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Pollution In Nigerian Auto-Mechanic Villages: A Review

Nkwoada A.U[1]alisa C.O[1], Amakom C.M[2]
[1]*Department of Chemistry, PMB 1526, Federal University of Technology Owerri.*
[2]*Department of Physics, PMB 1526, Federal University of Technology Owerri*
Corresponding Author: Nkwoada A.U1alisa C.O

Abstract: *The increasing number of malfunctioning automobiles withsubsequent increase in emission levels and waste handling is an environmental concern in Nigeria. The spills from lubricants, gasoline, diesel and by-products of used and spent engine oil constitute the major pollutants in auto mechanic villages in Nigeria. Its environmental pollution has beenpredominant through soil and groundwater contamination andalso poses a major anthropogenic threat. The studied heavy metals on contaminated soil showed that studies had focused on common metals of Cu, Cd, Pband Zn in the east and west regions, while trace metals were studied in the south and radioactive elements in the north. Statistical evaluation showed high occurrences of Cu, Cd, Pb and Zn in the four geo-political zones of Nigeria. The detrimental effects of auto-mechanic village activities were on humans and also disrupted growth and flowering of arable plants. The remediation application showed that soil type and contaminant characteristics play a major role in determining the type of remediation procedure to be applied.Hence,Nigeria should provide standard repairs and services to automobiles in-line with emerging technology and best environmental practices.*

Keywords: *Auto-mechanic, Pollution, contamination, automobiles, heavy metals*

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I. Introduction

The damagesarising from heavy metal pollution in Nigerian auto mechanic villages have induced large scale environmental degradation [1]. The predicted climatic change induced by such anthropogenic activity was projected to be first experienced in Africa. Thus heavily polluted nations like Nigeria, should take adequate measures to mitigate this change arising from anthropogenic activities [1, 2]. Our environment is composed of several layers of the atmosphere that are continually active, hence, pollutant gases emitted from point sources like automobile exhaust, forest fires and power plants would eventually get to other regionsby dispersion [3]. The drive behind this anthropogenic pollution includes urbanisation, over population and technological improvements; however, the increasing number of automobilesand associated wastes, withsubsequent increase in emission levels and waste handling is a serious environmental concern in Nigeria [2,3].

The wastes arising from automobiles are improperly handled in Nigeria by the system of vehicular repairlocations known as "Auto Mechanic Villages" [4]. The auto-mechanic villages (AMVs) are frequently cited in shanty neighbourhoods of cities and adjourning towns. The areas are usually characterised by poverty, overpopulation, and low level of education. It has been reported that the literacy level contributes to pollution and environmental deterioration in these areas due to information and knowledge gap [5]. Additionally, the spills from lubricants, gasoline, diesel and by-products of used and spent engine oil constitute the major pollutants in AMV [5, 6]. They environmental pollution scenario in Nigeria is compounded by the frequency of oil spills. For e.g. in 2010, only about 3203 cases were reported and also about 8 million cubic feet of natural gas are flared every day in the Niger delta region [6]. Again, about 50, 000 acres of mangrove vanished between 1986 and 2003 within Nigeria's Niger-Delta region [6]. These environmental incidents are rarely reported in other oil producing nations. Also Nigeria seem sluggish over matters of climatic change and its global warming threat [6, 7]. For instance, the 1988 toxic KOKO waste dump should have triggered mitigation measures and legislation on land use and waste handling, however, the post-practice of land use and waste handling afterwards had beenunpromising [8,9,10] and AMVs are notorious land polluters. Moreover, the high cost of renting a workshop in towns and cities had in its measure contributed to auto mechanic workshops been sighted in existing as shanties and slums [10,11].

Further studies have revealed that AMVs are small scale industries usually existing in populated areas were national electricity grid supply is marginal [12,13, 14].As small scale industries, AMVs exist as informal enterprise to secure regular wages for the practitioners [4] and due to such, pollution is prevalent in AMVs [16], child labour have been recorded in some countries [17] andAMVworkers are also at high risk of HIV/AIDS infection [18]. Thus the scenario is made worse by the increase in the importation of malfunctioning automobiles (Vehicles older than 10 years) in Nigeria. These have also led to corresponding increase in number

of AMVs. The malfunctioning vehicles often experience frequent automobile repairs, discard and abandoning of vehicular parts, which leads to increased soil contamination, groundwater pollution through leached heavy metals, release of waste oil and greases[4, 16, 19, 20]. Hence, there is the need to review the state of soil and water pollutionlevelsin AMVs based on heavy metal concentrations levels and to proffer solutions.

II. Soil And Waterpollution

The Effluents discharged from anthropogenic activities often contain toxic heavy metals that cause adverse effects in the environment [21]. They heavy metals when released, maybio-accumulate in plants or become toxic to aquatic organism [22]. The micro-scale industrial activities of AMVs have thus been reported to have induced soil and groundwater contaminations [10,22].Subsequently, when these contaminants are released, the affect water habitat, natural soil flora and fauna, and may pose as a potential disease for humansif ingestion [23, 24,25]. A study in Nigeria investigated the quality of irrigated water in clustered AMVsand observed that the ongoing activities of AMVs have affected surrounding ground water quality [26]. Another study of water quality in Minna, Nigeria, confirmed that effluents from AMVs had contaminated their local water quality [27]. Similarly, the physicochemical assessment of Ugborikoko/Okere stream in Nigeria also suggested that artisan activities of AMVswere responsible for the recorded pollution levels [28]. Furthermore, assessment of River Owo, in Nigeria showed high levels of heavy metals linked to the surrounding AMV industrial areas [29]. Whereas, Otamiri River in Owerri was assessed to be unfit for consumption due to activities of AMVs, landfill and mining activities [30]. Hence there is regional peculiarity of AMVs and its associated contamination sources and pollution threats due to topography, soil types, population and urbanization, awareness and waste disposal practices.

2.1 POLLUTION IN GEOPOLITICAL ZONES OF NIGERIA

A modelled study on the flow pattern of groundwater and particle migration around two AMVs in Eastern region showed that the pattern of stream divergent flows may encourage bioaccumulation [31]. Again high levels of hydrocarbon have been reported in the AMVs in Ebonyi in the Eastern region and were found to encourage growth of indigenous microbial degraders [32]. The determination of heavy metals (Pb, Cu, Ni and Cr) in soils of AMVs around Onitsha Metropolis in Eastern Nigerianalso showed that the toxic levels of pollutantscould induce health challenges [33].

Such high levels of heavy metals have also been found in Ile-Ife of western Nigeria as reported by a study on bioaccumulation of heavy metals by maize in aged AMVs [10, 23]. These bioaccumulations of heavy metals (Cr, Cd, Mn, Cu, Ni, Zn)in phytoplants have also been observed in Akoko Land in the West, while in Ibadan a populated large city in the west, the AMVs were confirmed to have induced adverse effects on both soil and water [36]. In OshodiLagos in the west, the levels of heavy metals were shown to be inhibiting microbial respiration in the soil [37]. Hence correlating with previously published articleson effects of heavy metals from AMVs to inhibit microbial growth and eventually contribute to deplete soil flora and soil fauna [10, 23, 34].

The North region had not been different in pollution threats from AMVs. In Makurdi, water pollution around AMVs was high and associated with abandoned metal scraps in AMVs [38]. In Kaduna, (populous and commercial city) in the North, soil pollution was detected around AMVs [39]. Albeit, the lower concentration levels of heavy metals determined around AMV dumpsites in Makurdi [40] may be uncharacteristic of the area due to soil typeor some other unreported factors. However, AMVs were generally identified and reported as pollution prone areas in the northern part of Nigeria.

The southern part of Nigeria is known for oil spillage and pipeline vandalism. However, the there is a growing concern over activities of AMVs to further proliferate the problem. In Obiaruku Delta state, physicochemical properties of some selected AMV study, detected and confirmed contamination of the soil in such areas [41]. In Uyo, occupational health assessment showed that the trace metal level poses higher occupational risk quotient for AMV workers [42]. The City of Benin had also experienced large scale pollution from disposal of used engine oil in soils around AMVs [42].

Finally, AMV contamination and pollution threats are also a problem in other African nations. For e.g. in Kumasi Ghana, assessment of Ashanti region showed that soil pollution around AMVs in the region [44] has reached toxic levels. Similarly, Tamale metropolis in Ghana also recorded high concentration of heavy metals in soils around AMVs [45] withcommon cases of leaching of heavy metals into soil and nearby streams [46]. In AMVs around Shashemane Addis Ababa, Ethiopia, high levels of heavy metals were confirmed with potential detrimental effects to the environment [47]. Thus AMV activities are indeed sources of pollution concern that affect the environment.

III. Sources Of Pollution

The sources of AMV pollution largely depends on the mechanic personnel, work area and practice. The engine oil of a running engine accumulates heavy metals [48] and when indiscriminately disposed on the soil increases heavy metal load of the top soil [49]. The heavy metals can also escape the surface of abandoned metal scrap via corrosion and leach into the surrounding soil [48]. AMVs near or within gas stations have also been identifiedas major sources of heavy metal contaminations [45]. Likewise, improper disposal of lubricating oil, used engine and motor oil by AMV workers is a majorcontributor of pollution [51].

The environmental pollution caused by AMVs, has been a concern to public environmental health and safety [52]. The common practice of open dumps and uncovered surface landfills in AMVs [53]and adulterated gasoline [54], largely contribute to higher pollution index of AMVs. The non-regularization of gasoline and petroleum product standardsmay continue to hamper any clean up approach [55]. The reason is because higher concentration levels of Cu, Zn, Mn, Si, V, Mo and Fe are present in regular gasoline and petroleum products sold in Nigeria [56]. They situation continues to deteriorate. For instance; study has shown that about 1.4 million litres of spent oil are annually disposed in Nekede Mechanic village in Imo State, Nigeria [57] with the devastating consequences. Additionally, spills and leakages, accidents and sabotage often compound the problem [58]. The non implementation of environmental laws, bribery and corruption creates room for more challenges [59, 60]. Again,the jammed traffic flows at AMVs can increase vehicular exhaust emissions [61]. Such vehicular emissions will eventually end up in soils or inhaled by humans [62]. In the soil, studies have shown bioaccumulation of metals (Fe, Ni, Mn, Zn, Cu, Cd, Cr and Pb) at different concentrations in certain medicinal plants [63]. Factors such as pH, organic matter, moisture content were at favourable conditions to these pollutants [64, 65]. Similarly, oil effluents disrupt the physicochemical balance of the soil and affect soil degrading bacteria in the soil [67] likewise soil invertebrates like earthworm and millipede [68]. Also the abundance of oil tolerant plants such as metal excluders or detoxifiers (*AmaranthusSpinosus and Amaranthushybridus*) in AMVs indicates that spent oil type of pollution is prevalent in AMVs [70]. Lichens are also common in AMVs and often indicate high levels of heavy metals pollution from battery, oil leakage and worn out tyre sources [70].

On the other hand, artisans' activities in AMVs often contribute to indiscriminate disposal of wastes on the top soil and will eventually cause groundwater contamination [71]. These unregulated activities reduce bioavailability of essential nutrients to plants in the soil, while increasing bioaccumulation of non essential elements [72]. Also,the absence of personal protective equipment endangers the AMV workers [73] especially during servicing of malfunctioning vehicles and disposal of used engine oil [74, 75]. Thus the sources of pollution in AMVs are numerous, prevalent and non-specific.

IV. Methodology In Pollution Studies

Heavy metals in AMVs have continued to pose environmental challenges to Nigeria as a nation. The table 1 below is an assessment of previous studies of heavy metals present in AMVs in Nigeria. From the table, observation showed that, the major researched AMVs in the East were Orji and Owerri AMV both in Imo State. Common analytes had been Cd, Cu and Cr and Pb using AAS.

Table 1: Assessment of heavy metal studies in the four rejionsof Nigeria

REGION	STUDY AREA	METHOD	ANALYTE	REF
EAST	Nekede/Orji	AAS	Cd, Cr, Cu, Fe, Pb	76
EAST	Nekede/Orji	AAS	Cd, Cu, Mn, Ni, Pb, Zn	77
EAST	Nekede/Orji	AAS	Cd, Cr, Cu, Fe, Mn, Ni, Pb	78
EAST	Nekede/Orji	AAS	Cd, Cr, Cu, Fe, Mn, Ni, Pb	79
EAST	Nekede/Orji	AAS	Cd, Cr, Cu, Fe, Mn, Ni, Pb	80
WEST	Soil A/Soil B/Soil C	AAS	Cd, Cr, Cu, Fe, Mn, Ni, Zn	35
WEST	Bodija/Oke Ado/Ijokodo	Unknown	Cd, Fe, Pb	36
WEST	Ap Bus stop/Ondo Road Junction/ NNPC Along road/Olubuse Junction 1/Olubuse Junction 2/ Opposite NNPC Along road/OAU Botanical Garden	AAS	Cd, Cu, Fe, Pb, Zn	70
WEST	Akungba/Ikare/Akoko	AAS	As	71
WEST	Capsite/Kobape Obada/Sagamu	AAS	Cd, Cr, Cu, Fe, Ni, Zn	81
WEST	Agbowo/Apete Dugbe/Ijokodo/Ojoo Mokola/BodijaOjuIrin	AAS	Cd, Cr, Cu, Ni, Pb	82
WEST	IkareAkoko 1 IkareAkoko 2 IkareAkoko 3	AAS	Cd, Cr, Cu, Fe, Ni, Zn, Pb	83
WEST	Idiaba/Kotopo/Fajol	AAS	Cr, Co, Cu, Ni, Pb, Zn	84
WEST	Oyemekun/Oke-Ijebu	AAS	Ba, Cd, Cr, Co, Cu, Fe, Ni, Pb,	85

	Ijapo/Ilesha/Ondo Road		Zn	
WEST	Iwo School/Odori Market/ Hospital Road/Fawibe Street/ Saint Anthony Primary School	AAS	Cr, Hg, Ni, Pb, Zn	86
NORTH	North Bank	AAS	Cd, Cu, Mn, Ni, Pb, Zn	65
NORTH	Apirr/ North Bank	AAS	Ag, As, Cd, Cr, Cu, Fe, Hg, Mn, Pb, Zn	87
NORTH	Samaru/Kofardoka/SabonGari/ Tudun Wada.	XRF	Al, Ba, Ca, Cr, Cu, Fe, Ga, K, Mn, Mo, Ni, P, Pb, S, Si, Ti, V, Zn	88
NORTH	Apir/Gboko	AAS	Cd, Cu, Mn, Ni, Pb, Zn	89
NORTH	Apir/Benue Industrial layout/ Integrated waste Dump	AAS	Cd, Cu and Pb	90
NORTH	Samaru/Kwagila/Wusasa/Kofan-Doka/Sun Seed/Muchia/SabonGari	XRF	As, Ba, Ca, Cu, Eu, Fe, K, Mn, Nb, Ni, Os, Pb, Rb, Re, Ru, S, Sr, Ti, Th, V, Y, Yb, Zn Zr	91
NORTH	Otukpo/Gboko/Makurdi	FAAS	Cd, Co, Cu, Mn, Ni, Pb, Zn	92
NORTH	Das Park	AAS	Cd, Cr, Cu, Mn, Pb, Zn	93
SOUTH	Site 1/Site 2/Site 3	AAS	Cd, Cu, Ni, Pb	42
SOUTH	Uwelu/Warri-Effurun	AAS	Cd, Cr, Cu, Fe, Mn, Ni, Pb, Zn	94
SOUTH	Warri-Effurun	AAS	Cd, Cu, Ni, Pb	95
SOUTH	Mile 3/Rumola/Trans-Amadi/ Rumuokoro	AAS	Cd, Hg, Ni, Pb, V	96
SOUTH	Point 1/Point 2/Point 3	AAS	Cu, Fe, Mn, Zn	97
SOUTH	Evbareke/Igun/Uwelu	AAS	Al, Ca, Cu, Fe, Mg, Mn, Na, K, P, Zn	98
SOUTH	Mile 2/Mile 3	AAS	Fe, Pb	99

The western region showed that other metals of interest such as Cr, Zn, Ni, and Fe had been conducted over the years. Again, AAS was the most common sampling methodology. There were also more named locations in the western region than in the eastern region. The North utilized other sampling methodology such as FAAS, XRF and AAS. They instrumentsmay have contributed to many analytesstudied due to the speed and robustness of the instrument. Moreover their locations were different when compared to the east. In the west, observation shows that only AAS methodology was used, In addition the study areas were in different locations. In contrast to east and west AMV studies that focused on heavy metals, the south analysed trace metals such as V, Mn, Mg, P, K, Ca while the North determined some radioactive elements like Zr, Yb, Sr, RbEu, Ru, Re and Th.

In order to statistically evaluate and review the different metals present in these four geo-political regions, agraph was plotted showing the frequency of occurrence of the heavy metals as per the four regions.The figure 1 below shows that in the east, Cd and Pb were the most studied and most abundant of all metals while Zn recorded the lowest frequency. The western scale showed that Zn, Pb, Ni, Cd, Cr and Cu were the metals of interest occurring in abundance whileAs, Ba, Hg and Mn recorded the least studied metal alsoshowing non availability of these metals in the area. The North regionfrequency chart showed high abundance of Zn, Cd, Pb, Cu and Mn metals. The other remaining 30 named metals in the chart were of low occurrence in the North. Likewise, observation of the South frequency chart depicted the high availability of Cu, Fe, Pb and Cd in studied area. While the other named metals in the chart showed average occurrence and availability.

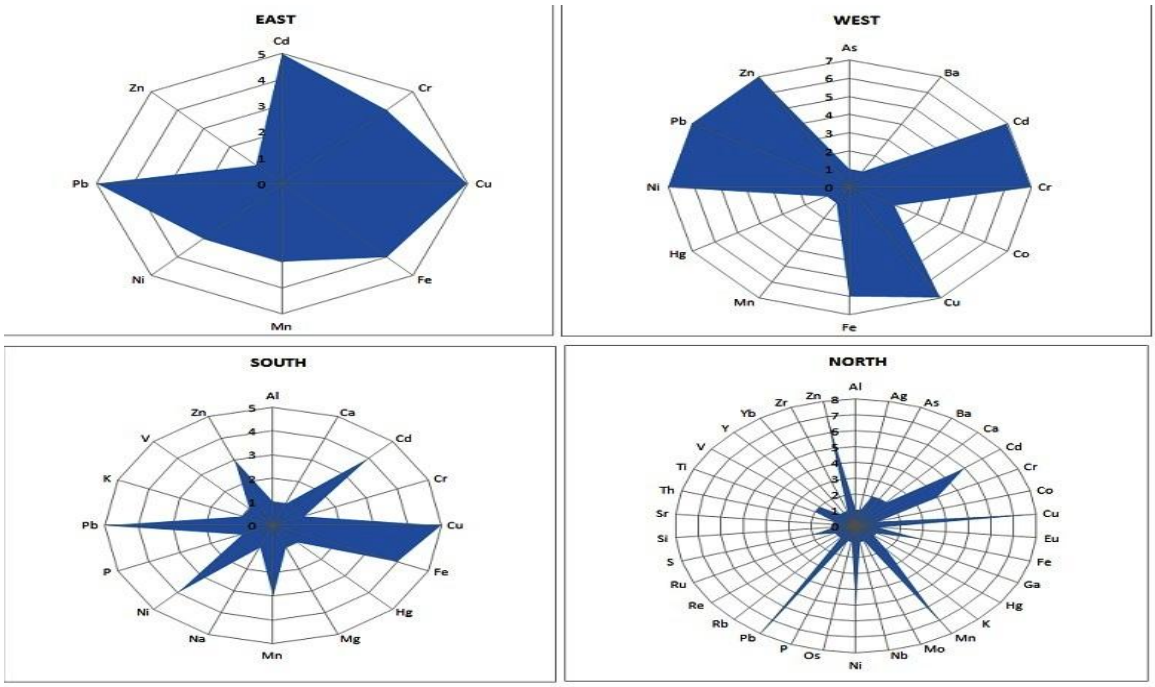

Figure 1: From L-R: Frequency chat on occurrence and availability of heavy metals in the East, West, North and South regions of Nigeria.

The figure 2 below depicted the 3D plot of common occurring metals in AMVs of the four regions of Nigeria.On the y-axis are the lists of sixteen common metals frequentlyanalysed in the four the four regional chat. The x- axis showed the four geopolitical zones while the z-axis depicted their functional levels (frequency of analyses). The frequency value of 2, 4 and 8 were the standard arbitrary value chosen to indicate analyte occurrence. Analytes analysed twice appeared as flat bars while analytes analysed more than twice had an extended bar. The 3D bar chart showed that the most common analysed metals in the east were Cd, Cr, Cu Fe, and Pb, The West was Cr, Cu, Ni, Pb and Zn, the North was Cd, Cu, Mn and Zn while the South was Cu, Cd, Fe, and Zn. Hence, Cu was identified as the most analysed metal in the following order: Cu > Cd ≥ Cr ≥ Pb ≥Zn.

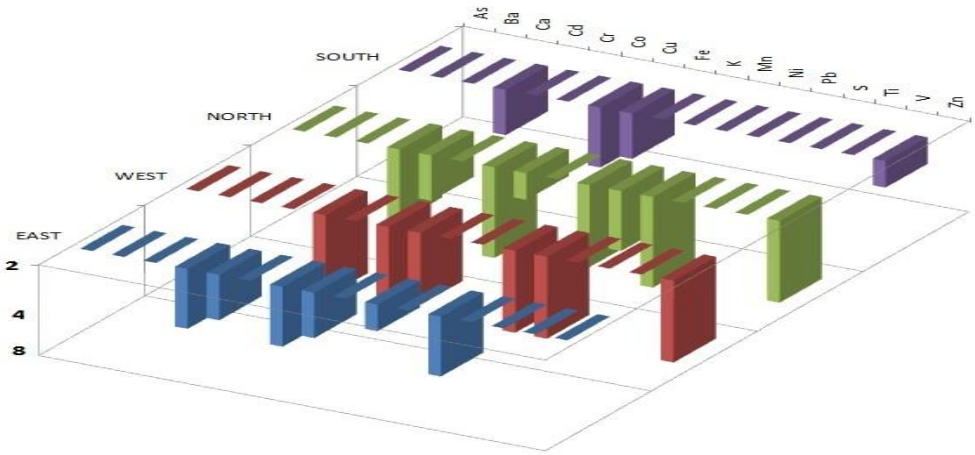

Figure 2: 3D plot of common metals in the four regions of Nigerian AMVs

V. Other Vehicular Pollutions

The reported widespread effects of activities of AMVs have remained detrimental to the human environment. In Malaysia, AMVs are also located within residential homes due to enforcement of regulation [100]. These roadside activities are a serious concern because itincreases lung malfunctioning and affects soil and water bodies. [101, 102]. AMVs in Nigeria often consist of mini-markets. These mini-markets regularly display their wares and consumables in the open, thereby increasing exposure to gaseous and particulate matter [103]. Research have also shown that exhaust emissions can pollute the air during engine idling, servicing or

repairs and can induce certain adverse health effects [104, 105]. Similarly,exposure of humans to gasoline exhaust particles, disrupts the epithelia vital protection mechanism in the body, thus making the immune system susceptible to toxins [106]. The global automotive industry has been conscious of gaseous and particulate emissions from automobiles that would pose occupational health risk especially exhaust emissions, crankcase blowby emissions and evaporative emissions [107, 108] by adoptive innovative researches to reduce these emissions. Research has shown that a typical automobile battery contains Pb and HCl and both are dangerous to humans. The Bumper of vehicles are cloned with Chromium and Cyanide; two poisonous potent metals. The Engine raves up evaporative and non evaporative emissions. It is also a source of used up oil that would eventually be discharged into the soil or water and contaminate the environment. The exhaust releases, particulate matters, polycyclic aromatic hydrocarbons, volatile organic compounds, unburnt hydrocarbon and other gaseous pollutants such as NO_2, CO, CO_2, SO_2. These be inhaled or ingested at different exposure rates and will eventually trigger health related diseases that affect cardiovascular regions other organs. More so, Gasoline tank releases benzene and hydrocarbon emissions during refuelling. Toxic chemicals such as dyes, greases and waxes, amines, nitrosamines, vinyl chloride, formaldehyde, phenols and other solvents are used in production of car seat textiles, tyres and plastic components [108].

VI. Effects Of Pollution

Spent lubricating oil when discharged into the soil inhibits the growth of plants by reducing height and leave formation [109, 110]. Reduced seedling length and root length have also been observed in certain plants like *Cassia Siemea* when exposed to exhaust emissions [111]. Spent oil effluents discharged indiscriminately have also terminated the growth of certain plant embryos like Cicer arietinum and Vignaradiata [112]. In *Zea Mays*, leaf formation was disrupted, stunted growth and high mortality rate was experienced when it was exposed to soils contaminated with used oil [113, 114]. In addition, there was the low yield and poor quality of grains observed during harvest for *ZeaMays* [115] and *ArachisHypogeai* [116]. In another study, Pb levels were higher than permissible limit in consumables sold around AMVs [117]. Thus indicating the possibility of bioaccumulation of heavy metals (Cd and Pb)in plants that are prevalent in Nigerian AMVs [118]. The microbial soil population have also been observedto be at risk at high concentration levels of heavy metals [119]. For e.g. when exposed to used engine oil, *Aspergillus nigervan Tiegh* mycelia growth experienced growth reduction in contrast to *Staphylococcus aureus* that found such environment as a new habitat. [120,121]. Thus the survival of microbes in AMVs polluted area can either be disturbed or enhanced by presence of certain contaminants [122]. The pollution level can sometimes cause a corresponding increase in soil organic carbon. These bring about the reduction of soil nitrate and phosphatelevel needed for biogeochemical cycle [123] which would eventual affect crop yield [124].

In humans, AMV workers are occupationally exposed to toxic metals arising from associated operations and repairs [20,125]. The major element of concern for humans is Pb. This single metal, can disrupt blood pressure, induce nephrotoxic effects, and affect the levels of Ca and P in metabolism of humans. It has also been observed to be dangerous to renal tubules and cardiovascular systems [125, 126, 127, 128, 129]. Child labours are frequently sighted in AMVs [130]. The Adult workers are often observed to be performing their duties such as lifting and carrying, pulling and pushing, twisting and turning, at different posture stance without any health and safety precautions. These activities constitute a major risk to the health and safety of the workers, because it will eventually affect their muscoskeletal balance [131]. The vehicle spray sections perform their activities in unenclosed platforms, releasing benzene and other toxic chemicals like phenol into the atmosphere [132]. Incredibly, over 150 organic compounds such as Polybrominated diphenyl ethers, ethylbenzene, styrene, toluene, formaldehyde are some of the air pollutants found in automobiles [133]. Moreover, working with brake parts can cause mesothelioma, deposition of tremolite, asbestos in the lungs and higher risk of ischemia of fingers [134, 135]. Thus AMVs activities poses greater risk of occupational health hazards.

VII. Remediation And Control

The remediation of pollution in AMVs and implementation of controls will be of both economic and environmental value to the Nigerian nation. Solidification and stabilization, flushing and Phytoextraction, vitrification and electrokinetic are some of the technologies for remediation of soil with low to moderate Cd, Zn, and Pb contamination [136, 137]. For high levels of toxic contaminants, excavation and removal, in-situ fixation and rhizofiltration, bioremediation can be applied [137, 138] for e.g. Plants like sunflower have also been used for bioremediation of contaminated soils [138]. The use of enhanced natural attenuation by periodically turning heavily polluted soil and by natural land farming practice in contaminated sites are also viable [139,140]. Thus, the genetic manipulation of biomass and metabolic pathways is a promising technology in phytoremediation [141]. Granular activated carbon is another promising approach used for polluted soils [142]. However, findings showed that soil type and contaminant characteristics play important role in determining the type of remediation that should be applied [143]. Moreover toxicological assessment of the heavy metals and use of biological

materials like surfactants are also important parameters to be determined before remediation [144, 145]. Other biological materials for remediation of contaminated soil in AMVs include the use of aerobically fixed bioreactors [146], use of earthworm as biocatalyst [147], use of poultry litter, and cow dung have all been successfully used in AMV remediation [148, 149] and restoration of nutrient depleted soil recorded. On the order hand, soil microbes like *Aspergillus niger*can be used as biosensors in environmental biomonitoring of soil polluted by heavy metal [150]. Bacteria like *pseudomonas, Corynebacterium species, bacillus sp, Pseudomonas aeruginosa, Serratia specie, and Alcaligenesfaecalis* have shown great potential for waste engine oil degradation [151, 152, 153] in contaminated soil environment. Similarly, *Aeruginosa, Micrococcus spp, Proteus mirabilis, Proteus vulgaris and Enterobacterspp* have been applied in petrol motor spirit and engine oil degradation [154]. Again microbial and fungi organisms like *Aspergillus species, Penicillium species, Moniliella species, Curvularia species and Mucor species* are known to be spent engine oil biodegraders [155, 156, 157].

The development and implementation of occupational health and safety for AMVs, awareness and implementation of personal protective equipment, and good waste disposal practices should be established and implemented [158, 159]. Subsequently technical skills and technology needed to efficiently service or repair vehicles using newer technologies should be acquired and utilized [160, 161].Such repairs and servicing should be carried out in an environmentequipment with modern workshoptools for painting, scrapping, welding, lifting and carryingetc[162]. Also, since the newer technologies used in automobiles are constantlyimproved with processors and sensors [163, 164], therefore repairs should be done by trained technicians and technologist [165, 166]. Thus in this light, setting up technical training centres and skill acquisition for technicians and technologist would be necessary to arrest ignorance and abuse [167, 168].

VIII. Findings And Recommendation

The review studyconducted had elucidated some of the problems that plague the Nigerian AMVs. The findings showed that 95% of the researched AMVs locations are located in the cities or nearby urban settlement. This however, does not exonerate the noticeable pollution activities of AMVs in the villages andlocal neighbourhoods. Few studies have been conducted on automobile pollution emitted from the cabinbut seldom on malfunctioning automobiles that are 10 years and older. Hence if performed, would elucidate associated health and environmental pollution from non-evaporativesources caused by malfunctioning automobiles. There had been the absence of studies conducted on heavy metal ingestion, absorption and digestion by AMV workers due to workplace environment. Such studies would provide more insight into the natureof heavy metal poisoning in AMV workers. Similarly, toxic atmospheric air pollutants existing within AMVs had not been reported as serious health concern by government agencies, nor had mainstream atmospheric research capture such environment. Thus,AMV localitiesmay be having poor air quality index risk due to atmospheric contamination.

Principally, the automobile industry occupies a niche in both production and consumption system [169] that flourishes with access to global technology [170]. They continue tomerge together through acquisitions, and thus share components and architecture. This leverages synergies with their partners locally and globally. Therefore, it becomes pertinent for a nation like Nigeria to provide standard repair workshops and services with global technology, implement favourable industry policies, and environmental pollution controls from automobiles [168] or risk constant environmentalpollution from vehicular sources.

To this end, it is therefore proposed that abandoned AMVs should be remediated and reclaimed to avoid further environmental degradation. Continuous assessment of pollutants around AMVs using biomonitoring and phyto-monitoring should be routinely implemented. Toxicological assessment of AMV workers exposed to pollution and contamination for data acquisition and utilization should be done regularly. The establishment of institutional training schools for technical training and promotion of technological skills acquisition and finally the implementation of anti-pollution initiative and occupational safety at work for AMV workers.

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