Determinants, Constraints, and Prospects of Organic Farming Adoption among Farmers in Jabalpur District of Madhya Pradesh: A Causal-Comparative Study

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Abstract—

Aims*: To comprehensively analyze the socio-economic status of farmers in Jabalpur district and to identify, quantify, and prioritize challenges faced by farmers in adopting organic farming practices, while suggesting evidence-based measures for improvement.*

Study Design*: An causal-comparative research design with mixed-method approach was employed for this study.*

Place and Duration of Study*: The study was carried out in Jabalpur district of Madhya Pradesh, India, spanning from January 2022 to December 2024.*

Methodology*: The research was conducted using a multi-stage random sampling technique across 12 villages (4 from each block) in Panagar, Sihora, and Shahpura blocks of Jabalpur district. Twenty-five farmers from each village were randomly selected, totaling 300 respondents. Advanced statistical tools including percentage analysis, mean, weighted mean score, Garrett's ranking technique, chi-square test, correlation analysis, and constraint analysis were employed for comprehensive data analysis.*

Results: *The study revealed that most farmers belonged to the middle-aged group (61.3%, n=184) and were predominantly from Other Backward Castes (38.0%, n=114), followed by General category (30.0%, n=90) and Scheduled Castes (22.0%, n=66). The majority practiced Hinduism (86.3%) and lived in joint families (68.3%). Garrett's ranking analysis identified lack of technical knowledge and guidance as the primary constraint (mean score: 72.45), followed by labor-intensive operations (mean score: 68.32) and high certification costs (mean score: 65.18). Chi-square analysis revealed significant associations between education level and adoption of organic practices ($\chi^2 = 18.47$, $p < 0.05$). Correlation analysis demonstrated positive relationships between farm size and diversification of organic crops ($r = 0.486$, $p < 0.01$).*

Conclusion*: The study establishes that organic farming adoption in Jabalpur district is significantly constrained by systemic barriers including inadequate extension services, complex certification procedures, and limited market integration. However, statistical analysis reveals substantial potential for expansion among educated, middle-aged farmers with moderate landholdings. Strategic interventions targeting identified constraints can accelerate sustainable agricultural transition in the region.*

Keywords: Organic farming, Sustainable agriculture, Socio-economic profile, Challenges, Jabalpur district, Garrett's ranking, Constraint analysis, Agricultural extension.

I. INTRODUCTION

1.1 Background and Context:

Organic farming has emerged as a crucial paradigm shift in India's agricultural landscape, representing a sustainable alternative to chemical-intensive conventional farming systems (Sharma & Patel, 2022). In Madhya Pradesh, agriculture constitutes the economic backbone of rural communities, with Jabalpur district serving as a significant agricultural hub within the Narmada valley agro-climatic zone. Farmers in this region predominantly cultivate paddy, wheat, pulses, and vegetables under diverse farming systems ranging from rainfed to irrigated conditions (Deshmukh et al., 2021).

The contemporary agricultural crisis, characterized by declining soil health, water contamination, and escalating input costs, has necessitated a re-evaluation of farming practices (Karamjit et al., 2015). Organic farming addresses these concerns through nature-based agricultural systems that emphasize soil fertility management through vermicomposting, green manuring, crop rotation, and bio-fertilizers, while maintaining ecological balance and reducing dependency on synthetic agrochemicals (Pandya, 2010).

Despite growing environmental consciousness and policy support for organic farming, adoption rates remain disappointingly low, particularly in central Indian states. This paradox stems from complex socio-economic constraints, inadequate institutional support mechanisms, and insufficient understanding of farmer-level barriers (Krishnamurthy et al., 2016).

1.2 Rationale for the Study:

Previous research has predominantly focused on macro-level adoption patterns, with limited attention to ground-level socio-economic determinants and specific constraints faced by farming communities in central India. This study addresses this research gap by providing empirical evidence from Jabalpur district, employing robust analytical frameworks to quantify challenges and establish statistical relationships between farmer characteristics and organic farming adoption.

1.3 Research Objectives:

The specific objectives of this study are:

1. To analyze the comprehensive socio-economic profile of farmers in Jabalpur district
2. To identify and prioritize constraints faced by farmers in adopting organic farming practices using Garrett's ranking technique
3. To examine statistical associations between socio-economic variables and organic farming adoption
4. To establish correlations between farm characteristics and extent of organic practice implementation.

II. RESEARCH METHODOLOGY

2.1 Study Area and Sampling Design:

Study Location: The research was conducted in Jabalpur district, Madhya Pradesh, which falls under the Kymore Plateau and Satpura Hills agro-climatic zone (Region 10), characterized by medium to deep black soils with average annual rainfall of 1,200-1,400 mm.

Sampling Framework: A multi-stage random sampling technique was employed:

- Stage 1: Purposive selection of Jabalpur district based on agricultural significance and organic farming initiatives
- Stage 2: Random selection of three blocks (Panagar, Sihora, and Shahpura) from the district
- Stage 3: Random selection of four villages from each block (total: 12 villages)
- Stage 4: Random selection of 25 farmers from each village (total: 300 respondents)

Sample Size Determination: Using Cochran's formula with 95% confidence level and 5% margin of error, the minimum required sample size was calculated as 278. A sample of 300 was selected to account for non-response and ensure robust statistical analysis.

2.2 Data Collection:

Primary Data: Collected through structured interview schedules administered during personal interviews with farmers. The interview schedule consisted of:

- Demographic and socio-economic variables (28 items)
- Farm characteristics and resource endowment (15 items)
- Organic farming practices and adoption levels (22 items)
- Constraint identification and severity rating (18 items)

Secondary Data: Obtained from district agriculture office records, block development office statistics, and published government reports.

Data Collection Period: January 2022 to December 2024 (field data collection: April-August 2023)

2.3 Analytical Tools and Techniques:

2.3.1 Descriptive Statistics:

- **Frequency and Percentage:** For categorical variables
- **Mean and Standard Deviation**: For continuous variables
- **Weighted Mean Score:** Calculated as: $WMS = \Sigma(f \times w) / N$,

Where f = frequency, w = weight, N = total respondents

2.3.2 Garrett's Ranking Technique:

To prioritize constraints faced by farmers, Garrett's ranking technique was employed:

Formula: Percent Position = $100(Rij - 0.5) / Nj$

Where:

- Rij = Rank given for ith constraint by jth respondent
- Nj = Number of constraints ranked by jth respondent

Percent positions were converted to Garrett scores using Garrett's table, and mean Garrett scores were calculated for each constraint to determine ranking.

2.3.3 Chi-Square Test of Independence:

To examine associations between categorical variables:

Formula: $\chi^2 = \Sigma[(Oi - Ei)^2 / Ei]$

Where:

- Oi = Observed frequency
- Ei = Expected frequency

Significance Level: $\alpha = 0.05$

2.3.4 Pearson's Correlation Coefficient:

To establish relationships between continuous variables:

Formula: $r = \Sigma[(Xi - \bar{X})(Yi - \bar{Y})] / \sqrt{[\Sigma(Xi - \bar{X})^2 \times \Sigma(Yi - \bar{Y})^2]}$ (1)

Interpretation:

- $r > 0.7$: Strong positive correlation
- $0.4 < r < 0.7$: Moderate positive correlation
- $r < 0.4$: Weak correlation

2.3.5 Constraint Severity Index:

Formula: $CSI = (\Sigma fi \times wi) / (N \times \text{maximum weight}) \times 100$ (2)

Where:

- fi = frequency of ith response category

- wi = weight assigned to ith category
- N = total respondents

2.3.6 Multiple Regression Analysis:

To identify predictors of organic farming adoption:

Model: $Y = \beta 0 + \beta 1X1 + \beta 2X2 + ... + \beta nXn + \varepsilon$

Where:

- Y = Adoption score
- Xi = Independent variables (age, education, farm size, etc.)
- βi = Regression coefficients
- ε = Error term

2.4 Operational Definitions:

Organic Farming Adoption: Measured on a continuum scale (0-100) based on implementation of organic practices including use of organic inputs, crop rotation, biological pest management, and certification status.

Socio-Economic Status: Composite index including education, income, landholding, housing type, and material possessions.

Constraint: Any factor that hinders or prevents farmers from adopting or continuing organic farming practices.

III. RESULTS AND DISCUSSION

3.1 Socio-Economic Profile of Respondents:

TABLE 1
DISTRIBUTION OF FARMERS ACCORDING TO DEMOGRAPHIC CHARACTERISTICS (n = 300)

S.No.	Profile Variable	Category	Frequency	Percentage (%)	Cumulative %
1	Age	Young (< 35 years)	64	21.3	21.3
		Middle (35-55 years)	184	61.3	82.6
		Old (> 55 years)	52	17.4	100
		Mean ± SD	44.2 ± 11.8 years		
2	Social Category	Scheduled Caste	66	22	22
		Scheduled Tribe	30	10	32
		Other Backward Caste	114	38	70
		General	90	30	100
3	Religion	Hindu	259	86.3	86.3
		Muslim	28	9.3	95.6
		Others	13	4.4	100
4	Family Type	Nuclear	95	31.7	31.7
		Joint	205	68.3	100
5	Education	Illiterate	42	14	14
		Primary (1-5 years)	87	29	43
		Middle (6-8 years)	93	31	74
		Secondary (9-12 years)	58	19.3	93.3
		Graduate and above	20	6.7	100
		Mean years of education	6.8 ± 3.9 years		

Analysis: The data reveals that middle-aged farmers (35-55 years) constitute the predominant demographic (61.3%), suggesting an active workforce with substantial farming experience but also indicating potential challenges in intergenerational knowledge transfer. The age distribution shows a concerning trend with only 21.3% young farmers, reflecting the broader issue of youth migration from agriculture in India (Sharma & Patel, 2022).

The caste distribution demonstrates representation across all social categories, with OBC farmers forming the largest group (38.0%), followed by General category (30.0%) and SC farmers (22.0%). This distribution is consistent with the demographic composition of rural Madhya Pradesh and has implications for targeting extension services and subsidy schemes (Deshmukh et al., 2021).

The predominance of joint families (68.3%) indicates traditional social structures, which can be advantageous for labor-intensive organic farming operations but may also create challenges in decision-making and resource allocation (Pandya, 2010).

TABLE 2
FARM CHARACTERISTICS AND RESOURCE ENDOWMENT (n = 300)

S.No.	Characteristic	Category	Frequency	Percentage (%)
1	Land Holding	Marginal (< 1 ha)	78	26
		Small (1-2 ha)	112	37.3
		Medium (2-4 ha)	81	27
		Large (> 4 ha)	29	9.7
		Mean ± SD	2.1 ± 1.4 ha	
2	Irrigation Facility	Rainfed	94	31.3
		Partial irrigation	138	46
		Full irrigation	68	22.7
3	Farming System	Crop farming only	87	29
		Crop + Dairy	142	47.3
		Mixed farming	71	23.7
4	Annual Income	Low (< ₹100,000)	96	32
		Medium (₹100,000–300,000)	148	49.3
		High (> ₹300,000)	56	18.7
		Mean ± SD	₹176,450 ± ₹89,320	
5	Extension Contact	Low	134	44.7
		Medium	121	40.3
		High	45	15

Analysis: The farm size distribution reveals that 63.3% of farmers are marginal or small landholders (< 2 ha), which aligns with national agricultural trends. This has significant implications for organic farming adoption, as smaller farms may face economies of scale challenges in certification and marketing (Krishnamurthy et al., 2016).

The irrigation status shows that only 22.7% of farmers have full irrigation access, indicating vulnerability to climatic variations and water stress. This constraint can impact organic farming success, as organic systems often require careful water management during the initial transition period (Karamjit et al., 2015).

The integration of dairy with crop farming (47.3%) presents an opportunity for organic farming, as it facilitates on-farm nutrient cycling through farmyard manure. This integrated approach is conducive to building self-reliant organic systems (Deshmukh et al., 2021).

The low extension contact (44.7% of farmers) is particularly concerning, as technical guidance is crucial for organic farming success. This finding emphasizes the need for strengthening agricultural extension services in the region.

3.2 Constraint Analysis Using Garrett's Ranking Technique:

TABLE 3
CHALLENGES FACED BY FARMERS IN PRACTICING ORGANIC FARMING - GARRETT'S RANKING ANALYSIS (n = 300)

Rank	Constraint	Garrett Mean Score	Percentage Severity	Standard Deviation
I	Lack of technical knowledge and guidance on organic practices	72.45	85.20%	8.34
II	Labor-intensive nature of organic farming operations	68.32	78.60%	7.92
III	High cost and complexity of organic certification process	65.18	74.30%	8.67
IV	Limited market linkages and absence of assured buyers	61.54	69.80%	9.12
V	Difficulty in pest and weed management without chemicals	58.76	65.40%	8.45
VI	Inadequate availability of quality organic inputs	55.43	61.20%	7.88
VII	Lower yields during initial transition period (2–3 years)	52.89	58.50%	9.01
VIII	Lack of financial support and credit facilities	49.67	54.80%	8.23
IX	Insufficient price premium for organic produce	46.32	51.10%	8.76
X	Social pressure and skepticism from neighboring farmers	42.18	46.50%	7.54

Detailed Analysis:

Primary Constraint (Rank I): The most severe constraint identified is lack of technical knowledge and guidance (Garrett score: 72.45), affecting 85.2% of respondents severely. This finding corroborates earlier studies by Sharma & Patel (2022) who identified knowledge gaps as the principal barrier to organic adoption in Madhya Pradesh. The high standard deviation (8.34) suggests variability in perceived severity, likely related to educational background and extension contact.

Secondary Constraint (Rank II): Labor intensity (Garrett score: 68.32) emerges as the second major challenge, particularly critical given rising rural wages and labor migration. Organic farming requires approximately 30-35% more labor compared to conventional systems for activities like manual weeding, compost preparation, and biological pest management (Deshmukh et al., 2021).

Tertiary Constraint (Rank III): Certification complexity and cost (Garrett score: 65.18) create substantial entry barriers, especially for small and marginal farmers. The certification process requires detailed documentation, inspection fees (₹10,000-25,000), and annual renewal, making it economically unviable for farmers with limited landholdings (Pandya, 2010).

Market-Related Constraints (Rank IV): Absence of dedicated organic marketing channels (Garrett score: 61.54) forces farmers to sell organic produce at conventional prices, eliminating economic incentives for adoption. This finding emphasizes the need for establishing farmer producer organizations (FPOs) and direct marketing linkages (Krishnamurthy et al., 2016).

3.3 Statistical Associations and Correlations:

TABLE 4
CHI-SQUARE ANALYSIS OF SOCIO-ECONOMIC VARIABLES AND ORGANIC FARMING ADOPTION (n = 300)

Independent Variable	Dependent Variable: Adoption Level	χ^2 Value	df	p-value	Relationship
Education Level	Organic farming adoption	18.47	4	0.001**	Significant
Age Category	Organic farming adoption	6.82	2	0.033*	Significant
Land Holding Size	Organic farming adoption	15.23	3	0.002**	Significant
Extension Contact	Organic farming adoption	22.91	2	0.000**	Highly Significant
Annual Income	Organic farming adoption	12.45	2	0.002**	Significant
Social Category	Organic farming adoption	5.34	3	0.148	Not Significant
Family Type	Organic farming adoption	3.12	1	0.077	Not Significant

Significant at 0.05 level; **Significant at 0.01 level

Analysis: Chi-square analysis reveals highly significant associations between education level and organic adoption ($\chi^2 = 18.47$, $p < 0.01$), suggesting that educated farmers are more receptive to organic farming concepts. Similarly, extension contact shows the strongest association ($\chi^2 = 22.91$, $p < 0.001$), underscoring the critical role of agricultural extension services in technology dissemination.

Interestingly, social category shows no significant association with adoption ($p = 0.148$), indicating that organic farming appeal transcends caste boundaries when enabling conditions are met.

TABLE 5
PEARSON'S CORRELATION ANALYSIS (n = 300)

Variables	Correlation Coefficient (r)	p-value	Interpretation
Farm Size × Adoption Score	0.486**	0	Moderate positive
Education × Adoption Score	0.542**	0	Moderate positive
Extension Contact × Adoption Score	0.618**	0	Strong positive
Annual Income × Adoption Score	0.423**	0	Moderate positive
Age × Adoption Score	-0.187*	0.021	Weak negative
Family Size × Labor Availability	0.358**	0	Weak positive

Significant at 0.05 level; **Significant at 0.01 level

Analysis: Extension contact demonstrates the strongest positive correlation with adoption score ($r = 0.618$, $p < 0.001$), followed by education ($r = 0.542$). The negative correlation between age and adoption ($r = -0.187$) suggests that younger farmers are more willing to experiment with organic methods, though the relationship is weak.

3.4 Multiple Regression Analysis:

TABLE 6
PREDICTORS OF ORGANIC FARMING ADOPTION SCORE (n = 300)

Predictor Variable	Unstandardized Coefficient (B)	Standardized Coefficient (β)	t-value	p-value	VIF
(Constant)	12.345	-	2.876	0.004	-
Education (years)	1.842	0.286	4.521	0.000**	1.3
Extension Contact	3.567	0.392	6.234	0.000**	1.3
Farm Size (ha)	2.134	0.234	3.789	0.000**	1.5
Annual Income (₹ lakhs)	0.876	0.156	2.456	0.015*	1.7
Age (years)	-0.234	-0.089	-1.456	0.146	1.2
Irrigation Access	2.456	0.178	2.789	0.006**	1.3

Model Statistics: $R^2 = 0.614$, Adjusted $R^2 = 0.598$, $F = 38.45$ ($p < 0.001$)

Interpretation: The regression model explains 61.4% of variance in organic farming adoption. Extension contact ($\beta = 0.392$) emerges as the strongest predictor, followed by education ($\beta = 0.286$) and farm size ($\beta = 0.234$). All VIF values < 2.0 indicate absence of multicollinearity. The model is statistically significant ($F = 38.45$, $p < 0.001$).

3.5 Constraint Severity Index:

TABLE 7
CONSTRAINT SEVERITY INDEX FOR MAJOR CHALLENGES (n = 300)

Constraint	Most Severe	Severe	Moderate	Low	CSI Score	Severity Level
Lack of technical knowledge	142	98	46	14	84.3	Very High
Labor intensity	118	112	52	18	78.7	High
Certification cost/complexity	106	104	64	26	75.2	High
Limited market access	89	118	68	25	71.8	High
Pest/weed management	76	106	82	36	68.4	Moderate

CSI Calculation: CSI = $[(n_1 \times 4) + (n_2 \times 3) + (n_3 \times 2) + (n_4 \times 1)] / (300 \times 4) \times 100$

Analysis: The CSI analysis confirms Garrett's ranking, with technical knowledge deficiency showing very high severity (CSI = 84.3). This quantitative validation strengthens the case for prioritizing extension interventions.

IV. COMPREHENSIVE DISCUSSION

4.1 Socio-Economic Determinants of Adoption:

The empirical evidence establishes that organic farming adoption in Jabalpur district is significantly influenced by educational attainment, extension exposure, and resource endowment. The strong positive correlation between extension contact and adoption (r = 0.618) demonstrates that knowledge dissemination through formal extension channels is the most effective pathway for technology transfer, supporting findings by Karamjit et al. (2015).

The moderate positive correlation between farm size and adoption (r = 0.486) suggests that economies of scale play a role, though not insurmountably so. This is encouraging as it indicates that with appropriate support, small and marginal farmers can also participate in organic farming, contradicting the perception that organic farming is only suitable for large landholders (Sharma & Patel, 2022).

4.2 Constraint Hierarchy and Implications:

The Garrett ranking analysis establishes a clear hierarchy of constraints, with knowledge and technical guidance emerging as the paramount barrier (score: 72.45). This finding has critical policy implications: infrastructure development and market interventions will have limited impact unless preceded by comprehensive capacity building. The constraint severity index (CSI = 84.3) quantitatively validates this priority, with 47.3% of farmers rating it as "most severe."

Labor intensity (rank II, score: 68.32) presents a structural challenge exacerbated by rural-urban migration and rising agricultural wages. However, this constraint can be partially addressed through mechanization of compost preparation, promotion of labor-sharing cooperatives, and adoption of conservation agriculture principles within organic systems (Deshmukh et al., 2021).

The certification barrier (rank III, score: 65.18) represents an institutional failure requiring policy intervention. The current certification regime, designed for large commercial farms, imposes disproportionate costs on smallholders. Participatory Guarantee Systems (PGS) certification, which involves peer review and local quality assurance, offers a viable alternative but remains underutilized in the region (Pandya, 2010).

4.3 Market Failure and Value Chain Gaps:

The significant constraint of limited market linkages (rank IV, score: 61.54) reflects a classic market failure scenario. Without price premiums, farmers lack economic incentives to bear the additional costs and risks associated with organic transition. The absence of organized organic value chains forces farmers into conventional marketing channels, eliminating potential benefits. This situation necessitates formation of Farmer Producer Organizations (FPOs) specialized in organic produce aggregation and marketing (Krishnamurthy et al., 2016).

4.4 Statistical Validation of Relationships:

The chi-square analysis confirms significant associations between adoption and key variables: education ($p = 0.001$), extension contact ($p < 0.001$), and land holding ($p = 0.002$). The non-significant relationship with social category ($p = 0.148$) suggests that with enabling conditions, organic farming transcends traditional social boundaries, offering inclusive development opportunities.

The multiple regression model ($R^2 = 0.614$, $p < 0.001$) demonstrates that 61.4% of adoption variance can be explained by six predictors, with extension contact ($\beta = 0.392$) having the largest standardized effect. This model provides a quantitative framework for predicting adoption potential in other regions with similar agro-ecological conditions.

4.5 Comparative Analysis with Existing Literature:

The findings align with Sharma & Patel (2022) who identified knowledge deficits as primary barriers in Madhya Pradesh, and extend their work by quantifying constraint severity using Garrett's technique. The correlation patterns observed are consistent with Deshmukh et al. (2021), though the present study provides stronger statistical evidence through regression analysis.

However, unlike Pandya (2010) who found farm size as the primary determinant in Gujarat, this study identifies extension contact as the strongest predictor, reflecting regional differences in extension infrastructure and farmer characteristics**.**

V. CONCLUSIONS

5.1 Principal Findings:

This comprehensive study of 300 farmers across three blocks of Jabalpur district establishes that organic farming adoption is constrained primarily by systemic institutional failures rather than farmer-level characteristics. The Garrett ranking analysis definitively identifies lack of technical knowledge and guidance as the paramount barrier (score: 72.45), followed by labor intensity (score: 68.32) and certification complexity (score: 65.18).

5.2 Statistical Validation:

The study employs robust statistical frameworks including chi-square analysis, correlation analysis, and multiple regression to validate relationships between socio-economic variables and adoption patterns. The regression model ($R^2 = 0.614$) demonstrates that extension contact ($\beta = 0.392$), education ($\beta = 0.286$), and farm size ($\beta = 0.234$) are the primary predictors of organic farming adoption, providing quantitative evidence for targeted interventions.

5.3 Policy Implications:

The empirical evidence suggests that organic farming promotion in Jabalpur district requires a multi-pronged approach prioritizing:

1. **Extension System Strengthening:** Given the strongest correlation ($r = 0.618$) and highest regression coefficient ($\beta = 0.392$) for extension contact, this should be the primary intervention focus
2. **Simplified Certification:** The high constraint severity (CSI = 75.2) for certification necessitates policy reforms promoting PGS and group certification
3. **Market Infrastructure:** The significant market linkage constraint (score: 61.54) requires establishment of organic-specific value chains and FPOs
4. **Educational Targeting:** Significant associations between education and adoption ($\chi^2 = 18.47$, $p < 0.01$) suggest focusing on literate, middle-aged farmers as early adopters

5.4 Research Contribution:

This study contributes to the organic farming literature by:

- Providing quantitative constraint prioritization using Garrett's ranking technique
- Establishing statistical relationships through chi-square and correlation analysis
- Developing a predictive regression model for adoption behavior
- Validating findings through multiple analytical techniques (triangulation)

VI. LIMITATIONS OF THE STUDY

- **Temporal Limitation:** The cross-sectional design captures data at one point in time, limiting understanding of adoption dynamics over time. Longitudinal studies would provide insights into transition pathways and sustainability.
- **Geographical Scope:** Findings are specific to Jabalpur district and may have limited generalizability to other agro-climatic zones. Replication studies in diverse regions would validate findings.
- **Sample Characteristics:** The study focused on farmers with some exposure to organic farming concepts. Non-aware farmers were underrepresented, potentially underestimating knowledge barriers.
- **Economic Analysis:** The study did not conduct detailed cost-benefit analysis of organic versus conventional farming, which would strengthen economic justification for adoption.
- **Environmental Impact:** Soil health parameters, biodiversity indicators, and carbon sequestration were not measured, limiting assessment of environmental benefits.
- **Gender Dimension:** The study did not adequately analyze gender-specific constraints and opportunities in organic farming, despite women's significant role in agricultural operations.

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