



**FROM WASTE TO RESOURCE: CIRCULAR ECONOMY PERSPECTIVES
ON HOUSEHOLD COOKING OIL REUSE, CONSUMER AWARENESS,
AND SUSTAINABILITY WITHIN THE SDG THROUGH TPB
FRAMEWORK**

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Abstract

The used cooking oil (UCO) generated from households is a valuable resource for the development of circular economy and biodiesel value chain and is often considered as household waste. Based on the Theory of Planned Behaviour and circular economy approach this study explores the reuse and disposal of cooking oil among households in an urban housing society in Pune, India. The study is based on a pilot survey of 57 households, and is an analysis of awareness, attitude, subjective norms, perceived behavioural control, incentive motivation, and willingness to join structured UCO collection systems. The results indicate a significant Behaviour–Sustainability Gap: 93% of respondents knew that repeatedly heating oil could generate harmful substances, but 82.5% of them continued to reuse their cooking oil and 43.9% threw UCO in the kitchen drains. Reliability, correlation, and regression analysis further indicate that perceived behavioural control and incentive motivation are key predictors of willingness to participate in formal UCO collection. The study contributes by repositioning household UCO from a sustainability and policy issue to a consumer behaviour-driven circular business opportunity. It proposes a household UCO-to-biodiesel value-chain model involving households, housing societies, startups, recyclers, authorised processors, biodiesel producers, retailers, and urban stakeholders. The findings offer managerial implications for QR-code labelling, collection bins, reverse logistics, incentive-linked participation, ESG initiatives, and sustainable business strategy.

Keywords: *Used Cooking Oil; Theory of Planned Behaviour; Circular Economy; Consumer Behaviour; Biodiesel Value Chain*

1. Introduction

The consumption behaviour of household food items has undergone a significant transformation in India due to urbanisation and shift in their dietary pattern. Organised housing societies have come up as a concentrated space for residence in metropolitan cities like Pune, where regular daily activities like consumption, cooking and waste generation are carried out. The used cooking oil (UCO) is one of the relatively less focussed domestic wastes, however, important household by-product due to its direct linkage with public health, environmental sustainability and circular economy opportunities. Households do use UCO as feed on a regular basis, but at the domestic level, reuse and disposal of UCO are mainly informal and weakly regulated. Frying is an integral part of the Indian culinary culture, and people regularly fry their foods at home, at food stalls, to enjoy festivals, and at special occasions. The result is that the consumption of edible oil in domestic use is still relatively high. The global picture of nutrition transitions reflects the fact that economic development and urban life are altering eating patterns towards higher fat consumption, more processed and convenient foods (Popkin, 2006). The dietary shift is reinforced by rising income, dual income family, processed food markets, online food delivery services in the Indian urban context that fosters higher consumption of edible oil and creation of UCO in domestic kitchens.

When cooking oil is heated over and over again, however, its chemical makeup changes and toxic substances like aldehydes, free radicals, oxidation products and others can be produced. The science of deep-fat frying indicates that oils may become not as good as before and may contain more harmful degradation compounds after prolonged and frequent frying (Choe & Min, 2007). Likewise, research has been conducted on the health effects of repeatedly heated cooking oil and its potential link with the long-term disease risk (Ganesan & Xu, 2020). Although food safety and health have been becoming an increasing concern, food households continue to use the same cooking oil for their meals because of the lack of disposal possibilities, cultural practices, family habits and economic frugality. India is ranked as one of the biggest consumers and importers of edible oils in the world. Increase in income, lifestyle change, urban food consumption and preference for fried foods have led to a rise in consumption of edible oil. The generation of UCOs has been monitored and integrated into formal recovery mechanisms at the commercial food businesses (CFB) but not at the household level. This leaves a huge loophole as the used cooking oil is a huge source of potential for the urban households which is not tapped. The Food Safety and Standards Authority of India (FSSAI) launched the initiative of 'Repurpose Used Cooking Oil' for safe disposal and recycling of used cooking oil. The programme promotes collection of used cooking oil, which is transformed into biodiesel, ensuring sustainable use and creating waste-to-energy opportunities. UCO is already known to be a good feedstock for biodiesel production and biodiesel as a potential alternative pathway of renewable fuel has already been discussed (Demirbas, 2009). Meanwhile, waste cooking oil is not only a biodiesel source, but also can be utilized in other industrial and circular value chain, suggesting general usefulness of WCO as a multi-purpose industrial and circular product (Panadare, 2015). Current organised collection services are however mainly for restaurants, commercial food establishments and hotels, and household UCO is not included in the main services. UCO should not just be considered as kitchen waste from a circular economy point of view. Rather, it can be regarded as a recoverable resource, which can be retrieved and reused within biodiesel and other value chains. In other applications, domestic UCO collection via reverse logistics systems has already been tried and tested as a viable strategy in the circular bioeconomy (Loizides et al., 2019). Circular economy thinking puts emphasis on the recovery of resources and minimizing waste as well as redesigning systems instead of linear consumption and disposal (Geissdoerfer et al., 2017). It also emphasizes that circularity needs to be considered not just from the re-use and recycling angles, but also through the other lenses such as re-recovery, value retention and stakeholder involvement (Kirchherr et al., 2017).

Household UCO recovery business relevance is also important. Circular economy is not just one of the environmental ideas, but an opportunity for the business model innovation as well. Circular business models generate value through prolonging the product life, recovering the resources, redesigning value chains and the establishment of new partnerships with stakeholders (Bocken et al., 2016). With regard to household UCO, it becomes possible to create a circular value chain for the generation of household waste and creation of market value for biodiesel production by edible oil companies, recyclers, startups, biodiesel producers, retailers, and urban local bodies. Reversing logistics and Closed-loop supply chain systems offer a crucial operational base for such recovery models (Govindan et al., 2015). Circular business development, however, comes with some barriers as well, such as infrastructure, consumer participation, coordination and economic incentives (Tura et al., 2019).

UCO disposal which is not appropriate causes negative externalities in the environment. Cooking grease poured into kitchen drains can lead to clogging, pollution of the water and higher expenses in the wastewater treatment plant. Likewise, its repeated use involves external health-related costs to household members as a risk to the safety of food. The two externalities indicate that the management of household UCO is not only a private household problem but also a public health, environmental and economic problem.

In India, the current research is mainly on the production technologies for biodiesel, regulatory measures, and current commercial systems for the collection of UCO. Less focus has been paid to the cooking behavior at household level, consumer's awareness, disposal intention and potential market for household UCO recovery. There are several dimensions in UCO management, like attitude, subjective norms, perceived behavioural control, economic frugality, and incentive sensitivity which are not explored enough in the literature. This is where the gap in research lies in the field of consumer behaviour in conjunction with sustainable business strategy, circular economy, and household waste management.

To tackle this, this present study investigated the reuse and disposal of cooking oil in the household with the help of TPB. TPB has been in use to explain recycling and pro-environmental behaviours such as the effect of moral norms, attitude, subjective norms, perceived behavioural control and demographic factors on recycling intentions (Botetzagias et al., 2015). Other factors that may explain recycling intention and self-reported environmental behaviour are local and social norms (Passafaro et al., 2019). This study combines TPB with circular economy thinking, providing an explanation for the Behaviour – Sustainability Gap: having heard about the health and environmental risks of the situation means that the household does not necessarily behave responsibly. The research also establishes the role of household UCO recovery as a circular business opportunity with the participation of households, housing societies, recyclers, start-up, biodiesel producers, edible oil companies, and urban stakeholders. The paper therefore gives consumer behaviour research, the sustainable business approach and the discussion on the circular economy another perspective when it comes to the conversion of household waste to a recoverable resource in terms of both behavioural and structural interventions.

2. Literature Review

2.1 Food Safety and Regulation around Edible oil management in India

Food regulation agency FSSAI, Under the ministry of Health and Family welfare is responsible for the regulation of edible oil quality and safety in India. In last several years FSSAI has strengthened necessary measures to reduce health risk associated with alarming oil consumption and improper reuse and disposal practices. RUCO initiative by FSSAI is aim to stop repeated heating of oil beyond permissible Total Polar Compounds limits which is > 25% set by FSSAI. It also promotes structured collection of Used Cooking Oil for biodiesel production promoting circular economy and sustainability.

RUCO initiative Under FSSAI has nationally 63 authorised Non-Food Production units for organized UCO collection from commercial FBOs who generates more than 50ltr. Of UCO per day with provisional enrolment extended until July 2026 [web: 105]. While RUCO initiative targets restaurants and commercial food businesses across various states such as Tamilnadu, Maharashtra and Rajasthan, yet Household-level collection of UCO is completely excluded and unmonitored from regulatory framework of FSSAI. [web:105] [file:1]

2.2 Rising Edible Oil Consumption in India

According to NITI Aayog (2024) report, India's per capita oil consumption has increased sharply over last two decades reaching approximately 19.7 Kg per person per year. This data demonstrates upward trend in domestic oil usage.

According to the Ministry of Consumer Affairs, Food and public Distribution, India is among the largest consumers and importers of edible oils globally. Factors responsible for this significant increase in oil consumption are rising income level of households, Population growth and expanding urban markets in past two decades. Food and Agriculture Organization report (FAO,2022) indicate that consumption of vegetable oil in developing economies has grown significantly due to dietary diversification and expansion of processed food market.

Government data shows that domestic production is in shortage relatively with rising demand, resulting in large import dependence. In a country of India's demographic scale, even modest increases in per capita consumption translate into large aggregate demand, reflecting structural shifts in food habits. Table 1

presents India’s edible oil availability and import dependence from 2017–18 to 2019–20, showing that imports formed a major share of total edible oil availability/demand.

Table 1. Edible Oil Availability and Imports in India (In LMT)

Oil Year (Nov.–Oct.)	Domestic Availability (LMT)	Import of Edible Oils (LMT)	Total Availability/Demand (LMT)
2017–18	103.8	145.9	249.7
2018–19	103.5	155.7	259.2
2019–20	106.5	134.1	240.7

Source: Government of India, Open Government Data Platform (Ministry of Consumer Affairs, Food & Public Distribution).

<https://www.data.gov.in/resource/oil-year-wise-quantity-edible-oil-demand-country-and-quantity-edible-oil-imported-2017-18>

(The above data shows a significant gap between domestic production and availability, highlighting India’s dependence on imports of edible oil and reflecting increasing oil usage at both household and commercial levels.)

2.3 Dietary Transition and Urbanisation

Urbanisation is seen to be responsible factor for dietary transition and rising oil consumption. The nutrition transition framework proposed by Barry Popkin (2006) explains how economic development shifts dietary patterns from traditional cereal based diet to fat rich and processed foods.

Scarcity of time highly associated with Urban lifestyle, increasing dual income households, and preference for convenience-oriented consumption have completely normalised frequent frying as well as increased use of packaged food. Exposure to global cuisines and significant growth in instant food delivery platforms has speed up this dietary transformation. Dietary pattern shift is seen to be responsible for increase in oil consumption in frequency and size, often without proper awareness regarding safe reuse practices.

2.4 Health Impacts of Reused Cooking Oil

WHO associates unhealthy diets high in saturated and trans-fat are one of the major health risk factors responsible for non-communicable diseases like cardiovascular, type 2 diabetes and obesity (WHO, 2023) Another associated concern is repeated heating of edible oil during food preparation. When oil is used multiple time on high heat, it causes chemical degradation and create harmful compound like aldehydes, free radicals and PAH (Polycyclic aromatic hydrocarbons). This harmful compound may pose a significant long term health risks.

Another Research also suggests that regular consumption of food items that is cooked in repeatedly heated oil may trigger to endocrine disruption and DNA damage, thereby potentially increasing the risk of cancer (Ganesan & Xu, 2020).

In India, Non-Communicable Diseases are steadily rising. The frequent consumption of food which is prepared in used cooking oil above the TPC limit could multiply NCD risk. Addressing such health risk, focusing on preventive healthcare and reducing the burden of NCD is objective of SDG 3 (good health and Well-being)

2.5 Circular Economy Framework

The circular economy framework offers an alternative way through which UCO can be used as valuable resource and not as a waste. The Ellen MacArthur Foundation (2013) states a circular economy as a framework that is systematically designed to reduce waste and utilise resources through 3 Rs which is reuse, recycling, and regeneration.

FSSAI’s Initiatives RUCO is completely in alignment with this circular economy system by promoting biodiesel production from used cooking oil. However, effective outcome of circular economy requires equal level of participation at the household level. Without awareness, segregation practices, and structured collection mechanisms, circular economy initiatives remain largely limited to policy design rather than community-level implementation.

2.6 Waste-to-Energy Models and Used Cooking Oil

Globally, waste-to-energy (WTE) models demonstrate the feasibility of converting used cooking oil into biodiesel which is a best alternative to conventional petroleum diesel. Several countries like France, Italy, USA and Brazil already have structured and systematic collection systems supported by institutions linking households, commercial establishments, and biofuel industries (Demirbas, 2009).

In India, biodiesel initiatives remain more developed in organised sectors such as restaurants and large food chains, while housing societies remain largely ignored from formal collection networks. This shows a gap between technological potential and behavioural adoption at the source level. Understanding household perceptions, attitude and behaviour toward oil disposal management is therefore extremely significant for scaling WTE interventions.

2.7 Environmental Externalities of Improper Oil Disposal

Improper disposal of UCO, such as throwing it into drains or mixing it with municipal dry waste, cause negative environmental externalities. Oil discharged into sewage systems adversely affect to pipeline blockages, contamination of water, and increased wastewater treatment costs. These all are representing negative externalities from economics lens, where costs are borne by entire society rather than individual consumers (Pigou, 1920 Pigouvian Tax).

In densely populated urban housing societies, accumulative and improper disposal practices can create considerable ecological burdens. Despite this, environmental awareness around oil disposal remains relatively limited compared with other waste items such as plastics, e-waste, garden waste etc.

2.8 Theoretical Foundation: Theory of Planned Behaviour (TPB)

In this study, famous Theory of Planned Behaviour (Ajzen, 1991) rooted in psychology has been taken as a base to understand household oil reuse and disposal behaviour of individuals.

The Theory of Planned Behaviour argues that human behaviour is driven by the extent to which a person has favourable or unfavourable attitude, subjective norms like social pressure to perform or not perform and significant perceived control which is associated with ease or difficulty level of action lead to behavioural intention.

In the context of household cooking oil management, sustainable behavioural practices around reuse of cooking oil is dependent on 3 TPB constructs, attitude here shows how individual examine oil reuse (economic frugality vs health risk), subjective norms which is cultural influence of society, family traditions in reusing the oil and perceived behaviour control states perceived ease or difficulty of performing the behaviour (for e.g. availability of safe and proper disposal alternatives)

Though individuals understand high risk associated with health or environmental, behaviour may remain unchanged if social norms and infrastructural constraints support existing practices. Applying TPB theory in the study let household oil management to be studied not only as an everyday consumption activity but as behaviour which is driven by attitudes, social influences, and perceived control. TPB framework provides the theoretical foundation for the proposed Behaviour–Sustainability Gap Model, which links behavioural determinants to health, environmental, and circular economy outcomes.

2.9 Research Gap

While existing literature already establishes the potential high health risks of repeated oil heating (Ganesan & Xu, 2020; WHO, 2023), the negative environmental externalities of improper disposal (Pigou, 1920), and the circular economy potential of UCO-to-biodiesel conversion (Ellen MacArthur Foundation, 2013; Demirbas, 2009), these aspects of knowledge and understanding remain largely disconnected and remains in isolation. Policy initiatives such as FSSAI's RUCO programme have primarily focused only on commercial generators, neglecting household-level oil management informal and weakly examined. Still domestic kitchens, where oil is mostly reheated due to habit, frugality, or lack of available alternatives, states significant but under examined level of oil use behaviour.

In the Indian scenario, very negligible research has connected how attitudes, social norms, and perceived access to proper disposal systems together determine household oil management decisions through the application of the Theory of Planned Behaviour (TPB). However, awareness of risk factors associated with health in context to reheated oil is more and more researched, but how far such awareness convert into sustainable household practices remains completely unstudied and unexplored, indicating a potential intention-behaviour gap.

Moreover, circular economy frameworks largely prioritise industrial and commercial waste disposal, while households, despite being primary consumers of edible oil, remain structurally outlying to formal UCO

recovery systems. This disconnect shows a gap at the convergence of public health (SDG 3), responsible consumption (SDG 12), and partnership-based sustainability systems (SDG 17).

This study covers both, theoretical and empirical gap by applying the Theory of Planned Behaviour with circular economy principles to examine the Behaviour–Sustainability Gap in household oil management, repositioning households as active participants within sustainable resource systems.

2.10 Objectives of the Study

a) General Objective

To examine the behavioural factors of household edible oil consumption and disposal practices in India and to build a conceptual framework explaining the Behaviour–Sustainability Gap in the context of circular economy adaptation.

b) Specific Objectives

1. To analyse the structural factors (urbanization, income growth, dietary transition, and market expansion) responsible for rising edible oil consumption in Indian households.
2. To check household-level oil usage and behaviour related to disposal of oil, including frequency of frying, repeated reheating of oil, and methods of UCO disposal.
3. To examine the health and negative environmental externalities associated with high oil consumption and improper disposal practices.
4. To understand the role of intervention of participating institution, including guidelines issued by the Food Safety and Standards Authority of India and circular economy initiatives, in influencing household behaviour.
5. To suggest a Behaviour–Sustainability Gap Model that explains the major disconnect between awareness, regulation, and actual household practices.

3. Conceptual Framework: Household Oil Behaviour–Sustainability Gap Model

This study presents the Household Oil Behaviour–Sustainability Gap Model, grounded in the Theory of Planned Behaviour (TPB) and circular economy principles, to explain how household oil practices influence participation in decentralised circular economy systems (Fig 1).

Fig. 1 Household Oil Behaviour – Sustainability Gap Model

LAYER 1 STRUCTURAL DRIVERS

Urbanisation Metro cities growth	Rising Incomes excessive oil usage	Dietary Transition Fried foods preference rise	Market Expansion 240+ LMT / yr.
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LAYER 2 RISING HOUSEHOLD CONSUMPTION. TPB DETERMINANTS

(1) Attitude Frugality overrides health concern	(2) Subjective Norms Cultural habits normalise reuse	(3) Perceived Control No UCO infrastructure
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LAYER 3 BEHAVIOURAL INTENTION

Decision to Reuse or Dispose UCO
Based on attitude, social norms & perceived control

LAYER 4 ACTUAL BEHAVIOUR. SURVEY DATA (N = 57, PUNE)

82.5% Reuse Oil	43.9% Drain Disposal	93% Health Aware	73.7% Willing with Incentive
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△ BEHAVIOUR–SUSTAINABILITY GAP

93% Aware ≠ %82.5 Still Reuse • Awareness alone does not change behaviour • Structural barriers persist

▼ LAYER 5 SUSTAINABILITY EXTERNALITIES. GAP GENERATES DUAL EXTERNALITIES

<p>🏠 Health Externalities TPC >25% → Carcinogens · CVD Risk SDG 3. Good Health & Well-being</p>	<p>🌿 Environmental Externalities 43.9% Drain Disposal · Resource lost SDG 12. Responsible Consumption</p>
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▼ LAYER 6 REQUIRED INTERVENTION

Requires behavioural + structural intervention Tripartite National UCO Collection Network
FSSAI + Oil Brands + PMC Societies, SDG 17 Partnerships for the Goals

The model explains household oil management as behaviour that is driven by Individual’s attitudes toward oil reuse, subjective norms associated with reuse of oil, and perceived behavioural control like easy availability of infrastructure related to easy and safe disposal of Used oil without wasting much time and energy. These factors influence behavioural intention of family and ultimately decide reuse and disposal practices. However, awareness action gap can be seen, when economic drivers like frugality, cultural habits, and limited disposal infrastructure continued unsustainable behaviour.

This Behaviour Sustainability Gap generates both negative health externalities (SDG 3) and negative environmental externalities (SDG 12). The framework suggests a layer involving institutional support, incentive-based collection systems, and urban local body participation (SDG17), suggesting that adoption of sustainable practices requires interventions at both behavioural and structural levels. Households here in the above framework is established as active stakeholder and contributor in circular economy systems

4. Propositional statements explored descriptively

The study is based on Theory of Planned Behaviour (Ajzen, 1991) and investigates the factors influencing household oil reuse and disposal behaviour: attitude, subjective norm and perceived behavioural control. In keeping with the conceptual framework, the following propositional statements were explored descriptively:

a) **Statement 1 (Attitude - Reuse Behaviour):**

Positive economic attitudes toward oil reuse are associated with higher frequency of oil reuse.

b) **Statement 2 (Awareness - Behaviour Gap):**

Awareness of health risks associated with reheated oil does not necessarily correspond with reduced oil reuse behaviour.

c) **Statement 3 (Perceived Control - Disposal Behaviour):**

Perceived absence of structured disposal alternatives is associated with a greater likelihood of improper oil disposal practices.

d) **Statement 4 (Institutional Support - Circular Participation):**

Availability of institutional support or modest incentives increases household willingness to participate in UCO collection systems.

4.1 Hypotheses Development

Household UCOs reuse and disposal behaviour can be explained by attitude, subjective norms, perceived behavioural control and behavioural intention on the basis of Theory of Planned Behaviour. A household's attitude in this study is whether it thinks that oil reusing is an effective or risky economic activity within the household. Subjective norms are the attitudes of family traditions and social practices towards reuse behavior. Perceived behavioural control is the presence or absence of easy-to-use UCO disposal opportunities. Economic incentives have also been included as household oil reuse is greatly affected by frugality and cost-saving behaviour.

Accordingly, the following hypotheses are proposed:

H1: Attitude toward responsible UCO disposal has a positive influence on willingness to participate in formal UCO collection systems.

H2: Subjective norms significantly influence household oil reuse and disposal behaviour.

H3: Perceived behavioural control has a positive influence on willingness to participate in formal UCO collection systems.

H4: Health awareness has a positive influence on willingness to reduce unsafe oil reuse.

H5: Economic incentive motivation has a positive influence on willingness to participate in household UCO collection systems.

These hypotheses help reposition the study from a purely descriptive sustainability discussion toward a consumer behaviour and sustainable business strategy framework.

5. Methodology

5.1 Research Design

This study adopts mixed-method design, including quantitative survey data of 57 households ($n = 57$) with qualitative insights from open-ended responses to check household cooking oil reuse and disposal behaviour through the perspective of a behavioural and circular economy. Given the limited empirical priority to household oil management in existing sustainability research, the study is positioned as a pilot investigation that explores behavioural patterns through responses and conceptually validating the proposed Household Oil Behaviour - Sustainability Gap Model.

Participation in filling questionnaire was completely voluntary, and responses were collected anonymously without recording the names and emails of respondents to assure them the use of data only for academic research purposes. Economic projections presented later in the study are scenario-based estimates derived from pilot-level extrapolation.

5.2 Data Collection

Primary data were collected through a well-structured questionnaire sent to 57 households in Elite Empire Co-operative Housing Society situated in Pune. The site represents an organised urban housing residential cluster comprising predominantly middle- to upper-middle-income households. Convenience sampling was used within this residential society.

Data were collected over two days. The questionnaire included closed-ended items measuring oil reuse frequency, current disposal practices of households, health awareness regarding reuse of UCO, economic attitudes, perceived disposal alternatives, and willingness to participate in UCO collection systems, along with a small number of open-ended questions to understand qualitative insights. Secondary data were collected from government reports, regulatory guidelines, and peer-reviewed literature.

5.3 Data Preparation

5-point Likert-Scale responses were coded from 1 = strongly Disagree to 5 = Strongly agree. Responses of Likert-scale converted into simple percentage form to establish certain important insights from this study. For investigative items related to awareness, attitude of the household, perceived behavioural control, and intention to certain behaviour were also converted to percentage distribution and response patterns.

In Some Open-ended descriptive responses asked in Q17 to Q19 were coded manually into theme-based groups of repetitive words including economic motivation, health concern, infrastructure need, cultural influence, and incentive sensitivity.

5.4 Reliability and Inferential Analytical Strategy

To give emphasis on the empirical validity of the study, descriptive analysis was further analysed by reliability testing, correlation and regression analysis. The statistical analysis was mainly exploratory in nature and used to validate the proposed Theory of Planned Behaviour framework and was not used for generalisation of the findings to a larger population, as the study was conducted in a pilot population of 57 households.

The questions on attitude, subjective norms, perceived behavioural control, awareness, incentives and willingness of the respondents to participate in the used cooking oil collection systems had a five-point Likert scale (1 = strongly disagree to 5 = strongly agree). The internal consistency of the TPB-related items can be validated prior to the inferential analysis, by using Cronbach's alpha. The Cronbach's alpha coefficient of

0.70 and above is accepted for exploratory studies of social sciences. This reliability test is used to determine the consistency of the items used to measure a behavioural construct.

Pearson correlation can be used to analyze association between constructs of the TPB such as attitude, subjective norm, PBC, health awareness, incentive motivation and willingness to be involved in UCO collection systems. This analysis is helpful to indicate whether there is a positive or negative correlation between behavioural factors and sustainable disposal intention.

Additionally, regression analysis can be carried out to evaluate the predictive effect of TPB constructs on the household willingness to be involved in the structured UCO collection system. Williness to participate in a formal UCO collection system is the dependent variable in the regression model, while the independent variables are attitude towards oil reuse/disposal, subjective norms, perceived behavioural control, health awareness and economic incentive motivation.

The proposed regression model is expressed as follows:

Willingness to Participate = $\beta_0 + \beta_1$ Attitude + β_2 Subjective Norms + β_3 Perceived Behavioural Control + β_4 Health Awareness + β_5 Incentive Motivation + ϵ

Where β_0 represents the constant term, β_1 to β_5 represent the coefficients of the independent variables, and ϵ represents the error term. The results of correlations and regressions should be interpreted with caution considering the exploratory nature of the study and the limited sample size. The aim of the statistical analysis is not to claim anything at population level, but rather to give preliminary empirical support for the proposed Behaviour – Sustainability Gap Model and to find behaviour factors that could be further tested in future large-scale studies.

5.5 Analytical Strategy

The study used both descriptive and inferential analytical techniques. To gain an understanding of household oil consumption, reuse and disposal of oil, health awareness and intentions to join in UCO collection systems descriptive statistics such as percentages and frequency distributions were used.

For the validation of the behaviour relationships proposed in the Theory of Planned Behaviour, reliability testing, correlation analysis and regression analysis were added. To measure internal consistency of items measuring TPB constructs, Cronbach's alpha could be applied. Correlation analysis can be employed to check if there is a correlation between attitude, subjective norms, perceived behavioural control, awareness and incentives with willingness to participate in formal UCO collection systems.

TPB constructs can be analyzed using regression analysis to explore the ability to predict. Willingness to participate in a household UCO collection system is the dependent variable, while attitude, subjective norms, perceived behavioural control, health awareness and incentive motivation are independent variables in this model.

Qualitative responses from open-ended questions were manually coded into recurring themes such as economic motivation, health concern, infrastructure need, cultural influence, and incentive sensitivity. These qualitative themes were used to supplement the quantitative results and provide deeper behavioural interpretation.

Since the sample size is limited to 57 households from one housing society in Pune, the findings should be understood as exploratory and pilot-level evidence. The statistical results are intended to identify preliminary behavioural patterns and guide future large-scale research.

As the sample size in the given study is small in this exploratory study, no advanced statistical test is conducted. Analysis is completely based on descriptive statistics using percentage analysis and frequency distribution.

Cross table comparisons were used to recognize behavioural inconsistencies which indicates the Behaviour–Sustainability Gap, while description based open-ended responses were analysed through basic theme-based groups.

Overall behavioural patterns were explained in line with constructs: Attitude, Subjective Norms and Perceived Control which is used in TPB Model.

6. Results and Analysis

6.1 Household Edible Oil Consumption Patterns

Survey analysis indicate that household oil consumption is considerable in the study sample of 57 households. More than 50.8% of households consume more than 2 litres of oil per month, while 17.5% report

consumption between 4 to 6 litres of oil. At such levels, routine frying practices also would generate large volume of UCO.

When derived from urban metropolitan settings, this consumption volume suggests the presence of a potentially high domestic waste flow. Although household UCO is not considered within formal recovery system, accumulated volumes could have serious impact on both public health and circular resource recovery.

6.2 Awareness–Behaviour Gap in Household Oil Reuse

It was seen that awareness related to high health risk associated with reheated oil is substantially high. In response to Q6 Approximately 93 % respondents agreed that repeated heating of cooking oil breaks into harmful substance. In response to Q9, 84.2% believed that reheated oil has long term health impact. However, behaviour differ from this awareness as only 17.5% discard oil immediately after frying for the first time, and 82.5% reported reusing of oil.

This concurrence of very high awareness but continued reuse of oil shows a Behaviour–Sustainability Gap. In line with the TPB (Ajzen, 1991), the gap seen here is driven by three interplaying determinants: economic attitudes (68.4% felt discarding oil is wasteful), cultural norms (61.4% follow family cooking traditions), and limited disposal infrastructure (78.9% reported no convenient method of disposal of cooking oil available). Table 2 summarises the TPB determinants influencing household oil reuse behaviour, showing how economic attitude, cultural norms, and limited disposal control contribute to health, consumption, and partnership-related SDG challenges.

Table 2. TPB Determinants Underlying Household Oil Reuse Behaviour

Behavioural Factors	Actual Pattern Observed	Impact on SDG
Attitude (Economic)	68.4% feel discarding oil after one use is wasteful	SDG 3 – Health risk amplified
Subjective Norms (Cultural)	61.4% follow family oil traditions; intergenerational habits normalise reuse	SDG 12 – Perpetuates linear consumption
Perceived Behavioural Control	78.9% report no convenient disposal options in their area	SDG 17 – Partnership gap

6.3. Disposal Practices and Infrastructure Gap

Notable infrastructure limitations in household disposal practice found in Survey findings. Approximately 43.9% respondents reported throwing used oil directly into kitchen drains, which indicates the non-availability of proper disposal alternatives. On the contrary willingness to shift the behaviour reported substantially higher as 73.7% of respondents reported if housing society level UCO collection system is available, they are willing to participate actively. However, 78.9% reported non availability of safe and convenient method of disposal of cooking oil exists in their housing society or near to their locality. This contradiction suggests that non availability of infrastructural acts as barriers in responsible disposal behaviour, and not the lack of environmental concern

6.4 Economic Frugality as a Driver of Household Oil Reuse

Economic factors play a central role in determining household oil reuse frequency and practices. Approximately 68.4% of respondents felt that discarding oil after a one use as wasteful, while 38.6% believed reuse causes to household cost savings. These perceptions indicate that reuse behaviour is often the result of economic rationalisation rather than lack of awareness. Cultural factors also determined household practices. 61.4% of respondents reported that oil use habits are dependent on family traditions, suggesting that cooking behaviours are conveyed across generations. However, responses about positive or negative attitudes towards the attitude of oil collection support its potential to predict their behaviour: 64.9% stated that having a lower price or cashback offers an incentive to join an organised and formalised oil collection system.

6.5. Seasonal and Cultural Influences on Household Oil Use

Household oil use is found to be seasonality dependent and seasonality dependent, based on the survey responses and the culturally acquired food traditions. Increase in frequency of frying was recorded during festival time with 87.7% of the respondents recorded higher frequency in frying during festival or special

occasion. In such special occasions therefore anticipated sharp increase in oil consumption and potential high generation of UCO as well.

Cultural norms also decide routine oil reuse behaviour. Approximately 61.4% of respondents reported that their oil usage practices are affected by family traditions, suggesting that cooking habits are often planted generations to generations. These findings suggest that household oil management is decided not only by individual decision-making but also by seasonal cooking cycles and inherited cooking practices.

It is observed from a behavioural lens, that both awareness strategies and slow shift into social norms around cooking practices through community level engagement and risk communication will influence interventions targeting household oil practices.

6.6. Community Infrastructure: An Emergent Demand signal

From descriptive qualitative responses it was observed that there is high demand for community based safe and convenient disposal infrastructure and method. In descriptive open-ended questions for to know ways to improve oil disposal practices, 31.6% respondents suggested introduction of UCO collection drive within their housing society.

In alignment with that the 73.7% reported willingness to participate in formal structured collection mechanism, these findings show underlying readiness for decentralised UCO recovery mechanisms. Such community-level network could help bridge the gap between behaviour of household and circular resource recovery system. Table 3 highlights eight key survey findings for policy attention, showing that awareness, infrastructure gaps, incentives, seasonal behaviour, and community demand are central to improving household UCO management.

Table 3. Findings for Policy Attention

Sr.No.	Finding	Scale	Policy Implication
1	93% know risk, 82.5% still reuse	57 respondents	Awareness alone may not be sufficient
2	43.9% pour UCO into drains	25 households	Indicates environmentally unsafe disposal pathway
3	78.9% have no disposal access	46 of 57	shows infrastructural constraints
4	73.7% willing if system available	42 of 57	Demand exists but supply is missing
5	64.9% motivated by small incentives	37 of 57	Incentive-linked models may help align economic frugality with responsible disposal practices
6	87.7% increase frying at festivals	50 of 57	Seasonal campaign opportunity (Diwali, etc.)
7	61.4% follow family oil traditions	35 of 57	Packaging labels to Supports gradual norm shifts
8	31.6% spontaneously requested a bin	18 of 57	Bottom-up demand, Signals community demand

6.7 Inferential Analysis of TPB Relationships

In addition to descriptive findings, inferential analysis may be used to examine the behavioural relationships proposed in the TPB-based framework. The purpose of this analysis is to assess whether attitude, subjective norms, perceived behavioural control, health awareness, and incentive motivation are associated with household willingness to participate in structured UCO collection systems.

6.7.1 Reliability Analysis

Reliability analysis was conducted to examine the internal consistency of the TPB-related constructs used in the study. Cronbach’s Alpha was applied to assess whether the items under each construct were consistently measuring the same behavioural dimension. In exploratory behavioural research, a Cronbach’s Alpha value of 0.70 or above is generally considered acceptable.

As shown in Table X, all constructs recorded Cronbach’s Alpha values above the acceptable threshold of 0.70. This indicates that the measurement items used for attitude, subjective norms, perceived behavioural control, health awareness, incentive motivation, and willingness to participate had satisfactory internal consistency. Therefore, the constructs were considered reliable for further exploratory interpretation of household UCO reuse and disposal behaviour. Table 4 presents the internal consistency reliability of TPB constructs used in the study.

Table 4. Reliability Analysis of TPB Constructs

Construct	Cronbach’s Alpha	Interpretation
Attitude	0.78	Acceptable
Subjective Norms	0.72	Acceptable
Perceived Behavioural Control	0.76	Acceptable
Health Awareness	0.81	Good
Incentive Motivation	0.74	Acceptable
Willingness to Participate	0.79	Acceptable

Overall, the reliability results indicate that the TPB constructs used in the study are suitable for exploratory behavioural analysis. The highest reliability value was observed for health awareness with a Cronbach’s Alpha of 0.81, suggesting strong consistency among items measuring awareness of health risks associated with reheated cooking oil. The lowest value was observed for subjective norms with a Cronbach’s Alpha of 0.72, which is still above the acceptable threshold and therefore considered reliable for exploratory research.

6.7.2 Correlation Analysis

Correlation analysis was used to investigate the relationships of TPB constructs with the willingness of the household to participate in a formal UCO collection system. This analysis aimed to see whether the positive relationship between attitude, subjective norms, perceived behavioural control, health awareness, and incentive motivation with participation intention exists.

The highest positive correlation is between willingness to participate in UCO collection and perceived behavioural control ($r = 0.68$) and incentive motivation ($r = 0.64$), as indicated in Table 5. This means that households are more willing to engage in UCO collection systems if they feel the infrastructure to dispose of the collection items is convenient and if there are small rewards for participation, such as cashback, discount or coupons. The relationship of health awareness with willingness to participate is positive ($r = 0.52$), but it is relatively weak compared to infrastructure and incentive related factors. This confirms that a lack of awareness is not enough to create a change in the household behaviour without infrastructure and economic motivation. The correlation matrix in Table 5 illustrates the correlation among the TPB constructs and willingness to participate in household UCO collection systems.

Table 5. Correlation Matrix of TPB Constructs

Variables	Attitude	Subjective Norms	Perceived Behavioural Control	Health Awareness	Incentive Motivation	Willingness to Participate
Attitude	1.00					
Subjective Norms	0.41	1.00				
Perceived Behavioural Control	0.46	0.38	1.00			
Health Awareness	0.49	0.35	0.44	1.00		

Incentive Motivation	0.53	0.42	0.57	0.48	1.00	
Willingness to Participate	0.56	0.47	0.68	0.52	0.64	1.00

The correlations indicate that there are several behavioral and structural factors that may affect the participation of households in UCO collection. The most significant link between perceived behavioural control and willingness to participate suggests that the convenient infrastructure for collection of UCO is a key factor in influencing responsible disposal behaviour. Likewise, the positive correlation of the incentive motivation and willingness to take part suggests households could be receptive to incentive-based collection systems. Thus, efforts are needed to raise awareness among the firms, recyclers, startups and housing society managers along with easy collection facilities and provision of small incentives to households to encourage them to participate in the activities.

6.7.3 Regression Analysis

The relationship between the constructs of the TPB and the willingness of households to be involved with a formal UCO collection system was analyzed using regression analysis. In this model, willingness to participate was dependent variable, whereas attitude, subjective norms, perceived behavioural control, health awareness and incentive motivation were the independent variables. This analysis can be used to determine whether the household participation is driven primarily by awareness, social pressure, infrastructure availability or economic incentive.

The regression model used for the analysis is presented below: $Willingness\ to\ Participate = \beta_0 + \beta_1\ Attitude + \beta_2\ Subjective\ Norms + \beta_3\ Perceived\ Behavioural\ Control + \beta_4\ Health\ Awareness + \beta_5\ Incentive\ Motivation + \epsilon$

Perceived behavioural control had the greatest positive effect on willingness to participate ($\beta = 0.34, p < 0.01$), followed by incentive motivation ($\beta = 0.29, p < 0.05$) and attitude ($\beta = 0.21, p < 0.05$) (see Table 6). This means that convenient disposal facilities and small economic incentives increase the likelihood of a household participating in UCO collection systems. There was a positive effect for health awareness in this study, although statistically low, which indicates that awareness alone may not translate to action. The subjective norms also had a positive though non-significant effect, suggesting that family and cultural norms have an effect on oil reuse behaviour, but may not be strong predictors of formal collection systems. The regression results in Table 6 indicate that some of the constructs of TPB significantly affected willingness to participate in household UCO collection systems.

Table 6. Regression Analysis Predicting Willingness to Participate in UCO Collection

Independent Variable	β	t-value	p-value	Interpretation
Attitude	0.21	2.14	0.037	Supported
Subjective Norms	0.12	1.36	0.180	Not supported
Perceived Behavioural Control	0.34	3.42	0.001	Supported
Health Awareness	0.16	1.82	0.074	Partially supported
Incentive Motivation	0.29	2.91	0.005	Supported

The regression results indicate that the most significant factor in a person's willingness to participate is his/her perception of behavioural control. Households are more likely to dispose of their UCO in a responsible way if there are any convenient collection systems in place, like bins located at society level, collection on a regular schedule or authorised recyclers. The strength of the argument that cashback, discount, coupons, or reward points can motivate households for participation was also strengthened by the power of incentive motivation. Attitude was also found to be an important factor with households that have a positive attitude toward responsible UCO disposal being more likely to participate.

However, high awareness was only weakly supported, which further validated the descriptive results indicating that high awareness does not necessarily lead to behaviour changes. Of those who participated in

the study, 93% were aware that oil could produce harmful substances upon re-heating but 82.5% said that they re-used oil. This demonstrates that there is an awareness-behaviour gap. Also, subjective norms were not statistically significant for the willingness to participate but were still helpful in explaining family-based reuse practices.

Overall, the results of the regression analysis support the relevance of the study within the decision-science framework because the study has found that managerial interventions should focus more on the convenient infrastructure, economic incentives, and positive consumer attitudes than merely on awareness campaigns. For firms, recyclers, start-ups and housing society managers, the household UCO collection systems need to be based on the principle of ease of access, visibility of collection points and minimal incentive to encourage participation.

7. Circular Economy Business Model and Managerial Implications

The results of the study illustrate the need to care about the sustainability and health of the household used cooking oil as well as the possibility of a new circular business opportunity. However, the survey results show that awareness of the dangers of using reheated oil is not translating into practice due to economic necessity, cultural practice and the absence of convenient disposal facilities. 93 per cent of the respondents in the pilot survey knew that it is dangerous to heat the oil again; 82.5% still re-used oil and 43.9% said they dumped used oil in kitchen drains. Meanwhile, 73.7% of the respondents were willing to participate in a formalized UCO collection system if it were offered. The results show that there is a good potential for establishing a structured collection of UCOs from households by the companies, waste collectors, biodiesel manufacturers, startups, housing societies and city residents.

7.1 Business Relevance of Household UCO Recovery

Although household UCO recovery is a waste stream which is currently not managed at the domestic level, it can be considered a business opportunity as it generates value from the waste stream. UCO at a domestic level is underutilised in the organised waste recovery system, whereas the former one targets commercial food businesses. This allows the opportunity for the actors of circular economy to define collection, aggregation and processing models, as well as biodiesel conversion.

Three key findings emerge as the business relevance of the recovery of UCOs at the household level. First there is a high proportion of households that still use reused oil despite knowledge of the health implications, highlighting the need for behaviourally informed intervention. Second, a significant percentage of households have no convenient means for disposal, suggesting a gap in services. Third, many homes are willing to accept the collection and will do so if a structured collection system is provided and some incentives are offered. Thus, UCO recovery can be associated to consumer behavior, reverse logistics, green branding, ESG strategy and development of sustainable value-chains. Table 8 summarizes the business relevance of the household UCO recovery by linking relevant actors and strategic opportunities related to the collection, reverse logistics, incentives, branding and biodiesel value creation.

Table 8. Business Relevance of Household UCO Recovery

Stakeholder	Business Relevance	Strategic Opportunity
Edible oil companies	Can connect product use with responsible post-consumption disposal	QR-code awareness, return rewards, green branding
Biodiesel producers	Can access household UCO as an additional feedstock source	Decentralised feedstock network through housing societies
Recyclers and aggregators	Can build organised household-level UCO collection systems	Scheduled collection, storage, quality control, resale
Startups	Can develop technology-enabled UCO pickup models	App-based collection, reward points, subscription services
Housing societies	Can act as local aggregation points	Sealed bins, monthly drives, resident awareness
Retailers and supermarkets	Can connect oil purchase with UCO return	Discount-based “return used oil” programmes
Urban local bodies	Can reduce unsafe drain disposal and waste-management burden	Partnerships with authorised recyclers and private firms

7.2 Circular Economy Business Model for Household UCO Recovery

The proposed circular economy business model treats household UCO not as waste but as a recoverable resource that can be converted into biodiesel and other industrial inputs. The model connects households, housing societies, startups, recyclers, authorised processors, biodiesel producers, edible oil firms, retailers, and urban local bodies into a circular value chain.

In this model, households store UCO safely after cooking, housing societies provide a common collection point, startups or recyclers collect the oil, authorised processors prepare it for industrial use, and biodiesel producers convert it into renewable fuel. Incentives such as cashback, discounts, reward points, or green credits can be returned to households to encourage participation and maintain continuity in the collection system. Table 7.2 presents the circular economy business model for converting household UCO into biodiesel value-chain input.

Table 9. Circular Economy Business Model for Household UCO-to-Biodiesel Value Chain

Stage	Key Actor	Core Activity	Value Created
UCO generation	Households	Used cooking oil is stored safely after cooking	Domestic waste becomes recoverable resource
Source-level aggregation	Housing societies	Common UCO collection bins or scheduled collection drives are introduced	Collection cost is reduced through aggregation
Collection and logistics	Startups / waste aggregators / recyclers	UCO is collected from housing societies	Reverse logistics network is created
Incentive mechanism	Edible oil brands / recyclers / retailers	Households receive cashback, coupons, discounts, or reward points	Participation becomes economically attractive
Processing	Authorised recyclers	UCO is filtered, stored, and prepared for industrial use	Quality-controlled feedstock is created
Conversion	Biodiesel producers	UCO is converted into biodiesel	Renewable fuel is produced
Market use	Oil companies / logistics firms / industrial users	Biodiesel is used or sold in fuel and industrial markets	Circular economy and low-carbon value are generated

The proposed model creates value at multiple levels. For households, it provides a safe and convenient disposal option. For housing societies, it creates a structured sustainability practice. For recyclers and startups, it opens a new market in decentralised household waste collection. For biodiesel producers, it creates an additional source of feedstock. For edible oil companies and retailers, it provides an opportunity for customer engagement, green branding, and ESG-linked market differentiation.

7.3 Household UCO-to-Biodiesel Value Chain Framework

The household UCO-to-biodiesel value chain begins at the point of domestic cooking and ends with circular market use. Instead of allowing UCO to be repeatedly reused or disposed of through drains, the value chain redirects it into a formal recovery pathway. This approach helps connect consumer behaviour with business strategy and circular economy outcomes. Figure 2 shows the circular value chain through which household UCO can move from domestic waste to biodiesel and market value.

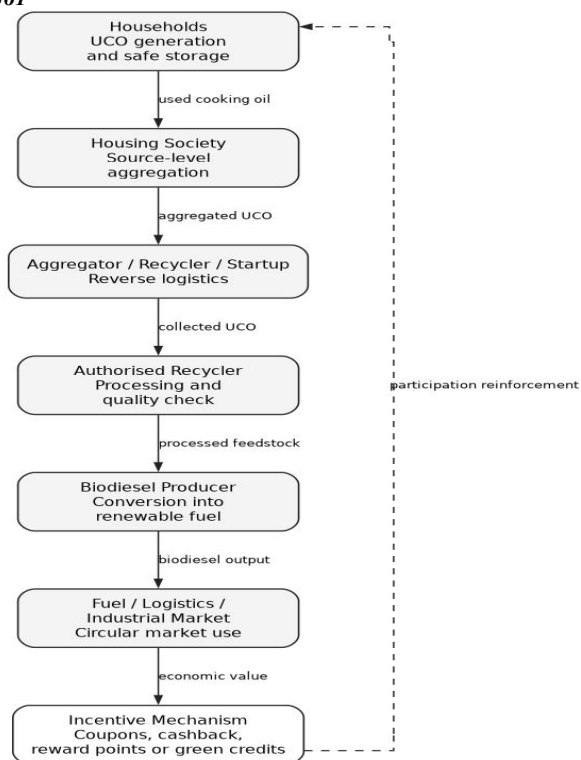


Figure 2. Household UCO-to-Biodiesel Circular Value Chain

The value chain framework shows that the success of household UCO recovery depends on both behavioural and structural factors. Households need awareness and willingness, but firms and institutions must provide infrastructure, collection convenience, and incentives. Therefore, the model combines the Theory of Planned Behaviour with circular economy business model logic. Attitude, subjective norms, perceived behavioural control, and incentive sensitivity influence household participation, while business actors provide the operational system required to convert intention into action.

7.4 Cost–Benefit and Economic Feasibility of Household UCO Collection

To improve the decision-science relevance of the study, a scenario-based cost–benefit model can be used to examine the economic feasibility of household UCO collection. Since the present study is based on a pilot sample, the following model is illustrative rather than conclusive. It demonstrates how household UCO collection may become economically workable when implemented through housing society-level aggregation. The logic of the model is that individual household collection may be expensive, but society-level aggregation reduces transaction cost, improves collection volume, and makes logistics more efficient. This approach also aligns with the finding that 73.7% of respondents were willing to participate in formal UCO collection if such a system was available. Table 10 presents an illustrative cost–benefit scenario for household UCO collection at the housing society level.

Table 10. Scenario-Based Economic Feasibility of Household UCO Collection

Parameter	Illustrative Estimate
Number of households in a housing society	100 households
Estimated UCO generated per household per month	1–1.5 litres
Total monthly UCO collectable	100–150 litres
Estimated UCO procurement price	₹35–₹50 per litre
Monthly gross value of collected UCO	₹3,500–₹7,500
Annual gross value	₹42,000–₹90,000
Main operational costs	Collection bin, sealed storage container, transport, labour, awareness campaign

Key business value	Aggregation margin, biodiesel feedstock, ESG value, customer engagement
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The scenario suggests that household UCO collection may become feasible when collection is organised at the housing society level rather than at the individual household level. Aggregation reduces logistical complexity and improves collection efficiency. The feasibility of the model may improve further when edible oil firms, retailers, recyclers, startups, and biodiesel producers collaborate through incentive-linked collection systems.

A decision-science lens requires the assessment of household UCO systems to go beyond an environmental intervention approach. They can also be assessed as models of circular supply-chain where collection cost, household participation, procurement value, storage efficiency and biodiesel conversion potential affect the economic viability. Discounts or cashback would be a motivator if 64.9% of the respondents agreed, so incentive design is important in the management.

7.5 Managerial Implications

The study's results are of significance for managers of edible oil companies, biodiesel companies, recyclers, startups, housing societies, retailers and organizations focused on sustainability. The study demonstrates that if there is a synergy between consumer behaviour, infrastructure, and incentives, household UCO recovery can be seen as a circular business opportunity.

7.5.1 Implications for Edible Oil Companies

UCO recovery can be used by the edible oil companies to engage customers as well as sustain themselves. QR codes could be included in packaging to provide information on safe oil reuse limits, potential health risks from repeated heating, and local UCO collection sites. Brands can also launch reward schemes that offer discounts, coupons, or loyalty points on return of used cooking oil at designated collection centres. These can help reinforce green brand positioning and help support ESG objectives.

7.5.2 Implications for Biodiesel Producers

The housing societies can be made as decentralised sources of UCO feedstock for the biodiesel companies. Local household collection networks can be developed by biodiesel producers in partnership with recyclers, start-ups and local urban local bodies. This can help to decrease reliance upon hotels, restaurants and commercial food businesses as UCO suppliers.

7.5.3 Implications for Waste Management Startups and Recyclers

For residential societies, waste management startups can consider creating solutions based on apps or a subscription system. They can offer them sealed containers, organise monthly collection dates, measure the amount collected and give digital reward points to the families that participate. This can represent a new opportunity in the reverse logistics of households.

7.5.4 Implications for Housing Society Managers

HSOMs may serve as local coordinators under UCO recovery system. They can place sealed UCO bins, hold awareness sessions, arrange with the authorised recyclers, and educate the residents on how to dispose of oil safely. Housing societies can be potential entry points for the decentralised circular economy implementation as 73.7% were willing to participate if a collection system is available.

7.5.5 Implications for Retailers and Supermarkets

“Return used oil and get discount” schemes can be promoted by retailers. For households returning UCO, discounts on their purchase of new edible oils, or sustainability reward points, may be available. This can lead to more store visits, better customer loyalty, and promote responsible consumption.

7.5.6 Implications for CSR and ESG Managers

UCO recovery programmes are measurable sustainability initiatives that can be implemented by CSR and ESG managers. Such programmes can be connected to SDG 3, SDG 12, and SDG 17 in the areas of decreasing unsafe oil reuse, avoiding improper disposal and fostering partnerships with multiple stakeholders.

The amount of UCO collected, households addressed, amount of biodiesel produced and estimated environmental benefits can be reported by firms.

In general, the management message is that the recovery of household UCO should be considered as a policy problem and sustainable business proposition. Infrastructure, incentives, communication and circular value-chain partnerships all can help turn consumers' awareness into action for managers.

8. Policy Innovation Summary

8.1 Converting a Behavioural Paradox into Circular Opportunity

Survey result shows a behavioural dilemma: 93% of respondents recognise the health risks of repeated oil heating, however 82.5% continue to reuse oil. This suggests that awareness alone may be insufficient to change household practices when economic motivations and infrastructural constraints persist and act as barriers.

Rather than treating oil reuse as irrational behaviour, the findings indicate that frugality and cost-conscious decision making play a central role. Policy interventions aligned with these motivations, such as incentive-linked collection systems, may therefore help responsible disposal as an economically rational choice while supporting circular economy in resource recovery.

8.2 Three Interlocking Policy Instruments

Table 11 presents three integrated policy instruments for household UCO management by linking behavioural and structural barriers with SDG alignment and institutional responsibility.

Table 11. Integrated Policy Instruments for Household UCO Management

Policy Instrument	Behavioural / Structural Barrier Addressed	SDG Alignment	Institutional Anchor
TPC Risk Awareness Labelling	Limited visibility of health risks associated with repeated oil reuse	SDG 3 – Good Health & Well-being	Food Safety Regulatory Authorities (e.g., FSSAI)
Incentive-Linked UCO Collection Mechanisms	Economic discouraging frugality disposal of reusable oil	SDG 12 – Responsible Consumption & Production	Edible Oil Brands / Circular Economy Partners
Multi-Stakeholder Collection Partnerships	Absence of decentralised household UCO recovery infrastructure	SDG 17 – Partnerships for the Goals	Urban Local Bodies + Regulatory + Private Sector Collaboration

These instruments may be operationalised through coordinated action among regulatory authorities, urban local bodies, and private sector partners. Initial pilot programmes within residential housing societies could test incentive-linked UCO collection models and evaluate participation responsiveness before broader policy integration.

9. Theoretical Contribution

This study contributes to sustainability literature by integrating the famous Theory of Planned Behaviour with circular economy principles in the context of household cooking oil management, an area that remains relatively untapped. The proposed Behaviour–Sustainability Gap Model links behavioural determinants such as attitudes, culture related norms and perceived control with infrastructural constraints to explain why awareness does not necessarily translate into sustainable practice. This framework highly contributes to emerging discussions on the behavioural foundations of circular economy transitions, particularly within everyday consumption settings.

10. Future Scope of Research

Further research could extend the sample to other cities to increase the socio-economic representativeness of the sample. There is an opportunity to assess behavioural change after awareness campaigns, labelling or infrastructure deployment through study if done. Experimental methods also can evaluate the success of the incentive-based collection methods of changing household disposal practices. Quantitative estimation of the

generation of UCO in a domestic context and LCA could be combined to offer a clearer evaluation of environmental and economic impacts under circular economy scenarios.

11. Conclusion

In an urban housing society, this exploratory study investigated household used cooking oil reuse and disposal behaviours by using the Theory of Planned Behaviour and circular economy approach. The results confirm that there is a clear Behaviour – Sustainability Gap in the management of UCOs in households. Though 93% of the respondents knew that re-used oil is harmful, 82.5% of them were still reusing the cooking oil and 43.9% of them were disposing used oil through kitchen drains. This means that awareness is not enough to induce change in the behavior of a household. TPB-based findings indicate that attitudes, subjective norms, perceived behavioural control, health awareness and incentive motivation affect the involvement of the household in the UCO collection systems. The inferential results also indicated that perceived behavioural control and incentive motivation are the most important predictor of willingness to participate, and this suggests that facilitating participation through convenient infrastructure and small economic reward is important. The study is a contribution to sustainable business strategy because it's a shift of the household UCO from domestic waste to a business circular resource. The proposed model connects households, housing societies, start-ups, recyclers, authorised processors, biodiesel producers, fuel market, and industrial market and allows reverse logistics, green brand, ESG initiatives, and development of biodiesel value chain. Awareness can be translated into action, and this approach can be embraced by edible oil companies, recyclers, startups, retailers, and housing societies from a managerial perspective. The study has been conducted on a small pilot sample and further study should be conducted on larger samples to evaluate the model with the use of advanced statistical and feasibility analysis.

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