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UNDERSTANDING HOUSEHOLD PRACTICES AND INCENTIVE-BASED PARTICIPATION IN WASTE COOKING OIL RECYCLING

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ABSTRACT
This study examines household awareness, disposal practices, and willingness to participate in Waste Cooking Oil (WCO) collection and recycling across four districts in the Hyderabad metropolitan area. A structured questionnaire was administered to 368 respondents to capture demographics, cooking oil usage, disposal behaviors, WCO recycling awareness, and willingness to accept (WTA) incentives at multiple price points. Descriptive statistics and graphical analyses were conducted using SPSS. Results indicate that most households are younger or middle-aged, educated, and predominantly use refined oil, spending moderately on 3–6 liters per month. Despite general environmental awareness, unsafe disposal practices are prevalent: over half pour WCO into drains, and a small proportion reuse or recycle. Awareness of WCO recyclability is low, with only 23–24% recognizing its potential for recycling and 10.6% having seen a collection bin. WTA analysis shows that households are most willing to participate at modest incentive levels (₹20–25 per litre), with acceptance declining sharply at higher price points. These findings highlight a gap between environmental knowledge and practical WCO management, while also suggesting significant potential for participation through targeted awareness programs, accessible collection infrastructure, and incentive-based schemes. The study provides actionable insights for policymakers, environmental agencies, and sustainability-driven organizations aiming to promote circular bioeconomy practices through effective household-level WCO management.

Keywords: *Waste Cooking Oil (WCO); Disposal Practices; Willingness to Accept (WTA); Cooking Oil Consumption; Waste management.*

INTRODUCTION
Waste management has become one of the world's most pressing environmental challenges, driven by rapid population growth, industrialisation, and rising consumption patterns. (Sperandio et al., 2019) These factors increase the volume of waste generated, posing substantial risks to both human health and ecosystems. Recycling remains a key strategy to mitigate these impacts, (Afroz et al., 2009; Gurbuz & Ozkan, 2019) and alongside materials such as paper, plastics, and PVC, waste cooking oil (WCO) has emerged as a promising recyclable resource. (Sperandio et al., 2019) Developed countries including the United States, Germany, Japan, Taiwan, and members of the European Union recognised WCO disposal issues early and successfully addressed them through strict regulations and strong citizen compliance. (Kabir et al., 2014a; Lee et al., 2023; Yang & Shan, 2021)

WCO produced from households, restaurants, caterers, and industrial kitchens becomes unsafe for consumption after repeated use due to increased free fatty acids. (Yacob et al., 2015) Improper disposal of WCO, such as dumping into drains or mixing with municipal solid waste, leads to severe environmental consequences including water pollution, greenhouse gas emissions, and ecosystem damage. (Hidalgo-Crespo et al., 2022; Matušinec et al., 2022; Xirogiannopoulou & Athanasiou, 2025) Pollution of waterways also threatens aquatic life and contributes to indirect human exposure through the food chain. (Kabir et al., 2014b) Such practices further result in economic losses and reduce opportunities for resource recovery. (De Feo et al., 2020)

Aligned with circular economy principles, recycling WCO supports waste-to-resource transitions by producing biodiesel and other value-added products, thereby reducing dependence on fossil fuels and enhancing energy security, (Hidalgo-Crespo et al., 2022; Lee et al., 2023) Growing global commitments, including the Paris Agreement and ICAO's 2050 carbon-neutrality targets, have sharply increased demand for WCO-based Sustainable Aviation Fuel (SAF). (Lee et al., 2024)

However, WCO supply chains (particularly at the household level) remain inefficient due to logistics challenges, contamination issues, and limited public participation. (Febijanto et al., 2023; Sperandio et al., 2019) To understand community perceptions and preferences regarding WCO collection, this study aims to examine household awareness, disposal practices, and willingness to participate in Waste Cooking Oil (WCO) collection and recycling.

METHODOLOGY
This study employed a descriptive and analytical research design to examine household awareness, disposal behaviour, and willingness to accept (WTA) incentives for Waste Cooking Oil (WCO) collection across

Rangareddy, Sangareddy, Medchal–Malkajgiri, and Hyderabad districts. Primary data were collected from 368 households using a structured questionnaire covering demographics, cooking oil usage, disposal patterns, awareness of WCO recyclability, and WTA at multiple price levels. A non-probability convenience sampling technique was used due to accessibility and voluntary participation. The collected data were coded and analysed using IBM SPSS, employing descriptive statistics (frequencies, percentages), graphical representation (bar charts and pie charts), cross-tabulations to compare behavioural trends across demographic groups, and chi-square tests to assess associations between awareness, disposal practices, and willingness to participate in collection programs. All respondents participated voluntarily, and no personally identifiable information was collected, ensuring confidentiality and ethical compliance. The methodology enabled a clear understanding of household-level behaviours and perceptions related to WCO recycling, supporting evidence-based conclusions and recommendations.

DATA ANALYSIS AND INTERPRETATION

Variable	Category	Frequency	Valid %
Age Group	20–30 years	164	44.6
	31–40 years	112	30.4
	41–50 years	70	19.0
	51–60 years	16	4.3
	Above 60 years	6	1.6
Location	Rangareddy	93	25.3
	Sangareddy	104	28.3
	Medchal–Malkajgiri	67	18.2
	Hyderabad	104	28.3
Education Level	High School	45	12.2
	Intermediate	62	16.8
	Bachelor's Degree	175	47.6
	Master's Degree	80	21.7
	Doctorate	6	1.6
Household Income	₹30,000–60,000	112	30.4
	₹61,000–90,000	58	15.8
	₹91,000–1,20,000	71	19.3
	₹1,21,000–1,50,000	45	12.2
	₹1,51,000–1,80,000	29	7.9
	> ₹1,81,000	53	14.4
Family Size	≤ 2 members	17	4.6
	3 members	73	19.8
	4 members	171	46.5
	5 members	75	20.4
	≥ 6 members	32	8.7
Type of Oil Used	Refined Oil	309	84.0
	Cold-Pressed Oil	59	16.0

Behavioural patterns:

Variable	Category	Frequency	Valid Percent	Cumulative Percent
Monthly_Oil_Expense	< Rs. 200	15	4.1	4.1
	Rs. 201–400	80	21.7	25.8
	Rs. 401–600	138	37.5	63.3
	Rs. 601–800	75	20.4	83.7
	Rs. 801–1000	32	8.7	92.4
	> Rs. 1000	21	5.7	100.0
	Total Valid	361	100.0	
Monthly_Oil_Consumption	< 2 liters	69	18.8	18.8
	3–6 liters	259	70.4	89.2
	6–8 liters	27	7.3	96.5
	8–10 liters	5	1.4	97.9
	> 10 liters	7	1.9	100.0
	Total Valid	367	100.0	
WCO_Disposal_Method	Drainage	193	52.5	52.5
	Garbage	42	11.4	63.9

	Soil	25	6.8	70.7
	Recycle myself	14	3.8	74.5
	Donate to maid/neighbor	14	3.8	78.3
	Reuse	79	21.5	100.0
	Total Valid	367	100.0	

Knowledge and Awareness Variables

Awareness Variable	Response Category	Frequency	Valid %
Knowledge that WCO is Recyclable	Yes	86	23.4
	No	282	76.6
Seen a WCO Collection Bin (N = 367)	Yes	39	10.6
	No	328	89.4
Heard About WCO Recycling	Yes	87	23.6
	No	281	76.4
Knowledge of Environmental Impact of Improper Disposal	Yes	191	51.9
	No	177	48.1

Willingness to Accept (WTA) Price Levels

WTA Price	Yes %	No %	Valid N
₹20/litre	80.1	19.9	266
₹25/litre	72.3	27.7	368
₹30/litre	19.6	80.4	102
₹35/litre	19.5	80.5	82
₹40/litre	33.3	66.7	66

Interpretation

The demographic analysis reveals that most respondents belong to the younger and middle-aged population, with 44.6% in the 20–30 age group and 30.4% between 31–40 years. This indicates that the sample largely represents active household consumers responsible for food preparation and waste management. Respondents are distributed across four major districts of the Hyderabad metropolitan region, with Sangareddy and Hyderabad accounting for the highest participation (28.3% each). Nearly half of the respondents (47.6%) hold a bachelor's degree, while 21.7% possess a master's degree, indicating a relatively educated sample likely to have better awareness of environmental issues. In terms of income, 30.4% fall within the ₹30,000–60,000 category, followed by 19.3% in the ₹91,000–1,20,000 range, representing a mix of lower-middle and middle-income households. Family size patterns show that the majority (46.5%) come from four-member households, reflecting typical urban nuclear family structures. Consumption patterns indicate that refined oil is predominantly used (84%), while only 16% prefer cold-pressed oils, demonstrating a preference for economical and readily available cooking oils.

Behavioral analysis indicates moderate oil expenditure and consumption. Most households spend ₹401–600 per month on oil (37.5%), with 70.4% consuming 3–6 liters monthly. This suggests typical cooking patterns and cost-conscious purchasing behavior. However, WCO disposal practices reveal considerable environmental risk: 52.5% pour oil into drains, 11.4% dispose it as garbage, while only a small proportion reuse, recycle personally, or donate oil (29.1%). Unsafe disposal practices dominate, indicating a gap between general environmental awareness and actual responsible behavior.

Awareness levels regarding WCO recycling are relatively low. Only 23.4% of respondents know that WCO is recyclable, 10.6% have seen a collection bin, and 23.6% have heard about recycling programs. Slightly higher environmental consciousness is observed, with 51.9% acknowledging the negative impact of improper disposal. This suggests that households understand general environmental risks but lack knowledge of specific WCO management pathways.

Willingness to Accept (WTA) shows households are responsive to modest incentives: 80.1% accept ₹20 per litre and 72.3% at ₹25 per litre, but willingness declines sharply at higher prices, indicating price sensitivity and limited familiarity with WCO's market value.

Overall, the findings reveal that households exhibit **moderate consumption patterns, predominantly unsafe disposal behaviors, low recycling awareness, and high potential for incentive-based participation**. Structured awareness campaigns, accessible collection mechanisms, and modest incentive schemes are likely to

enhance household engagement in WCO recycling, bridging the gap between environmental knowledge and sustainable disposal practices.

DISCUSSION

The findings of the study reveal a substantial lack of awareness and knowledge regarding Waste Cooking Oil (WCO) recycling among households. Although WCO has significant environmental and health implications, most respondents have limited exposure to information or initiatives promoting its safe disposal and reuse. Only 23.4% of households reported knowing that WCO is recyclable, and merely 10.6% had seen a collection bin in their locality, indicating low visibility and accessibility of collection infrastructure. Awareness of WCO recycling initiatives is similarly low, with only 23.6% having heard about such practices. In contrast, general environmental consciousness appears higher, as 51.9% of respondents recognize the negative impact of improper WCO disposal. This highlights a gap between broad environmental awareness and specific knowledge of actionable practices such as WCO segregation, collection, and recycling.

Behavioral analysis shows that households generally maintain moderate cooking oil consumption and expenditure patterns. The largest proportion (37.5%) spends ₹401–600 per month, with most consuming 3–6 liters of oil monthly (70.4%), reflecting consistent cooking habits and cost-conscious purchasing behavior. Very few households spend below ₹200 or above ₹1000, and high consumption (>6 liters) is relatively uncommon, suggesting that the sample primarily represents average urban nuclear families. Despite moderate use, unsafe disposal practices dominate: 52.5% pour oil into drains, 11.4% discard it as garbage, and only a minority engage in responsible practices such as reuse (21.5%), recycling personally (3.8%), or donating to others (3.8%). Overall, 64% of households employ unsafe disposal methods, indicating widespread environmental and infrastructural risk.

These results underscore the need for targeted interventions. Although awareness of WCO recycling is low, there is potential for participation through structured programs. Community-level educational campaigns via schools, residential associations, and digital media can bridge knowledge gaps, while visible and accessible collection points can facilitate proper disposal. Incentive-based schemes, such as modest monetary compensation, buy-back programs, or reward points, may motivate households to adopt sustainable practices. Since a portion of respondents already reuse or donate WCO, these interventions could leverage existing behaviors to increase engagement.

In conclusion, the study highlights a critical mismatch between environmental knowledge and disposal behavior, emphasizing the urgent need for combined strategies involving awareness enhancement, infrastructure provision, and incentive mechanisms. Such measures can promote responsible household-level WCO management, reduce environmental pollution, and support the transition toward a circular bioeconomy.

CONCLUSION

The study reveals a significant gap between household environmental awareness and WCO recycling practices. Although 51.9% of respondents recognize the environmental risks of improper WCO disposal, only a small proportion are aware that WCO can be recycled, and very few have encountered collection infrastructure in their locality. Unsafe disposal practices, such as draining oil into sinks or discarding it in general waste, remain prevalent, posing environmental and urban infrastructure risks. Demographically, households are primarily younger, educated, moderately affluent, and mostly nuclear families, with moderate monthly expenditure and consumption of refined cooking oil. Behavioral insights indicate that responsible disposal practices are limited, while WTA analysis shows households respond positively to modest incentives (₹20–25 per litre), with acceptance declining at higher price points, reflecting price sensitivity and limited familiarity with WCO's market value. These findings underscore the need for multi-pronged interventions, including structured awareness campaigns, accessible collection points, and incentive-based programs, supported by collaboration between municipal authorities, NGOs, and community organizations. By addressing knowledge gaps, improving infrastructure, and offering modest incentives, households can be encouraged to adopt sustainable WCO disposal practices, thereby reducing environmental pollution and supporting circular bioeconomy objectives. While the study is geographically limited and based on self-reported data, it provides practical insights for designing effective WCO recycling programs and promoting long-term household-level sustainability.

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