Policy Prescriptions for Conversion to Organic Agriculture- A Study in the Konkan Belt of Maharashtra

Sharmita Ghosh[1] & Arshad Bhat[2]

[1]Research Scholar, Amity Institute of Liberal Arts, Amity University Mumbai, Maharashtra, India; Email id-sarmita_dey@yahoo.co.in

[2]Assistant Professor, Amity Institute of Liberal Arts, Amity University Mumbai, Maharashtra, India; Email id-ahbhat@mum.amity.edu

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ABSTRACT:

In the ecologically fragile and undeveloped Konkan belt of Maharashtra, India, this study assesses the economic feasibility and sociodemographic factors of switching from inorganic (conventional) to organic rice agriculture. The study uses Independent Sample T-tests and a Binary Logistic Regression model to assess economic comparability and forecast adoption probabilities using primary survey data gathered from 188 paddy farmers in the Palghar, Thane, and Raigad districts (94 of whom practise organic farming and 94 of whom practise inorganic farming). The results of the T-test show that organic farming is economically viable. The Binary Logistic Regression model, which correctly classifies 73.9% of the adoption cases, identifies formal education ($p = 0.013$, Odds Ratio = 2.78), livestock ownership ($p = 0.053$, Odds Ratio = 2.097), and structured market access ($p = 0.065$, Odds Ratio = 4.197) as the critical sociodemographic drivers of organic agriculture. A mixed-method triangulation framework is utilised with qualitative studies to overcome the limitations of the quantitative method. The study comes to the conclusion that incorporating livestock, professionalising Farmer Producer Organisations (FPOs), and continuing "hand-holding" are essential to internalising negative externalities and creating a self-sufficient and sustainable rural economy.

Keywords: Organic Agriculture; Economic Viability; Independent Sample T-test; Konkan Belt; Sustainable

1. Introduction

Global food systems currently stand at a critical crossroads. Industrialized, high-input chemical agriculture, while having successfully increased immediate crop production since the mid-20th century, has exacted a severe toll on global environmental systems and public health. The very food systems responsible for delivering food security are major drivers of planetary degradation, contributing to one-third of global greenhouse gas emissions and consuming 70% of the world's freshwater withdrawals. As early as 1987, the Brundtland Report (Our Common Future) warned against an over-reliance on synthetic fertilizers and pesticides, calling upon national governments to develop and subsidize organic plant nutrients and natural pest control methods (WCED, 1987). Today, these sustainable approaches are deeply embedded within the United Nations' 2030 Agenda, aligning closely with Sustainable Development Goal (SDG) 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action). In India, agriculture forms the socio-economic backbone of the rural population. Historically, traditional Indian agriculture was organic, biodiverse, and self-reliant by default for thousands of years, relying on indigenous knowledge, crop rotation, and mixed crop-livestock farming systems (Mansata et al., 2017). Distinguished colonial-era scientists, such as Dr. John Augustus Voelcker who visited India in 1889 and Sir Albert Howard, praised these ancient Indian peasant techniques for their ecological balance and productivity (Voelcker, 1891; Pereira, 1993). Before the mid-1960s, India possessed an estimated 200,000 distinct, locally adapted rice varieties characterized by outstanding taste, aroma, and climate resilience (Alvares, 1986). However, the adoption of the Green Revolution package in the late 1960s, marked by high-yielding variety (HYV) seeds, monocultures, chemical fertilizers, and synthetic pesticides, abruptly dismantled this traditional seed sovereignty, causing the loss of over 90% of indigenous germplasm (Nelson et al., 2019). While chemical-intensive agriculture achieved short-term grain self-sufficiency, its long-term negative externalities have now manifested as declining soil fertility, groundwater depletion, pesticide-induced health crises, rising production costs, and deep-seated agrarian distress (Ramanjanyelu, 2015).

Despite growing awareness of the ecological and health hazards of chemical agriculture, the transition to sustainable farming methods remains remarkably slow. Currently, only about 5% of Indian farmers practice organic farming. Understanding the determinants of this transition necessitates localized empirical research. Farmers believe that without chemical fertilisers, agricultural yield is lower in organic farming. Though this is true for the three-year conversion period, after obtaining organic certification, the food can be sold at a premium price in farmers' markets or organic supermarkets, resulting in profitability.

1.1 Focus of the study

This study focuses on the Konkan belt of Maharashtra, an agro-climatic zone characterized by heavy monsoonal rainfall (2,000 to 4,000 mm) and rugged topography. Situated between the Sahyadri hills (Western Ghats) and the Arabian Sea, the Konkan belt is a distinct physiographic division in western Maharashtra. The region possesses fertile alluvial and laterite soils, with strong water-retention capacity necessary for flooded paddy production. This region is characterized by challenges because of the predominance of rainfed areas, fluctuating climatic conditions, and acute underdevelopment (Shaha et al., 2020). Rice is the staple crop and food source in the Konkan division, contributing over 40% of the state's total rice production (Singh, 2014). According to the Agriculture Census 2021–22 provisional estimates, the average size of the state's operating holdings is 1.23 hectares. (GOM, 2025). Within this setting, this paper investigates the comparative economics of organic versus inorganic rice cultivation. It formally tests whether organic paddy is economically viable and models the sociodemographic variables that encourage or inhibit farmers from adopting chemical-free agricultural practices. The study also explores the institutional architecture, structural linkages, supply chain blockages, and policy prerequisites governing the organic rice transition.

1.2 Research objectives

This research paper will look into the following areas-

1. Comparing the profitability of organic and inorganic rice.

2. Examining the socioeconomic barriers, motivators for organic transition

3. Examining the function of the rice supply chain

4. Outlining the policy recommendations for switching to organic farming

1.3 Literature Review

The literature on the comparative economics of sustainable versus conventional agriculture is structured around three primary debates: the negative externalities of chemical agriculture, the comparability of crop yields under organic systems, and the sociodemographic determinants of adoption. The devastating ecological consequences of chemical pesticides were first documented in Rachel Carlson's (1962) seminal work 'Silent Spring', which illustrated how chemical residues contaminate the food chain and disrupt entire ecosystems. In the Indian context, Shiva (2010) criticized the Green Revolution for widening regional and socio-economic disparities between big and small landholders. In Punjab's Malwa region, groundwater contamination from fertilizer and pesticide runoffs is linked to a notable rise in cancer cases, kidney failure, and reproductive disorders (Kaur & Sinha, 2013). Furthermore, continuous chemical overuse has triggered pest resistance, requiring increasingly higher dosages and compounding farmer vulnerability (Tabashnik et al., 2009). On the other hand, organic agriculture offers substantial environmental and nutritional benefits. Fell (2003) noted that organically grown food can contain up to 58% more polyphenolic antioxidants compared to conventional produce. Pimentel (2006) established that organic farming reduces soil erosion, which causes a global loss of 24 billion tonnes of fertile topsoil annually, and enhances microbial biodiversity to secure natural nitrogen fixation. Shiva (2017) further demonstrated that organic matter application improves soil water-retention capacity, rendering farms resilient to monsoonal droughts and flooding. Economically, comparative studies present mixed evidence regarding costs, yields, and profit margins. In Erode, Tamil Nadu, Rengaraju et al. (2022) found organic turmeric cultivation highly profitable, yielding a Benefit-Cost Ratio (BCR) of 1.77 versus 1.58 for conventional methods due to lower input costs. Similarly, Panotra et al. (2021) demonstrated that organic Basmati 370 in Jammu achieved a BCR of 2.97. However, other researchers report a yield reduction. In Madhya Pradesh, Verma et al. (2019) reported that inorganic paddy produced 36% higher raw yields and 45.6% higher net returns than organic systems, which suffered from high manual labor costs and inadequate organic input supply.

The determinants of organic transition encompass a range of internal farm characteristics and external institutional factors. Karipidis and Karypidou (2021) identified education, market accessibility, subsidy availability, age, and environmental beliefs as key drivers. While environmental concerns and health benefits strongly motivate adoption (Ashari et al., 2016; Janjhua et al., 2018), farmers are often deterred by the 'yield apprehension' and high transaction costs during the initial three-year transition period (Das, 2007; Priyanga & Venkataraman, 2017).

So far, research on the Konkan belt has been restricted to model farm locations and has not included farmer fields with probabilistic statistical analysis for actual economic viability and of the entire Konkan rice supply chain.

2. Methodology

This study adopts a mixed-method triangulation design, combining a robust quantitative survey with qualitative insights to ensure validity and credibility. To select a representative sample, a multi-stage purposive sampling method was employed across three stages:

1. **Stage I (District Selection):** Three major rice-producing districts-Palghar, Thane, and Raigad-were selected out of the five districts in the Konkan belt due to their high concentration of both organic and inorganic cultivators.

2. **Stage II (Taluka Selection):** Seven specific talukas were chosen based on the local availability of organic clusters: Wada and Jawahar (Palghar); Kalyan, Murbad, and Bhiwandi (Thane); and Karjat and Roha (Raigad).

3. **Stage III (Farmer Selection):** Equal numbers of organic and inorganic farmers were selected from each taluka. This yielded a total sample size of 188 farmers, comprising 94 organic and 94 inorganic paddy growers, surveyed during the Kharif season of 2022.

Table 1: Distribution of Sample Farmers by District and Taluka

District	Talukas	Organic Farmers	Inorganic Farmers	Total
Palghar	Wada, Jawahar	21	21	42
Thane	Kalyan, Murbad, Bhiwandi	49	49	98
Raigad	Karjat, Roha	24	24	48
Total		**94**	**94**	**188**

Source- Compiled by the researcher

2.1 Hypothesis Formulation and Model Specifications

To evaluate economic viability, the study formulates null (H_0) and alternative (H_1) hypotheses concerning the mean differences of six parameters: Yield (Y/ha), Variable Cost (VC/ha), Selling Price (SP/kg), Total Revenue (TR/ha), Profit (Profit/ha), and Rate of Return (R/Return). The null hypothesis (H0) assumes equal performance across both farming systems, while the alternative hypothesis (H1) assumes a statistically significant difference. In this specification, variable costs are derived as the sum of all imputed and actual costs (including labor, seeds, machinery, manure, plant protection, irrigation, and working capital interest calculated at a 7% interest rate over half the crop cycle). Total Revenue is the product of Yield and Selling Price.

To identify the key drivers of organic adoption, a Binary Logistic Regression model is specified. The dependent variable is categorical, denoting the adoption of organic farming ($Y = 1$ if organic, $Y = 0$ if inorganic).

Socio-demographic independent variables are dummy-coded to ensure binary compatibility for the Logit regression (Table 4).

3. Quantitative Results & Discussion

The quantitative results provide empirical validation of the economic performance of both production systems and expose the sociological factors influencing farmer behaviors. The descriptive demographic analysis reveals that 127 out of 188 farmers (67.6%) hold farm areas of up to 5 acres, and 172 farmers fall within the small and marginal classification, highlighting the dominance of smallholder agriculture in the region. Livestock ownership is highly prevalent among organic practitioners, with 63% (58 of 94 organic farmers) owning cattle compared to only 51% (48 of 94 inorganic farmers), showing a dependency on animal-based manure for organic input production.

Table 2: Comparison of Means for Organic and Inorganic Rice Cultivation

Economic variable	Organic Mean (N=94)	Inorganic Mean(N=94)	Relative difference (%)
Variable Cost per Hectare (Rs.)	47,964.11	40,707.33	17.80%
Yield per Hectare (kg)	2,845.54	2,760.14	3.10%
Selling Price per kg (Rs.)	34.88	23.88	46.10%

Total Revenue per Hectare (Rs.)	92,696.29	66,467.60	39.50%
Net Profit per Hectare (Rs.)	44,732.19	25,760.27	73.60%
Rate of Return	1.13	0.91	24.20%

Source- Compiled by the researcher

3.1 Economic Viability and Independent Sample T-Test Results

Simply evaluating the means is insufficient to draw rigorous economic conclusions, as differences can occur due to random monsoonal fluctuations. Therefore, the Independent Sample T-test was conducted to determine the statistical significance ($p < 0.05$) of these differences (Table 3).

Table 3: Statistical Significance and T-test Parameters

Variables	t- value	p- value	Statistical Inference
VC/ha	2.067	0.04	Significant ($p < 0.05$)
Y/ha	0.339	0.735	Not Significant
SP/ kg	4.346	0	Significant ($p < 0.01$)
TR/ha	2.637	0.009	Significant ($p < 0.01$)
Profit/ha	2.046	0.042	Significant ($p < 0.05$)
Rateof Return	0.974	0.331	Not Significant

The t-test results reveal several critical insights for policy.

First, the null hypothesis for Variable Cost (H_0VC) is rejected ($t = 2.067$, $p = 0.040$). Organic farming has a statistically significant higher variable cost (Rs. 47,964/ha) than inorganic farming (Rs. 40,707/ha). Second, and most importantly, the null hypothesis for Yield (H_0Y) is retained ($t = 0.339$, $p = 0.735$). There is no statistically significant difference in raw productivity (mean of 2,845.54 kg/ha for organic versus 2,760.14 kg/ha for inorganic). This finding provides crucial empirical proof that debunks the prevalent 'yield apprehension' that deters farmers and policy makers from transitioning. Third, the null hypothesis for Selling Price (H_0SP) is strongly rejected ($t = 4.346$, $p = 0.000$). Organic rice achieves a statistically significant higher selling price (mean of Rs. 34.88/kg) compared to inorganic rice (Rs. 23.88/kg). This price premium, facilitated by niche markets and certification support, is the primary economic driver of organic farming. Consequently, the null hypothesis for Net Profit (H_0P) is rejected ($t = 2.046$, $p = 0.042$). Organic rice cultivation generates Rs. 44,732.19/ha of net profit, which is nearly double the Rs. 25,760.27/ha generated by inorganic rice. Although the Rate of Return is higher for organic (1.13 versus 0.91), the difference is not statistically significant ($p = 0.331$)

Overall, organic rice cultivation is economically viable, as its premium price robustly compensates for the slightly higher variable costs.

3.2 Sociodemographic Determinants: Binary Logistic Regression Analysis

In this model, the probability P of adoption is modeled as a function of eight independent variables:

$$\boldsymbol{ln}\big(\boldsymbol{P}/(\mathbf{1}-\boldsymbol{P})\big)=\boldsymbol{b0}+\boldsymbol{b1}(\boldsymbol{Age}) \\ +\boldsymbol{b2}(\boldsymbol{Gender}) \\ +\boldsymbol{b3}(\boldsymbol{FarmSize}) \\ +\boldsymbol{b4}(\boldsymbol{FamilySize}) \\ +\boldsymbol{b5}(\boldsymbol{Livestock}) \\ +\boldsymbol{b6}(\boldsymbol{Education}) \\ +\boldsymbol{b7}(\boldsymbol{Markets}) \\ +\boldsymbol{b8}(\boldsymbol{Trainings})$$

Table 4: Binary Logistic Regression Summary of Significant Variables

Variables	B	S.E.	Wald	Df	Sig	Exp(B)
Education	1.022	0.413	6.14	1	0.013	2.78
Livestock	0.741	0.382	3.751	1	0.053	2.097
Market	1.434	0.777	3.41	1	0.065	4.197

The regression summary highlights three statistically significant predictors of organic transition in the Konkan belt. First, Education is highly significant at the 5% level (B = 1.022, Wald = 6.140, p = 0.013). Its positive coefficient and Odds Ratio of 2.780 indicate that farmers with higher formal education (above class 10) are nearly three times more likely to adopt organic farming compared to less-educated farmers. Education fosters a 'broad-minded mindset' (Patel et al., 2017), helping farmers understand the ecological hazards of chemicals, appreciate long-term health benefits, and adopt complex organic practices such as composting and crop rotation.

Second, Livestock ownership is significant at the 10% level (B = 0.741, Wald = 3.751, p = 0.053). An Odds Ratio of 2.097 shows that owning cattle doubles the likelihood of practicing organic farming. This is a highly logical finding, as cattle dung and urine are the foundational ingredients for producing indigenous bio-inputs (like Jeevamrut), reducing reliance on commercial organic fertilizers and lowering cash outlays.

Third, Market Access represents the most powerful predictor in the model, significant at the 10% level (B = 1.434, Wald = 3.410, p = 0.065). With a substantial Odds Ratio of 4.197, farmers with access to organized markets or direct marketing channels are more than four times as likely to practice organic farming. This highlights the critical role of forward linkages and supply chain integration (Bhandari et al., 2017). This provides empirical justification for institutional policies to focus heavily on market infrastructure, cooperative branding, and aggregation.

3.3 Qualitative Results & Discussion

Although quantitative studies have established the potential viability of organic rice, this paper presents a comprehensive qualitative inquiry into the organic rice transition in the Konkan belt. To overcome the methodological limitations of quantitative field surveys like memory bias, lack of written financial records, and the informal nature of rural transactions, this study utilizes a Mixed-Method Triangulation Design involves validating quantitative findings (in this case, the parallel survey of 188 paddy farmers) with multiple qualitative approaches, thereby enabling a deeper, more realistic exploration of behavioral, administrative, and supply chain variables. It comprises six distinct qualitative analyses:

a. The Observation Method (Participant & Unstructured)-The researcher engaged in active field-level observation and networking to understand the broader organic farming movement and supply chain dynamics. This included participating in Beejotsav 2023**,** a seed saving and sovereignty festival at Mahatma Gandhi's Sewagram Ashram in Wardha. The researcher visited Biofach India in 2023 and 2024, an international organic trade fair in Greater Noida to analyze market dynamics. In 2023, the researcher also visited the OFAI Biennial Meet held in Aluva, Kerala which focused on knowledge sharing and networking among organic practitioners and the seed museum of Bharat Agro Industries Federation (BAIF) in 2023 and organic rice fields in Palghar district. Mention may be made of visits to regional fairs in Navi Mumbai and Pune, alongside the Agriculture Rice Research Station at Karjat.

b. Semi-Structured Retailer Interviews-The researcher conducted in-depth interviews with eight organic rice retailers across stores in Mumbai, Thane, Palghar, and Raigad. These interviews targeted the practical barriers to retailing, such as low consumer awareness, limited shelf-life, high transportation overheads, and storage challenges like insect infestation.

c. Linkage and Value Chain Discussions-To map the backward and forward linkages of the rice economy, interviews were carried out with ten agricultural input suppliers (including five from Krishi Vigyan Kendras), alongside aggregators, rice processors, and distributors. This helped document the cost structures and availability of organic inputs versus chemical alternatives.

d. FPO Performance Evaluations-The researcher interviewed representatives from ten Farmer Producer Organisations (FPOs) to analyze their performance and the structural challenges they face in the Konkan division. The analysis highlighted barriers such as a lack of professional management, geographic distance, and restricted access to collateral-free credit.

e. Focus Group Discussion-. A formal online Focus Group Discussion (FGD) was held comprising of a six-expert panel included one agricultural scientist, two university faculty members, two specialized organic store owners, and one post-graduate environmental studies researcher. The panel analyzed the "hand-holding gap" under existing schemes (like the 3-year limit of the PKVY scheme), soil organic matter construction, and the need for a decadal policy framework.

f. Case Study Method-The researcher developed three detailed case studies of support organizations to illustrate successful long-term organic farming models. Two non-governmental organizations operating in the Palghar district are analysed—the Bharatiya Agro Industries Foundation (BAIF) and the Govardhan Ecovillage (GEV) and contrasted with Sahaja Aharam, a highly successful federation of organic farmer cooperatives based on a direct-to-consumer cooperative retail chain model in southern India.

4. Discussion and Policy Prescriptions

The quantitative and qualitative studies have established the first three research objectives. The crucial final step in transforming scientific insight into ideas for a better future for farmers, consumers, and even the environment is policy prescriptions which is the fourth and final research objective.

These suggestions are crucial since organic farming adoption requires specific interventions to overcome systemic "switch-back" behaviour brought on by insufficient support cycles, rather than just statistical evidence of profitability. The following are some of the recommendations for policy that come from the research:

A) *Institutionalising Collectivisation-* Individual smallholder farmers in India face high transaction costs and struggle to meet diverse consumer demands on their own. Promoting Farmer Producer Organisations (FPOs) and village cooperatives helps farmers collectivise, achieve economies of scale, and directly connect with institutional buyers to secure better prices.

B) *Putting in place a "Handholding" and Support Framework-*The current three-year government support cycle is inadequate and often leads to farmers reverting to conventional farming once assistance ends. A minimum ten-year support plan is needed, with the first three years focusing on technical training and soil health, followed by seven years of marketing and infrastructure development.

C) *Reducing Logistics Expenses by Raising Customer Awareness*- High market logistics and storage costs pose a major financial challenge for organic retailers due to seasonal or inconsistent consumer demand. Local awareness campaigns, digital outreach, and trusted certifications like the Jaivik Bharat logo are essential to stimulate steady demand and reduce inventory holding times.

D) *Using Value and Agribusiness Startups to Close the Rural Income Gap* -Supporting rural agribusiness startups for farm-gate processing and value addition is critical to bridging the investment gap in organic farming. If we consider it as a circular economy model in which, for example, farmers purchase inputs from a local vendor, money keeps circulating within the village rather than leaving it.

E) *Establishing an organic ecosystem while involving women in the process*- Transitioning to organic farming mitigates the negative health and environmental impacts of chemical agriculture while lowering external input costs. Actively involving women farmers as enablers who collaborate, train peers, and produce local inputs is crucial for building a self-sustaining organic ecosystem.

F) *Supporting government officials with knowledge*- Government officials often lack a solid organic knowledge base, sometimes leading to contradictory support for both chemical and organic methods and wasted resources. Providing these officials with capacity-building support from award-winning organic farmers is essential to establish a reliable information supply chain

5. Conclusion

We can conclude that the Konkan belt's shift to organic rice production is both economically and socially necessary. The Konkan belt's shift to organic rice farming is a complex plan intended to restore economic independence through seed sovereignty and the use of locally adapted indigenous varieties while internalising the "true costs" of conventional agriculture, such as environmental poisoning and serious health crises. Farmers can sustain yields that are statistically comparable to inorganic systems by shifting toward scientific soil management that emphasises organic matter and varied cropping. Relying on F.P.O.s to support village-level agribusiness startups and value-addition units that retain wealth locally, embodying the Gandhian principle of Gram Swaraj, will bridge the market "trust gap" through transparent certification and direct institutional linkages, guaranteeing that farmers receive a fair premium, transforming the rural economy into a self-sufficient and resilient ecosystem.

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