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WHITE BLACK LEGAL is an open access, peer-reviewed and refereed journal provide dedicated to express views on topical legal issues, thereby generating a cross current of ideas on emerging matters. This platform shall also ignite the initiative and desire of young law students to contribute in the field of law. The erudite response of legal luminaries shall be solicited to enable readers to explore challenges that lie before law makers, lawyers and the society at large, in the event of the ever changing social, economic and technological scenario.

With this thought, we hereby present to you

# **FROM HYDROCARBON DEPENDENCY TO ETHANOL ASPIRATION: INDIA'S E20 EXPERIMENT IN THE BALANCE OF SUSTAINABILITY AND SOVEREIGNTY**

AUTHORED BY - PROF. DR. C. USHA

## **Abstract**

India's tryst with energy transition is epitomised in its ethanol blending programme—an ambitious journey from E0 to E20 petrol. Heralded as a panacea for oil dependence, agrarian distress, and environmental degradation, this experiment promises much but also courts peril. The paper interrogates the ethanol paradigm through multiple lenses: energy sovereignty, ecological prudence, food security, and consumer welfare. It argues that while the programme is a promising pathway towards sustainable mobility, it risks becoming an ecological mirage unless anchored in technological innovation, policy foresight, and judicious balancing of competing rights.

India's ongoing energy transition finds a strong expression in its ethanol blending programme, which seeks to gradually move from E0 (pure petrol) to E20 (20% ethanol blended petrol). This initiative has been projected as a multipurpose solution capable of simultaneously reducing oil import dependence, addressing agrarian distress by creating new markets for surplus crops, and mitigating environmental degradation by lowering carbon emissions from the transport sector. However, beneath this optimistic narrative lie complex challenges that demand critical scrutiny. Ethanol production is fundamentally linked to agricultural cycles, land use, and water consumption, raising urgent questions of sustainability and food security.

Diverting sugarcane or other food crops towards fuel may exacerbate ecological stress and inflate food prices, thereby adversely affecting consumer welfare. At the same time, the programme sits at the intersection of energy sovereignty and environmental prudence, where balancing growth and sustainability becomes a delicate act. This paper examines the ethanol blending policy through multiple lenses, including technology adoption, regulatory design, and rights-based frameworks. It contends that while India's ethanol path can be a promising step

towards sustainable mobility, it risks becoming an ecological mirage unless guided by innovation, policy foresight, and a balanced approach to competing societal interests.

**Keywords:** - Ethanol blending, Energy transition, Food security, Environmental sustainability, Consumer welfare, Policy foresight.

## **1. Introduction:-**

For a nation historically tethered to the fluctuating fortunes of imported crude oil, ethanol has been positioned as an emblem of liberation. Branded by policymakers as a home-grown elixir, it promises to transmute India's agrarian surplus into a liquid fuel that not only powers engines but also fuels aspirations of sovereignty, sustainability, and self-reliance.<sup>1</sup> The Government of India's announcement, envisioning a transition to 20% ethanol blending (E20) by 2025, is celebrated as an achievement that straddles economic foresight, environmental virtue, and geopolitical strategy. Yet, the celebratory narrative is punctuated by skepticism: beneath the rhetoric of green mobility lie profound questions about food security, ecological prudence, and distributive justice.<sup>2</sup>

Ethanol blending is not merely a story of fuel substitution; it is the stage upon which larger questions of India's development trajectory are rehearsed. On one hand, it is heralded as a decisive response to the vulnerabilities of an oil-dependent economy, where rising import bills often compromise fiscal stability and expose the nation to global price shocks. On the other hand, ethanol blending is projected as a salve for agrarian distress, channelling surplus sugarcane, maize, and other crops into remunerative markets. The programme thus weaves an alluring policy tapestry in which the farmer, the consumer, and the environment are all portrayed as beneficiaries.<sup>3</sup>

However, the ethanol narrative also evokes discomfoting realities. Ethanol production in India is deeply interlinked with crop cycles that are themselves shaped by monsoons, groundwater extraction, and policy subsidies. Sugarcane, the dominant feedstock, is notoriously water-intensive, and its large-scale diversion to fuel risks accentuating regional

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<sup>1</sup> Planning Commission, Report of the Expert Committee on Integrated Energy Policy 142 (2006).

<sup>2</sup> Ministry of Petroleum and Natural Gas, National Policy on Biofuels (2018).

<sup>3</sup> R. Kumar, "Biofuel and Water Use in India," *Economic & Political Weekly*, Vol. 55, Issue 33, at 25 (2020).

water crises, especially in drought-prone states like Maharashtra and Karnataka.<sup>4</sup> Similarly, diverting maize and rice towards biofuel production might elevate food prices, jeopardising nutritional access for India's vast population. Thus, the very scheme that claims to deliver food and energy sovereignty could paradoxically deepen vulnerabilities in both domains.<sup>5</sup> From an environmental perspective, ethanol is promoted as a renewable alternative capable of reducing tailpipe emissions, especially carbon monoxide and hydrocarbons. Yet, this reduction must be juxtaposed against the ecological footprint of cultivating ethanol feedstocks: deforestation for crop expansion, chemical-intensive farming, and the carbon intensity of irrigation and processing. Without robust lifecycle assessments, the environmental gain may, in reality, be modest or even negative. Policymakers, therefore, confront an uneasy paradox: ethanol is green at the exhaust pipe but may not always be green at its origin.<sup>6</sup>

The celebration of ethanol blending as a marker of energy sovereignty also warrants caution. While the programme reduces crude oil imports, it simultaneously deepens dependence on agricultural outputs whose availability is inherently volatile. Crop failures due to erratic rainfall or climate change could destabilise ethanol supplies, raising questions about the resilience of the strategy. In such a scenario, reliance on ethanol may merely exchange one form of vulnerability (global crude markets) with another (domestic climate-sensitive agriculture). Furthermore, large-scale ethanol blending presupposes massive investments in refining capacities, distribution networks, and testing protocols for automobile engines—a transformation that is both capital and technology intensive.<sup>7</sup>

Central to the policy imagination is the vision of ethanol as a socially equitable solution that uplifts farmers while offering consumers cheaper and cleaner fuel. Yet, as critics point out, the farmer-benefit narrative is often selective and skewed. Only specific agricultural producers—predominantly sugarcane growers—are positioned as direct beneficiaries, raising distributive justice concerns across regions and crops. Meanwhile, the consumer's welfare is not guaranteed, as ethanol-blended fuels are often priced on par with or even higher than conventional petrol, offsetting anticipated economic gains.

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<sup>4</sup> A. Gulati & P.K. Joshi, "Agriculture and Water Management in India," *Indian Journal of Agricultural Economics*, Vol. 77, No. 1, at 14 (2022).

<sup>5</sup> Intergovernmental Panel on Climate Change, *Climate Change Mitigation Report* (2021).

<sup>6</sup> S. Narain & C. Bhushan, *Biofuels: The Story of India's Experiment with Energy Crops* 63 (Centre for Science and Environment, 2019).

<sup>7</sup> NITI Aayog, *Roadmap for Ethanol Blending in India 2020–25* (2021).

In legal and regulatory terms, the ethanol programme must navigate multiple, sometimes conflicting, imperatives: environmental legislations, food security obligations, and commitments under international trade and climate frameworks. The Food Corporation of India (FCI), for instance, is periodically directed to divert excess grains to ethanol distilleries while simultaneously tasked with ensuring the availability of subsidised food through the Public Distribution System. This dual mandate generates contradictions that are both institutional and ethical. Internationally, India's ethanol blending ambitions draw attention under the World Trade Organization's rules and under climate diplomacy commitments made in the Paris Agreement. Whether ethanol serves as a bridge fuel towards decarbonisation or merely locks India into another resource-intensive pathway is a matter of ongoing policy debate.

Ultimately, the question animating this paper is whether ethanol represents an emancipatory force or an ecological mirage. Can one liquid reconcile the imperatives of sustainability, sovereignty, and social justice? Or is ethanol a policy chimera—captivating in vision but fraught in execution? This inquiry is not simply about one biofuel policy but about the broader trajectory of India's energy governance.<sup>8</sup> In treating ethanol as the “elixir at the pump,” the paper contends that society must interrogate not only its promise but also its peril. Ethanol blending, if left unguided by innovation, regulatory foresight, and a rights-conscious approach, risks becoming a pathway of misplaced optimism. Conversely, if anchored in technology, water-efficient crops, second-generation biofuels, and equitable distribution frameworks, it can become a cornerstone of India's sustainable mobility roadmap.<sup>9</sup>

The ethanol programme's triumph or failure will thus hinge on choices made today: whether to privilege short-term optics or long-term sustainability, whether to narrowly secure energy sovereignty or holistically balance environmental and social justice. The “elixir at the pump” is therefore both a metaphor of emancipation and a mirror reflecting deeper dilemmas of India's developmental future.<sup>10</sup>

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<sup>8</sup> P. BIRTHAL, “Farmers' Welfare in the Era of Biofuel Policies,” *Indian Journal of Economics and Development*, Vol. 15, No. 2, at 45 (2019).

<sup>9</sup> Price Control Authority, “Consumer Impact of Blended Fuels in India,” *Annual Review of Energy Pricing*, Vol. 7 (2022).

<sup>10</sup> Food Corporation of India Circular No. 12/2022-23, “Diversion of Surplus Grains to Ethanol Production.”

## **2. Ethanol - Strategic Sovereignty**

India's energy landscape is defined by a structural vulnerability: excessive dependence on imported crude oil. More than four-fifths of domestic fuel requirements are met through imports, largely sourced from West Asia. This dependency is not merely an economic burden but also a geopolitical liability. Every fluctuation in oil supply or pricing—whether arising from geopolitical crises in the Gulf, the decisions of OPEC+, or disruptions in global shipping—translates into higher domestic fuel costs, inflationary pressures, and strains on India's current account balance. Against this backdrop, ethanol blending is less an optional environmental indulgence and more a geopolitical necessity. It marks a modest but important assertion of energy autonomy in a world still dominated by hydrocarbon politics.

The case for sovereignty through ethanol extends beyond economics. India's dependence on West Asian oil routinely influences its foreign policy. Energy security compels delicate balancing between competing regional powers, as well as cautious engagement with global conflicts involving oil producers. By sourcing a portion of its fuel domestically in the form of ethanol, India strengthens its bargaining position in international affairs. A diversified energy basket, where a measurable fraction is produced indigenously, lends greater resilience to the national economy and, critically, expands the space for foreign policy manoeuvre.

The government's decision to fast-forward its ethanol blending target to E20 by 2025 reflects this recognition. Ethanol is not an end in itself; it is a stepping stone towards broader energy sovereignty. It reduces foreign exchange outflow, engages local industries in distillation and refining, and injects strategic flexibility into energy planning. It also creates a narrative of self-reliance that aligns with other flagship initiatives emphasising indigenous capacity-building.

However, sovereignty delivered through ethanol is not unqualified. Unlike oil imports, which can be diversified through international trade, ethanol production is tied to the domestic agrarian economy and vulnerable to climate conditions. Erratic rainfall, droughts, or crop failures could restrict ethanol availability, creating another form of insecurity—this time internal rather than external. Moreover, ethanol production capacity requires heavy initial investment in distilleries and blending infrastructure. Sovereignty therefore comes not as a ready-made shield but as the outcome of sustained adaptation in agriculture, industry, and

policy.

Nevertheless, the symbolic power of ethanol blending cannot be overlooked. It sends a message that India refuses to remain perpetually captive to international oil markets. Even if the contribution of ethanol to total consumption is relatively modest, its impact on national morale, fiscal balances, and diplomatic positioning makes it a vital element of energy strategy. Put differently, ethanol does not grant India complete independence, but it does affirm the country's capacity to take incremental steps toward strategic sovereignty in a world where energy remains a lever of global power.

### **3. Ethanol - Agrarian Alchemy**

Equally significant is ethanol's promise to reconfigure India's troubled agrarian economy. Rural distress has remained an enduring concern, with cycles of bumper harvests paradoxically depressing farm incomes due to oversupply and price crashes. Ethanol blending intervenes in this vicious cycle by creating a new and stable market for agricultural surpluses. The metaphor of "alchemy" captures the imaginative leap here: surplus sugarcane and foodgrains are transformed from burdensome excess into valuable fuel.

Sugarcane is central to this process. When oversupply depresses sugar mill prices, farmers are often left unpaid for months, exacerbating rural indebtedness. By diverting part of this cane into ethanol production, both millers and farmers gain relief. Mills diversify their revenues, securing liquidity, while farmers gain assurance of timely procurement. For the government, ethanol provides an attractive policy lever: instead of endless subsidies to manage surplus cane or procurement costs, excess output is channelled into a revenue-generating industry.

Grains such as rice and maize also form part of this equation. India often procures more cereal than it can store effectively, leading to wastage in food warehouses. By diverting these surpluses to fuel distilleries, the state simultaneously manages food stocks and supports blending targets. Farmers, for their part, gain from buoyant demand and stable prices. Politically, the arrangement creates an image of farmers as vital contributors not only to national food security but also to energy security.

Yet, like all alchemy, this transformation comes with risks. Most prominently, the “food versus fuel” debate highlights the tension between energy demand and subsistence needs. In years of surplus, grain diversion may seem benign; but in lean years, incentivising diversion could hurt food availability and raise consumer prices. Furthermore, ethanol policies inherently benefit specific groups of farmers—mainly those growing cane or surplus cereals, in irrigated and politically influential states. Smallholders in rainfed regions, or cultivators of non-feedstock crops like pulses and oilseeds, receive little benefit from this ethanol economy. The distributive justice of agrarian alchemy therefore remains questionable.

Environmental sustainability also compounds these contradictions. Sugarcane is among the most water-intensive crops in India. Expanding ethanol supply primarily from cane could intensify groundwater depletion, soil exhaustion, and regional water tensions. Thus, while ethanol may appear to be a solution for rural distress, it risks embedding long-term agrarian vulnerabilities.

For the promise of agrarian alchemy to be realised equitably, India will need to pivot towards second-generation biofuels that rely less on food crops and more on residues—husks, stalks, straw, or even municipal waste. This shift would allow benefits to spread across a greater pool of farmers while avoiding direct competition with food supply. Until then, agrarian alchemy remains a double-edged proposition—empowering yet exclusionary, promising yet precarious.

#### **4. Ethanol - Ecological Redemption**

For a country wrestling with worsening air pollution, rising greenhouse gas emissions, and global climate obligations, ethanol presents itself as a route to ecological redemption. The appeal is straightforward: ethanol burns more cleanly than petrol, producing lower emissions of carbon monoxide, hydrocarbons, and particulate matter. In cities like Delhi, where vehicular pollution compounds seasonal smog, ethanol-blended fuels are positioned as a pragmatic solution that can deliver measurable improvement in air quality with relatively minor systemic disruption.

At the global scale, ethanol blending also supports India’s climate diplomacy. As part of its Nationally Determined Contributions under the Paris Agreement, India has pledged to reduce

the emissions intensity of its economy. Partial substitution of fossil fuels with ethanol helps demonstrate tangible policy progress toward this commitment. Ethanol thus operates both as a domestic instrument for pollution control and as an international marker of climate responsibility.

Yet, redemption is never absolute. While ethanol may lower emissions at the vehicle's tailpipe, questions arise when its entire lifecycle is assessed. Sugarcane cultivation, the primary feedstock, is water-intensive and fertiliser-heavy, contributing significantly to groundwater depletion and nitrous oxide emissions. Distillation processes themselves require considerable thermal energy, often derived from fossil inputs, which partly negates ethanol's ecological gains. In effect, ethanol may appear green when consumed but grey in its production stage, raising the spectre of shifting rather than resolving environmental burdens. Moreover, ethanol requires land—land that could otherwise be allocated to food or conservation. Expansion of fuel crop cultivation intensifies monocultures, reducing biodiversity and straining ecosystems. In the absence of a diversified feedstock base, ecological redemption can shade into ecological displacement: saving emissions at the city level by incurring degradation at the farm or forest level.

Despite these caveats, ethanol retains powerful symbolic appeal. It is politically convenient, requiring consumers to make no lifestyle changes while delivering perceptible, if modest, environmental benefits. This incrementalism—small reductions achieved through blended fuels—makes the policy more feasible than radical alternatives, such as rapid electrification of transport or carbon taxes. For policymakers, ethanol provides visible results at lower political cost, reinforcing its status as a transitional “green” measure.

To transform ethanol into true ecological redemption, India must invest in advanced biofuel technologies. Second-generation ethanol derived from agricultural residues, municipal waste, or non-food crops offers higher net ecological benefits and avoids direct competition with food and water. Linking ethanol to circular economy principles can ensure genuine sustainability. Without such innovation, ethanol risks becoming an ecological mirage, appearing to redeem while merely redistributing environmental harm.

In short, ethanol provides India with an environmental foothold: it is neither a panacea nor a fraud, but a transitional reclamation of ecological balance. Whether it matures into authentic

redemption depends on long-term innovation, regulation, and foresight.

## **5. Food versus Fuel**

The tension between using crops for food and for fuel lies at the heart of the ethanol debate in India. Large volumes of rice, maize, and sugarcane are being procured and divested away from food distribution systems into bioethanol production units. This practice has serious implications for a country where over 190 million people still suffer from undernourishment. Article 21 of the Indian Constitution guarantees the right to life, which has been interpreted to encompass the right to food. Yet the policy shift towards biofuels prioritises the fuel tanks of urban middle-class vehicles over the nutritional needs of vulnerable rural households. The diversion of grains also risks driving food inflation. When staple crops are redirected to distilleries rather than markets and public distribution channels, supply tightens and prices climb. For daily wage earners and below-poverty households, even slight increases in the price of rice or maize are devastating. The irony is hard to miss: ethanol may present itself as a “clean” fuel for India’s future but ends up creating a social divide by subsidising mobility for the affluent and undercutting food security for the poor. In essence, food-versus-fuel illuminates a moral and constitutional contradiction in India’s green energy strategy.

## **6. The Water Paradox**

Water is the invisible currency of bioethanol production. Its voracious consumption, often overlooked in celebratory policy narratives, exposes the ecological fragility of India's ethanol transition. Sugarcane—the primary feedstock—demands enormous amounts of water for cultivation. The statistics are staggering: approximately 2,800 litres of freshwater may be required to produce a single litre of ethanol through sugarcane molasses. In drought-prone states like Maharashtra, where farmers already struggle with depleting aquifers, this creates an environmental paradox. The water stress is not an abstract possibility but a lived crisis, with villages experiencing falling groundwater tables, failed wells, and inter-village conflicts over irrigation rights. Ironically, at a time when experts call for crop diversification and water-efficient farming models, ethanol policy entrenches dependence on the least sustainable crop. Furthermore, the heavy use of groundwater to support ethanol production often sidelines small-scale farmers who cannot afford borewells, deepening rural inequities. In ecological terms, the narrative of ethanol as “green fuel” collapses, because it externalises water costs onto fragile ecosystems and distressed communities. Thus, what appears as a solution to

energy security simultaneously worsens water insecurity, raising the question: can an energy strategy be sustainable if it undermines the most basic element of life itself?

### **7. The Vehicular Dilemma**

India's transition to ethanol-blended fuels highlights a fundamental technological and economic divide between new and old vehicles on the road. Policymakers advocate the E20 target—petrol blended with 20% ethanol—to reduce fossil fuel imports and emissions. However, the reality of India's vehicle stock complicates this picture. Newer models may be manufactured with E20-compatible engines, but the larger portion of India's vehicular fleet comprises older legacy vehicles. These engines, not originally designed for higher ethanol concentrations, face several risks: corrosion of fuel pipes, damage to engine coatings, reduced efficiency, and lower mileage. Repair and maintenance costs arising from ethanol incompatibility eventually get transferred to unsuspecting consumers, particularly middle- and lower-income vehicle owners who cannot afford quick replacement. Auto manufacturers, while adapting production lines, have been hesitant to provide cost-free retrofits for existing users. Moreover, small towns and rural India—where second-hand vehicles are most prevalent—may end up absorbing the hidden costs of this so-called energy diversification. Thus, the “green mobility” transition risks uneven social outcomes. Instead of democratising access to affordable and sustainable transport, ethanol blending may deepen vehicular inequalities, leaving the poor saddled with higher maintenance bills while the better-off seamlessly upgrade to ethanol-friendly modern vehicles.

### **8. The Mirage of Carbon Neutrality**

Ethanol has long been touted as nearly carbon-neutral, since the carbon dioxide emitted when it burns is ostensibly offset by the carbon absorbed during crop growth. Yet such simplified arithmetic ignores the hidden emissions buried in its life cycle. Agricultural production of ethanol feedstock relies heavily on fertiliser and pesticide inputs, most of which are energy-intensive to manufacture and transport. Ground realities add further complications: irrigation pumps powered by diesel, tractors operating on fossil fuels, and processing units that distill ethanol often run on coal or grid electricity sourced from non-renewable sources. When the entire chain of production is assessed—“from plough to pump”—the supposed carbon neutrality begins to look illusory. Lifecycle analyses indicate that ethanol can, in certain contexts, have a carbon footprint comparable to or even higher than conventional petrol. What

worsens the case is land-use change: forests and fallows converted for feedstock cultivation diminish carbon sinks while locking the farming cycle into fossil-reliant subsidies. Hence, the ethanol pathway risks being more a repackaged fossil fuel narrative than a genuinely renewable alternative. It sustains a political story of green progress without reconciling the ecological arithmetic. In this sense, ethanol's "clean" energy is often more fiction than fact.

### **9. Conclusion: Towards a Second-Generation Future**

India's ethanol journey embodies the quintessential paradox of sustainable development: the tension between addressing immediate economic imperatives and safeguarding long-term environmental stability. On one hand, blending ethanol with petrol helps reduce crude oil imports, lowers foreign exchange outflows, and signals a move towards energy sovereignty. Yet, on the other hand, the first-generation ethanol model—rooted in diverting food grains and water-intensive crops—risks exacerbating food insecurity, deepening agrarian distress, and overburdening fragile ecosystems. Such contradictions reveal that while E20 petrol may serve as a transitional bridge, it cannot be enshrined as the permanent solution.

A truly future-ready biofuel strategy must move beyond first-generation limits and embrace second-generation alternatives, such as producing ethanol from agricultural residues, municipal solid waste, and algae. Unlike grain-based ethanol, these sources do not compete with human food requirements or intensively drain freshwater reserves. Instead, they transform waste into energy, mitigate stubble burning, reduce landfill pressures, and carry the potential to unlock rural incomes through decentralized processing units. Importantly, advancing such technologies would align climate commitments with development goals, without forcing trade-offs between nutrition, water security, and clean air.

India's ethanol policy, therefore, must be understood as Janus-faced. One visage projects optimism: a pathway to energy diversification and carbon reduction. The other visage offers a cautionary reminder: of inflation, ecological harm, and structural inequities that may result from ill-conceived implementation. The real challenge for policymakers is to tilt the balance towards promise rather than peril. In pursuing energy sovereignty, India cannot afford to mortgage its agrarian future, deplete its water tables, or perpetuate social injustice. The path forward lies not in abandoning ethanol altogether, but in recalibrating ambition towards resilient second-generation biofuels that sustain both the economy and the ecology.

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