03.31.2025 JOURNAL OF

Env. Management & Construction Res. (JEMCR) Vol. 7 No. 4

ENVIRONMENTAL CHALLENGES OF POOR HANDLING OF END OF LIFE TYRES AND THEIR IMPACT ON PROPERTIES RENTAL VALUES IN MUDA LAWAL BAUCHI METROPOLIS

***SANI JA'AFAR ALIYU; **ESV. HAFSATU JIDERE BALA; **SANI GAMBO SANI; & *ABUBAKAR ABDULBAKI**

*Department of Urban and Regional Planning, Federal Polytechnic Bauchi, Bauchi State, Nigeria. **Department of Estate Management and Valuation, Federal Polytechnic Bauchi, Bauchi State, Nigeria

DOI Link: https://doi.org/10.70382/bejemcr.v7i4.011

ABSTRACT

The aim of this project is to find out the impact of poor handling on end of life tyres on properties rental values in Muda Lawal Bauchi metropolis. To be able to carry out this study, the research reviewed relevant literature on the issue to form the theoretical base of the subject. The purpose of these study is mainly: To determine an impact of poor handling of end of life tyres (ELTs) on property rental value. The main instrument used in collecting data for the study is questionnaire. The questionnaires consist of 12 items which are administered and analyzed using mean and standard deviation. The population of the study was 1500 the sample size was obtained using

Introduction

End of life tyres refers to tyres that has ceased to perform it original function having exhausted all its re-use options. End of life tyres (ELT's) are not reasonable as a second hand purchase. They are special tyres of waste. There are municipal waste rather than hazardous waste. Transportation is sector. It drives socioeconomic and technological development. By the year 2050, population of the globe will exceed 9 billion and number of automobile will be about 2.4

E-ISSN 3026-8982 P-ISSN 3027-2904

the Krejcie & Morgan table 1970 and the sample size is three hundred and six (306), out of which two hundred and ninety-five (295) were retrieved and used for analysis. The Statistical Package for Social Sciences (SPSS) was used for the analysis. This research seeks to reconcile the needs of Nigerians (automobile/vehicle consumption) with the capacity of the environment to cope with the consequences of economic development in Nigeria. The research therefore recommends that +green or eco-friendly measures examined in the work should be locally developed, adopted and implemented for environmental protection, resource conservation and sustainable development.

Key words: Environmental Challenges, Waste management, pollution, property rental value

billion, population increase urbanization, standard of living, and demand for mobility have enlarged demand and supply of tyres.

According to the European Environmental Agency, pollution is the introduction of substances or energy into the environment, resulting in deliration effects of such a nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment (Mathew 2015).

To understand why scrap tyres are environmental hazards, it is important to understand the properties of tyres. A tyre is a rubber covering, pneumatically inflated and placed round a wheel to provide a flexible cushion and form a soft contact with the road (Uzo *et al.*, 2011) Tyres are manufactured for use in almost all forms of mechanical vehicles such as passenger cars, bicycles, tricycles, vans, trucks, airplanes, etc. The materials of modern pneumatic tyres are synthetic rubber, natural rubber, fabric, wire, carbon black and other chemical compounds.

Most times, when tyres have served their original purpose, there are usually discarded in landfills or stockpiled or burned in open field. In many jurisdictions of the world, ELTs are purchase, ELTs are special tyre of waste.

There are municipal solid wastes rather than hazardous wastes (Mathew 2015).

When it is decided that the used tyre is neither reusable nor reconstruct able, it is discarded and the recycling or recovery process begins. Since the 2015 Stockholm convention on the environment, environmental sustainability has been a recurrent theme in the face of increasing environmental pollution. Pollution is the introduction of substances into the environment whose by-products in time have harmful or negative effects on the environment. (Ismel *et al*., 2010)

LITERATURE REVIEW

End-of life tyre (ELT) or scrap tyre refers to tyre that has ceased to perform its original function having exhausted all its re-use options. It is a non-reusable tyre in its original form. ELTs are not re-usable as a second hand purchase (David, 2018) ELTs are a special type of waste. There are municipal solid wastes rather than hazardous wastes (Adewole, 2018) When it is decided that the used tyre is neither reusable nor reconstructable, it is discarded and the recycling or recovery process begins. Since the 1972 Stockholm Conference on the environment, environmental sustainability has been a recurrent theme in the face of increasing environmental pollution. Pollution is the introduction of substances into the environment whose by-products in time have harmful or negative effects on the environment. Environmental pollution arises because of man's activity that directly and indirectly affects the environment. When a foreign substance is introduced into the environment in a high and unmonitored concentration, it becomes a pollutant and a threat to the environment. According to the European Environment Agency, pollution is the introduction of substances or energy into the environment, resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment (Ben *et al*., 2013).

Traditional Methods of Scrap Tyre Disposal

The increasing pollution caused by the increased use of automobiles and other vehicles has become a cause for alarm around the world. However beneficial

tyres may be to mobility, scrap tyres negatively affect the environment when improperly disposed of. Below are examples of methods of scrap tyre disposal that negatively affects the environment.

Landfilling/ Stockpiling

Landfilling is one of the common methods of waste disposal in the world. Yearly, millions of tons waste go into already overcrowded landfills. Tyres occupy so much land space in landfills due to their large mass. Tyres are basically non-biodegradable because of their complex chemical and physical composition. Thus, they could take decades to decay and are extremely difficult to compact in landfills because of their buoyancy. Their buoyancy makes them bubble up to the surface of the landfill causing damages to landfill liners installed to prevent leachates from polluting nearby soil, surface and ground water. In addition, when there bubble up to the surface, the tyres pose a fire hazard. This is due to the large quantities of petroleum and other hazardous chemicals in tyres. A tyre fire in a tyre dump is extremely difficult to put out and the resultant air pollution as well as the soil, surface water and ground water pollution could be deadly. Finding suitable space for the appropriate disposal of scrap tyres constitutes a major problem in scrap tyre disposal. The increase in the production and consumption of automobiles has equally increased the incidence of illegal stockpiling. When tyre wastes are stockpiled, they tend to collect water and thereby provide suitable breeding ground for malaria causing mosquitoes. The negative environmental impact of landfilling or stockpiling of tyre wastes is huge. Although, landfilling is generally the cheapest and most convenient method of disposing of solid wastes such as ELTs, landfilling of whole or shredded tyres is entirely prohibited in some countries for reasons stated above. In the EU, landfilling of whole and shredded tyre is banned while in South Australia, whole tyres are banned. Landfill bans or restrictions when well-planned and implemented with sufficient time for adjustments, can produce significant reductions in disposal of tyre wastes and increase resource recovery (Ijebor, 2016)

Burning

The state, process, sensation, or effect of being on fire, burned, or subjected to intense heat. a process in which a substance reacts with oxygen to give heat

and light. Scrap tyre burning offers ephemeral relief from scrap tyre menace and long term negative environmental impacts. Open burning of scrap tyres in dumpsites and landfills is a major occurrence in underdeveloped countries as Nigeria. Open burning of scrap tyres generates a soot toxic smoke and large quantities of hazardous gaseous emissions. The soot and toxic residues emitted from burning tyres may cause environmental harm, nuisance and pose direct threats to the economy, public health and safety. It reduces the value of commercial and residential property value. More so, the toxins released from the smoke can contaminate soil quality, groundwater and surface water. Airborne emissions from the open burning of End of Life Tyres are common occurrence in Nigeria (FME, 2019).

There is also the incidence of tyre fires. A Tyre fire is an event that involves the unintentional combustion of large quantities of tyres, typically when in locations where they are stored, dumped, or processed. The fire releases soot that contains lead, cyanide, carbon monoxide, sulphur dioxide, and products of butadiene, arsenic compounds and styrene all harmful to human health. The toxicity is even stronger if this contains metals such as nickel and tin, which you get when you throw the whole tyre into the furnace. The heat from tyre fires is tremendous and tyres begin melting into a sticky burning hot pool of pyrolytic oil. Tyre fires arising from whatever causes poses serious health implications. Tyre fires could cause asthma and respiratory complications, irritation, cough and chest pain, central nervous system depression, high blood pressure and subsequent heart disease; cancer and inflammation of mucous membranes. However, burning scrap tyres at industrial facilities during the process of pyrolysis does not pose these health risks if conducted properly as it is an eco-friendly process (FME, 2019).

END OF LIFE TYRE WASTE SITUATION IN NIGERIA

The rapid increase in Nigeria's population growth and income growth has resulted in a corresponding increase in the importation and purchase of all forms of motor vehicles. This change in consumption pattern has caused an increase in the amount of scrap tyres generated periodically. The number of scrap tyres in Nigeria increases monthly thereby amounting to high

concentration of this solid waste in environmentally harmful quantity. It is estimated that thousands of tons of scrap tyres are abandoned in various parts of the country. (FME, 2019) Many ELTs in Nigeria also end up in the waterways and on the streets. Many are also burned during festivities; as roasting material in abattoirs and in extrajudicial killings of suspected criminals. Tyres have been stock piled around the country for years both legally and illegally in landfills and open dumpsites. These open dumpsites, which are usually indiscriminately located near residential settlements, causes leachate to contaminate nearby soil, surface and underground water bodies that are relevant to the residents who completely depend on those resources. This situation is aggravated by the absence of a scrap tyre waste collecting system as well as designated specially constructed landfill sites in the country for tyre wastes. This further highlights the need for a comprehensive national solid waste management policy that would incorporate this present scrap tyre menace (FME, 2019).

Recycling is still a nascent concept in Nigeria and as such has not received much attention from the government. Material recovery or recycling operations are carried out mostly by the private sector that employ scavengers to sort refuse for a fee and salvage any recyclable waste material prior to the ultimate disposal of the waste. Presently there is no tyre recycling or resource recovery facility in the country. Thus, legislations, policies as well as technologies championing tyre recycling; resource recovery and addressing issues of tyre manufacturing, haulage, disposal, storage, processing, etc. are practically non-existent.

FRAMEWORK FOR ELT WASTE MANAGEMENT IN NIGERIA

Tyres are a worldwide problem when they become waste. This problem associated with ELT waste management is not alien to Nigeria. Each year in Nigeria, new accumulations are added to the already existing heap including the bulk dumped into the creeks, canals, and other waterways that are not accounted for. Sadly, there are no formal records or statistics on the number of ELT waste tyres generated in each state of the Federation. The Federal, States and Local governments have established various Laws, Regulations,

Policies, and bye laws as the case may be; as well as agencies for waste management but none makes a comprehensive statement on ELT or scrap tyre wastes. The existing ELT waste management in Nigeria is poorly developed and very weak majorly because of lack of general awareness by legislators and the public alike of the negative impact of waste tyres on the environment. In formulating a sustainable waste tyre management strategy in Nigeria, consideration must be given to the numbers of both locally manufactured (if any) and imported tyres; although, this is made difficult by the absence of formal data on how much of ELT wastes are generated in Nigeria (FME, 2019).

CONSTITUTION OF THE FEDERAL REPUBLIC OF NIGERIA 1999 (AS AMENDED)

The Nigerian constitution recognizes the importance of environmental protection and resource conservation when it provided in section 20 that it is an objective of the Nigerian State to improve and protect the air, land, water, forest and wildlife of Nigeria. The Constitution intended that this objective be achieved through promulgation and adoption of necessary laws, policies, regulations and international Conventions on environmental protection and resource conservation for sustainable development. The constitution also grants powers to the Local Government to oversee among other things, refuse disposal (Land Use Act., 1999).

NATIONAL ENVIRONMENTAL STANDARDS AND REGULATION ENFORCEMENT AGENCY (NESREA) ACT 2007

The NESREA Act is the major federal Law guiding environmental matters in Nigeria. It makes provision for solid waste management in Nigeria and prescribes penal sanctions for acts that run contrary to proper and adequate waste disposal procedures and practices. The Act is administered by the Federal Ministry of Environment, Housing and Urban Development (FMEHUD) alongside the National Environmental Standards and Regulation Enforcement Agency established under the NESREA Act of 2007. The agency in line with its statutory functions can do the following:

i. Review and enforce compliance with laws, guidelines, policies, standards and international agreements on scrap tyre waste pollution, waste management, atmospheric protection, air quality, ozone depletion, water quality, waste management, environmental sanitation, pollution control, and removal control methods as it relates to scrap tyre waste.
ii. Enforce compliance with regulations on the importation, exportation, production, distribution, storage, sale, use, handling of products such as rubber tyres and the disposal of scrap tyre wastes.
iii. Provide environmental education on sustainable environmental management in relation to scrap tyres, promote manufacturers, dealers, importers compliance with environmental regulations if any on rubber tyre use and disposal and also create public awareness in Nigeria on the need for consumers to patronise high quality tyres with long life cycle so that the rate of scrap tyre waste generation would reduce.
iv. The Agency is also deemed to have power to prohibit rubber tyre production processes in Nigeria and use of equipment or technology in tyre production and disposal in the country that undermine environmental quality.
v. The agency shall also conduct field follow-up of compliance with set standards and take procedures prescribed by law against any violator. The agency shall also conduct public investigations on waste tyre pollution and the degradation resulting from scrap tyre wastes. The Agency has powers to develop environmental monitoring networks, compile and synthesize environmental data on the number of scrap tyres in each state of the country.
vi. The agency shall oversee and promote research on scrap tyre wastes management. The agency may also make regulations monitoring and controlling activities of scrap tyre incineration in the country as well as landfilling.
vii. The Agency may make regulations for protecting public health and promotion of environmental sanitation targeted at collecting all scrap tyres in the country.

viii. The agency can also apprehend and punish in accordance to law, any importer who imports substandard tyres into the country thereby making Nigeria a dump yard for scrap tyres.

ix. The Agency shall also have power to prohibit rubber tyre production processes in Nigeria and use of equipment or technology in tyre production and disposal in the country that undermine environmental quality. The agency shall also conduct field follow-up of compliance with set standards and take procedures prescribed by law against any violator. The agency shall also conduct public investigations on pollution and the degradation resulting from scrap tyre wastes.

x. The agency shall also review existing guidelines, regulations and standards on environment including atmospheric protection, air quality, ozone depleting substances, water quality, waste management and environmental sanitation, other forms of pollution.

xi. The Agency shall also oversee removal of polluting substances; develop environmental monitoring networks; compile and synthesize environmental data on the number of scrap tyres in each state of the country.

xii. The Agency shall also undertake, coordinate, utilize and promote research on sustainable industrial and domestic methods in disposing scrap tyres for the elimination of pollution and such other matters related to environmental protection and research on the effects, and basic data on chemical, physical and biological effects of scrap tyres on the environment.

xiii. The agency may also make regulations maintaining air quality and preventing ozone depletion by monitoring and controlling activities of scrap tyre incineration in the country as well as landfilling.

xiv. The agency by curbing scrap tyre incineration in the country can also maintain water quality for protecting public health or welfare. The Agency may make regulations for protecting public health and promotion of environmental sanitation targeted at collecting all scrap tyres in the country.

xv. The agency can also apprehend and punish in accordance to law, any importer who imports substandard tyres into the country thereby making Nigeria a dump yard for scrap tyres.

xvi. The agency shall co-operate with other Government agencies for the removal of all polluting scrap tyres in the country through application of any locally developed or international best practice or best clean-up technology for scrap tyre wastes management. The Agency shall co-operate with other Government agencies for the removal of all polluting scrap tyres in the country through application of any locally developed or international best practice or best clean-up technology for scrap tyre wastes management (NESREA 2007).

Regulations (UNDER NESREA)

In order to effectively enforce the statutory functions of NESREA, the Minister of Environment empowered by the NESREA Act made Regulations. These Regulations are to be implemented at all levels of government. Some of the Regulations vital to this research are:

1. **The National Environmental (Surface and Groundwater Quality Control) Regulations, 2010:** these Regulations aims to restore, enhance and preserve the physical, chemical and biological integrity of the nation's surface and ground waters; and to maintain existing water uses. NESREA can use this Regulation to protect surface and ground waters from scrap tyre pollution.
2. **The National Environmental (Sanitation and Wastes Control) Regulations, 2009:** these Regulations aim to adopt sustainable and environmentally friendly practices in sanitation and waste management in order to minimise pollution. It makes adequate provisions for solid waste control, minimization, waste sorting at source, reuse, recycling and energy recovery and environmental sanitation including penal sanctions. It applies to all categories of wastes generated in Nigeria including end-of-life. The regulation provides amongst other things, guidelines on the control of solid wastes. It seeks to ensure healthy living, safe environment, safe and nuisance-free disposal of all kinds of wastes including tyre wastes in order to adequately protect public health.

   These Regulation will in relation to this research, regulate the collection, transportation, treatment and final disposal of tyre wastes. It will also

promote effective Stakeholders participation in scrap tyre waste management and generate employment opportunities, reduce poverty; optimize labour and equipment in waste management to enhance increased productivity through appropriate sustainable technologies for recycling of waste components. Through these Regulations, an institutional framework for tyre waste disposal and transformation can be built and maintained at affordable cost.

These Regulations can in accordance with its objectives, conduct research to determine per capita tyre waste generation in Nigeria, build a scrap tyre database, and establish regulations, sanctions and enforcement mechanisms for scrap tyre waste management from source of generation to the point of disposal. The NESREA as well as the Federal, State and Local governments and the Private sector alike can in line with these Regulations source for sustainable funding and technical assistance in waste tyre research, recycling and material recovery projects as well as develop a Scrap Tyre Waste Master Plan as a national blue print for effective Scrap Tyre Waste Management in Nigeria. There are also empowered to collaborate with relevant Stakeholders and environmental sanitation agencies on scrap tyre waste management as well as permitting, licensing and registration of tyre waste management facilities that require EIA certification.

The Regulations provides for the establishment and management of standard Sanitary landfills and encourages recycling incineration as a method of waste treatment for selected wastes. It is hoped that the governments and all relevant bodies will develop and implement these Regulations in the integrated scrap tyre waste management scheme.

3. **The National Environmental (Ozone Layer Protection) Regulations, 2009**: These Regulations seeks to prohibit ozone depleting substances and activities in Nigeria. NESREA can implement these Regulations to protect the ozone from causes resulting from scrap tyre burning.
4. **National Environmental (Control of Bush/ Forest Fire and Open Burning) Regulations, 2010**: these Regulations seek to prevent and minimise the destruction of the ecosystem through fire outbreak and burning of any

materials that may affect the health of the ecosystem through the emission of hazardous air pollutants. NESREA can implement these Regulations to protect Nigeria's environment and peoples from the hazards of scrap tyre fires.

5. **National Environmental (Domestic and Industrial Plastic, Rubber and Foam Sector) Regulations, 2010**: these Regulations aim to prevent and minimize pollution from all operations and ancillary activities of the rubber sector amongst others to the Nigerian environment. The Regulations specifically makes mention of the rubber industry, which includes the tyre manufacturing industry. NESREA can implement these Regulations to ensure that all industrial processes in the manufacture and disposal via recycling, resource recovery, pyrolysis, vulcanization, etc. are in compliance with laid down laws and regulations specific to the tyre industry. There is need for specific laws and regulations on tyre industries and tyre waste management in Nigeria.
6. **National Environmental (Permitting and Licensing System) Regulations, 2009**: these Regulations enable consistent application of environmental laws, regulations and standards in all sectors of the economy and geographical regions. NESREA can implement these Regulations to ensure that all tyre industries, facilities, stores, processors, haulers, transporters, dealers, importers and exporters have the necessary licences, permits, documentations, registrations, etc.

NESREA Permits

In order for industrial facilities and businesses whose operations may have an impact on the Nigerian environment to be environmentally friendly as well as being compliant with existing environmental laws and Regulations, NESREA issues several kinds of permits. The permits of importance to this research are the Air quality Permit, the Eco-Guard Certification and the Wastes and Toxic Substances Permit.

LAND USE ACT, 1978.

This Act grants control over land to State governments for proper allocation towards beneficial purposes to the state. This Act could come in handy in the

selection of lands to be used as landfill sites for the final disposal of ELTs in all the states of the Federation and also for the establishment of tyre recycling and reprocessing facilities.

GREEN TYRE RECYCLYING OPTIONS TOWARDS SUSTAINABLE WASTE TYRE DISPOSAL

Tyre recycling is the process of repurposing vehicle tyres that are no longer suitable for use on vehicles due to wear and tear or irreparable damage. The process of tyre recycling involves the collection and separation of tyre waste materials, the preparation of scrap tyres for re-use, processing, and re-manufacture; and the re-processing, re-manufacture and re-use of these materials. Since ELTs are difficult to dispose of, they could be converted into potential economically viable and sustainable products instead of being left to constitute environmental menace. This has spurred research into ways to successfully dispose of or recycle tyres into economically viable and sustainable products. Scrap tyres are indeed not only an environmental issue, but also as an economic benefit. The tyre and rubber waste recycling business is a very thriving industry. It is the major sector of the economy of the United States and it generates a whooping annual sum of 959.2 million dollars from registered and licensed Tyre and Rubber Waste Recycling companies in the country. The industry also employs several thousands of people. Despite the huge capital outlay, the market for recycled tyres is huge and can accommodate loads of investors. Tyre recycling is a very profitable venture. To convert the waste tyre into a valuable product, it must first be reduced in size and then recycled. Tyre recycling reduces the negative environmental impacts of tyre stockpiling, burning and landfilling. It has become a resource-efficient approach to tyre waste management and pollution control. It makes for sustainable development as it not only protects the environment; it is both economically and socially beneficial. Popular tyre recycling methods practiced around the world are examined below:

Rethreading

Rethreading used tyres is a form of tyre recycling. When a tyre's lifecycle comes to an end, the tyre tread depth reduces. At this point, the best course is

to repair or retreat the used tyre and then re-use it for the same original purpose for which it was designed. One of the best uses of ELTs is to retreat them, but this process is quite expensive and very few countries resort to it. Rethreading gives used, worn out tyres an extended useful life because during the process, about 80% of the original material value of a tyre is available for re-use. The U.K. has benefited from reusing and exporting rethreaded tyre casings. The U.S. has taken advantage of the growing market in rethreaded tyres because it is highly sustainable.

According to the American Remanufacturing Industries Council and Future Marketing Insights, the cost of rethreaded tyres is 30-50per cent lower than that of a new tyre and generates huge income for the American economy. Rethreads are definitely greener than new tyres and the rethreading process produces less carbon emissions and uses far less oil than the production of a new tyre (Ben, 2013)

Material Recovery or Waste Transformation

When used tyres reach the end of their lifespan, their physical and chemical composition could be recovered before final disposal. The complex physical and chemical composition of tyres makes them a highly valuable resource for various secondary raw materials that may be recovered such as rubber, steel, powder and fibre. In the process of material recovery of tyres, whole tyres, which are the larger particles of waste tyres, could be shredded into rubber chips that are useful in civil engineering. Other smaller particles of tyres are converted into rubber granules and powder that are used in the market to sell car parts and components, compounds in bitumen or varnish. The market regarding bitumen production has increased considerably (Ben, 2013).

The process of waste transformation and material recovery in all its aspects saves landfill space and save the environment from attendant pollution. Recovery methods involve three main aspects: materials recovery, energy recovery and re-use in a whole or part form for miscellaneous physical purposes. The traditional method of stockpiling tyres or dumping in landfills is vastly becoming out of tune with modern and sustainable environmental practices. Efforts are now geared towards reducing the amounts of waste

generated; thus, the emphasis on waste transformation, resource recovery and recycling. In practicing waste transformation or material recovery, regards must be had to the economic factors as the process could be cost intensive albeit truly sustainable. The transformation of scrap tyres into new economically viable products generates revenues from sale and exportation for the State. The social implications are bountiful as several sicknesses arising from burning, stockpiling of tyres will be reduced, and people can use whole tyres or recovered tyre products in domestic and industrial applications. More so, using people to pick up all used tyres in all neighbourhoods creates job opportunities and boosts economic living. Waste transformation is the process of altering the physical, chemical, and biological components of wastes to become a new valuable product. The practice of waste transformation or material recovery, which is a form of recycling, improves the effectiveness and efficiency of already existing solid waste management operations and systems. In relation to tyres, waste transformation or the process of material recovery involves recovering the re-usable and recyclable components of rubber tyre thereby reducing the disposal of whole tyres in landfills; saving land space for only final waste material that cannot be transformed any further or reduced. At the end of the material recovery process, there is a considerable reduction of the original tyre waste material during waste transformation (Ben, 2013).

This process of material recovery of waste tyres is truly sustainable and should be practiced by Nigeria. The UK has derived great environmental benefits in recycling and processing whole tyres, tyre shreds, rubber granulates and rubber powders. Several technologies are developed and practiced to encourage waste transformation and material recovery from scrap tyres. Such technologies are cryogenic, shredding and pyrolysis. Statistics of the European Tyre and Rubber Manufacturers Association (ETRMA) shows that about 95% of Europe's ELTs were successfully recovered through energy and material recovery processes. In the U.S., 4.39 million tonnes of waste tyres were recovered through energy and material recovery process (Ben, 2013).

Tyre shredding or Rubber Crumbing.

Tyre shredding or rubber crumbing is usually the first procedure in the tyre recycling process. The process involves the reduction of used tyres into small manageable chips separated into major components of rubber and steel called crumb rubber. This form of recycling is environmentally friendly, and allows used tyres to be used repeatedly. Tyre shredding or crumbing is done to provide a raw material in a form of rubber crumbs or to reduce the volume of tyres before landfilling. Shredded tyres and Crumbed Rubber are also known as Tyre Derived Aggregate (TDA). They have many civil engineering applications such as barriers for collision reduction, for sound and impact absorption properties; as insulation in building foundations and road base material; highway crash barriers, sound absorbing walls, boat fenders on harbour walls. Also, entire homes 'green buildings' can be built with whole tyres by ramming them full of earth and covering them with concrete, known as earth ships. It is also used as sub-grade fill, light rail vibration and embankments, back-fill for walls and bridge abutments, sub-grade insulation for roads, landfill projects, and septic system drain fields, coastal protection and off-coast break water, erosion control on steep slopes or roadsides, rainwater runoff, blasting mats, wave action that protects piers and marshes, and sound barriers between roadways and residences They are used in landfills for leachate lines; as a back-fill for retaining walls; as fill for landfill gas trench collection wells; as back-fill for roadway landslide repair projects as well as a vibration damping material for railway lines. Scrap tyres can also be used in landscaping as artificial turf or synthetic carpet grass in homes, offices and athletic and recreational areas like stadiums, airports for the embedment of runway lighting in landing surfaces for aircraft. It is also used in agricultural applications as mulch in agriculture applications; as material to be cut up into shoe soles or other simple rubber goods like mats, floor tiles, dock fenders, muffler hangers, support pads for back hoes, well chocks, brake pads, traffic calming devices, clothing accessories such as belts, handbags and buttons.

It is used as raw material in the rubber and steel industry; for flooring of indoor and outdoor sports courts, as roofing material, walk pads, carpet

padding or underlay, dock bumpers, patio decks, railroad crossing blocks, livestock mats, sidewalks, rubber tiles and bricks, animal bedding, movable speed bumps, and curbing/edging, etc. The rubber can also be moulded with plastic for products like pallets and railroad ties. Rubber from tyres is sometimes ground into medium-sized chunks and used as rubber mulch. Rubber crumb can also be used as an infill, alone or blended with coarse sand, as in infill for grass-like synthetic turf products such as Field-turf. It is also used in erosion control and rainwater runoff and to protect piers and marshland from wave action. In the U.S.A and EU, shredded rubber crumbs are mixed into hot melt asphalt typically a crumb rubber modifier-recycled asphalt pavement CRM-RAP and as an aggregate in cement manufacturing for making 'green buildings and structures (Ben, 2013).

Pyrolysis Process or Energy Recovery

Tyre Derived Fuel (TDF) popularly referred to as waste to energy process, is amongst the first market for scrap tyres on the global scale and remains the most beneficial and highly sustainable end use as supplemental fuel in Europe, Asia-Pacific and the United States. Pyrolysis is a thermal degradation process in which organic material is decomposed at high temperature usually from 500-600 degree Celsius in either an oxygen-free or low-oxygen atmosphere. The purpose of pyrolysis is to break the tyre into its original components of oil, gas, solid residue (char), and low-grade carbon black, which cannot be used in tyre manufacture. Pyrolysis of scrap tyres offers an environmentally and economically feasible method for transforming waste tyres into heat and electrical energy. Pyrolysis of scrap or waste tyres (WT) is an attractive alternative to disposal in landfills, allowing the high energy content of the tyre to be recovered as fuel. The products of pyrolysis have properties that would allow their easy re-use. Using tyres as fuel produces equal energy as burning oil and 25% more energy than burning coal. Tyre pyrolysis plants are in use in several countries now, including the USA, Japan, India, and France. The black Carbon black produced by pyrolysis application (CBP) or rubber char is more economical compared to carbon black produced primarily from petroleum and is more price-efficient. It is to be used as a raw material in the

following industries such as the electric cable jacketing, the conveyor bands; carrier bands; home and doormats; black nylon bags; hoses, doormats, rubber additives; cable jackets; automotive spare parts; heat isolation; black colorant in rubber materials; plastic pipes; black colourant in industrial rubber products, plastic pipes and firefighting.

The pyro process converts scrap tyres into Pyro Diesel Oil (PDO). High grade Light Speed Diesel Oil (LDO) and Industrial Furnace Oil (IFO). Recovered LDO and IFO can be used to generate electricity and help mitigate the nation's power shortages. LDO and IFO are suitable fuel oils for rural pump sets and gen sets. The U.S. EPA acknowledges tyre-derived fuels as a viable alternative to the use of fossil fuels so long as proper regulatory controls are in place.

The use of ELTs (whole tyres, half tyres, shredded rubber wood chips) is increasingly regarded as a valid alternative fuel in the cement industry. Since tyres are largely composed of hydrocarbons, they may provide an alternative non-fossil fuel resource when they are burned in special incinerators or kilns. Tyres may therefore be burnt to provide energy for the production of steam for vulcanization, electricity, cement, lime paper, steel wires, zinc oxide and sodium sulphate. However, it is currently being challenge due to the steep fall in oil prices in recent years.

Other ELT Repurposing Options

Scrap tyres can be vulcanized when they have reached a point whereby their re-use option is exhausted. Then, the physical properties of the ELTs can be exploited beyond the original purpose mainly for aesthetic purposes. Used tyres in a whole condition or mashed, cut or sliced, can be utilised in garden beds as bark mulch or rubber mulch to hold in the water and to prevent weeds from growing. Rubber mulch is also good in playgrounds as it has elasticity, which gives it a springy quality when used in a thick layer. This makes it a natural choice for playgrounds, where the extra springiness provides additional safety for children when they fall off playground equipment.

Research Methodology

This chapter focuses on the methods employed to achieve the aims and objective of the study. It also explains the procedure followed and the

instruments used in collecting and analyzing relevant data. It further looks at the sources and the nature of the data, the research design, target, population, sampling techniques, sample size, data requirement, questionnaire design and relevant tools for data presentation and method of data analysis.

Method of Data Analysis

For this research work, the method of data analysis shall involve both quantitative and qualitative method which involve the uses of frequencies, percentage and explanation.

Validity and Reliability

The research design of this questionnaire restricts the subject to respond only on the questionnaire for the purpose of this research. This will be done to facilitate data analysis, estimation of validity and reliability indirect such as recording response from the respondent and computing result using simple percentage table.

DATA PRESENTATION, ANALYSIS AND RESULT

This chapter analyzes the responses given by the respondents. It lies mostly on the responses obtained from questionnaires administered as being discussed in the previous chapter. These responses are presented and analyzed in a tabular form expressed in percentage (%).

Table 1: Questionnaire distributed

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Retrieved	295	96.4	96.4	96.4
	Not Retrieved	11	3.6	3.6	100.0
	Total	306	100.0	100.0	

Source: Field Survey, 2022

In analyzing the rate of respondents, out of the three hundred and six questionnaires distributed, eleven (11) representing 3.6% were not returned,

while the remaining two hundred and ninety-five (295) representing 96.4% were properly filled and returned. Therefore, two hundred and ninety-five (295) questionnaires were used for analysis.

CONCLUSION AND RECOMMENDATION

End-of life tyre (ELT) or scrap tyre refers to tyre that has ceased to perform its original function having exhausted all its re-use options. It is a non-reusable tyre in its original form. ELTs are not re-usable as a second hand purchase. ELTs are a special kind of waste; they are municipal solid wastes rather than hazardous wastes. When it is decided that the used tyre is neither reusable nor reconstructable, it is discarded and the recycling or recovery process begins. Since the 1972 Stockholm Conference on the environment, environmental sustainability has been a recurrent theme in the face of increasing environmental pollution. Pollution is the introduction of substances into the environment whose by-products in time have harmful or negative effects on the environment. Environmental pollution arises because of man's activity that directly and indirectly affects the environment. When a foreign substance is introduced into the environment in a high and unmonitored concentration, it becomes a pollutant and a threat to the environment. According to the European Environment Agency, pollution is the introduction of substances or energy into the environment, resulting in deleterious effects of such a nature as to endanger human health, harm living resources and ecosystems, and impair or interfere with amenities and other legitimate uses of the environment.

Conclusion

This research seeks to sought out a way for proper disposal of end life tyres and also enlighten most Nigerians (automobile/vehicle consumption) with the impact of poor handling of end life tyres on properties rental values and its consequences on the environment. Nigerians and the world at large can enjoy the benefits of tyres without having to destroy the environment for the present and future generations. There must be a balance between tyre consumption and environmental, social and economic development. The

handling of end of life tyres would be maximized and its impact on properties rental values would not be negatively affected this will be a step towards a sustainable development in the community and country at large.

Recommendation

From the research findings and the result obtained from the analysis the researcher therefore recommends the following suggestions in the light of the increasing problems associated with ELTs or scrap tyres in Nigeria:

i. The Nigerian government should encourage the establishment of facilities for retreading of tyres since making use of retreads will help to reduce the rate at which used end of life tyres are generated.
ii. I recommend that the environmental protection agency should organize a sanitation enlightment programme on the negative impact of ELTs
iii. Incineration of tyres in cement kilns, paper industries should be practiced in Nigeria as this consumes large quantities of used tyres and produces no residue for further disposal.
iv. At the rate at which scrap tyres are accumulating in Nigeria, there is need for the enactment of a waste tyre manufacturing and disposal law or regulation that would among other things, fix a legal minimum tyre tread thickness; regulate waste tyre manufacturing, car and tyre sales, tyre importation, storage, processing, disposal, etc.
v. In addition, integrated policies on tyre waste minimization reuse, recycling, and disposal should be developed at all levels of government just like the USA and Australia. This would reduce waste tyre generation and save landfill space.
vi. Wastes segregation from the point of generation should be practiced in relation to tyres in Nigeria and efforts should be directed towards increasing the collection efficiency of scrap tyres. So as to improve the value of properties in affected areas.
vii. In addition to the Policy Statement on wastes contained in the Revised National Policy on the Environment, which makes it an objective of government to secure and enforce a legislative ban on plastic bags

should also be expanded to secure and enforce a legislative ban on the open burning, and illegal or legal landfilling and stockpiling of whole tyres as conditions would permit.

viii. The should government seek to dispose final tyre wastes in landfills or monofills, it should be a landfill in a designated location, faraway from residential areas. The landfill or monofill should be built in line with modern engineering specifications.

ix. I will recommend that the various agencies like NESREA, FEPA, SEPASL to take in charge of quality check and control of waste to ensure that Nigeria is no longer a dumping ground for poor quality tyres.

REFERENCES

Adewole, T.A. (2018) Waste Management towards sustainable Development in Nigeria: A case study of Lagos State. International Non-Governmental Organization (NGO) journal, 4, 173-179.

Ben (2003). Scrap tyres disposal and recycling options. A report from RAPRA'S industry analysis and publishing group, 2003.

Ben et al (2013). "An Environmental impact assessment of the open burning of scrap tyres," Journal of Applied Sciences, vol. 14, no. 21, pp. 2695-2703, 2013.

David (2018). "The use of scrap tyres in rotary cement kilns," in Municipal Solid Waste, CRC Press, 2020, pp. 105-123.

FME (2019), "Urban air pollution from open burning of municipal solid waste," Environmental Quality Management, vol. 28, no. 4, pp. 67-74, 2019.

Ijebor (2016). "Comparative study of Municipal solid waste fuel and refuse Derived fuel in the gasification process using multi stage downdraft gasifier", Automotive Experience, Vol. 4, no. 2, 2021, doi: 10.31603/ae.4625.

Ismel et al (2019), "Environmental impact of end of life tyre (ELT) or scrap tyre waste pollution and the need for sustainable waste tyre disposal and transformation mechanism in Nigeria," Nnamdi Azikiwe University Journal of International Law and Jurisprudence, vol.10, no. 2 pp. 60-70, 2019.

Land Use act (1999): "The land use act and land administration in 21st century Nigeria", Need for reforms. https://dx.doi.org/10.4314/jsdlp.v9i1.5

Matthew (2015). "A review of environment impacts and environmental applications of shredded scrap tyres," Scrap tyre Derived Geometrical – opportunities and Challenges; Hazarika, H., Yasuhara, K., Eds,pp 3-18, 2015.

NESREA Acts 2007)." National Environmental Standards and Regulations Enforcement Agency (Establishment) Act, 2007". 2007 ACT No.25. an act to provide for the establishment of National Environmental Standards and Regulations Enforcement Agency charged with responsibility for the protection and development of the environment in Nigeria, and for related matters. 30th July, 2007.

Stockholm conference (1972). "Environment and sustainable development", United Nations Conference on the Human Environment, 5th to 6th June 1972, Stockholm. www.un.org/en/conferences/environment/stockholm1972

Uzo et al (2011), "Waste tyre rubber as a secondary fuel for power plants," Fuel, vol. 88, no. 12, pp. 2473-24800, 2009.

Vigoslostry, Klurkon & Joze (2017), "Research of sustainable use of tyre shreds in landfill," sustainability, Vol. 8, no. 8, pp. 767, 2016.

Welman, C., Kruger, F & Mitchell, B. (2009): "Research Methodology", Oxford University Press, Oxford, 2009, pp. 146.