

Mirroring Households Adaptive Strategies of Perceived Environmental Disaster Outcomes of Artisanal Refining In Communities along Imo River Axis

Ozakpo, Ogaga Akpode¹; Afowowe, Henry Babatunde²; Kpang, MeeluBari Barinua Tsaro³

²Centre for Disaster Risk Management and Development Studies, University of Port Harcourt

^{1,3}Department of Geography and Environmental Management, University of Port Harcourt, Port Harcourt, Rivers State, Nigeria

Abstract: Artisanal refining along the Imo River, Rivers State, Nigeria, presents a plethora of environmental challenges. This study aimed at mirroring adaptive strategies employed by households to withstand the environmental problems arising from artisanal refining activities in the area. A cross-sectional research survey design was employed and a sample size of 400 obtained by using the Taro Yamane equation of sample size determination. Descriptive statistics was used in summarizing the data, and Kruskal–Wallis H tests (χ^2) was adopted to analyze the responses on environmental disaster outcomes across communities. The results showed that 75.4% of respondents were aware of artisanal refining activities in the area and the environmental impacts were significant, with weighted means (WM) for air pollution, soil contamination, and water degradation at 3.2, 3.15, and 3.12 respectively and fire risk at 3.26. Kruskal–Wallis tests confirmed no statistically significant variation across communities ($p > 0.05$) indicating uniform exposure. It was revealed that household adaptive strategies widely adopted across the communities include relocation (80%), water treatment (80%), livelihood diversification (81%), youth skills training (82%), and local security enhancement (WM = 3.17), with Kruskal–Wallis analysis showing no significant variation ($p > 0.05$). The findings highlight the systemic nature of artisanal refining impacts and adaptive behaviours. Consequently, environmental remediation, livelihood diversification, environmental education and coordinated intervention programmes were recommended for urgent implementation.

Keywords: Relocation, Households, Perception, Artisanal Refining, Adaptation Strategies

I. INTRODUCTION

Exploration and exploitation of crude oil is very profitable in the world and is observed as one of the major sources of revenue in some developing countries (Romson, 2022). Artisanal refining which is also known as Illegal crude oil refining or oil bunkering is regarded as the activities or processes that include the theft of crude oil and its local refining, using resources found locally, traditional knowledge and skills, and little or no use of modern-day technology (Douglas, 2018). This illegal petroleum refining and its associated activities do not only produce very poor-quality products, they have also led to severe environmental pollution and degradation of the ecosystem. Vegetation, soil, water (surface and sub-surface), flora and fauna, as well as the rich biodiversity and atmospheric air have all been affected by pollution. Intensification of the greenhouse effect associated with global warming and climate change, acid rain, photochemical smog, reduced atmospheric visibility, dearth of forests, ozone layer depletion, soot/heavy metal deposition, poor water quality, soil contamination, disturbance of communities/flora/fauna, and destruction of ecosystems are some of the environmental impacts of this petroleum industry operation (Ojirika, Joel & Ugbebor, 2019). The United Nations Environment Programme (UNEP), (2011) noted that the crude oil usually consists of crude oil that is boiled, and the distillates are collected, cooled, and condensed in tanks to be used locally for transportation, energy, or lighting. It further noted that the materials are often crude illegal materials, such as metal pipes and drums that are welded together. In order to extract petroleum products, petroleum (crude oil) is heated over a certain range of boiling points in a manufactured oven. The leftover residue is then released into the environment without regard for the effects on the ecosystem. In other words, large amounts of waste are dumped on land, rivers, and streams (Arimoro, 2009).

In 1995, the World Bank conducted a thorough assessment of the area and came to the following conclusions among others: that the environment was filthy and all development indicators were well below acceptable standards. The outcome of the effect on the ecosystem is so severe that the toxic components in the Niger Delta soil changed the chemical properties of the soil, and if left unchecked, it could completely destroy the ecosystems of wetland areas. It has resulted in widespread refiner deaths in this area due to unintentional

burning, soot production that pollutes the air and causes many respiratory ailments, and contamination of nearby water bodies from runoff and effluent discharges (Yebrade, & Tanee, 2016). In support of the submission of Arimoro (2009), UNEP (2011) reported that crude oil contamination has destroyed land, rivers, and streams; killed fishes, polluted groundwater and soil, and also destroyed the vegetation, particularly in oil-producing regions. Artisanal refining of stolen oil is generally observed to contribute to oil spillage in the Niger Delta region. As a result of these spills, the adverse effects are already clear as it has greater implications on the community and the environment. It is observed that oil spillage has affected immediate communities removing the sources of income from farming and fishing activities. Most of the residents are currently affected by different environmental issues, ranging from poor health conditions, inadequate housing facilities, contaminated drinking water sources, barren lands for agriculture, and dead rivers for fishing activities (David & Bobo, 2019).

The Niger Delta region of Nigeria is the crude oil and natural gas hub of Nigeria with several networks of product pipelines (both surface and subsurface) dotting the entire landscape which has created a social problem of vandalization of product pipelines and artisanal refining and the associated environmental hazards (Amangabara & Njoku, 2012). In Nigeria, over 90% of the nation's foreign exchange profits come from the exploration and exploitation of crude oil (Uma & Hajj-Ottman, 2017). Despite these huge foreign exchange profits, Romson (2022) and Ufuoma (2022) observed that approximately 250,000 barrels of crude oil are stolen daily in Nigeria with the majority sold internationally while about 25% stay in the Niger Delta for illegal oil refining and consumption. The widespread prevalence of artisanal refining has resulted in the pollution of air, water, and soil resources, posing severe risks to biodiversity and the health of local populations. The Imo River axis especially in Oyigbo, Omuma and Etche has become a hotspot for artisanal refining of crude oil, raising significant concern for the stability of communities and the broader environment. The activities of artisanal refining in riverine areas, especially around the Imo River region are greatly generating large volumes of wastes which are not improperly managed and indiscriminately released into the environment. It is against this backdrop that this study seeks to assess artisanal refining environmental disaster outcomes and adaptation strategies employed by households in communities along the Imo river in Rivers State, Nigeria.

II. MATERIALS AND METHODS

2.1 Study Area

The study area embraces Etche, Omuma and Oyigbo Local Government Areas drained by the Imo River. The area is located within latitude 6° 58'N to 7°20'N and longitude 4°48'E to 5°12'E (Figure 1). Omuma LGA occupies a total area of 170 sq. km with an estimated population of 171,832 inhabitants with majority of the dwellers being members of Etche ethnic group (Abbey & Onyebueke, 2020). The provisional boundaries of Oyigbo is about 247km². There are seventeen notable villages in Oyigbo with an estimated population of about 222,687 (NPC, 2006) and because of its energy related industries it is a popular destination for immigrants (Udogu, 2005) whereas Etche LGA occupies a total area of 805 square kilometers and an estimated population of 249,454 people. The study area lies within the Wet equatorial climate; high cloud cover and fewer sunshine hours cause damp weather conditions throughout most parts of the year. The major vegetation in the study area comprises mangrove and freshwater swamp. The mangrove forest extends from Sapele (Delta state) connecting with the freshwater swamp some few kilometers inland, which in turn gives way to the rainforest inland (Ministry of Environment, 2003). The landform was created from accumulated marine and deltaic sediment over 50 million years ago in the upper Cretaceous period (UNEP, 2011). The sediments deposited by fluvial processes centuries ago led to the formation of a relatively flat alluvium basin like natural levees and ox-bow lakes (Shittu, 2014). The deltaic plain is flat lying at about 40m above sea level towards the interior, and less than 8m above sea level on approaching the coast (Shittu, 2014). A high rainfall regime, shallow aquifer, and flat topography cause perennial inundation when rivers overflow their banks. Similarly, UNEP (2011) recently reported that there is only one aquifer serving both shallow and deeper boreholes; the shallowest water table is about 0.7m below ground level while the deepest is around 14m below ground level.

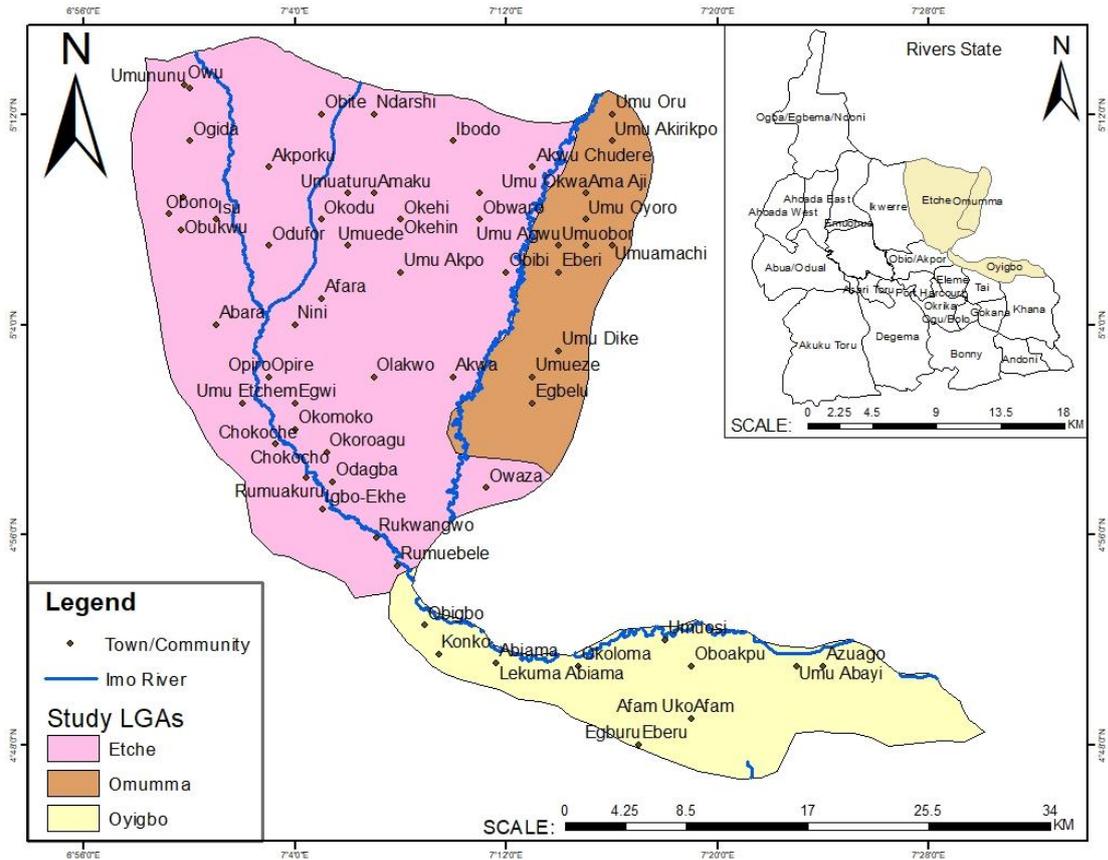


Figure 1: Study Areas: Etche, Omuma and Oyigbo LGAs

2.2 Population of the Study

Based on the eligibility criteria and various attributes of inclusion of the population, the selected communities are displayed in Table 1. The National Population Commission data of 2006 for each of the LGAs was used as the base year and projected to 2024 using an annual growth rate of 3.2%. Also, the Malthus Exponential Model was adopted to project the current population of the study areas. The formula for the Malthus Exponential Model is given thus:

$$P_t = P_o e^{r \cdot t} \dots \dots \dots (1)$$

Where P_t = Population to be projected, P_o = population of the base year; t = time, r = rate of increase (natural increase divided by 100), e = exponential factor and constant at 2.718. in order to obtain an optimum sample of the target population, the Taro Yamane (1967) formula for sample size determination was utilized;

$$n = \frac{N}{1 + N(e)^2} \dots \dots \dots (2)$$

Where: e = Level of precision (0.05),
 N = Population,
 n = Sample size,
 1 = Constant

Table 1: Projected Population of the Study

LGA's of Study	Sampled Communities	2006 Population (NPC)	Projected Population (2024)	Percentage in Projected Population	Questionnaire Proportion (Target Population)
Etche	Odagba, Igbo-Ekhe, Ogida, Elele, Rumuebele	249,936	444,886	52.5	210
Oyigbo	Obete, Okpontonu, Nkpukpu, Ekerenta, Umuagbai, Mrihu	125,331	223,089	26.4	106
Omuma	Akwu-Chudere, Obibi, Umuobor, Obwaro, Umuokwa	100,366	178,652	21.1	84

Source: National Population Commission (2006)
 Researcher's Fieldwork (2024)

2.3 Data Collection/Analyses

According to Baridam (2001) the use of descriptive statistics as statistical techniques helps to summarize our data and be able to describe such data, while Obasi (1999) asserted that such statistical technique gives researchers the ability to understand the characteristics, similarities, variation, and trends etc. of the variables studied. A simple random sampling technique was adopted in the selection of 400 respondents. Consequently, 400 copies of questionnaire were designed, validated and administered to the respondents. The retrieved copies of questionnaire were coded and subjected to statistical analysis in the excel environment of Statistical Package for the Social Sciences (SPSS). Descriptive statistics such as frequency counts, percentages and tables were used in the presentation of the results whereas the hypotheses of the study were tested using Kruskal Wallis H test at 95% level of significance.

III. Results

Table 2: Perception of environmental impacts of artisanal refining activities on communities in the study area

Environmental Impact of Artisanal Refining Activities	SA (%)	A (%)	D (%)	SD (%)	Total (%)	WM
Artisanal refining activities cause significant air pollution in the community	159 (40)	179 (45)	40 (10)	20 (5)	398 (100)	3.2
Artisanal refining activities contaminate the soil and farmland	167 (42)	159 (40)	48 (12)	24 (6)	398 (100)	3.19
Water sources in the community have been negatively impacted by artisanal refining activities	151 (38)	171 (43)	48 (12)	28 (7)	398 (100)	3.12
Biodiversity (plants and animals) in the community has been reduced due to artisanal refining	139 (35)	167 (42)	60 (15)	32 (8)	398 (100)	3.04
Artisanal refining activities increase the risk of fire outbreaks and explosions	167 (42)	183 (46)	32 (8)	16 (4)	398 (100)	3.26
The presence of artisanal refining activities discourages investment in the community	139 (35)	151 (38)	72 (18)	36 (9)	398 (100)	2.98
Artisanal refining activities have made farmlands less productive	147 (37)	167 (42)	56 (14)	28 (7)	398 (100)	3.09
The activities lead to oil spillage and environmental degradation	159 (40)	179 (45)	40 (10)	20 (5)	398 (100)	3.2
Health issues in the community are linked to artisanal refining activities	155 (39)	175 (44)	44 (11)	24 (6)	398 (100)	3.17
Artisanal refining activities contribute to long-term climate change effects in the area	127 (32)	151 (38)	80 (20)	40 (10)	398 (100)	2.9

The data in Table 2 show that majority of respondents believed that artisanal refining activities cause significant air pollution in the community. Forty percent strongly agreed and 45% agreed while only 10% disagreed and 5% strongly disagreed. This pattern highlights a strong and widely shared perception that the uncontrolled burning and processing of crude oil directly pollutes the air residents breathe. Such activities often release thick soot, volatile gases and particulates that can be observed on rooftops, plants and even on people’s skin and clothes. The weighted mean of 3.2 reinforces this consensus and points to air pollution as one of the most obvious and pressing environmental consequences of artisanal refining. Similarly, most respondents indicated that artisanal refining contaminates soil and farmland. Forty-two percent strongly agreed and 40% agreed compared to smaller proportions of disagreement. It is obvious as reflected in the people’s opinion reduced soil fertility, damaged crops, declining agricultural productivity and lack of food security are linked to contamination from oil leaks and residue from refining processes. Since many households depend on farming as their main source of livelihood, soil contamination represents not just an environmental threat but also an alarming economic threat. Water sources were also widely seen as negatively impacted upon by artisanal refining whereas 38% strongly agreed and 43% agreed, and only a small fraction disagreed. This response shows that people in the community associate changes in the color, taste and safety of their water with nearby refining activities. Polluted water poses risks for drinking, cooking and sanitation and undermines traditional fishing and aquaculture practices. The weighted mean of 3.12 indicates that this is one of the major environmental worries tied to artisanal refining. The respondents also pointed to reduction in biodiversity as a

consequence of artisanal refining activities following 35% of the people that strongly agreed and 42% agreed, while only 23% disagreed. This suggests that biodiversity loss is recognized but may be less immediately visible to some respondents compared to pollution or fire outbreaks. Nonetheless, the overall response highlights how artisanal refining disrupts the habitats of plants and animals, alters ecosystems and leads to the disappearance of species important for food, medicine and cultural practices. Another strongly held view among respondents was that artisanal refining increases the risk of fire outbreaks and explosions with 42% in strong agreement and 46% agreed, this issue scored the highest weighted mean of 3.26. This is not surprising as these refining sites are often makeshift and unregulated, with crude oil and flammable by-products handled in unsafe ways. Such conditions create an obvious and immediate danger to life and property, explaining why respondents rated this hazard so highly.

The presence of artisanal refining activities was also thought to discourage investment in the community. However, this item attracted the lowest weighted mean of 2.98. Although 35% strongly agreed and 38% agreed, there was more disagreement compared to other items. This mixed response suggests that while many see artisanal refining as a deterrent to legitimate business and property development, some may feel that these activities also bring informal economic opportunities or that investment decisions are shaped by other factors beyond environmental degradation. Respondents agreed that artisanal refining activities have made farmlands less productive, with 37 percent strongly agreeing and 42% agreeing. This reflects widespread recognition of the gradual but serious impact of hydrocarbon residues on soil fertility. Reduced productivity affects household incomes and community food supplies, creating a cycle of poverty and environmental damage. Oil spillage and environmental degradation received responses similar to air pollution, with 40% strongly agreeing and 45% agreeing. This reflects the tangible reality of oil stains on land and waterways that residents can easily observe. Spillage damages both land and aquatic ecosystems and can persist for years without remediation, reducing the land's potential for farming and other uses.

A majority also agreed that health issues in the community are linked to artisanal refining, with 39% strongly agreeing and 44% agreeing. This points to growing awareness of possible respiratory illnesses, skin diseases, cancers and other ailments arising from long-term exposure to pollution. For residents, health impacts may be one of the most personal and distressing consequences of artisanal refining activities. Finally, the contribution of artisanal refining to long-term climate change effects scored the lowest weighted mean at 2.9, with 32% strongly agreeing and 38% agreeing but 30% disagreeing. This suggests that while people understand local effects like pollution and fire risks, the link to global climate change is more abstract and less visible. Nonetheless, the responses still show that a significant proportion of residents associate these activities with larger environmental and climatic changes. Overall, the pattern across all these items is one of strong agreement that artisanal refining activities cause widespread environmental damage in the community. Air, soil and water pollution, declining farm productivity, health hazards and fire risks stand out as the most immediate and clearly perceived impacts. Even in areas of lower consensus such as investment discouragement or climate change effects, there remains a significant majority acknowledging negative consequences, underscoring the urgency of addressing artisanal refining both as an environmental and a public health issue.

Table 3. Respondents perception of the adaptive strategies adopted among households in the communities hosting artisanal refining

Adaptive Strategies Adopted Due to Artisanal Refining Activities	SA (%)	A (%)	D (%)	SD (%)	Total (%)	WM
Relocating to safer parts of the community to avoid pollution and insecurity	148 (37)	172 (43)	56 (14)	22 (6)	398 (100)	3.11
Increasing household water treatment due to contaminated water sources	155 (39)	163 (41)	54 (14)	26 (6)	398 (100)	3.12
Changing farming patterns or relocating farmland away from polluted areas	161 (40)	159 (40)	54 (14)	24 (6)	398 (100)	3.14
Using alternative sources of income to reduce dependence on artisanal refining	152 (38)	169 (43)	52 (13)	25 (6)	398 (100)	3.13
Strengthening local security or vigilante groups to protect community members	166 (42)	158 (40)	50 (13)	24 (6)	398 (100)	3.17
Participating in community sensitization or awareness campaigns on dangers of artisanal refining	160 (40)	167 (42)	49 (12)	22 (6)	398 (100)	3.16
Pressuring government and oil companies for remediation and development	153 (38)	171 (43)	50 (13)	24 (6)	398 (100)	3.13
Organizing community clean-ups to mitigate environmental damage	147 (37)	169 (43)	55 (14)	27 (7)	398 (100)	3.09
Cooperating with law enforcement to report illegal refining activities	164 (41)	160 (40)	50 (13)	24 (6)	398 (100)	3.16
Educating youths on skills acquisition to divert them from artisanal refining activities	158 (40)	167 (42)	51 (13)	22 (6)	398 (100)	3.15

The perception of adaptive strategies adopted by communities hosting artisanal activities is shown in Table 3 and the agreement levels remain high, with roughly 78 to 83% of respondents subscribing to strongly agreed or agreed options. Weighted means cluster between 3.09 and 3.17 on a 4-point scale, indicating widespread acceptance of these strategies as necessary responses to the hazards and disruptions caused by artisanal refining. Relocating to safer parts of the community is one of the most direct and visible adaptive strategies, with 80% of respondents in agreement. This reflects how residents respond to chronic pollution, insecurity and the threat of explosions or raids by moving their homes, businesses or farms farther from hotspots. Relocation is costly and disruptive (it can break up social networks, increase commuting times and strain host neighbourhoods that receive displaced households), but the high level of agreement shows it is a common risk-reduction tactic in the face of perceived danger.

Increasing household water treatment due to contaminated sources also features prominently, with 80% agreement. As artisanal refining contaminates rivers, wells and boreholes, households invest in filtration, boiling or chemical treatment to make water safer. This adaptation adds recurring costs (especially for poorer families), but it directly mitigates waterborne disease risk and protects household health. The measure highlights how environmental contamination shifts the burden of safety onto residents themselves. Changing farming patterns or relocating farmland away from polluted areas, reported by 80%, reveals how livelihoods adapt under environmental stress. Farmers may abandon plots near oil-impacted creeks or flare sites and seek land farther away, or they may switch to crops perceived as less vulnerable to contamination. This adaptation has far-reaching effects on food production, land tenure and travel costs, and it can accelerate land conflicts when farmers move into already occupied areas. Using alternative income sources to reduce dependence on artisanal refining, also embraced by 81% of respondents, reflects an effort to diversify livelihoods. Families attempt to reduce their exposure to illicit and hazardous work by engaging in petty trade, transport, craftsmanship or migration for wage work. This not only lowers their direct involvement in illegal refining but can also stabilize household incomes and reduce vulnerability to sudden crackdowns or environmental disasters.

Strengthening local security or vigilante groups, which drew the highest weighted mean of 3.17, shows that communities are taking collective steps to manage crime and violence linked to artisanal refining. When

public policing is weak or absent, vigilantes fill the gap, providing patrols, intelligence and deterrence. This is a double-edged adaptation (while it can improve safety and community cohesion, it may also entrench non-state actors and produce its own risks if not well regulated). Participation in community sensitization or awareness campaigns, reported by 82 percent, points to social learning and collective action. By sharing knowledge about the dangers of artisanal refining (health risks, environmental damage, legal consequences), communities hope to change behaviour, especially among youths. This reflects a preventive approach that addresses root causes, rather than just coping with consequences. Pressuring government and oil companies for remediation and development, with a weighted mean of 3.13, indicates households recognize the structural causes of artisanal refining and push for systemic solutions. Residents expect corporate social responsibility and state interventions (such as clean-up projects, infrastructure, jobs and alternative livelihoods). This adaptation is political in nature, seeking long-term change rather than short-term coping.

Organizing community clean-ups to mitigate environmental damage is another widely accepted response. With 80% in agreement, these collective actions help remove oil residues, trash and debris, improve drainage and restore some sense of normalcy. While they cannot fully remediate contamination, they signal community agency and may reduce immediate exposure risks. Cooperating with law enforcement to report illegal refining, also at 81% agreement, is a significant shift. Residents are not merely avoiding artisanal refining but actively aligning with formal authorities to curb it. This can be risky (it may provoke retaliation from those engaged in the trade), but it shows a growing recognition that illegal refining undermines community well-being. Finally, educating youths on skills acquisition to divert them from artisanal refining, with 82% agreement, targets the generational dimension of adaptation. By equipping young people with alternative skills and employment pathways, communities hope to break the cycle of dependence on illegal refining. This strategy looks beyond immediate coping to long-term transformation of livelihoods. The data portrays a community mobilizing on multiple fronts (physical relocation, household investments, livelihood diversification, collective security, civic action and youth education). These adaptive strategies show both resilience and a desire for systemic change. However, they also imply significant costs, trade-offs and an ongoing shift of responsibility from institutions to households and communities. Without robust external support, such self-directed adaptations may slow but not stop the underlying harm of artisanal refining activities.

Table 4: The Kruskal Wallis H test summary testing the difference in the environmental impacts of artisanal refining activities among the communities

Environmental Impact of Artisanal Refining Activities	n	Df	X²	Asymp. Sig.	Remark
Artisanal refining activities cause significant air pollution in the community	398	397	4.212	0.239	Not Significant
Artisanal refining activities contaminate the soil and farmland	398	397	3.987	0.263	Not Significant
Water sources in the community have been negatively impacted by artisanal refining activities	398	397	2.745	0.432	Not Significant
Biodiversity (plants and animals) in the community has been reduced due to artisanal refining	398	397	5.102	0.164	Not Significant
Artisanal refining activities increase the risk of fire outbreaks and explosions	398	397	4.345	0.227	Not Significant
The presence of artisanal refining activities discourages investment in the community	398	397	3.563	0.312	Not Significant
Artisanal refining activities have made farmlands less productive	398	397	2.988	0.394	Not Significant
The activities lead to oil spillage and environmental degradation	398	397	4.889	0.18	Not Significant
Health issues in the community are linked to artisanal refining activities	398	397	3.781	0.286	Not Significant
Artisanal refining activities contribute to long-term climate change effects in the area	398	397	2.556	0.465	Not Significant

The Kruskal–Wallis H test was carried out to compare how respondents from different communities perceived the environmental impacts of artisanal refining activities (Table 4). It is clear that there were no statistically significant differences between communities, indicating a high level of consensus in people’s experiences and perceptions. For air pollution, which is often the most immediate and visible effect of artisanal refining, the test showed no significant differences across communities, $\chi^2 (397) = 4.21, p = .239$. Respondents across the study area similarly agreed that soil and farmland are contaminated by artisanal refining, $\chi^2 (397) = 3.99, p = .263$, and that local water sources are negatively affected, $\chi^2 (397) = 2.75, p = .432$. The finding for biodiversity was consistent with this pattern. Regardless of location, respondents reported that plants and animals have been reduced due to refining activities, $\chi^2 (397) = 5.10, p = .164$. Fire outbreaks and explosions are another common fear in areas with artisanal refining. However, the Kruskal–Wallis test showed no significant differences between communities in perceiving this risk, $\chi^2 (397) = 4.35, p = .227$. Likewise, residents across the study area agreed that the presence of refining activities discourages investment, $\chi^2 (397) = 3.56, p = .312$, and makes farmlands less productive, $\chi^2 (397) = 2.99, p = .394$. The perception of oil spillage and environmental degradation followed the same pattern, $\chi^2 (397) = 4.89, p = .180$. Health issues linked to artisanal refining were also broadly shared concerns, with no significant differences in perception across the sampled communities, $\chi^2 (397) = 3.78, p = .286$. Finally, respondents consistently reported that artisanal refining contributes to longer-term climate change effects in the area, $\chi^2 (397) = 2.56, p = .465$. These findings show a striking uniformity. The lack of significant differences suggests that the environmental and health problems caused by artisanal refining are not isolated to a few locations but are widely experienced across the entire study area. This pattern reflects how pervasive the impacts of artisanal refining have become: air, water, soil, biodiversity, economic investment, farmland productivity, and human health are all being affected in ways that people in different communities can readily see and feel. In practical terms, it means any policy or intervention aimed at mitigating the environmental impacts of artisanal refining must be broad and community-wide rather than targeted at only one location. The results underscore the urgency of developing coordinated environmental management and public health responses that address the shared reality across all affected communities.

Table 5. The Kruskal Wallis H test summary for variation in the adaptive strategies adopted across the study area

Adaptive Strategies Adopted Due to Artisanal Refining Activities	N	Df	X²	Asymp. Sig.	Remark
Relocating to safer parts of the community to avoid pollution and insecurity	398	397	4.016	0.259	Not Significant
Increasing household water treatment due to contaminated water sources	398	397	3.765	0.289	Not Significant
Changing farming patterns or relocating farmland away from polluted areas	398	397	4.283	0.233	Not Significant
Using alternative sources of income to reduce dependence on artisanal refining	398	397	3.658	0.301	Not Significant
Strengthening local security or vigilante groups to protect community members	398	397	4.472	0.215	Not Significant
Participating in community sensitization or awareness campaigns on dangers of artisanal refining	398	397	3.982	0.264	Not Significant
Pressuring government and oil companies for remediation and development	398	397	4.221	0.24	Not Significant
Organizing community clean-ups to mitigate environmental damage	398	397	3.547	0.316	Not Significant
Cooperating with law enforcement to report illegal refining activities	398	397	4.362	0.226	Not Significant
Educating youths on skills acquisition to divert them from artisanal refining activities	398	397	3.789	0.286	Not Significant

A Kruskal–Wallis H test was conducted to determine whether there were significant differences in the adaptive strategies adopted by households across the communities affected by artisanal refining activities. The results of the test, as shown in Table 5, indicate that there were no statistically significant differences in the adaptive strategies examined (all $p > .05$).

Specifically, relocating to safer parts of the community ($H = 4.02, p = .259$), increasing household water treatment ($H = 3.77, p = .289$), and changing farming patterns or relocating farmland ($H = 4.28, p = .233$) all showed no significant variation between communities. Similarly, using alternative sources of income ($H = 3.66,$

$p = .301$) and strengthening local security or vigilante groups ($H = 4.47, p = .215$) were consistently reported strategies without statistically significant differences. Participation in community sensitization or awareness campaigns ($H = 3.98, p = .264$), pressuring government and oil companies for remediation and development ($H = 4.22, p = .240$), and organizing community clean-ups to mitigate environmental damage ($H = 3.55, p = .316$) also reflected a uniform pattern across communities. In the same vein, cooperating with law enforcement to report illegal refining activities ($H = 4.36, p = .226$) and educating youths on skills acquisition to divert them from artisanal refining ($H = 3.79, p = .286$) did not differ significantly across the study area. The Kruskal–Wallis analysis suggests that respondents from the various communities are largely adopting similar adaptive measures in response to artisanal refining activities. This consistency implies that the environmental and socioeconomic pressures produced by artisanal refining may be shaping comparable coping strategies across different local contexts, rather than leading to community-specific adaptations.

IV. Discussion of Results

4.1. Environmental impacts of artisanal refining activities on communities in the study area

The findings from Table 2 reveal a strong and widespread perception among residents that artisanal refining activities cause significant environmental damage. The high proportion of respondents who strongly agreed or agreed that artisanal refining contributes to air pollution (85% combined, weighted mean 3.2) indicates that air quality deterioration is one of the most obvious and pressing local issues. This aligns with the work of UNEP (2011), which documented pervasive soot and volatile organic compound emissions from artisanal oil refining in the Niger Delta. Similarly, Obahopo and Nwachukwu (2023) reported that communities living near unregulated oil processing plants in southern Nigeria experience chronic exposure to airborne pollutants, resulting in respiratory illnesses and visible environmental degradation. These findings reinforce the view that the impacts of artisanal refining are not only observable but deeply embedded in everyday life, including soot on rooftops, plants, and clothing. Soil and farmland contamination were also a key concern, with 82% of respondents agreeing or strongly agreeing. This mirrors earlier research showing that hydrocarbons from spills and refining residues degrade soil quality and reduce crop productivity (Nriagu *et al.*, 2016; Agbalajobi & Oladele, 2022). In communities where agriculture is a major livelihood, such contamination translates into declining food security and income loss. The respondents' recognition of this link underscores the economic as well as environmental dimension of artisanal refining.

Water pollution emerged as another critical issue, with 81% of respondents perceiving their water sources to be negatively impacted. This finding resonates with UNEP's (2011) report on the Ogoniland region, which documented benzene levels in groundwater far exceeding WHO standards in areas near artisanal refining. Such contamination undermines domestic water use and threatens aquaculture, an important source of protein and income. By acknowledging these risks, respondents highlight the everyday struggles tied to accessing safe drinking water and maintaining traditional livelihoods like fishing. Biodiversity loss, though slightly less strongly perceived, still showed a majority agreement (77% combined). This echoes findings by Eze and Ezenwaka (2021), who showed that oil pollution alters local ecosystems, disrupts food chains, and leads to the disappearance of medicinal plants and animal species. Although biodiversity loss is less visible than pollution or fire outbreaks, it is nonetheless an indicator of long-term ecological damage with cultural and livelihood implications. Concerns about fire outbreaks and explosions scored the highest weighted mean (3.26). This is unsurprising given that artisanal refining sites are typically unregulated and hazardous, with crude oil stored and processed in makeshift facilities. Similar fears have been documented by Okoro *et al.* (2020), who found that fire hazards in artisanal refining hubs not only destroy property but also exacerbate health crises, displacing entire communities when accidents occur. This perception underscores how respondents view artisanal refining as an immediate threat to life and safety, not just a distant environmental risk.

Perceptions of reduced investment, although still notable, received the lowest weighted mean (2.98). This mixed response suggests that some residents may see informal economic opportunities arising from artisanal refining despite its environmental downsides. However, scholars such as Obi and Rustad (2019) argue that the presence of illicit oil activities generally discourages legitimate investment and erodes long-term economic development. This divergence between perceived and documented effects highlights the complexity of community attitudes toward artisanal refining.

Respondents also linked artisanal refining to decreased farmland productivity, oil spillage, and increased health problems. These patterns reinforce literature documenting the cumulative environmental and health impacts of oil industry activities in the Niger Delta (Nriagu *et al.*, 2016; UNEP, 2011). The acknowledgment of health effects in particular (weighted mean above 3.0) underscores growing awareness of respiratory illnesses, skin conditions, and even cancers linked to hydrocarbon exposure (Orisakwe *et al.*, 2021). While the connection to long-term climate change scored lowest (weighted mean 2.9), this may reflect the abstract and global nature of climate change compared to immediate and visible local effects such as soot or contaminated water. The

Kruskal–Wallis test results (Table 4) showed no statistically significant differences between communities for all ten indicators, from air pollution to climate change perceptions. This uniformity suggests that environmental and health impacts from artisanal refining are pervasive rather than localized. Similar findings were reported by Agbalajobi and Oladele (2022), who found consistent environmental degradation patterns across multiple oil-producing communities in the Niger Delta. The lack of variation here strengthens the argument that artisanal refining is a region-wide challenge requiring coordinated interventions. It also reflects the interconnectedness of ecosystems, where pollutants travel through air and water systems to affect communities far beyond the refining sites themselves (UNEP, 2011). The data show that residents perceive artisanal refining as a major threat to environmental quality, economic stability, and public health. This consensus is consistent with a growing body of research documenting the environmental crisis associated with unregulated oil processing in Nigeria. Policy responses, therefore, should be designed as broad, community-wide interventions rather than isolated clean-up efforts. This could include stricter enforcement of environmental regulations, provision of alternative livelihoods, community-led monitoring of pollution, and remediation of contaminated sites, echoing recommendations by UNEP (2011) and Nriagu *et al.* (2016).

4.2. The adaptive strategies adopted among the households in the communities hosting artisanal refining

The data in Table 3 indicates that households in communities hosting artisanal refining activities are not passive victims but actively adopt a range of coping and adaptive strategies as reflected in the opinion of 78–83% of respondents. This reflects widespread acceptance of these strategies as necessary responses to the hazards and disruptions caused by artisanal refining (Oriji, Agwanwo, & Eze, 2025; Suku, Ugwoha, & Orikpete, 2023). Relocation to safer parts of the community is one of the most direct adaptive strategies, with 80% agreement. This action responds to chronic pollution, insecurity, and the threat of explosions, illustrating that residents actively seek risk reduction despite associated costs such as social network disruption, longer commutes, and pressure on host neighbourhoods (Ebe, Perri, & Ohaka, 2025). Increased household water treatment, also agreed upon by 80 percent of respondents, reflects an adaptation to contamination of rivers, wells, and boreholes. Households invest in filtration, boiling, or chemical treatment to reduce health risks, placing the burden of environmental safety on the residents themselves (Elisha & Ipregha, 2022; Suku *et al.*, 2023). Also, changes in farming patterns, including relocating farmland away from polluted areas, also receive 80% agreement. This adaptation mitigates exposure to environmental hazards but can increase travel costs, disrupt traditional land-use patterns, and exacerbate land tenure conflicts (Oriji *et al.*, 2025). Similarly, adopting alternative income sources, agreed by 81% of respondents, highlights efforts to reduce dependence on artisanal refining. Diversification through petty trade, transport, craftsmanship, or wage labour reduces direct involvement in illicit activities and enhances household resilience to sudden shocks (Ayodele, 2025; Oriji *et al.*, 2025). Strengthening local security or vigilante groups, with the highest weighted mean of 3.17, reflects collective action to manage crime and violence associated with artisanal refining. While such efforts can improve community safety and cohesion, they may also entrench non-state actors and produce unintended risks if unregulated (Ebe *et al.*, 2025; Elisha & Ipregha, 2022). Participation in community sensitization campaigns, reported by 82%, represents social learning and collective action aimed at preventing harm, particularly among youths. This preventive approach seeks to influence behaviour rather than simply cope with consequences (Suku *et al.*, 2023). Pressuring government and oil companies for remediation and development, with a weighted mean of 3.13, demonstrates awareness of structural causes and a push for systemic solutions. Residents expect state interventions and corporate social responsibility measures such as clean-up projects, infrastructure development, and alternative livelihoods (Ayodele, 2025; Oriji *et al.*, 2025). Community clean-up, agreed by 80%, is further evidence of local agencies in mitigating environmental damage, although their capacity to fully remediate contamination is limited (Ebe *et al.*, 2025). Cooperation with law enforcement to report illegal refining, agreed by 81%, signals alignment with formal authorities, despite the risk of retaliation from those involved in illegal activities (Elisha & Ipregha, 2022). Finally, educating youths on skills acquisition to divert them from artisanal refining, agreed by 82%, addresses generational vulnerability by promoting alternative livelihoods and reducing the intergenerational perpetuation of risky practices (Ayodele, 2025; Suku *et al.*, 2023). Overall, these findings show households mobilizing across multiple fronts such as relocation, household investments, livelihood diversification, collective security, civic engagement, and youth education. While these strategies demonstrate resilience and agency, they also impose costs, indicate trade-offs, and shift responsibility from institutions to communities. Without strong external support, these adaptations may slow but not fully prevent the economic and social harms of artisanal refining (Oriji *et al.*, 2025; Ebe *et al.*, 2025).

4.3. The variation in the adaptive strategies adopted across the study area

The results of the Kruskal–Wallis H test, as presented in Table 5, indicate that there were no statistically significant differences in the adoption of adaptive strategies across communities affected by artisanal refining activities, with all p-values exceeding .05. Specifically, strategies such as relocating to safer parts of the

community (H = 4.02, p = .259), increasing household water treatment (H = 3.77, p = .289), and changing farming patterns or relocating farmland (H = 4.28, p = .233) did not differ significantly among the communities. Similarly, the use of alternative sources of income (H = 3.66, p = .301) and strengthening local security or vigilante groups (H = 4.47, p = .215) were consistently reported strategies across the study area. Other adaptive measures, including participation in community sensitization campaigns (H = 3.98, p = .264), pressuring government and oil companies for remediation and development (H = 4.22, p = .240), organizing community clean-ups (H = 3.55, p = .316), cooperating with law enforcement (H = 4.36, p = .226), and educating youths on skills acquisition (H = 3.79, p = .286) also showed no significant variation across communities. These findings suggest a uniform adoption of coping mechanisms among households, reflecting a shared response to the hazards, disruptions, and socioeconomic pressures associated with artisanal refining (Oriji, Agwanwo, & Eze, 2025; Suku, Ugwoha, & Orikpete, 2023). The consistency observed in these adaptive strategies aligns with the notion that communities facing similar environmental stressors tend to converge on comparable coping mechanisms, regardless of local contextual differences (Ebe, Perri, & Ohaka, 2025; Elisha & Ipregha, 2022). Households appear to prioritize strategies that reduce immediate risk, safeguard health, maintain livelihoods, and engage collective action, suggesting that the pressures created by artisanal refining such as contamination, insecurity, and economic disruption produce common patterns of adaptation across affected areas. This uniformity in coping responses underscores the importance of designing intervention programmes that address shared challenges and support community-wide resilience rather than focusing exclusively on site-specific measures (Ayodele, 2025; Oriji *et al.*, 2025).

V. Conclusion and Recommendations

The study revealed overwhelmingly from respondents' views that artisanal refining generates severe environmental degradation, particularly air, soil, and water pollution, alongside declining farmland productivity and biodiversity loss. Fire outbreaks and explosions were perceived as immediate hazards, while the deterrent effect on investment was less uniformly acknowledged. Health implications, including respiratory and skin diseases, were widely recognized, though long-term climate effects were less apparent to residents. Also, no significant differences in perceptions across communities, suggested a shared and pervasive experience of environmental impacts. The pervasive environmental degradation caused by artisanal refining, encompassing air, water, and soil pollution, biodiversity loss, and health risks, is consistently recognized across communities. These impacts demonstrate the urgent need for coordinated environmental management and public health interventions that mitigate immediate hazards while addressing long-term ecological consequences. Based on the findings of the study, the recommendations proposed include: strict enforcement of regulations, remediation through clean-up programmes, environmental education campaigns, community policing and youth empowerment through vocational training for vulnerable youth.

References

- [1] Agbalajobi, T. D., & Oladele, O. I. (2022). Environmental degradation and livelihoods in oil-producing communities in Nigeria. *International Journal of Environmental Studies*, 79(4), 621-638.
- [2] Amangabara, G. (2012). Assessing Groundwater Vulnerability to the Activities of Artisanal Refining in Bolo and Environs, Ogu/Bolo Local Government Area of Rivers State; Nigeria. *British Journal of Environment and Climate Change*, 2(1), 28-36.
- [3] Arimoro FO. (2009). Impact of rubber effluent discharges on the water quality and macro invertebrate community assemblages in a forest stream in the Niger Delta. *Chemosphere*. 77. 440-449
- [4] Ayodele, A. (2025). The framing of the informal oil economy in Nigeria: Toward epistemic justice of the illegal artisanal oil refineries in the Niger Delta. *Nature*.
- [5] Douglas, S. I. (2018). Effect of Illegally Refined Crude oil ("kpo- fire") Residue on Soil Fungi. *International Journal of Current Microbiological Applied Science* 7(12): 3309-3316.
- [6] Ebe, G. U., Perri, T. O., and Ohaka, B. U. (2025). Residents' perceptions on artisanal refining of crude oil and its impact on air quality in rural communities in Rivers State, Nigeria. *International Journal of Research and Innovation in Social Science*, 9(2), 3625-3638.
- [7] Elisha, O. D., & Ipregha, E. G. (2022). Community-based intervention in the control of artisanal refining against the environment in Niger Delta region, Nigeria. *Asian Journal of Current Research*, 7(3), 21-33.
- [8] Eze, C. U., & Ezenwaka, C. J. (2021). Oil pollution and biodiversity loss in the Niger Delta. *Environmental Monitoring and Assessment*, 193(2), 93.
- [9] Obahopo, J., & Nwachukwu, C. (2023). Community health outcomes near artisanal oil refining sites in southern Nigeria. *African Journal of Environmental Science and Technology*, 17(5), 145-158.
- [10] Obi, C. I., & Rustad, S. A. (2019). Oil and insurgency in the Niger Delta: Managing the complex politics of petro-violence. Zed Books.

- [11] Ojirika, E. C., Joel, O. F., and Ugbebor, N. J. (2019). Evaluation of Quality of Automotive Gas Oil Produced By Artisanal Petroleum Refineries in Rivers State, Niger Delta. In *SPE Nigeria Annual International Conference and Exhibition*.
- [12] Okoro, C. E., Udoh, F. T., & Nnadi, J. I. (2020). Fire hazards in artisanal oil refining: An assessment of risks and safety practices. *Journal of Environmental Management*, 259,
- [13] Oriji, C. C., Agwanwo, D. E., & Eze, E. C. (2025). Artisanal crude oil refineries: Indulgence, effects, and coping strategies in Ikwerre Local Government Area of Rivers State, Nigeria. *International Journal of Sociology and Management Studies*, 10(2), 100–112.
- [14] Orisakwe, O. E., Akumj, G. B., & Ogbodo, M. E. (2021). Exposure to crude oil and its health impacts on Niger Delta communities. *Environmental Science and Pollution Research*, 28(17), 21540–21552.
- [15] Romsom, E. (2022). Global oil theft: impact and policy responses. WIDER Working Paper. UNU-WIDER. United Nations University World Institute for Development Economics Research 47pp /16 <https://doi.org/10.35188/UNU-WIDER/2022/147-1>
- [16] Suku, P. G., Ugwoha, E., & Orikipte, O. F. (2024). Artisanal crude oil refining in the Niger Delta: Environmental impacts, health outcomes, and strategies for sustainable mitigation. *Journal of Earth and Environmental Science Research* 6(5), 2-9.
- [17] Ufuoma, V. (2022). NNPC calls for special court to prosecute oil theft, laments loss of \$1.5bn to vandals. International Centre for Investigative Reporting (ICIR), 8/04/2022. Available at: [www.icir.org/nnpc-calls-for-special-court-to-prosecute-oil-theft-laments-loss-of-\\$1.5bnto-vandals/](http://www.icir.org/nnpc-calls-for-special-court-to-prosecute-oil-theft-laments-loss-of-$1.5bnto-vandals/)
- [18] Umar, A.T., and Hajj-Ottman, M.S. (2017). Causes and Consequences of Crude Oil Pipeline Vandalism in the Niger Delta Region of Nigeria. A Confirmatory Factor Analysis Approach. *Cogent Economics and Finance*, 5, 1 – 23.
- [19] UNEP. (United Nations Environment Programme) (2011): Environmental assessment of Ogoniland. Nairobi, Kenya: https://postconflict.unep.ch/publications/OEA/UNEP_OEA.pdf
- [20] Nriagu, J., Udofia, E. A., Ekong, I., and Ebuk, G. (2016). Health Risks Associated with Oil Pollution in the Niger Delta, Nigeria. *International Journal of Environmental Research and Public Health*, Vol. 13, 346.
- [21] *Yebrade, M, Tanee, F. B. G. (2016). Assessing the impact of Artisanal Refining on Vegetation and Soil Quality: A case study of Warri Southwest Salt Wetland of Delta State, Nigeria. Research Journal of Environment Toxic. 10(4): 205-212*