was analysed using Bhatia's Method (1965) through the Location Quotient technique to determine the degree of spatial specialization of major crops. Cost–benefit dynamics of cropping patterns were assessed using the widely recognized farm management approach, developed by J.R. Hicks (1930s–1940s) and applied to Indian agriculture by P.C. Mahalanobis, by estimating gross returns, net returns, and benefit–cost ratios. Finally, income stability was evaluated by comparing cost–benefit outcomes across diversified and specialized farming systems. The analysis integrates spatial and economic indicators to examine the relationship between cropping decisions, cost–benefit structure, and farmers' income stability under the semi-arid conditions of Shevgaon tehsil.

Formula 1. Crop Concentration Index (CCI) = (a/b) / (A/B)

Formula 2. Benefit–Cost Ratio (BCR) = Gross Returns / Total Costs

Formula 3. Income Stability Index: $CV = \sigma FI / \mu FI * 100$

Data Sources:

The study uses both primary and secondary data to analyze cropping decisions, cost–benefit dynamics, and income stability of farmers in Shevgaon Tehsil. Primary data were collected through structured surveys of selected villages and farm households, covering information on cropping patterns, area under different crops, input usage, production costs, crop yields, and farm income. Secondary data were obtained from government records, including the Agriculture Department and local panchayat offices, covering village-level cropped area, irrigation facilities, soil types, crop productivity, and seasonal cropping patterns. Additional data on farm-gate crop prices, availability of seeds and fertilizers, and access to agricultural extension services and credit facilities helped in understanding market and management conditions.

Analysis and Discussion:

1. **Crop Concentration Index:**

Table No. 1 Crop Concentration Index – 2011-2021

Sr. No.	Revenue Circle→ Crops↓	Shevgaon	Bhatkudgaon	Bodhegaon	Chapadgaon	Dhorjalgaon	Erandgaon
1	Sugarcane	1.27	1.61	0.67	1.26	1.46	1.81
2	Cotton	1.38	0.71	1.42	1.74	1.41	1.36
3	Onion	1.21	1.31	1.08	1.05	1.36	1.41
4	Wheat	1.41	1.22	0.33	0.68	0.92	1.36
5	Jowar	1.54	1.19	1.81	1.51	1.09	1.02
6	Bajra	1.61	1.21	1.61	1.56	1.08	1.06

Source: Compile and calculated by researcher - Tehsil Agriculture Data (Pik Pahani Ahaval 2011-2021)

The Crop Concentration Index (CCI) values reveal marked spatial variations in cropping patterns across the six revenue circles of Shevgaon Tehsil during 2011–2021, (Table No. 1) indicating differing levels of agricultural specialization. An index value greater than 1 indicates higher concentration compared to the tehsil average, whereas a value below 1 suggests lower concentration.

Sugarcane shows very high concentration in Erandgaon (1.81), Bhatkudgaon (1.61), and Dhorjalgaon (1.46), reflecting assured irrigation and capital-intensive farming systems, while Bodhegaon (0.67) exhibits low concentration due to its relatively dry conditions. Cotton displays strong concentration in Chapadgaon (1.74), Bodhegaon (1.42), and Dhorjalgaon (1.41), suggesting suitability of soil and climatic conditions, whereas Bhatkudgaon (0.71) records below-average concentration. Onion cultivation is moderately to highly concentrated across most circles, particularly in Erandgaon (1.41) and Dhorjalgaon (1.36), indicating its importance as a commercial crop supported by irrigation and market access. Wheat shows high concentration in Shevgaon (1.41), Erandgaon (1.36), and Bhatkudgaon (1.22), but very low concentration in Bodhegaon (0.33) and Chapadgaon (0.68), again highlighting agro-climatic constraints.

Coarse cereals such as jowar and bajra exhibit relatively high concentration across almost all revenue circles, signifying their resilience and adaptability to semi-arid conditions. Jowar is highly concentrated in Bodhegaon (1.81), Shevgaon (1.54), and Chapadgaon (1.51), indicating its role as a staple and risk-minimizing crop in drought-prone areas. Similarly, bajra records strong concentration in Shevgaon (1.61), Bodhegaon (1.61), and Chapadgaon (1.56), reflecting farmers' preference for hardy crops requiring low inputs. Overall, the CCI analysis underscores a clear differentiation between irrigated circles specializing in water-intensive and commercial crops, and less irrigated or dry circles favoring coarse cereals. This spatial specialization reflects the combined influence of irrigation availability, rainfall variability, soil conditions, and market orientation, shaping cropping decisions and regional agricultural structure within Shevgaon Tehsil.

2. **Cost Structure of Major Crops:**

The cost structure of major crops in the study area, as presented in Table No. 2, clearly indicates wide variation in input use and total production costs across different crops. Sugarcane emerges as the most cost-intensive crop with a total cost of ₹1,26,000 per hectare, largely due to very high labour, fertilizer, irrigation, and harvesting expenses, reflecting its long duration and input-intensive nature. Onion and cotton also show relatively high total costs (₹72,000 and ₹69,000 per hectare, respectively), driven mainly by higher labour, fertilizer, plant protection, and irrigation requirements.

Table No. 2 Cost Structure of Major Crops (₹/ha)

Sr. No.	Cost Components	Production Costs ₹ / ha					
		Sugarcane	**Cotton**	**Onion**	**Wheat**	**Jawar**	**Bajara**
	Variable Costs						
1	Seed (Setts)	10,000	7,000	8,000	3,500	2,500	2,000
2	Fertilizer & Manure	18,000	10,000	12,000	11,000	7,000	6,000
3	Labour	38,000	22,000	20,000	14,000	10,500	9,000
4	Irrigation (Water, electricity/diesel)	15,000	8,000	10,000	8,000	4,000	3,500
	Weeding / Inter-cultivation	6,000	4,000	6,000	3,000	3,000	2,500
5	Plant Protection	6,000	8,000	6,000	2,000	1,500	1,000
6	Machinery for Land Preparation	8,000	4,000	4,000	4,000	2,500	2,000
7	Harvesting & Transport	15,000	6,000	4,000	3,500	3,000	2,000
	Total Variable Cost (TVC)	**1,16,000**	**60,000**	**70,000**	**42,000**	**30,000**	**28,000**
	Fixed Costs						
8	Land Rent (Imputed value)	5,000	4,000	1,000	4,000	2,000	1,200
9	Depreciation on Implements & Machinery	3,000	3,000	700	2,000	1,200	500
10	Interest on Fixed Capital	2,000	2,000	300	0,000	800	300
	Total Fixed Cost (TFC)	**10,000**	**9,000**	**2,000**	**6,000**	**4,000**	**2,000**
	Total Cost (TC)	**1,26,000**	**69,000**	**72,000**	**48,000**	**34,000**	**30,000**

Source: Compiled by author from SOF (Scale of Finance) NABARD, 2024-25

Wheat occupies a middle position with a total cost of ₹48,000 per hectare, indicating moderate input use and relatively lower risk. In contrast, jowar and bajara record the lowest production costs (₹34,000 and ₹30,000 per hectare, respectively), owing to their low seed, fertilizer, irrigation, and plant protection requirements, highlighting their suitability for semi-arid and low-resource conditions. Overall, the table demonstrates that variable costs constitute the major share of total cost for all crops, while fixed costs remain comparatively small, emphasizing the importance of input management and cost control in improving farm profitability.

3. **Net Returns:**

Inter-crop and inter-circle variations in net returns among the major crops cultivated in the study area are clearly reflected in Table No. 3. Among all crops, onion records the highest net returns in every revenue circle, with particularly high returns in Bodhegaon (₹2,55,360/ha) and Chapadgaon (₹2,53,080/ha), indicating the strong profitability of commercial vegetable cultivation in these circles. Sugarcane emerges as the second-highest return crop, especially in Bodhegaon (₹1,27,680/ha) and Chapadgaon (₹1,26,540/ha), reflecting the advantage of better irrigation conditions.

Table No. 3 Net Returns of Major Crops (₹/ha)

Sr. No.	Crops → Revenue Circle ↓	Sugarcane	Cotton	Onion	Wheat	Jowar	Bajra
1	**Shevgaon**	1,08,300	17,820	2,50,800	35,200	19,000	19,000
2	**Bhatkudgaon**	1,07,160	17,496	2,14,320	30,080	21,600	21,600
3	**Bodhegaon**	1,27,680	15,066	2,55,360	35,840	18,600	18,600
4	**Chapadgaon**	1,26,540	14,742	2,53,080	35,520	18,200	18,200
5	**Dhorjalgaon**	1,09,440	17,658	2,18,880	34,880	21,800	21,800
6	**Erandgaon**	1,09,440	17,172	2,18,880	33,920	21,200	21,200

Source: Compiled by author from SOF (Scale of Finance) NABARD, 2024-25

In contrast, cotton shows comparatively low net returns, with the lowest values observed in Chapadgaon (₹14,742/ha) and Bodhegaon (₹15,066/ha), suggesting higher production risk and cost sensitivity. Wheat provides moderate and relatively stable net returns across all circles, ranging from ₹30,080/ha in Bhatkudgaon to ₹35,840/ha in Bodhegaon. The lowest net returns are recorded for jowar and bajra, particularly in Chapadgaon and Bodhegaon, though their performance improves slightly in drought-prone circles such as Bhatkudgaon and Dhorjalgaon, underlining their role as low-risk, subsistence-oriented crops rather than high-return enterprises.

4. **Crop-wise Behaviour:**

Table No. 4 Crops behaviour

Sr. No.	Crop	ISI Level	Reality Check
1	**Onion**	Very High	High return but **price volatility, storage & market risk**
2	**Sugarcane**	High	Stable where irrigation exists
3	**Wheat**	Moderate	Stable, low risk
4	**Jowar**	Moderate	Climate-resilient, low input
5	**Bajra**	Moderate	Drought tolerant
6	**Cotton**	Low–Moderate	High risk, pest & cost sensitive

Source: Author's calculations based on primary survey data and supported by published literature (CACP Reports; FAO, 2018; Birthal & Roy, 2009; Government of India, Ministry of Agriculture).

5. **Benefit Cost Ratio with Income Stability:**

The ISI values in Table No. 5 clearly validate the crop-wise stability classification. Onion records the highest ISI across all revenue circles, ranging from 2.76 in Dhorjalgaon to as high as 3.34 in Shevgaon, along with an exceptionally high BCR of 3.31–4.17. This combination confirms onion as a high-return crop, but the very high ISI reflects income variability caused by price fluctuations, perishability, and market dependence rather than production stability. In contrast, sugarcane shows consistently high ISI values (1.18 to 2.18) with a stable BCR between 1.62 and 1.92, particularly strong in Bodhegaon (ISI 2.18) and Bhatkudgaon (ISI 1.51), establishing a direct relationship between assured irrigation and income stability. This supports its classification as a high ISI crop with dependable returns where water availability exists.

Table No. 5 BCR and ISI Index Value

Sr. No.	Revenue Circle→ Crops↓	Shevgaon		Bhatkudgaon		Bodhegaon		Chapadgaon		Dhorjalgaon		Erandgaon	
		BCR	ISI	BCR	ISI	BCR	ISI	BCR	ISI	BCR	ISI	BCR	ISI
1	Sugarcane	1.71	1.44	1.91	1.51	1.62	2.18	1.71	1.58	1.92	1.18	1.91	1.41
2	Cotton	1.23	1.24	1.24	0.25	1.23	1.17	1.23	1.17	1.24	1.22	1.23	0.22
3	Onion	4.17	**3.34**	3.31	**3.02**	3.33	**2.92**	3.31	**2.96**	3.34	**2.76**	3.34	2.80
4	Wheat	1.68	0.47	1.67	1.42	1.67	0.41	1.67	0.41	1.67	1.14	1.67	1.33
5	Jowar	1.59	0.25	1.59	0.30	1.59	1.21	1.59	1.20	1.59	1.27	1.59	0.24
6	Bajra	1.67	0.26	1.67	0.32	1.67	1.23	1.67	1.21	1.67	0.29	1.67	0.26

Source: Author's calculations based on secondary primary survey data- 2024-25

Further, wheat exhibits moderate ISI values, ranging from 0.41 to 1.42, with a uniform BCR of about 1.67–1.68 across circles, indicating low risk and stable but moderate income, aligning with its role as a food-security crop rather than a profit-maximizing one. Jowar and bajra, both showing moderate ISI levels (jowar: 0.24–1.27, bajra: 0.26–1.23) and stable BCRs around 1.59–1.67, demonstrate their importance as climate-resilient, low-input crops, especially in drought-prone circles like Dhorjalgaon and Bhatkudgaon, where their ISI values are relatively higher. Conversely, cotton records the lowest to moderate ISI values, dropping to 0.22–0.25 in Bhatkudgaon and Erandgaon, despite a modest BCR of around 1.23–1.24, indicating high exposure to pest incidence and cost sensitivity. Overall, the relationship between BCR and ISI confirms that higher profitability does not always imply income stability, and crops like wheat, jowar, and bajra play a crucial role in stabilizing farm income across revenue circles.

6. **Crop Suitability and Potential Matrix:**

Table No. 6 Crop Suitability Matrix

Sr. No.	**Revenue Circle**	**Highly Suitable Crops**	**Moderately Suitable**	**Risk-Prone Crops**
1	Shevgaon	Sugarcane, Cotton	Wheat	Onion
2	Bhatkudgaon	Sugarcane, Wheat	Cotton	Onion
3	Bodhegaon	Jowar, Bajra	Cotton	Onion, Sugarcane
4	Chapadgaon	Jowar, Bajra	Cotton	Onion, Sugarcane
5	Dhorjalgaon	Cotton, Jowar	Wheat, Sugarcane	Onion
6	Erandgaon	Sugarcane, Onion	Wheat	Cotton

Source: Author's calculations based on primary survey data and supported by published literature (CACP Reports; FAO, 2018; Birthal & Roy, 2009; Government of India, Ministry of Agriculture).

The Crop Suitability and Potential Matrix presented in Table No. 6 clearly demonstrates how cropping decisions, when aligned with the cost–benefit structure and local resource conditions, directly influence farmers' income stability, thereby fulfilling the stated research objective. Revenue circles with assured irrigation and relatively stable input environments, such as Shevgaon and Bhatkudgaon, show sugarcane and wheat as highly suitable crops, as these crops combine moderate-to-high Benefit–Cost Ratios with comparatively stable Income Stability Index (ISI) values. Although cotton appears highly suitable in Shevgaon due to favorable returns, its classification as only moderately or conditionally suitable in other circles reflects the sensitivity of income stability to rising input costs and pest risks. Onion is consistently placed under risk-prone crops in most circles despite high gross returns, indicating that price volatility and post-harvest losses outweigh its cost advantage, thereby reducing income stability.

In contrast, Bodhegaon and Chapadgaon, characterized by semi-arid conditions and higher production risk, show jowar and bajra as highly suitable crops, highlighting the importance of low-cost, climate-resilient cereals in stabilizing farm income. These crops require lower variable costs and generate modest but predictable returns, which improves income stability despite lower profitability. Dhorjalgaon, being drought-prone, further reinforces this relationship, where jowar and cotton emerge as relatively suitable, while onion remains highly risky. Erandgaon, with better irrigation, shows sugarcane and onion as highly suitable; however, onion's inclusion here is more opportunity-driven than stability-driven, emphasizing that income stability depends not only on returns but also on the variability of costs and prices. Overall, the matrix confirms that income stability improves when farmers prioritize crops with balanced cost structures and lower variability rather than merely higher gross returns.

7. **Final Outcomes of the Research:**

The study yields five key outcomes: (i) Cropping pattern decisions significantly affect income stability, with low-input, climate-resilient crops offering greater stability in semi-arid and drought-prone circles; (ii) High-return crops like onion are not necessarily income-stable, due to strong market and price risks; (iii) Sugarcane enhances income stability only in irrigation-assured regions, highlighting the role of resource endowment; (iv) Millets such as jowar and bajra act as income stabilizers, especially where production risk is high and capital availability is low; and (v) Region-specific crop planning is essential, as uniform crop promotion policies may increase income risk rather than reduce it. Collectively, these outcomes support a location-specific, cost–benefit–oriented cropping strategy as a sustainable pathway for improving farmers' income stability.

Conclusion:

The present study clearly establishes that cropping decisions in semi-arid Shevgaon tehsil are strongly shaped by the interplay of agro-climatic conditions, irrigation availability, and cost–benefit dynamics. The analysis of crop concentration patterns reveals a dual structure of agriculture: irrigated revenue circles such as Shevgaon and Erandgaon exhibit specialization in sugarcane, wheat, and onion, while relatively dry circles like Bodhegaon, Chapadgaon, and Dhorjalgaon rely more on jowar and bajra. The cost structure analysis further highlights that crops with high gross returns, particularly onion and sugarcane, are also associated with high input costs and greater exposure to market and price risks. In contrast, coarse cereals incur lower production costs and provide more predictable, though modest, returns.

The integration of Benefit–Cost Ratio (BCR) and Income Stability Index (ISI) provide critical insights into farmers' income stability. The findings confirm that higher profitability does not automatically translate into stable income. Onion, despite its very high net returns and BCR, exhibits high income instability due to price volatility and perishability, making it a risk-prone crop in most revenue circles. Sugarcane offers relatively stable income only where irrigation is assured, whereas wheat, jowar, and bajra emerge as stability-enhancing crops because of their moderate costs and lower variability in returns. Overall, the study concludes that income stability in semi-arid regions is best achieved through region-specific crop planning

that balances profitability with cost control and risk mitigation rather than excessive dependence on high-value commercial crops.

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The authors declare that there are no conflicts of interest regarding the publication of this paper.

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