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Repurposing Used Cooking Oil into Biodiesel: A Case Study on Zomato's Sustainable Bio-entrepreneurship Model

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Abstract

India has been struggling with a serious sustainability challenge of reuse and improper disposal of used cooking oil. Millions of litres of **used cooking oil** have been either reintroduced into the food chain or discarded, ultimately leading to cardiovascular disease risks and food adulteration. To address this problem, innovative **circular bioeconomy models** have been developed to convert used cooking oil into **biodiesel,** an alternative renewable energy source. This paper shall explore **Zomato's** collaborative initiative with BioD Energy. This case study also sheds light on sustainable **bio-entrepreneurship** in action along with CSR acknowledgement. This partnership enables Zomato to collect 1000 litres of Used Cooking Oil per month from restaurants across major cities and convert it into Biodiesel, which is then blended with conventional diesel and supplied to oil companies. This initiative also supported the government's National target of converting 220 crore litres of Used Cooking Oil into Biodiesel by 2022, which was envisioned by FSSAI. This study is a perfect blend of Zomato's business-driven environment strategy and the practical implementation of circular economy principles into food service operations. This will create an economically viable and socially responsible path forward for **sustainable businesses.**

Keywords: Used Cooking Oil, Biodiesel, Bio-entrepreneurship, sustainable businesses, Zomato, circular bioeconomy

Introduction

The worldwide search for sustainable and renewable energy alternatives has accelerated due to the growing environmental burden of fossil fuel use. Biodiesel is a promising way to reduce carbon emissions and improper waste disposal, especially when it is produced from waste feedstocks such as used cooking oil (UCO) (Hamed et al., 2021; Sreelekha et al., 2024). Difficulties with feedstock collection, heterogeneity, and quality control are among the reasons for the limited use of UCO-based biodiesel (Leung et al., 2010). Out-of-control UCO reuse and disposal in India not only endangers public health but also contributes to environmental pollution (FSSAI, 2023). It is the need of the hour to have an integrated system that connects waste streams from the food industry to sustainable fuel production and is traceable to address these issues. Zomato's sustainable bioentrepreneurship model is a significant example of such integration, in collaboration with Biod Energy (BioD). It ensures the collection of UCO from restaurants and routes it to biodiesel production, where it is further blended with conventional diesel (Inc42, 2019). By optimising its extensive digital infrastructure and restaurant network, Zomato's model symbolises a scalable, circular-economy approach that reconciles urban waste management with renewable energy generation.

Composition of Used Cooking Oil (UCO)

Frequent heating and prolonged exposure to heat and oxidation during frying produce a different type of oil from that of fresh vegetable oils. Monounsaturated, polyunsaturated, and saturated fatty acids are generally present in adequate amounts in fresh oils. But UCO has a higher percentage of saturated and Monounsaturated fatty acids, whereas polyunsaturated fatty acid content continues to decline due to oxidative breakdown and thermal degradation. Long-term heating also leads to the hydrolysis and oxidation of triglycerides and phospholipids, which in turn produce free fatty acids (FFAs), aldehydes, ketones, peroxides, and other polar compounds. These chemical changes impact the oil's nutritional value and change its viscosity, colour, and sensory qualities.

It is important to understand the detailed chemical composition of UCO for its efficient repurposing into biodiesel. The presence of Free Fatty Acids and other degradation products can affect the yield and quality of biodiesel during transesterification. To meet the standards for sustainable biofuel production and circular economy principles, monitoring these compositional parameters has become important. (Awogbemi, 2019).

Impact Of UCO

Overaccumulation and improper disposal of used cooking oil (UCO) can have significant effects on the environment, ecosystem, and the general public's health. UCO can create blockages when released into drainage systems, leading to urban flooding and clogged sewers. The oil also disrupts aquatic ecosystems by creating a thin surface layer that impedes oxygen transfer. Free fatty acids, aldehydes, and polymerised compounds found in UCO are toxic to microbial communities and also bioaccumulate, disrupting aquatic food chains. Besides contributing to air pollution, it causes oxidative stress, inflammation, and an increased risk of cardiovascular and metabolic diseases in people by releasing volatile organic compounds and polycyclic aromatic hydrocarbons into the air. It also leads to soil pollution by disrupting microbial activity and soil structure, ultimately causing soil infertility. Sankhyan highlights the need for renewable energy sources, which can be aligned with the circular economy by using sustainable methods for collecting, recycling, and valuing waste, such as converting UCO into biodiesel.

Collection of UCO

The collection of UCO can be traced as part of India's RUCO (Repurpose Used Cooking Oil) initiative, led by the Food Safety and Standards Authority of India (FSSAI) in partnership with the Ministry of Petroleum & Natural Gas, in which Zomato has set up an effective system of collection of UCO from partner restaurants. Blue storage drums are offered free of charge by Zomato to ensure proper safety storage for restaurants. These filled drums are later collected by trucks, and the empty ones are returned for further collection; this ensures a smooth and sanitary process. Restaurants that are not yet part of this program are welcome to join the initiative with Zomato, and they will be paid for the collected oil to encourage both economic incentives and environmental responsibility. India's objectives of producing sustainable energy and lowering carbon emissions are fulfilled by converting collected UCO into biodiesel at approved biodiesel production facilities. By establishing a comprehensive framework for an

ethically sound waste management system and the production of renewable fuel, Zomato demonstrates its dedication to sustainable bioentrepreneurship and the circular economy (Zomato Blog, 2019; News18, 2019).

Regulations and Policies for UCO Collection

A well-organised regulatory and policy framework that guarantees sustainable use, safe collection, and traceability supports the management of used cooking oil (UCO) in India. One important program is RUCO (Repurpose Used Cooking Oil), launched by the Food Safety and Standards Authority of India (FSSAI) and the Ministry of Petroleum and Natural Gas (MoPNG). This program reduces environmental contamination and creates a dependable feedstock for biodiesel production by requiring the segregation, safe storage, and proper collection of UCO from homes, restaurants, and the HoReCa sector.

Under the FSSAI guidelines, food businesses are encouraged to partner with authorised aggregators, maintain hygienic storage of UCO, and ensure traceability from generation to collection. The National Policy on Biofuels also sets targets for biodiesel blending and encourages the use of UCO as a renewable feedstock to meet energy and sustainability goals. These regulations create an ecosystem that incentivises responsible disposal, supports circular-economy practices, and provides opportunities for bioentrepreneurial models, such as Zomato's UCO collection program. By adhering to these policies, companies and restaurants not only comply with legal standards but also help reduce environmental hazards and promote renewable energy production.

Processing of UCO

Zomato and authorised biodiesel producers under their partnership programme convert the UCO into biodiesel. Zomato ensures the smooth collection of UCO from partner restaurants through its blue drum collection system and ensures proper storage, traceability, and regulatory compliance. After collection, the oil is transported to biodiesel facilities for processing. During the process, pre-treatment removes solid food particles and dries the material to reduce moisture before the transesterification reaction.

In this chemical process, triglycerides in the oil react with methanol in the presence of a catalyst—typically alkaline (NaOH, KOH), acidic (H_2SO_4), or enzymatic—to produce fatty acid methyl esters (FAME), which constitute biodiesel, and glycerol as a by-product. After the reaction, the mixture separates into biodiesel and glycerol, and the biodiesel is purified to meet fuel quality standards.

This partnership model ensures a circular-economy approach, turning waste oil into renewable fuel while providing economic incentives for restaurants and supporting India's sustainable energy initiatives. By ensuring proper collection, traceability, and compliance, Zomato and its partners contribute to both environmental protection and bioentrepreneurship.

Economic and Business Prospective

The repurposing of Used Cooking Oil (UCO) into biodiesel can be a significant economic cum sustainable model of entrepreneurial opportunities, particularly for food delivery platforms, restaurants, and renewable energy producers. For companies like Zomato, developing a structured UCO collection system has proven to be a new revenue stream while encouraging

sustainability and corporate social responsibility (CSR) initiatives. Partner restaurants benefit financially through monetary incentives for the UCO they supply, creating a win-win model that encourages reduction in environmental liabilities.

From a market perspective, UCO-based biodiesel is a cost-effective alternative to conventional diesel, as the raw material is essentially a waste product with minimal procurement cost. By collecting UCO from multiple restaurants and food chains, Zomato-like platforms can ensure a continuous supply at scale, which is crucial for commercial biodiesel production. This model depicts how circular economy principles can be applied to a profitable business, amalgamating sustainability with economic viability.

Moreover, UCO-based biodiesel production increases job creation and entrepreneurial activity across the supply chain, including collection, transportation, processing, and distribution. It also stimulates innovation in logistics, tracking, and quality control, as transparency and compliance are crucial for regulatory adherence and market acceptance. Overall, this model highlights the economic and business perspective on UCO repurposing, focusing on how the concepts of reuse, recycling, and reducing can be used to convert environmental challenges into profitable bioentrepreneurship ventures, as exemplified by Zomato's sustainable model.

Research Methodology

The study relies primarily on secondary data from company sustainability reports, FSSAI notifications, government policy documents, and relevant academic literature. The assessment of data is done using circular economy practices, sustainability impact, and bio-entrepreneurial value creation. Selected case for the study: Zomato's collaboration with BioD Energy to convert used cooking oil into biodiesel. Due to limited access to proprietary data, the study relies on a combination of secondary data sources, which is acceptable for a descriptive and exploratory case study.

Conclusion

Zomato's sustainable bioentrepreneurship model has addressed persistent urban waste challenges by repurposing Used Cooking Oil (UCO) into biodiesel, an innovative and practical approach. Through the integration of technology, logistics, and sustainability principles, Zomato has demonstrated the impact of digital platforms not only on food delivery but also on environmental conservation and renewable energy production (FSSAI, 2020). Zomato's collaboration with biodiesel manufacturers and regulatory bodies, such as the Food Safety and Standards Authority of India (FSSAI), has truly converted waste into value. This initiative under RUCO (Repurpose Used Cooking Oil) directly contributed to reducing improper oil disposal, mitigating water and soil pollution, and lowering carbon emissions (FSSAI, 2019). This model perfectly demonstrates that corporate-led sustainability can simultaneously generate environmental, economic, and social value (Singh & Sharma, 2020). In fact, much of the 140 crore litres per annum of UCO can be converted into biodiesel, which can ideally result in an 80% reduction in carbon emissions compared to conventional diesel (Atabani et al., 2012; Demirbas, 2009).

This initiative by Zomato is also aligned with the Sustainable Development Goals (SDGs), particularly SDG 7 (Affordable and Clean Energy), SDG 12 (Responsible Consumption and

Production), and SDG 13 (Climate Action), as well as the private sector's potential to support national biofuel blending targets (United Nations, 2015). However, this initiative also comes with certain limitations and challenges, such as inconsistent UCO supply, lack of awareness among small food operators, and high collection and processing costs (Leung et al., 2010). To achieve large-scale transformation, a few areas need attention, such as stronger policy incentives, improved collection logistics, and enhanced awareness campaigns.

In conclusion, Zomato's UCO-to-biodiesel initiative judiciously integrates bioentrepreneurship in practice and transformed environmental waste into economic opportunity. It highlights the power of innovation, collaboration, and sustainability in both business and environmental progress. This model can ensure that profitability and social responsibility go hand in hand, setting a benchmark for future bio-based enterprises. Zomato's sustainable bioentrepreneurship model is a perfect example of CSR, innovation, sustainability, and economic consciousness, fostering a circular economy. The idea of reuse and recycling, with the aim of minimising input costs for a final eco-friendly product, has demonstrated an intelligent partnership among Zomato-like platforms, restaurants, and biodiesel production units. UCO can produce harmful compounds, such as aldehydes and trans fats, when improperly discarded or reused multiple times, leading to serious environmental and health hazards (Leung et al., 2010). Zomato's initiative to redirect this waste stream into biodiesel production has helped convert potential pollutants into a clean, renewable resource, thereby fulfilling national and global sustainability goals (Atabani et al., 2012). Regarding the environment, converting UCO to biodiesel has reduced our dependence on fossil fuels and lowered carbon emissions by nearly 80% compared to petroleum diesel (Demirbas, 2009). Moreover, biodiesel derived from UCO emits significantly fewer particulates, sulfur oxides, and carbon monoxide, which contributes to improving air quality and supporting India's commitments under the Paris Climate Agreement and the United Nations Sustainable Development Goals (SDGs)—particularly SDG 7 (Affordable and Clean Energy) and SDG 13 (Climate Action) (United Nations, 2015). From a bioentrepreneurial perspective, Zomato's initiative highlights the potential of private enterprises to integrate environmental sustainability, technology, and innovation. The partnership between Zomato and thousands of restaurants has optimised the digital infrastructure for producing biodiesel from UCO (FSSAI, 2020). Zomato's collaboration with biodiesel manufacturers and regulatory bodies, such as the Food Safety and Standards Authority of India (FSSAI), has truly converted waste into value. This initiative under RUCO (Repurpose Used Cooking Oil) directly contributed to reducing improper oil disposal, mitigating water and soil pollution, and lowering carbon emissions (FSSAI, 2019).

However, despite the successful implementation of this model, it faces numerous challenges with respect to logistics, collections, integration, the adequate availability of UCO, and other costs involved in the process (FSSAI, 2020). In addition, large-scale implementation remains a critical concern due to UCO quality standards across diverse food outlets (Atabani et al., 2012). To address these issues, it is necessary to work on policy incentives, innovation, collection systems, and holistic management while keeping government agencies in the loop. Other industries should adopt Zomato's model to integrate sustainability and entrepreneurship for a better, more eco-friendly environment and future. There is still a need to spread awareness of such business-driven sustainability initiatives that can contribute to national energy goals.

In summary, Zomato's UCO-to-biodiesel initiative case reflects the revolutionary potential of sustainable bioentrepreneurship in the food and energy sectors. By integrating waste reduction, renewable energy generation, and social responsibility, this model demonstrates that sustainability can be both economically viable and environmentally impactful—turning a widespread waste problem into a catalyst for clean energy innovation and circular economy growth.

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