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Assessment of Used Motor Oil (Umo) Disposal Practices by Local Automobile Repair Garage Mechanics: A Case of Ilala Municipality, Dar Es Salaam, Tanzania

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Abstract
The improper disposal of used motor oil (UMO) is a growing environmental concern, particularly in rapidly urbanizing areas with expanding automotive sectors. In many developing cities, local automobile repair garages significantly contribute to this issue due to poor waste management practices and limited regulatory oversight. This study assessed the knowledge and practices regarding UMO collection, storage, and disposal among mechanics in automobile repair garages within Ilala Municipality, Dar es Salaam, Tanzania. Data were gathered through structured questionnaires, interviews, and observations from 20 garages, involving 100 automobile mechanics. The results revealed that 80% of respondents sold used oil to customers for reuse, while 5% disposed of it directly into the ground. Regarding storage, 61% used plastic or metal drums, 16% used plastic containers, and 15% utilized any available containers, with 82% reporting no issues with storage. Awareness of environmental risks was relatively high, as 87% of mechanics were aware of the pollution caused by UMO, and 99% acknowledged the prevalence of careless disposal at garage sites. Weekly UMO generation was recorded at 1,628.5 liters from servicing 418 cars. Despite some government efforts, such as training programs and support for recycling practices, challenges persist, including poor record-keeping and the location of 84% of garages in residential areas. The study recommends enhanced training for garage workers and local communities and greater investment in sustainable waste management systems to align with the Sustainable Development Goals (SDGs) by 2030.
Key Words: *Used Motor Oil (UMO), Disposal Practices, Garage Mechanics, Automobile Repairs*
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Introduction

Waste generation has significantly increased in recent decades and shows no signs of slowing down (Global Waste Generation Statistics and Facts, 2023). Projections estimate that 2050 global municipal solid waste will rise by approximately 70%, reaching 3.4 billion metric tons (GWG Statistics & Facts, 2023; Eurostat, 2023). This escalation is driven by population growth, urbanization, economic expansion, and changing consumer habits. As waste volumes grow, effective waste treatment and disposal systems become increasingly urgent (WGRI, 2019).

Within this broader context, the disposal of used motor oil (UMO) presents a significant environmental challenge. Globally, some progress has been made towards sustainable oil waste management through re-refining practices, especially in developed countries. However, disparities remain. While countries such as Brazil, China, India, Germany, France, and Canada classify used oil as hazardous waste and have developed robust re-refining capacities, others lack the infrastructure or policy frameworks needed for safe management (Kline Group, 2023).

According to Kunal Mahajan (2022) of Kline's Chemicals & Energy Practice, Canada leads in UMO generation due to its high consumption of automotive lubricants. In contrast, countries like Japan and India generate less due to the dominance of lubricants like greases and metal-working fluids that produce minimal waste oil. Countries like the U.S., China, and Brazil have well-established re-refining systems, while nations such as Japan, South Korea, and Thailand still largely dispose of UMO through combustion for fuel (Kline, 2022).

Oil management in Africa is less advanced. Studies in Botswana, Lesotho, Mauritius, Namibia, Nigeria, Tanzania, South Africa, and Zambia (AI, 2013; DANIDA, 2013, cited by Bruce, 2014) have shown that while awareness of waste oil hazards is growing, economic and policy instruments for environmentally sound management are still underdeveloped. Notably, these studies often exclude a focus on automotive garages, major used oil generators in urban areas.

The automotive industry's rapid growth has increased waste motor oil volume globally, especially in developing regions. Vehicle repair and maintenance services—including oil changes, battery replacements, and metal machining—are essential but produce hazardous waste such as used oil, spent batteries, organic solvents, asbestos brake linings, and worn tires (Edian, 2020). Used motor oil, in particular, contains persistent contaminants including polycyclic aromatic hydrocarbons (PAHs) and heavy metals like zinc (Zn), lead (Pb), and arsenic (As), posing serious risks to both environmental and public health (Hussein, 2022).

The global lubricant oil demand is approximately 41.35 million metric tons, with Africa consuming about 2.068 million tons. Kenya accounts for roughly 0.007 million metric tons and South Africa for 0.305 million metric tons (NEMA, 2014). In Tanzania, demand is increasing steadily, with the Ministry of Energy reporting a 7% rise in supply from 2020 to 2023, amounting to 55,520 kilolitres (49,180 metric tons) (Iain & Omar, 2022).

Lubricants degrade over time, becoming contaminated and unsuitable for further use. The U.S. EPA defines "used oil" as petroleum-based or synthetic oil that has become contaminated through use. In contrast, "waste oil" refers to contaminated oil regardless of origin (US EPA, 2013, cited by NEMA, 2014). Both types require proper management to prevent environmental contamination (NEMC, 2019; Edian, 2020).

The primary sources of UMO include vehicle servicing centers, farms, industries, and maritime operations (Edian, 2020). In East Africa, petrol stations generate less UMO than open-air garages, which provide various services and are often preferred by motorists. These informal garages are particularly problematic as they typically operate on permeable ground, heightening the risk of groundwater pollution through oil spillage (NEMA, 2014).

Kenya has initiated a Safe Waste Oil Disposal (SWOD) initiative involving collecting and centralizing used oil treatment (NEMA, 2014). However, Tanzania lacks documented evidence of a comparable system. In Dar es Salaam, UMO is often collected in drums or small containers without a transparent chain of custody. Despite existing petroleum waste oil recycling regulations, this leads to unregulated repurposing or unsafe disposal (EWURA, 2017).

Tanzania’s legal framework, established under the Environmental Management Act (EMA, 2004) and the National Environmental Policy (1997, R.E. 2021), mandates sustainable environmental management. The National Environmental Management Council (NEMC) enforces these laws through compliance monitoring, environmental impact assessments, research, and public awareness campaigns.

Despite this framework, the realities of UMO disposal from local garages remain concerning. PAHs and heavy metals in waste oil increase its polluting potential, mainly when poorly managed storage, handling, and disposal practices. Studies from Tanzania and Kenya confirm that such mismanagement leads to significant environmental degradation and poses public health risks (Wilson & Naiman, 2013; NEMA, 2014).

Given the rising lubricant consumption, increased motor vehicle use, and informal garage operations in residential neighborhoods, there is an urgent need to assess and improve UMO management practices. This study focuses on Ilala Municipality in Dar es Salaam, where informal automotive repair garages are prevalent and represent a significant source of used oil. The findings aim to inform policy and promote sustainable waste oil practices that align with national regulations and global environmental targets.

Table 1.1 Narrates the challenges facing local automobile repair garages

S/No.	Environmental challenge	Effects/impacts
1	Many garage sites were built in residential areas	Humans' health endangers wildlife, insects, and environmental pollution
2	Local automobile repair garages used oil	Blocks plants from photosynthesis, disrupting the food chain. Hinders the nation's progress towards Sustainable Development (Eze & Chijioke, 2018)
3	Used engine oil affects the health of garage workers	Causes haematological disorders, decreased erythrocyte, haemoglobin, haematocrit, platelet levels, and increased blood pressure in developing countries (Atare *et al.,* 2018). Immunological and reproductive systems damage the kidneys, liver, heart, lungs, and the nervous system.
4	Used engine oil on the health of fauna	Toxic contamination, impaired reproduction, damaged intestinal tracts, and reduced fur insulation.
5	Used motor oil is insoluble, persistent, and can contain toxic chemicals and heavy metals.	Source of oil contamination for waterways that results in pollution of drinking water sources (NEMC, 2024).
6	Other challenges include competition, economic issues, technological issues, and poor customer service due to a lack of genuine spares, no formal education on repairs, lack of incentives, and a poor working environment.	They may fail to get enough customers due to a lack of technology, the right equipment for repairs, and the use of electric cars. Poor service leads to customer shifting, negative impacts, and reduced profits (Kiunsi & Lemeiruti, 2015; Francis, 2018).

These cases have been reported in Ghana, Nigeria, Ethiopia, Kenya, Tanzania, Mozambique, and South Africa. Used motor oil is insoluble, persistent, and can contain toxic chemicals and heavy metals that are slow to degrade. These stick to everything from beach sand to bird feathers, and these toxic compounds can cause severe health problems like heart damage, stunted growth, immune system effects, and even death. It's a major source of oil contamination of waterways and can result in pollution of drinking water sources. Despite existing laws, some service providers have not adhered to guidelines and regulations set by the Ministry of Health and the Environment (NEMC, 2024).

This research therefore aims to assess awareness, knowledge, and practices regarding the appropriate disposal of used oil that is sustainable and eco-friendly to prevent pollution. It seeks to inform decision-makers, practitioners, academics, local community workers, the private sector, automotive industries, development partners, and other beneficiaries about the importance of sustainable Waste Oil/Used Motor Oil (UMO) disposal management. This is essential for creating a uniform system for managing waste oil in an environmentally sound manner, as well as ensuring legal and environmental compliance with business performance.

Conceptual Framework to Manage Used Motor Oil (UMO) Waste

Figure 1.1 indicates that comprehensive waste oil management strategies are essential in development processes to rid the environment and water resources of pollution caused by used motor oil waste. This will improve waste management for sustainable development by conserving environmental and water resources. The conceptual issues addressed in this research focus on motor oil's sustainable disposal and management practices to reduce its impact on environmental and socio-economic development. Best practices include proper management of used motor oil separation, storage, collection, transportation, recycling, re-refining, and re-use.

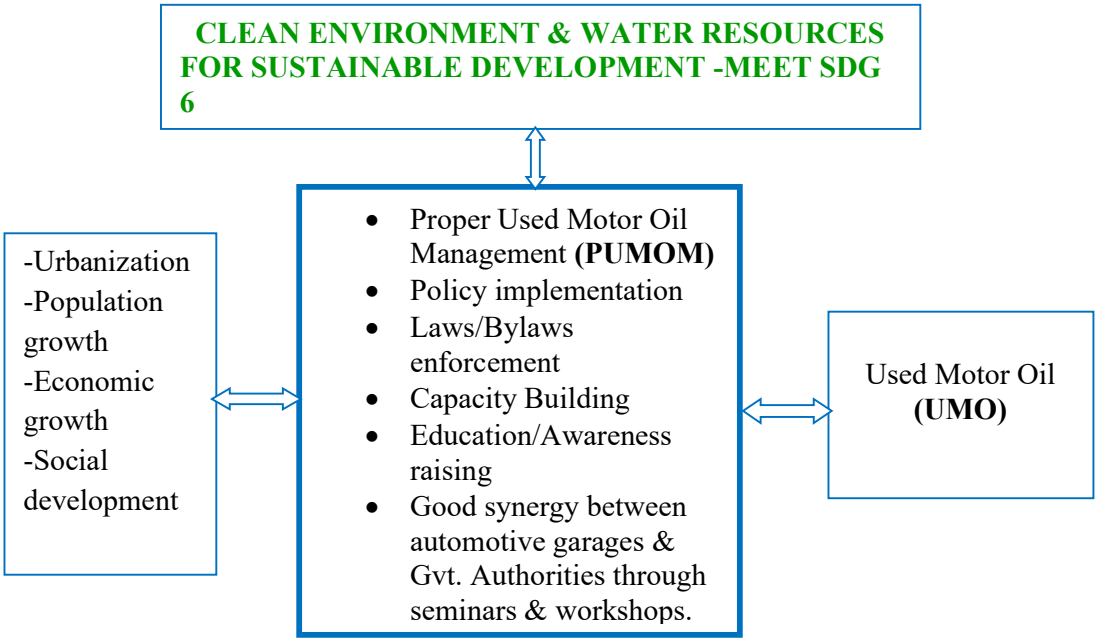
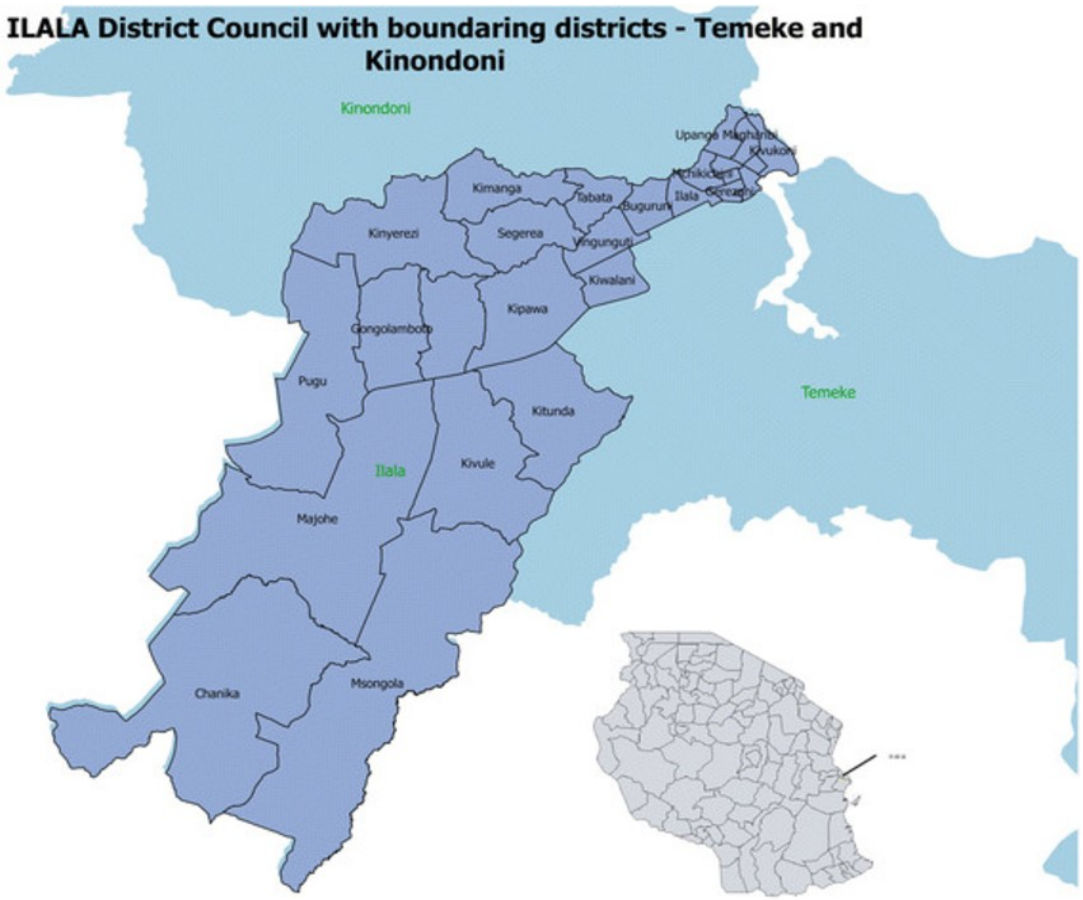


Fig. 1.1: Conceptual framework for Used Motor Oil Waste Management
(Source: this study, 2024**)**

The Study Area

The study area was Dar es Salaam City, specifically within Ilala Municipality. Dar es Salaam City serves as a reference point, with an estimated population of 4,364,541 (Current DCC website, accessed on April 17, 2024). It is the third fastest-growing city in Africa and the tenth in the world, featuring a population density of approximately 2,700 people per km². The Indian Ocean borders the city to the east, with coastal areas to the north and south and the inland region to the west. Dar es Salaam covers an area of 1,393 km² and includes 8 offshore islands (LBSAP, 2023). The city functions as Tanzania's economic, industrial, commercial, trading, educational, cultural, and transportation hub. Currently, Dar es Salaam generates an average of approximately 4,600 tons of waste per day. The solid waste generation rate is estimated at 1 kg/day per household, which exceeds typical values for developing countries, ranging from 0.4 to 0.6 kg/day per household (NSWM, 2018). The map below shows Ilala Municipality, located within the boundaries of Kinondoni and Temeke.



Target Population and Sample Size

The Ilala Municipality has a population of approximately 1,649,912, according to the 2022 National Tanzania Census. Specifically, the Bungoni ward within the Ilala Municipality had a population of 47,278 as of the 2022 census. This ward serves as an ancestral home for the Zaramo people and has evolved into a cosmopolitan area. The researcher's sample included all automotive repair and maintenance service garages (both informal and formal), garage mechanics, car owners, local leaders from Ilala, authorities, used oil recyclers and sellers, collectors, and car dealers.

Five garages (or automotive repair workshops) were visited at each site. A total of 20 automotive repair garages were included, comprising mechanical workshops and used oil collection and recycling centers, with a combined workforce of 340 mechanics. A purposive sampling method was used to survey 100 respondents from the 20 automotive repair garages.

Sample Size Formula: the **Yamane formula with 95% confidence level.**

n = N / (1 + N * (e)^2):

n = sample size

N = population size

e = margin of error (from 95% expressed as a decimal, e.g., 0.05 for 5%)

Data analysis

Data extracted from the administered questionnaires and interviews were analyzed using statistical tools such as pie charts, tables, and bar charts for percentages and errors analysis.

Results and Findings

Demographic characteristics of the survey respondents -Age, Gender and Education

Most of the participants (97.0%) who provided information in the Survey on the Knowledge and Awareness of Mechanics in Automotive Garages regarding used engine oil (UMO) disposal practices were male, while 3.0% were female. About two-thirds of the mechanics (66.7%) were between 20 and 50 years old, while 27.8% were under 20 years and 2.0% were over 50 years of age (Table 1.2).

Table 1.2 Age of respondents [Source: this study, 2024**]**

Age	Gender		
Age range (years)	Males, n=97 (%)	Female, n=3 (%)	Total, n=100 (%)
Under 18 – 19	27.8	0.0	27.0
20 – 30	29.9	1.0	30.0
31 – 40	30.9	2.0	32.0
41 – 50	9.3	0.0	9.0
Above 50	2.0	0.0	2.0
Total, n = 100	100.0	100.0	100.0

Most garage mechanics in the informal auto-repair shops within the municipality received an education up to Primary, VETA, and Secondary levels (23%, 28%, and 31%, respectively), while more or less than ten percent had no formal education or attained a tertiary level of education (11.0% and 7.0%, respectively) (Figure 1.2).

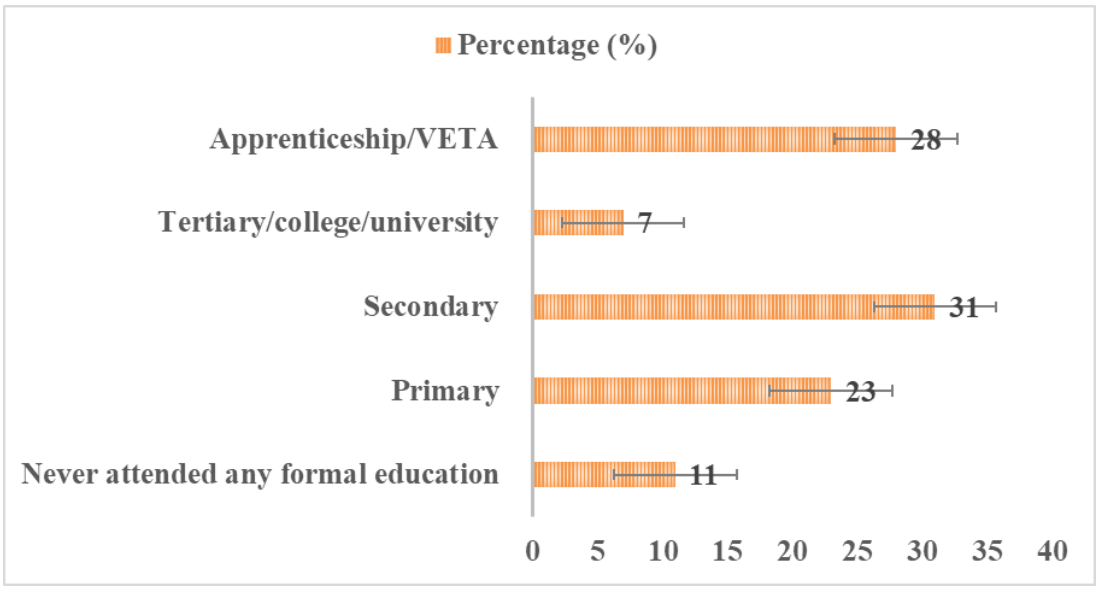


Figure 1.2 Education levels of the Garage Mechanics

(Source: Field Study, 2024)

Working experience of the garage mechanics

Regarding the working experience of mechanics within the Ilala municipality, when asked the question, "How long have you been working as a mechanic in the automotive repair industry?", approximately 76.0% of mechanics reported having more than ten years of experience. In comparison, 9% and 15% of respondents had less than one year of working experience (Figure 1.3).

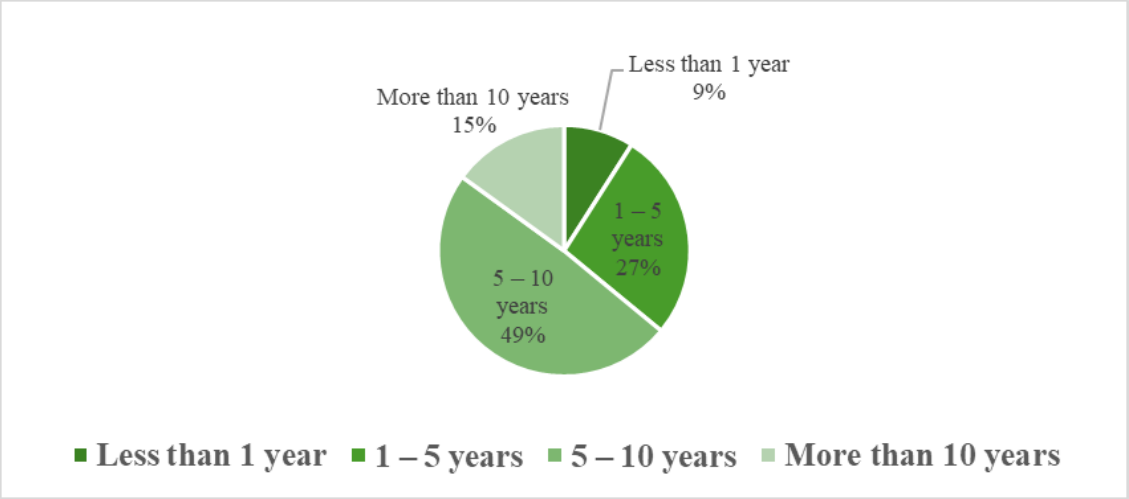


Figure 1.3 Working experience of the garage mechanics (Source: Field Study, 2024)

Knowledge and effects of UMO

The results regarding mechanics' knowledge of the environmental impacts of UMO leaks or spills on land indicate that it may enter soil and groundwater systems, consequently reducing soil productivity and contaminating surface and groundwater supplies, as reported in Figure 1.4. The results show that many respondents across all garages (87%) answered "Yes."

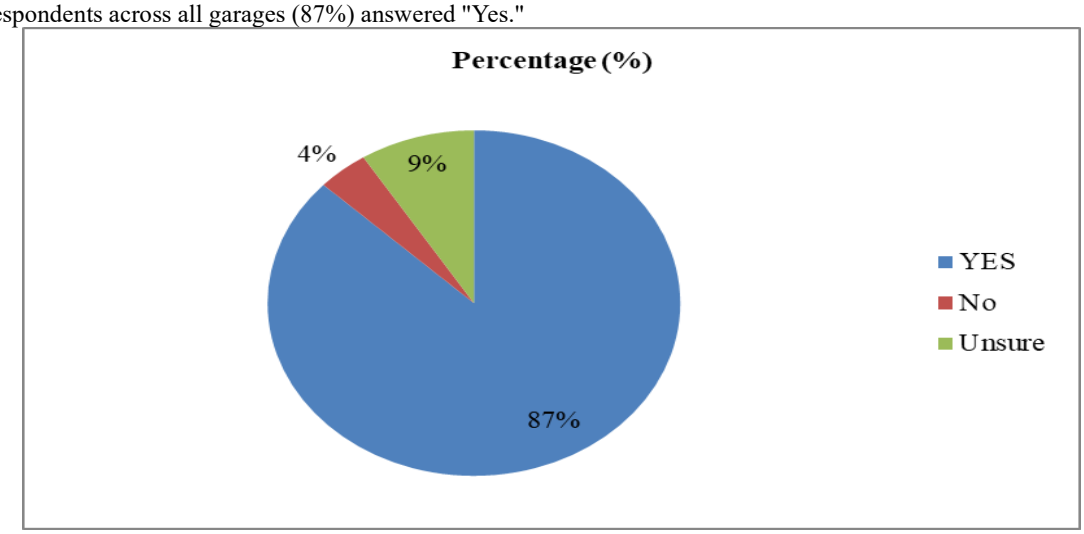


Figure 1.4 Garage Mechanics' Knowledge and Awareness on Environmental and water sources impacts of used motor oil (UMO) (Source: Field Study, 2024)

Waste Oil Generation, Collection, and Storage Practices

Regarding waste oil generation, the results indicate that site 'A' produces a total of 422 liters of used oil from 97 cars per week, site 'B' produces a total of 413 liters of used oil from 95 cars per week, and site 'C' generates a total of 516 liters of used oil from 132 cars serviced weekly. In comparison, site 'D' produces a total of 372 liters of used oil from 98 cars per week. A total of 1628.50 liters (10.24 barrels) of used oil was collected in one week from 418 cars (Figure 1.5).

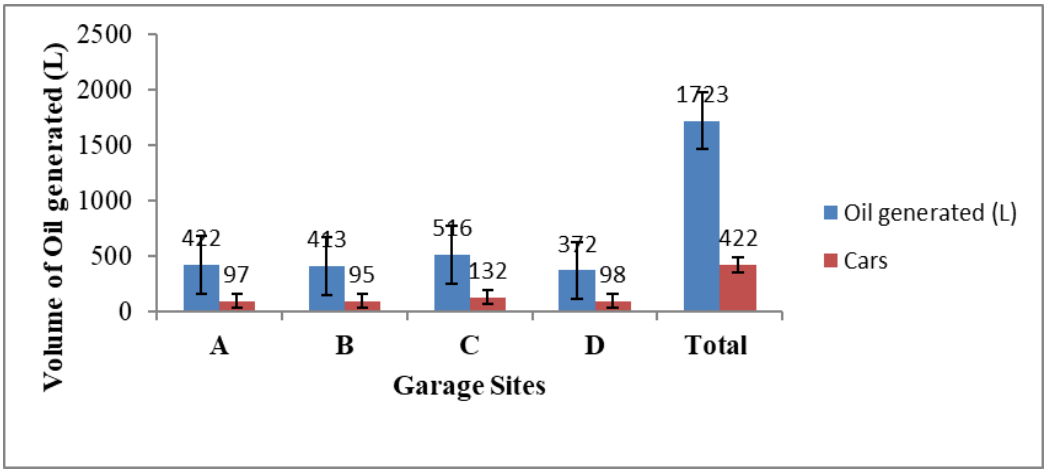


Figure 1.5 Volume of Waste Oil generated and cars at garages (Source: Field, 2024**)**

Of the mechanics interviewed, approximately 5% reported using metal drums, 16% used plastic drums or bottles, and 15% utilized any available container, while 61% stored their materials in either plastic or metal drums, as shown in Figure 1.6.

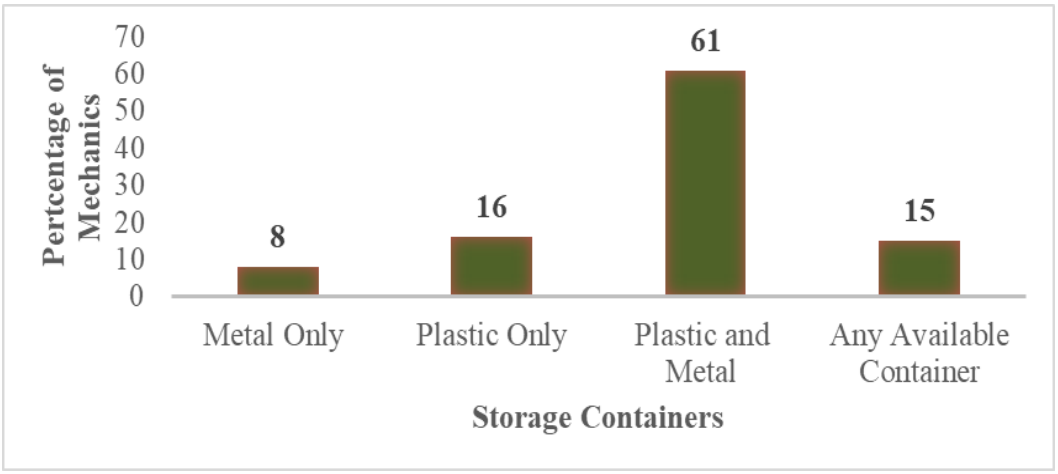


Figure 1.6 Percentage Used Oil Storage Containers (Source: Field Study, 2024)

In the survey, approximately 82% of both formal and informal garages reported no issues storing their generated used oils for later disposal, while 18% encountered storage problems.

Disposal Practices of Used Motor Oil by Garage Mechanics

The opinions of garage mechanics regarding used oil disposal practices indicate that about 80% sold the used oil they generated to customers, 5% disposed of it in the environment, and 13% gave it away for free. In contrast, the remaining 2% provided it to their clients. Most garage locations were situated on free land or open ground, with approximately 84% across all areas of the Karume and Machinga Complex. Only 10% of the surfaces in the Msimbazi and Kariakoo city center were covered in concrete, and about 6% of the visited garage sites featured wood and concrete coverage, as shown in Figure 1.7.

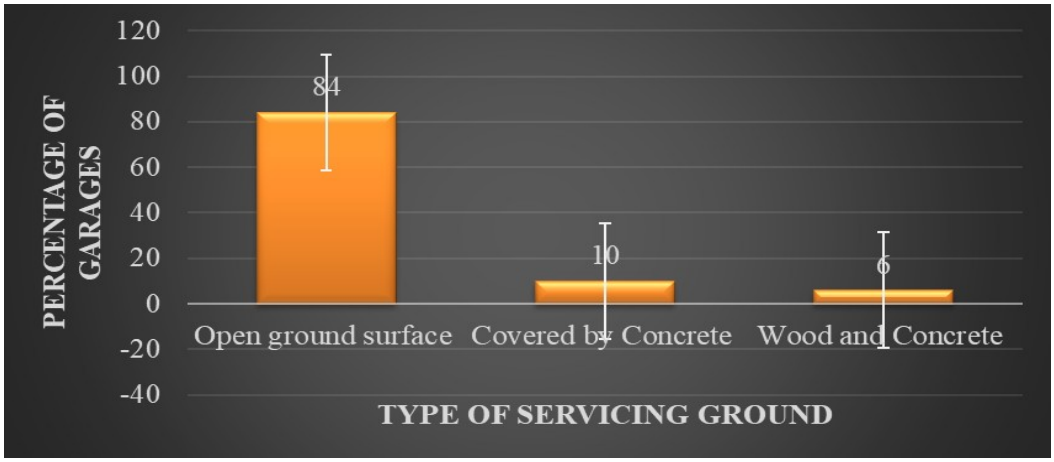


Figure 1.7 Nature of Serving Surface of the Garages (Source: Field Study, 2024**)**

During an on-site visit, it was observed that few proper disposal mechanisms are in place. Consequently, the environment is consistently contaminated with used oil and its associated contaminants, which may end up on open ground surfaces and in water sources.

Discussion

Some service technicians can earn an associate's degree in both developed and developing countries, including Malaysia, India, and Ghana (California Used Oil Recycling Report, 2023). Courses typically cover basic mathematics, computers, electronics, and automotive repair. Additionally, some programs include classes in customer service, English, and other essential skills related to automotive waste generation, storage, and recycling.

Knowledge levels of Mechanics in handling used oil waste from local garages

In this study, visits to most local garages show that mechanics indiscriminately and intuitively dump automotive waste in the form of liquids/oil, gases, and solids in their auto-servicing workshop environments due to their low level of awareness (Plate 1).

Plate 1. Indiscriminately disposed of automotive repair waste
(Source: Field Study, 2024**)**

The same situation has been reported by Kiunsi and Lemeiruti (2015), as well as by Francis Daudi Sinkamba (2018), whose study was conducted in Mbeya City, Tanzania, and by Kunal (2022), who researched the handling of used oil in countries around the globe. To raise awareness of the environmental issues related to the indiscriminate disposal of used motor oil waste, auto garage mechanics and their employers can enroll in part-time Higher National Diploma (HND) programs offered at various polytechnics throughout the country. These include Don Bosco Polytechnic in Msasani–Dar es Salaam, VETA Colleges, the Industrial Equipment College of Morogoro, and the Heavy Equipment Institute in Kijitonyama-Dar es Salaam, allowing them to earn higher diplomas and degrees in automotive technology.

The findings from the interviews indicate that most mechanics participated in seminars and training organized by the local government, ward leaders, and representatives from NEMC over an unspecified timeframe. In an interview with one of the mechanics at Gongo la Mboto in the municipality, he stated, “We always get training on different environmental issues and perspectives from Municipal council, Ward, and even those from NEMC.” Despite the training and seminars provided by local governments, physical observations revealed that informal sector auto mechanics still dispose of hazardous waste in their working environment, such as used oils, oil filters, and oil-contaminated rags. Zitte et al. (2016) contended that effective workshop management includes improved employee training and initiatives to raise awareness about the necessity and benefits of waste minimization. This leads to preventive maintenance that reduces leaks and spills in the environment and water sources (Michael, 2015; Mong’ina, 2018; Aurelio, 2023).

Collection and storage of Used Motor Oil by Garage Mechanics

Used oil can be collected from various engine oil products, which typically include crankcase oils from gasoline, diesel, and LPG/CNG engines, as well as brake fluid, gear oils, transmission fluids, hydraulic oils and fluids, compressor oils, refrigeration oils, industrial process oils, and electrical insulating oil. Used motor oil (UMO) should be stored in a leak-proof container with a secure lid, such as a clean plastic or metal container, preferably the original motor oil container. Keeping the container in a clean, dry location away from direct sunlight is essential to prevent contamination and degradation. UMO tanks must be constructed of steel and padlocked when not in use. The floor of the UMO tank bund must be made of concrete or asphalt, not soil, clay, or gravel. All tanks should be regularly inspected for integrity. UMO tank maintenance records must be kept for five years (New Zealand Ministry for the Environment, 2000).

Disposal Practices of Used Motor Oil by Garage Mechanics

Some mechanics engage in inappropriate practices with used oil, including pouring it on weeds, spraying it on roads as a dust suppressant, using it to clean tools, and treating timber posts and fences to protect them from termites. Additionally, significant volumes of used oil are disposed of directly into the environment, with some garages in the city pouring it onto the ground. This happens because most garage work areas have bare soil designated for disposal. Currently, in Dar es Salaam, none of the automobile repair garages can recycle the oil generated for reuse, and no accredited used oil collection centers are available in the country (Tanzania EIA Methodology, 2013). The “dungadunga” boys at Vingunguti along Nyerenyere Road indicate that they sell the used oil they collect from the garages to timber merchants to spray timber species for protection against termite attacks. Furthermore, they also sell some of the used oil to corn millers and road constructors, who mix it with coal tar for road construction, along with other unlicensed used oil dealers. To ensure proper storage and, more importantly, appropriate disposal of used oils, many developed countries—such as the USA, China, Japan, and Australia—encourage the proper use of motor oil by establishing and certifying used oil recycling collection centers in most of their cities and towns. This system ensures that certified used oil collection centers accept used motor oil from the public for a recycling fee. These countries also support the establishment of local used oil collection and recycling centers, where community members can drop off their oil, which are operated by the local tribe (Michael, 2015). Michael et al. (2015) and Zitte et al. (2016) have reported similar situations in their countries, noting that the disposal of collected used oil must occur only at sites that meet the criteria for a used oil transfer station.

Conclusion and Recommendation

This study assessed the knowledge and practices surrounding the collection, storage, and disposal of used motor oil (UMO) among local automobile repair garage mechanics in Ilala Municipality, Dar es Salaam. The findings indicate that UMO generated during automotive repair contains harmful substances such as polycyclic aromatic hydrocarbons (PAHs), zinc (Zn), lead (Pb), and arsenic (As) that contribute to environmental pollution and pose serious health risks if improperly managed. At the same time, most mechanics showed awareness of these risks, but unsafe disposal practices persist, particularly in informal and residential garage settings.

To mitigate the environmental and health risks associated with UMO, it is recommended that the government intensify targeted training and capacity-building programs for local mechanics, emphasizing environmentally sound practices for oil handling and disposal. At the same time, efforts should focus on establishing centralized collection systems and investing in oil recycling or treatment facilities. Stronger regulatory enforcement, regular site inspections, and active community engagement should support these interventions. Collectively, these measures will promote safer UMO management, protect public health and water resources, and significantly contribute to Tanzania's progress toward achieving the Sustainable Development Goals by 2030.

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