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Spent Lubricant Oil Generation Rate and Handling Practices Among Automobile Mechanics in Selected Mechanic Workshops in Ibadan, Oyo State, Nigeria

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Abstract

Many African countries, especially Nigeria, are grappling with proper management of spent lubricant oil, which poses an immediate threat to the environment and human health. Addressing this issue can considerably reduce environmental and health risk. Therefore, this study was aimed at investigating the spent lubricant oil generation rate and handling practices in selected mechanic workshops in Nigeria. A descriptive cross-sectional study design was employed. Pre-tested semi-structured interviewer-administered questionnaire was utilized to obtain information from the automobile mechanics on spent lubricant oil generation rate and handling practices. Also, an observational checklist and Focus Group Discussion guide were used to obtain information on the current state of automobile mechanics' spent lubricant oil management practices and the challenges faced. Descriptive statistics were used to analyze the quantitative data while the qualitative data was summarized using thematic analysis. The results revealed a huge volume of 448.06 barrels of spent lubricant oil generated annually, which is sufficient to boost its availability for small-scale recycling. Furthermore, 10 (19.6%) of the mechanics reused, sold, and disposed of spent lubricant oil on land without treatment, whilst the majority, 41 (80.4%) of the mechanics simply reused and sold spent lubricant oil without treatment, which is entirely inappropriate. Thematic investigation went on to show that the mechanics' lack of training and resources for appropriate recycling options contributed to their ignorance of the correct procedures for managing spent lubricant oil. Therefore, the study emphasizes the need for mechanics' training and resources for appropriate recycling options to reduce environmental and health risk.

Keywords:
Mechanic Village, Automobile Mechanics, Hazardous Waste, Spent Lubricant Oil, Generation Rate, Handling Practice

INTRODUCTION

Mechanic villages are often a hub for automobile maintenance and repairs, making them an important source of spent lubricant oil, contributing significantly to Nigeria's annual generation rate of 87 million litres of spent lubricant oil (Zitte *et al*., 2016; and Nwachukwu *et al*., 2012). Following the discovery that spent lubricant oil contains a variety of pollutants, including toxic metals and hazardous substances (Ahamad *et al*., 2015; Fong *et al*., 2017; and Olannye, 2023), many nations, including Spain, the United States of America, Denmark, Germany, and others, have put in place approaches such as acid-clay process, solvent treatment method, vacuum distillation, hydro-treatment, membrane technology, thin-film evaporation, and other integrated technologies for dealing with spent lubricant oil disposal (Bridjanian, and Sattarin, 2006; Eman and Shoaib, 2012; Ossman and Farouq, 2015; Osman *et al*., 2017; Oladimeji *et al*., 2018; and Olannye *et al*., 2022).

Sadly, previous studies have shown that efficient spent lubricant oil management is a challenge in many African nations, particularly Nigeria, where most of the waste poses an imminent threat to the environment and public health due to improper handling practices (Agbogidi and Ilondu, 2013; Rotimi and Ekperusi, 2014; Akintunde *et al*., 2015; Nwite and Alu, 2015; Obazuaye *et al*., 2016; and Otobong and Ediene, 2017). Zitte *et al*. (2016) and Nwachukwu *et al*. (2012) stated that the generated spent lubricant oils are used locally in Nigeria for a variety of purposes that have an impact on the environment and human health. These include wood preservation, controlling weeds and dust, construction of roads, serving as a source of fuel for burning, preventing the rusting of bolts and nuts, reapplying in old engines as well as moulding equipment in block industries, and therapeutic purposes when used on cuts and wounds.

The study effectively sheds light on an overlooked aspect of environmental pollution and waste management. The focus on a specific Mechanic Village in Ibadan offers a localized perspective, contributing to the understanding of waste management practices in similar urban areas. Moreover, addressing concerns related to spent lubricant oil management can significantly minimize the environmental and health risks connected to improper spent lubricant oil handling. Therefore, this study was conducted to investigate the spent lubricant oil generation rate and handling practices among mechanics in a Mechanic Village in Nigeria.

MATERIALS AND METHODS

Study area

The study area was Irepodun Mechanic Village situated in Bodija-Ojuirin, Ibadan North Local Government Area (LGA), which is one of the five LGAs in Ibadan city of Oyo State capital. The southwest of Nigeria is home to Ibadan, one of Sub-Saharan Africa's largest indigenous cities. According to Figure 1, Ibadan North LGA is bordered to the north by Akinyele and Lagelu LGA, to the east by Egbeda LGA, to the west by Ibadan North West LGA, and to the south by Ibadan North East LGA. It is situated between latitudes 7º 38'N and 7° 44'N and longitudes 3º 88'E and 3° 95'E. Based on the 2006 census data and a growth rate of 3.46%, the estimated population for Ibadan North LGA in 2016 was 432,900. It has a population density of 16,033 people per square kilometre and a 27 km^2 land area. The area receives rainy (April to October) and dry (November to March) seasons, with sporadic severe winds and storms. The relative humidity is 74.55%, with temperatures reaching a maximum of 26.46°C and a minimum of 21.42°C, respectively. The average annual precipitation is 1420.06 mm and falls over a period of 109 days (Ann and Samuel, 2018).

Study design

A descriptive cross-sectional design involving the use of semi-structured interviewer-administered questionnaire, observational checklist and semi-structured guide was employed in this study to provide information on spent lubricant oil generation rate and explore mechanics' handling practices, management challenges, attitudes and motivations regarding spent lubricant oil.

Study population

The study population consisted of auto-mechanics within the age group of 20 – 60 in the selected mechanic village.

Sample size

Total sampling was adopted because there was a relatively small number of automobile workshops and diverse range of activities, including different types of vehicle repairs, oil handling practices, and

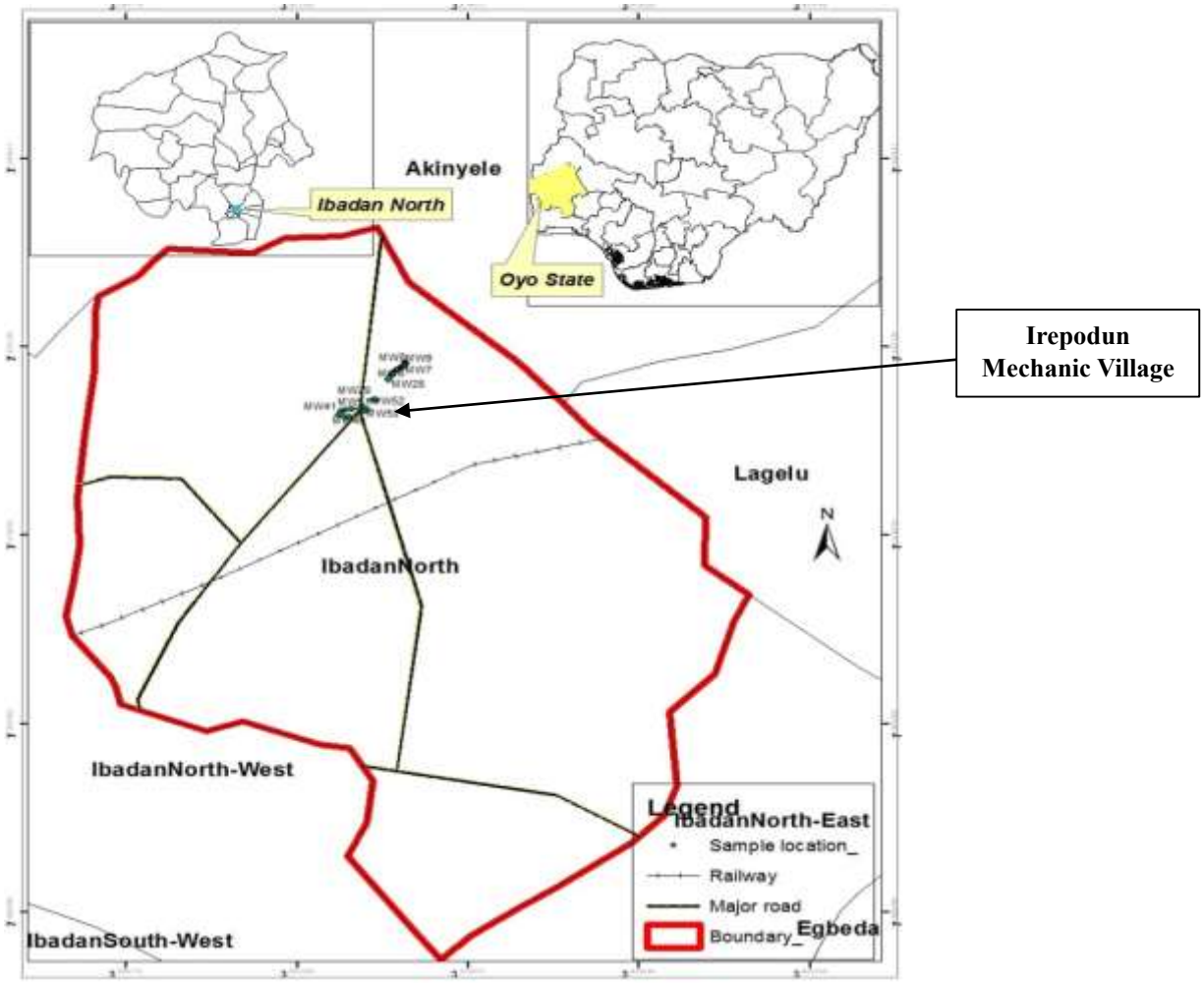

Figure 1: Map of Ibadan North Local Government Area

waste management approaches in the designated mechanic village. Total sampling ensured that all variations were captured, providing a comprehensive understanding of the practices and their environmental implications.

Sampling procedure

Ibadan North LGA was chosen purposively from three LGAs with Mechanic Villages in the Ibadan metropolitan based on having the highest number of mechanic villages. Irepodun mechanic village was purposely selected from the three mechanic villages in Ibadan North LGA owing to the enormous number of automobiles that come to the mechanic village for oil changes every day. The automobile repair workshops in the selected mechanic village were then numbered, yielding a total of 52 automobile repair workshops in the mechanic village. An auto-mechanic within the age group of 20 – 60 was selected from each automobile repair workshop in the mechanic village to participate in the study.

Data collection for survey

The following tools were used to obtain the data used in this study:

Questionnaire

Each auto-mobile mechanic responded to a semi-structured questionnaire by providing information on socio-demographic traits, the brands of lubricant oil they used the most frequently, spent lubricant oil generation rate, and the methods for handling spent lubricant oil after oil change. A pre-test of the designed questionnaire was carried out among auto-mechanics in Oke-Ado mechanic village, Ibadan Southwest LGA of Oyo State, Nigeria. Cronbach's Alpha Method was then used to assess the questionnaire's reliability. An alpha coefficient of 0.7, more than 0.5, was observed; this result is a

reliable indicator of the questionnaire's ability to extract relevant information from automobile mechanics. Three research assistants who were fluent in the Yoruba language-speaking, reading, and writing-were selected and trained in administering the questionnaire before the actual administration took place.

Observational Checklist

A checklist was used to conduct an on-site observation at the study location, during which time mechanic operators were noted for their use of coveralls, their skin being stained by spent lubricant oil, the presence or absence of oil spills, storage facilities, and vehicles in the workshops.

Semi-structured Guide

Focus Group Discussions (FDGs) were conducted using a semi-structured guide to explore mechanics' handling practices, management challenges, policy perspectives, attitudes and motivations regarding spent lubricant oil. Purposive sampling was used to select participants who are actively engaged in mechanical work for at least 2 years and have experience handling and managing spent lubricant oil. The sampling aimed to capture a range of experiences, including mechanics from small, medium, and large workshops. Three FDGs, each comprising 6 – 8 participants, were held at different mechanic workshops within the mechanic village.

Discussions were moderated by an experienced facilitator using a semi-structured guide and lasted approximately 90 minutes each. Each FGD was audio-recorded with participants' consent, and detailed notes were taken to capture key observations, including non-verbal cues and group dynamics that might inform the analysis. To ensure reliability, the coding process involved both predefined codes based on the research questions and emergent codes identified during the analysis. Reflexivity was practiced throughout the analysis to minimize researcher bias.

Data Management and Statistical Analysis

This study relied on the use of Statistical Package for the Social Sciences (SPSS) version 23 for data analysis. Descriptive statistics were used to analyze the sociodemographic data, as well as to identify the quantity and types of automobiles that required an oil change, the amount of spent oil produced by each oil change, the facilities for storing spent oil prior to disposal, and the spent oil disposal methods. The awareness of automobile mechanics on the recycling of spent oil was investigated using descriptive statistics. For analyses of the qualitative data, audio recordings from the FGDs were transcribed verbatim to ensure all the discussions were accurately captured. Non-verbal observations recorded in the field notes were integrated into the transcripts where relevant. Thematic analysis with the assistance of NVivo software was employed to analyze the data. An initial coding framework was developed based on the research objectives, covering key themes such as "disposal practices," "policy influence," "challenges faced," "attitudes toward compliance," and "suggestions for improvement." Additional codes emerged from the data as new themes were identified.

RESULTS

Sociodemographic Characteristics of Automobile Mechanics in the Study

According to the survey findings, the mean age of mechanics in the study was 50.4±8.5 years, with the majority 31 (59.6%) having a secondary education as their highest level of education. In terms of mechanics' monthly income, 18 (34.6%) earned less than N50,000, 31 (59.6%) made between N50,000 and N100,000, and a few, 3 (5.7%) made more than N100,000 (Table 1).

Characteristics of the Mechanic Village and the Generation Rate of Spent Lubricant Oil

All the auto mechanics in the study mechanic village were observed working while donning coveralls with black oil stains on their skin. In the mechanic village, there were 223 automobiles visible at the time of the survey. The majority, 28 (53.8%) of the workshops in the mechanic village had five vehicles or more. Plate 1 depicts the numerous kinds of automobiles that can be found in the mechanic village. Mobil super 1000 20W-50, Conoil golden Super Diesel Oil SAE 40, A-Z TXP Plus, Ammasco Engine Oil, Forte oil (Super V and Visco 2000), and Ammasco Rondo HD 50 SAE 40 are the brands of mineral lubricant oil used in the mechanic village. Mobil 1 and Total quartz 9000 energy synthetic technology oil 5W-40 are the synthetic lubricant oil brands used.

Table 1: Sociodemographic Characteristics of Automobile Mechanics in the Study Area

N=52

Sociodemographic Variables	Number	Percentage
Sex		
All males	52	100
Age		
< 45	14	26.9
45 – 55	25	48.1
> 55	13	25.0
Marital Status		
All married	52	100
Highest Education Level		
Secondary School Education	31	59.6
Primary School Education	15	28.9
No Formal Education	6	11.5
Monthly Earnings		
< N50, 000	18	34.6
N50,000 - N100,000	31	59.6
≥ N100,000	3	5.8

Mobil super 1000 20W-50 and Mobil 1 0W-40 were the most popular brands of lubricant oil for gasoline engines, while Ammasco Rondo HD 50 SAE 40 and Total quartz energy 9000 5W-40 were the most popular brands of lubricant oil for diesel engines. An average of 151 automobiles in the study mechanic village were recorded for oil changes every day. The majority 39 (75%) of mechanics reported that they change the oil on fewer than four automobiles every day (Table 2). In one month, 5937 litres (37. 34 barrels) of spent lubricant oil were generated from a total of 1196 vehicles, 687 of which were small and 509 of which were medium in size (Table 2). In a single year, the majority 36 (68.5%) of mechanics produced between 1000 and 2000 litres spent lubricant oil (Table 2). This results in the production of 71,244 litres (448.06 barrels) of lubricant oil waste annually.

Plate 1: Automobiles that are frequently spotted in various workshops at the study mechanic village- (a) Saloon cars (b) Hilux vans and saloon cars (c) Minivan and Saloon cars (d) Jeep and saloon cars (e) Saloon cars, Space bus and Jeep

Table 2: Generation of Spent Lubricant Oil **N = 52**

Variables	Number	Percentage
Handling of Engine Kind		
Gasoline	50	96.15
Diesel	2	3.85
Number of Vehicles Needing Oil Change Daily		
< 4 vehicles	39	75
4 Vehicles and above	13	25
Number of Vehicles Needing Oil Change Monthly		
< 20 vehicles	19	36.54
20 – 25 vehicles	16	30.77
> 25 vehicles	17	32.69
Spent Lubricant Oil Volume Generated Monthly		
< 100 litres	25	48.08
100 – 150 litres	19	36.54
>150 litres	8	15.39
Spent Lubricant Oil Volume Generated Annually		
< 1000 litres	10	19.23
1000 – 2000 litres	36	69.23
>2000 litres	6	11.54

Spent Lubricant Oil Management Practices

Every mechanic admitted to storing spent lubricating oil in plastic barrels. Furthermore, 10 (19.6%) of the mechanics reused, sold, and disposed of spent lubricant oil on land, while most, 41 (80.4%) of the mechanics just reused and sold spent lubricant oil. In the study Mechanic village, auto mechanics frequently use the following reuse techniques:

i. Used as an oil to release nuts with tight seals
ii. Prevention of rust on metal equipment
iii. Combined with grease for gear oil
iv. Reuse as gear and power steering oil
v. Source of fuel for burning
vi. Used as hydraulic fluid for jacks, lifts and props
vii. Medication for any wound, cuts or any ailments
viii. Pest and weed control for gardens and workshops
ix. Used as ball joint oil for ball and socket joint
x. Emergency lubricants for vintage automotive engines
xi. Dust prevention for land and floor
xii. Wood preservation
xiii. Decarbonizing battery heads

The mechanics were not familiar with the recycling of spent lubricant oil, but they all agreed that if there is a better technique to recycle spent lubricant oil in a cost-effective manner, they will use it.

Thematic Investigation of the Focus Group Discussions (FDGs)

Three major themes emerged from the thematic analysis of the FGDs:

i. Awareness and knowledge gaps,
ii. Barriers to effective implementation, and
iii. Suggested strategies for improvement.

For the first theme, participants commonly highlighted a lack of information, stating, *'We often feel uninformed about the proper practices*.' This awareness gap was further linked to the second theme, where participants identified specific barriers such as inadequate training and insufficient resources. One participant noted, *'Even if we want to do things correctly, we don't have the tools or support.*' Despite these challenges, participants provided constructive suggestions, forming the third theme. Many expressed the need for more accessible training programs, with one participant suggesting, *'Workshops could help us understand what needs to be done and how to do it.*' These interconnected themes highlight the importance of addressing informational and structural barriers to improve practice.

DISCUSSION

The sociodemographic characteristics of auto mechanics in this study indicate that the auto mechanics were mostly males with an average age of 50.4±8.5 years, predominantly having a secondary school education and earning between N50,000 and N100,000. Furthermore, the selected mechanic village in this study generated a lot of spent lubricant oil, which is enough to enhance its availability for small-scale recycling. Also, the breakdown of spent lubricant oil generation would be particularly valuable for policymakers and stakeholders. This report corroborates with the findings of Udebuani *et al*. (2010) and Nwachukwu *et al*. (2012), that reported significant amounts of spent lubricant oil produced in mechanic villages in the South-Eastern region of Nigeria. Moreover, the findings in this study revealed improper handling of spent lubricant oil among the auto mechanics despite the significant amount of spent lubricant oil produced. This report confirms the conclusion of previous studies by Zitte *et al*. (2016) and Nwachukwu *et al*. (2012), which found that many African countries, particularly Nigeria, are struggling with proper management of spent lubricant oil, which poses an immediate threat to the environment and human health.

To further address the issue of improper spent lubricant oil handling among auto mechanics, the study found that auto mechanics improperly handled spent lubricant oil across sociodemographic groups (such as sex, age, education, and income), implying that other, more systemic or shared factors, rather than individual characteristics, may have a greater influence on these handling practices. Thematic investigation further revealed that the mechanics' lack of training and resources for appropriate recycling options contributed to their ignorance of the correct procedures for managing spent lubricant oil. Despite these challenges, the mechanics expressed a need for the establishment of workshops for training on appropriate recycling options. This thematic investigation, thus, emphasizes the necessity of tackling informational and structural impediments to improving practice.

CONCLUSION AND RECOMMENDATIONS

The study identified a significant annual generation of spent lubricant oil in the mechanic village, indicating a substantial potential for small-scale recycling initiatives. Additionally, it emphasized the inadequate handling of spent lubricant oil by mechanics, stemming from insufficient training and lack of resources for proper recycling methods. To address this issue, it is recommended that targeted training programs and resource provisions be implemented to enhance the proper management of spent lubricant oil. Furthermore, government enforcement of regulations governing the handling of spent lubricant oil is essential. Expanding on policy recommendations and fostering collaborations with local authorities could enhance the feasibility and effectiveness of these initiatives.

Data Availability Statement: The data that support the findings of this study are not publicly available due to privacy and ethical restrictions. To protect the confidentiality of the study participants, access to the data is restricted. However, data may be available from the corresponding author upon reasonable request and with permission from the relevant ethics review board, subject to compliance with applicable privacy regulations and institutional guidelines.

Ethical Statement: Ethical approval was sought from Oyo State Ministry of Health Research Ethics Committee before the commencement of the study and informed consent was obtained from all participants. Participants were fully informed about the study's purpose, procedures, and potential risks, with their rights to confidentiality and anonymity strictly protected.

Authors Contributions: Donald Uzowulu Olannye- Conceptualization and Study Design; Methodology and Data Collection; Resources; Data Analysis and Interpretation; Writing- Original Draft Preparation; Writing- Review and Editing; Project Administration, Elizabeth Omoladun Oloruntoba- Supervision, Validation; Visualization; Writing- Review and Editing, Sunday Oloruntoba Isehunwa- Supervision, Validation; Visualization; Writing- Review and Editing. Note: All authors read and approved the final version of the manuscript.

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Conflict of Interest: The authors have no competing interests to declare.

Supplementary Material: This study forms a component of a larger investigation conducted as part of my PhD thesis, which focused on evaluating the efficiency of a fabricated small-scale solvent extractor for recovering base oil from spent lubricant oil. Additional details on the methodology and findings from the broader study are available in the supplementary material.

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