



EXPLORING FARMER, MILL AUTHORITY, AND EXPERT PERSPECTIVES ON FUEL ETHANOL PRODUCTION IN MAHARASHTRA'S COOPERATIVE SUGAR MILLS

Dr. Aparna Das

RESEARCH ARTICLE



Author Details: Assistant Professor, in Economics, Sree Narayana College for Women, Kollam, Kerala, India.

Corresponding Author:
Dr. Aparna Das

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Abstract

India's commitment to reducing its carbon footprint has brought renewed focus on biofuels, particularly fuel ethanol derived from sugarcane molasses. While the policy framework has evolved to support ethanol blending in petrol, actual production and adoption remain inconsistent. This study explores the perspectives of key stakeholders—farmers, cooperative sugar mill authorities, and sectoral experts—on the prospects and challenges of fuel ethanol production in Maharashtra, a leading state in sugarcane and fuel ethanol output. Employing a qualitative research design, data was gathered through structured interviews with 30 sugarcane farmers, 10 mill authorities, and 8 subject experts. The fieldwork is supported by a ten-year panel dataset (2006–07 to 2015–16) from 71 cooperative mills in Maharashtra. The findings reveal that while farmers continue to cultivate sugarcane due to government-assured pricing (Fair and Remunerative Price), they are often unaware of the fuel ethanol value chain or its long-term benefits. Mill authorities cite pricing uncertainty, delayed procurement by Oil Marketing Companies (OMCs), and inadequate infrastructure as persistent barriers. Experts stress the need for decentralised distillation units, consistent policy support, and enhanced coordination between the sugar and energy sectors. The study concludes that while ethanol production holds socio-economic and environmental promise, it can only thrive with targeted policy intervention, improved stakeholder awareness, and a stable market ecosystem. These findings contribute to the ongoing dialogue on sustainable fuel transitions and rural development in India.

Keywords: *Bioethanol, sugarcane, cooperative sugar mills, stakeholder perspectives, Maharashtra, energy policy, rural economy.*

1. Introduction

The global search for sustainable energy solutions has intensified in the wake of growing environmental concerns, depleting fossil fuel reserves, and international commitments such as the Paris Agreement of 2015. Among renewable alternatives, biofuels—especially those derived from biomass—have gained prominence as cleaner, more sustainable options. India, like many developing nations, has taken notable steps to integrate biofuels into its energy mix, particularly ethanol produced from sugarcane molasses, a by-product of the sugar industry.

In the Indian context, the sugar industry plays a dual role in both energy and rural development. Sugarcane, cultivated widely in several states, serves as a key feedstock for ethanol production. Among these, Maharashtra stands out as the largest sugar-producing and second-largest sugarcane-cultivating state in the country. The state's cooperative sugar mills not only anchor the rural economy but also serve as potential hubs for ethanol production.

Despite a clear policy push—most notably the launch of the National Biofuel Policy in 2009—India's ethanol production continues to face numerous bottlenecks. This is particularly paradoxical in light of the substantial increase in sugarcane and sugar production between 2009–10 and 2014–15, which theoretically should have enhanced ethanol output. However, the sluggish pace of establishing ethanol facilities in sugar mills raises questions about the practical challenges faced on the ground.

This study is rooted in the production context of 71 cooperative sugar mills in Maharashtra, analysed over a ten-year period from 2006–07 to 2015–16. While previous research has focused primarily on production data and cost-efficiency, this article takes a qualitative turn, examining the perspectives of the key stakeholders in the industry—sugarcane farmers, mill authorities, and sectoral experts. These voices are critical to understanding the socio-economic, institutional, and operational realities that shape the fuel ethanol production landscape in India.

By capturing the lived experiences and insights of these stake holders, this study aims to uncover the ground-level constraints and untapped potential of fuel ethanol production in Maharashtra. The findings seek to inform future policy directions and support a more integrated approach to India's renewable energy goals.

2. Methodology

This study adopts a qualitative research design aimed at exploring the perspectives of key stakeholders involved in sugarcane-based fuel ethanol production in Maharashtra. The focus is on understanding the socio-economic, operational, and policy-related challenges faced by farmers, cooperative sugar mill authorities, and subject experts. While the broader research utilised both quantitative and qualitative methods, this article draws exclusively on qualitative data gathered through key informant interviews. Respondents were selected purposively to reflect a range of experiences and insights relevant to the biofuel sector. The sample comprised 30 sugarcane farmers, 10 cooperative sugar mill authorities, and 8 sectoral experts associated with sugar research institutions and energy policy. Data collection was carried out through a mix of structured questionnaires, telephonic interviews, and email correspondence. The selection of participants was guided by their proximity to or involvement in sugarcane cultivation and ethanol-related operations.

The qualitative responses were used to complement and contextualise a panel dataset covering 71 cooperative sugar mills in Maharashtra for the ten-year period from 2006–07 to 2015–16. Although the broader study included private mills, primary data collection from them was not feasible due to their reluctance to share operational and financial information. Hence, the present analysis is confined to cooperative mills.

The interviews focused on issues such as awareness of fuel ethanol production, perceived benefits and risks, infrastructural and policy bottlenecks, market conditions, and the perceived role of government incentives. Thematic patterns emerging from the stakeholder responses were compared with trends observed in secondary data to triangulate findings.

Given the exploratory nature of this study, emphasis was placed on capturing the lived realities and contextual knowledge of the participants rather than generating generalisable statistical conclusions. The approach is grounded in the belief that the success of biofuel policies depends not only on macroeconomic viability but also on the active engagement of those directly involved in the value chain.

3. Findings

The qualitative data collected from farmers, mill authorities, and sectoral experts provided rich insights into the status, challenges, and expectations surrounding ethanol production in Maharashtra's cooperative sugar mills. Three major thematic categories emerged:

3.1 Farmer Perspectives: Awareness, Incentives, and Constraints

The majority of the 30 interviewed farmers were aware of the by-products generated from sugarcane, particularly molasses, but few understood the role of fuel ethanol in India's energy mix or its long-term implications. Their engagement with sugarcane cultivation was primarily driven by the Fair and Remunerative Price (FRP) guaranteed by the government, which ensured predictable income, despite delays in payments.

Several farmers expressed concern over delayed cane payments and mill arrears, yet continued growing sugarcane due to the vote-linked pricing policies and the lack of viable crop alternatives. The drought in 2014–15 had severely impacted cane output, yet the FRP obligations remained unchanged, placing additional burden on both growers and mills.

Farmers also showed little knowledge of ethanol blending policies or how enhanced ethanol production could benefit them directly, signalling a gap in awareness and policy communication at the grassroots level.

3.2 Mill Authorities: Operational Barriers and Policy Friction

Among the 10 cooperative mill authorities interviewed, a clear concern was the inconsistent and delayed procurement of ethanol by Oil Marketing Companies (OMCs). Although the National Biofuel Policy of 2009 led to a noticeable increase in the number of operational ethanol units (from 6–8 in 2006–09 to 27 by 2015–16), this expansion was often not matched by assured pricing or timely contracts, making ethanol production less attractive than sugar in certain years.

Mill authorities cited three key constraints:

- **Unattractive or static ethanol pricing**, especially when compared to fluctuating sugar prices.
- **Lack of working capital** and inadequate government support for upgrading technology or expanding ethanol capacity.
- **Regulatory uncertainty**, with frequent changes in blending targets and unclear incentives.

Some mills had to halt ethanol production temporarily, despite having the infrastructure, due to procurement delays or non-remunerative prices – an issue reflected in your operational status data across the study years.

3.3 Expert Insights: Integration, Technology, and Structural Gaps

The eight sectoral experts interviewed stressed the need for a more integrated approach to ethanol production. They pointed out that while mills with sugar, distillery, and ethanol units showed higher profitability and output, a lack of consistent government support and poor market integration had held back potential.

Experts particularly emphasised:

- Decentralised distillation infrastructure to avoid transportation and procurement bottlenecks.
- Clarity in procurement policy, including long-term pricing contracts with OMCs.
- The need for education and training programmes for farmers and local stakeholders to promote ethanol awareness.
- Encouragement of modern ethanol production technologies, noting that while azeotropic methods sometimes yielded higher returns.

Overall, experts viewed ethanol as a vital opportunity for enhancing rural incomes and reducing fossil fuel dependence, but stressed that success depends on coordinated policy, technological modernisation, and stronger grassroots engagement.

4. Discussion

The insights emerging from this study highlight the complex interplay between policy ambition, institutional readiness, and stakeholder engagement in India's ethanol production landscape. While biofuel policies have promoted ethanol blending and infrastructure growth, their implementation has encountered several structural and operational challenges on the ground.

Among farmers, continued cultivation of sugarcane was found to be driven largely by government-assured pricing through the Fair and Remunerative Price (FRP) mechanism, rather than an informed understanding of the ethanol value chain. Although they are central to the supply of raw material, farmers demonstrated limited awareness of how sugarcane by-products, such as molasses, contribute to ethanol production and India's clean energy targets. This disconnect suggests the need for better policy communication and engagement at the grassroots level. Bridging this information gap can not only build broader stakeholder support but also encourage diversified and sustainable farming practices.

Mill authorities offered a more nuanced perspective, recognising the strategic importance of ethanol while simultaneously pointing to serious constraints in its production and sale. Many cooperative mills had invested in ethanol production facilities following the introduction of the National Biofuel Policy, and ethanol output did expand during the subsequent years. However, inconsistent procurement by Oil Marketing Companies (OMCs), unattractive or stagnant ethanol pricing, and frequent delays in disbursements were cited as key deterrents. Some mills, despite having operational capacity, were forced to suspend ethanol production due to pricing uncertainties and logistical bottlenecks. These findings reveal that capacity creation alone is insufficient unless it is supported by a reliable and remunerative market environment.

Experts reinforced this assessment, arguing that the ethanol ecosystem in India suffers less from technological limitations and more from institutional fragmentation. While distillation technologies such as molecular sieve and azeotropic methods are in use, the choice of technology was found to have minimal impact on revenue. This points to broader issues of policy coherence, market coordination, and incentive alignment. Experts also advocated for decentralised distillation units, more flexible procurement models, and targeted government support for infrastructure development.

Overall, the study underscores that the success of ethanol production in cooperative sugar mills depends not only on technical and infrastructural capacity but also on the strength of institutional linkages and stakeholder engagement. Policy efforts need to shift from merely setting blending targets to fostering a more stable and responsive ecosystem – where farmers are informed, mills are supported, and procurement agencies operate with greater predictability and transparency.

5. Conclusion

This study set out to explore the perspectives of farmers, cooperative sugar mill authorities, and sectoral experts on the production and policy environment surrounding sugarcane-based ethanol in Maharashtra. While India's national biofuel strategy has been ambitious in scope, its execution at the grassroots level reveals a number of structural and operational shortcomings.

The voices of farmers highlighted a recurring theme: while they continue to grow sugarcane due to favourable pricing and political support, their understanding of ethanol's role in the energy economy remains minimal. This suggests that the biofuel mission, though well-intentioned, lacks the local-level engagement required for holistic success.

Cooperative mill authorities, on the other hand, expressed optimism about ethanol's potential but cited persistent issues – particularly delayed procurement by Oil Marketing Companies, unattractive ethanol pricing, and lack of financial incentives for capacity expansion. These factors weaken the confidence of producers and disrupt continuity in ethanol production, even when infrastructure exists.

Sectoral experts reinforced the need for a more integrated approach – one that bridges the gap between production potential and policy execution. Their recommendations stressed decentralised distillation, improved procurement systems, and broader stakeholder education.

While this study is based on data from 2006–07 to 2015–16, it provides a valuable foundation for understanding the early challenges of ethanol integration in India. Since then, the ethanol sector has witnessed accelerated growth, especially under the Ethanol Blending Programme (EBP) and the National Bioenergy Programme. The government has advanced its target of achieving 20% ethanol blending in petrol by 2025. These developments make the insights from this study even more relevant, as the expansion of ethanol production will succeed only if the concerns and contributions of local stakeholders are actively addressed.

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