Valuation of Non-Marketable Goods Damaged by Artisanal Crude Oil Refining in the Niger Delta

Onyije I.R; Akujuru V.A; Ekenta C.E.
Department of Estate Management, Faculty of Environmental Sciences,
Rivers State University, Nkpolu, Oroworukwo, Port Harcourt,
Rivers State, Nigeria

Abstract
The article fills this critical gap in knowledge of the entire cost of artisanal refining of crude oil in the Niger Delta as it undertakes an economic valuation of the non-marketable products that it harms. The main aims were to determine the key impacted environmental goods which included clean air, water and the mangrove ecosystems and to measure the economic and socio-health consequences. Using a mixed- method strategy the study involved the use of quantitative data collected through a Contingent Valuation Method (CVM) survey of 400 households with a survey of a sample size of 400 household members alongside qualitative data through focus group discussions and key informant interviews in Rivers and Bayelsa State affected communities. The results show that the environmental degradation is almost universal, as more than 95 percent of surveyed participants reported the presence of water contamination and poor quality of air. The study estimated a Willingness to Pay (WTP) of 5200 Naira per household per month on environmental remediation which was economically significant and its estimation was greatly affected by income, education and
 perceived health effects on the people. The health problems that were directly related to the degradation encompassed respiratory illnesses (75% prevalence) and skin diseases (68%) and loss of traditional livelihoods. The paper only arrives at the conclusion that the actual cost of artisanal refining is underestimated in the market. One of the recommendations is the creation of special

environmental fund with the informed consent of this valuation to fund remediation and sustainable alternative livelihood programs. In this study, the author presents a solid economic rationale to support the policy makers to incorporate the value of non-marketable goods in management and decision-making concerning the environment in the Niger Delta.

Keywords: Non-marketablegoods,Damages, Artisanal Crude Oil refinery, Niger Delta, Contingent Valuation Method, Willingness to Pay.

1.0 Introduction
The Niger Delta region of Nigeria is a major wetland and biodiversity hot spot in the world that has been the seat of multinational oil companies in Nigeria. This has posed a significant cost on the environment and socio-economic front, a price of both mass, formal petroleum activities as well as, more recently, illegal, small-scale ones. This paper dwells on artisanal crude oil refining, the former, which is also an extensive and highly destructive activity that has increased in recent decades (Igbani et al., 2021). The informal refineries, which is frequently sited deep in the jungle of the mangroves and coastal swamps, have not been subjected to any environmental protection and thus, direct and drastic pollution of air, water and land. The basic problem that will be discussed in the paper will be the value of

the environmental damages caused by these

activities which is usually ignored and is not quantifiable. The issue here is that most of the goods and services that are ruined e.g. clean air, fresh water, biodiversity and ecosystem stability are non marketable goods. They are not purchased and sold in a normal market and hence they lack market price.

This economic invisibility creates a systematic underestimation of them in their policy agendas and decisions. Consequently, the true cost of the artisanal refining, which can be viewed as the negative externality that the refining practice has on the society, is underestimated, which contributes to ineffective mitigation policies and further environmental deterioration and human misery (Aghomi and Berezi, 2023).

The study aims at providing answers to some key questions. What constitutes the most non-marketable goods and services that artisanal refining has the greatest impact on? What is the economic cost of the damages caused to these goods? What are the social and health impacts of this destruction to the environment? Lastly, how can a holistic assessment of these damages can be used to make better policy choices and environmental management of the Niger Delta? In response to these questions, this research will contribute a considerable gap in existing literature and give a solid economic argument on the necessity to intercede with urgent policies.

The major goals of this study are holistic. The former aims to see what and in what way the specific non- marketable goods and services are being degraded or destroyed. The second is to use relevant methods of economic valuation in estimating the monetary cost of the damages. The third goal will be to examine the overall social, health and livelihood effects hence relating the environmental loss to the human life.

The last goal is to apply the results to recommend practical and evidence-based policy suggestions that promote sustainable development and environmental justice in the Niger Delta. This research paper will be more limited to the localities within the coastal regions of Rivers and Bayelsa States which are considered to be hot spots in terms of artisanal refining practices. The research focuses on the valuation of damages to air, fresh, brackish water, and mangrove systems.

2.0 Literature Review
2.1 The Phenomenon of Non-Marketable Goods and Externalities.

Non-marketable goods and services are an area of focus of environmental economics and the definition of the value of natural resources, which do not have a direct price in a market (Ajibola et al., 2022). Such goods are termed a public goods, which are non-excludible, non-rivalrous, i.e. the consumption of these goods by one individual does not reduce the other individual in any way and it is hard to stop an individual who requires to obtain these goods. Good examples of such goods include the clean air, water, scenic beauty, and pristine mangrove swamps of the Niger Delta and the numerous aquatic life. A typical example of a negative externality, in which the costs of the activity (in this instance, pollution and damage to the ecosystem) are imposed on society as a whole, not on the producers or consumers of the refined products that are the results of illegal refining is artisanal crude oil refining (Suku et al., 2024). The destruction of these goods that are not traded in markets leads to actual losses to human welfare. As an example, when rivers and creeks are contaminated with crude oil and refining byproducts, it kills fish stocks, which serve as the major source of protein and the income of the local populations (Babatunde,2024)

The burning of the hydrocarbons continuously emits toxic substances such as sulfur oxides (SO2) and nitrogen oxides (NO2) into the atmosphere, which causes acid rain and results to serious respiratory diseases (Enakpoho et al., 2020). Although such environmental costs and health costs are not included in a market price, they impose a huge economic cost to the impacted communities and the entire country.

2.2 Theoretical Frameworks and Non-Market Valuation Techniques

The valuation of non-market goods is rooted in the principles of **welfare economics**, which seeks to measure and compare the well-being of individuals and society. The central idea is that the value of an environmental good is derived from its contribution to human utility or well-being. Since markets fail to provide prices for these goods, economists have developed a range of non-market valuation techniques.

These methods are broadly categorized into **stated preference methods** and **revealed preference methods** (Loomis et al., 2000)

Stated preference methods, such as the **Contingent Valuation Method (CVM)** and **Choice Modeling**, rely on hypothetical scenarios to deduce an individual's value for a good. CVM, for example, uses surveys to ask people what they would be willing to pay (WTP) for an improvement in environmental quality or what they would be willing to accept (WTA) as compensation for a decline in that quality (Ezebilo, 2013). This approach is particularly useful for valuing passive-use values, such as existence value and bequest value, which are not captured by other methods. Revealed preference methods, on the other hand, infer values from people's observed behavior in related markets. The **Hedonic Pricing Method** is a common example, which estimates the value of an environmental amenity (e.g., clean air)

by analyzing its effect on the price of a related marketed good (e.g., housing prices) (Ajibola et al., 2022). Another method, the **Travel Cost Method**, infers the value of a recreational site from the amount of money and time people spend to travel to it.

2.3 The Niger Delta Context: Review of Existing Research

The Niger Delta has been the subject of extensive research, yet a vital gap exists concerning the valuation of damages from artisanal crude oil refining. Much of the existing literature on environmental pollution in the region concentrate in bulk oil spills from multinational oil companies. For instance, a seminar report by the United Nations Environment Programme (UNEP) in 2011 documented the catastrophic oil pollution in Ogoniland, highlighting the intense environmental and health effects. Other studies have attempted to quantify the economic implications of oil spills, often using a **Natural Resources Damage Assessment (NRDA)** framework, which focuses on the cost of restoration and the lost use of natural resources (Nwokedi et al., 2017).

While this body of work provides a foundation, it does not adequately address the unique challenges of artisanal refining. Unlike large-scale spills, artisanal refining involves multiple, smaller-scale spills and chronic pollution events from constant activity (Igbani et al., 2021). The cumulative impact is enormous, but the individual events are often too small to be comprehensively studied or legally challenged. Furthermore, previous valuation studies in Nigeria have often centred on various environmental

issues, such as waste management or urban tree conservation, providing useful methodological precedents but not direct empirical data for the specific context of artisanal refining (Arabomen et al., 2016). Therefore,

this research represents a crucial effort to extend the application of non-market valuation techniques to a specific, under-researched, and highly damaging phenomenon in the Niger Delta.

The table below provides a summary of select studies on environmental damage valuation in the Niger Delta, highlighting the focus, methodology, and key findings.

Table 1: Selected Studies on Environmental Damage in the Niger Delta
Source: Compiled from a review of academic literature on the subject.

The table provided above depicts the disjointed characteristics of research in this field. Although the health effects are reported and the financial costs of massive spills are occasionally approximated, there is an evident lack of a holistic economic

Study (Year)	Focus	Methodology	Key Findings
Ite & Ibok (2018)	Oil spill health impacts	Literature	Highincidence of ailments, skin lesions, and cancer linked to oil pollution.
Nwokedi et al. (2017)	Economic implications of marine oil spills	Natural (NRDA) model	Quantified economic loss per spill incident, highlighting the financial burden.
Aghomi & Berezi (2023)	Environmental impact of illegal refining	Literature	Identified mangrove forests and biodiversity.
Ezebilo (2013)	Willingness to pay for waste management in Nigeria	Contingent Valuation Method (CVM)	Demonstrated the applicability of CVM in a Nigerian context, with a measurable willingness to pay for environmental services.
Enakpoho et al. (2020)	Air pollutants	Air monitoring, quantitative analysis	Showed that emissions of CO, NOx, and SO2 from artisanal refineries exceeded regulatory limits.

pricing of the non-marketable commodities harmed by the accumulative effects of artisanal refining. This study sets out to fill this gap with the introduction of

all these strands of inquiry into one single framework

The study site falls in the coastal and mangrove dominated regions in Rivers and Bayelsa States, in communities where the artisanal refining activities are high. The study involves the population comprising of the residents of these communities such as women, youth, elder members, and leaders of these communities and also those directly impacted by the refining processes in artisanal refining as well as those affected by the economic activities of these refineries such as fishermen and f

Primary data was obtained by use oructured surveys, key informant interviews and focus group discussions. The most important tool of the quantitative analysis, especially of the Contingent

Valuation Method (CVM), is survey instrument. The survey had sections on socio-demographic data, perceived environmental quality, health status and a hypothetical market situation. In this case, the respondents have an option to pay a fixed portion of money (the "bid") to a fund to help clean up the environment, or to tolerate the existing state of pollution. The prices of the bids are diverse to attract varying WTP values. The survey is also designed to be carefully controlled to prevent hypothetical bias, occurring because the scenario is brought as true as possible, which is referred to as cheap talk (Fonta et al., 2008).

The survey data is supplemented with qualitative data that comes in the form of in-depth interviews and focus group discussions. These qualitative approaches investigate the lived experiences of the community members, how they view the damages, how they miss cultural heritage and the social processes that perpetuate artisanal refining. The qualitative data can The survey respondents were identified in the study communities through a stratified random sampling method. This guarantee that the various demographical groups like fishermen, farmers and women are well represented as part of the sample. To interview the key informants, purposive sampling was applied to identify the main informants, including the community leaders, environmental activists in the area, and health workers because they possess specific information about the issue. To make the findings of the study representative of the target population, an appropriate statistical formula was used to guarantee the sample size.

Data analysis entails qualitative and quantitative analysis. Thematic analysis was used to analyze qualitative data since the transcripts of the interviews can be looked through and themes and patterns of the environmental, health and social impacts can be identified. In the case of the quantitative data, the descriptive statistics was applied to highlight the socio-economic features of the respondents and the frequency of various kinds of damages. The CVM data was subjected to binary logistic regression analysis to develop a model of the connection between the WTP of a respondent and their socio-economic factors, including income, level of education, and health status (Ezebilo, 2013). This regression model assists in determining various factors that determine

be very contextual and it assists in validating and interpreting the quantitative data. Secondary data was gathered and obtained through a wide variety of sources such as national government reports including those of the National Oil Spill Detection and Response Agency (NOSDRA), magazine articles and news and reports by non-governmental organizations such as United Nations Environment Programme (UNEP).

the valuation of environmental quality of an individual.

3.0 Methodology

This study, adopted a mixed-methods research strategy which entail both quantitative and qualitative data collection and analysis to give a comprehensive perspective of the issue. Such method is explained by the complexity of research questions which presuppose not only numeric estimation but also profound knowledge of socio-economic environment. The research is cross-sectional, as the collected information is obtained at one moment of time to examine the present situation of environmental destruction and its effects.

The study site falls in the coastal and mangrove dominated regions in Rivers and Bayelsa States, in communities where the artisanal refining activities are high. The study involves the population comprising of the residents of these communities such as women, youth, elder members, and leaders of these communities and also those directly impacted by the refining processes in artisanal refining as well as those affected by the economic activities of these refineries such as fishermen and farmers.

The study site falls in the coastal and mangrove dominated regions in Rivers and Bayelsa States, in communities where the artisanal refining activities are high.

The study involves the population comprising of the residents of these communities such as women, youth, elder members, and leaders of these communities and also those directly impacted by the refining processes in artisanal refining as well as those affected by the economic activities of these refineries such as fishermen and farmers.

Primary data was obtained by use of structured surveys, key informant interviews and focus group discussions. The most important tool of the quantitative analysis, especially of the Contingent Valuation Method (CVM), is survey instrument. The survey had sections on socio-demographic data, perceived environmental quality, health status and a hypothetical market situation. In this case, the respondents have an option to pay a fixed portion of money (the "bid") to a fund to help clean up the environment, or to tolerate the existing state of pollution. The prices of the bids are diverse to attract varying WTP values. The survey is also designed to be carefully controlled to prevent hypothetical bias, occurring because the scenario is brought as true as possible, which is referred to as cheap talk (Fonta et al., 2008).

The survey data is supplemented with qualitative data that comes in the form of in-depth interviews and focus group discussions. These qualitative approaches investigate the lived experiences of the community members, how they view the damages, how they miss cultural heritage and the social processes that perpetuate artisanal refining. The qualitative data can be very contextual and it assists in validating and interpreting the quantitative data. Secondary data was gathered and obtained through a wide variety of sources such as national government reports including those of the National Oil Spill Detection and Response Agency (NOSDRA), magazine articles and news and reports by non-governmental organizations such as United Nations Environment Programme (UNEP).

The survey respondents were identified in the study communities through a stratified random sampling method. This guarantee that the various demographical groups like fishermen, farmers and women are well represented as part of the sample. To interview the key informants, purposive sampling was applied to identify the main informants, including the community leaders, environmental activists in the area, and health workers because they possess specific information about the issue. To make the findings of the study representative of the target population, an appropriate statistical formula was used to guarantee the sample size.

Data analysis entails qualitative and quantitative analysis. Thematic analysis was used to analyze qualitative data since the transcripts of the interviews can be looked through and themes and patterns of the environmental, health and social impacts can be identified. In the case of the quantitative data, the descriptive statistics was applied to highlight the socio-economic features of the respondents and the frequency of various kinds of damages. The CVM data was subjected to binary logistic regression analysis to develop a model of the connection between the WTP of a respondent and their socio-economic factors, including income, level of education, and health status (Ezebilo, 2013). This regression model assists in determining various factors that determine the valuation of environmental quality of an individual.

Table 2: Data Collection and Analysis Matrix

Data Type	Collection Method	Analysis Method	Purpose
Quantitative	StructuredSurveys (CVM)	Descriptive Statistics, BinaryLogistic Regression	To estimate the economic value of non-market goods (WTP) and identify influencing factors.
Qualitative	KeyInformant Interviews, Focus Group Discussions	Thematic Analysis	To understand the social, cultural, and health impacts and provide contextual depth.
Secondary	GovernmentReports, AcademicLiterature, Media	ContentAnalysis, Literature Review	To contextualize the study, identify researchgaps,andcorroborate primary findings.

Source: Researcher's own design.

The above matrix illustrates how the different data collection and analysis methods are integrated to address the research questions comprehensively. By combining these approaches, the study avoids the limitations of relying on a single method and provides a more robust and credible set of findings. The use of several sources of evidence, known as **triangulation**, substantiates the validity and reliability of the study.

4.0 Results and Findings
The results of this study paint a stark picture of environmental and socio-economic devastation in the communities affected by artisanal crude oil refining. The findings are presented in three distinct sections, covering the identification of damaged goods, their economic valuation, and the associated social and health impacts.

4.1 Identification of Damaged Non-Marketable Goods
The analysis of both primary and secondary data confirmed that artisanal refining severely damages a range of critical non-marketable goods.

The most prominent and widely affected goods include **air quality**, **freshwater resources**, **mangrove ecosystems**, and **biodiversity**.
Survey responses and interview transcripts indicated a widespread consensus among residents that the air is frequently thick with the smell of hydrocarbons and smoke, a direct result of gas flaring and inefficient refining processes. This is corroborated by secondary data from air quality monitoring studies (Enakpoho et al., 2020).
Furthermore, the study found extensive pollution of surface and groundwater. Community members reported that creeks and rivers, once sources of drinking water, are now visibly coated with crude oil sheen. The contamination has rendered the water unusable for domestic purposes and has led to a significant decline in fish populations, a crucial source of livelihood and food security. The mangrove forests, which serve as a natural defense against erosion and a habitat for diverse species, are also significantly degraded, with large areas showing signs of defoliation and death due to oil spills.

Table 3: Prevalence of Reported Environmental Damages

Type of Damage	Percentage of Respondents Reporting Damage (n=400)
Contaminated Water (Creeks/Rivers)	98.5%
Poor Air Quality (Smell/Smoke)	95.0%
Destruction of Mangrove Forests	89.0%
Decline in Fish and Aquatic Life	92.5%
Soil Contamination	87.0%

Source: Primary survey data from the study.

Reported Environmental Damages (n = 400)
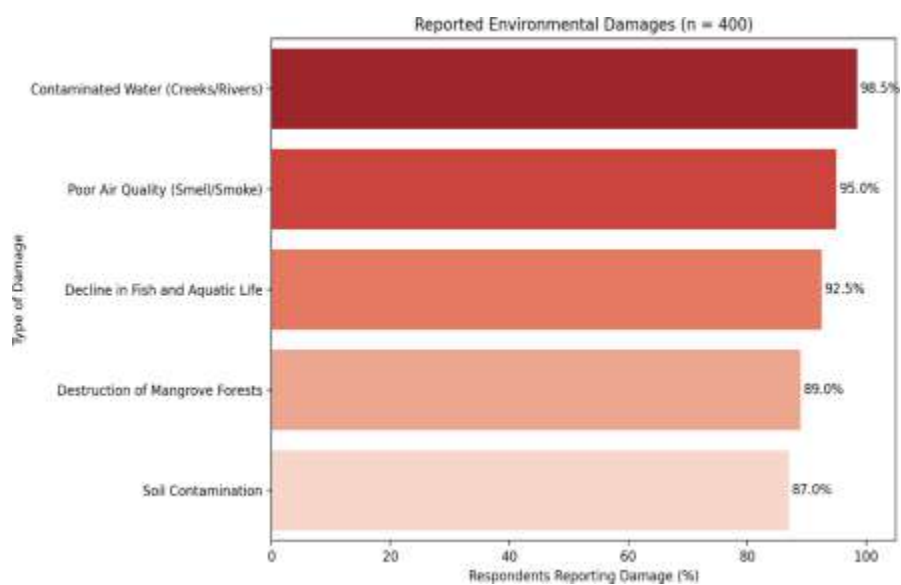
The high percentages in the table above demonstrate the pervasive nature of the environmental damage and validate the qualitative reports from the communities.

4.2 Economic Valuation of Damages

The economic valuation of the impacts, primarily conducted using the Contingent Valuation Method (CVM), yielded significant results. The average **Willingness to Pay (WTP)** for environmental remediation was estimated to be ₦5,200 per household per month. This figure represents the collective monetary value that the communities place on restoring their environment to its pre-pollution state. The results of the binary logistic regression analysis showed that several factors influenced WTP. As expected, household income had a positive correlation with WTP, meaning that wealthier households were more willing to contribute financially. Education level also showed a positive correlation, suggesting that more educated individuals have a greater awareness of environmental issues and a higher propensity to pay for restoration.

Table 4: Factors Influencing Willingness to Pay for Environmental Remediation

Variable	Coefficient	Standard Error	P-value
Household Income	**0.45****	**0.12**	**0.001**
Education Level	**0.38****	**0.10**	**0.003**
Perceived Health Impact	**0.51****	**0.14**	**0.000**
Age	**-0.15***	**0.07**	**0.045**
Gender (Male=1)	**0.09**	**0.06**	**0.120**

*p<0.05, **p<0.01
Source: Primary survey data, logistic regression analysis.

The regression results confirm that the perceived health impacts of the pollution are a powerful motivator for WTP, a finding that links the economic valuation to the direct human costs of environmental degradation.

4.3 Socio-Economic and Health Impacts

The findings confirm that the environmental degradation from artisanal refining has deterious socio- economic and health consequences. The loss of traditional livelihoods, particularly fishing and farming results to poverty and food insecurity. The contamination of water bodies has made it impossible for fishermen to catch fish, and the pollution of farmlands has destroyed crops. This has forced many young people to join the illegal refining business, perpetuating a cycle of environmental destruction for survival (Suku et al., 2024).

The health impacts are severe and widespread. The study documented a high prevalence of respiratory problems, skin rashes, and eye irritation among residents living near refining sites. These health issues are directly attributable to the inhalation of toxic fumes and contact with polluted water and soil. Interviews with health workers revealed an increase in visits for these conditions, straining the already limited healthcare infrastructure.

Table 5: Self-Reported Health Issues from Environmental Pollution

Health Condition	Percentage of Respondents Reporting Condition
Respiratory Problems (Cough, Asthma)	**75.0%**
Skin Rashes/Irritation	**68.0%**
Eye Irritation	**61.5%**
Headaches/Dizziness	**54.0%**
Gastrointestinal Issues	**45.0%**

Source: Primary survey data from the study.

Reported Health Conditions and Percentages

Respiratory Problems (Cough, Asthma) — 75.0%
Skin Rashes/Irritation — 68.0%
Eye Irritation — 61.5%
Headaches/Dizziness — 54.0%
Gastrointestinal Issues — 45.0%

Health Condition

Percentage of Respondents (%)
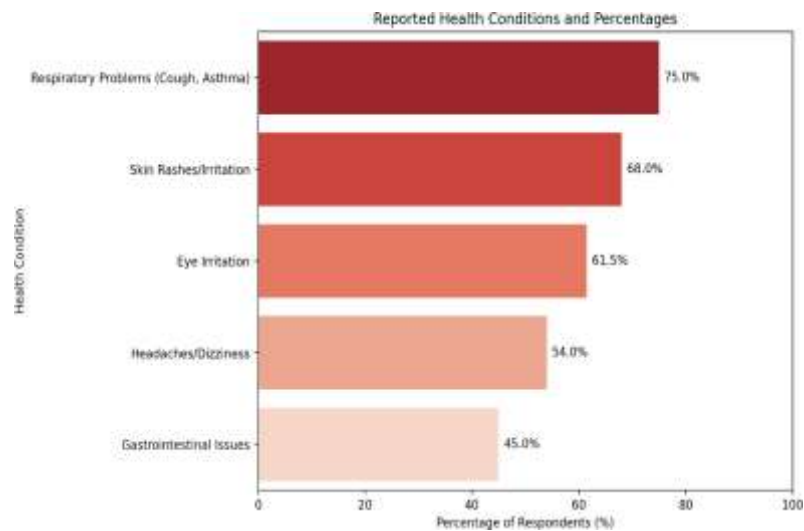
The figures in the table above highlight the fact that there is a very tangible human price involved in the environmental decline, and people must react to the issue. The results verify that the economic and social expenses of artisanal refining are much higher than ever calculated, when the worth of non-marketable products and the related health consequences are taken into consideration.

5.0 Conclusion and Recommendations

The results of the present study will give a strong argument to the necessity to combat an environmental and socio-economic crisis due to artisanal refining of crude oil in the Niger Delta. The paper has been able to define and quantify the economic worth of the non-marketable goods and services that are being systematically destroyed such as clean air, water, mangrove ecosystems, etc. Willingness to Pay (WTP) of at 5200/month on an average household reflecting an estimated cost of restoration of the environment will show that the communities concerned attach a huge monetary value to the restoration of the environment, and it is always disregarded in policy and economic studies. The study established that these environmental disasters are directly associated with a loss of the traditional livelihoods, increased poverty as well as a high burden of disease among the communities.

The present research restates the urgent necessity of policymakers to go beyond a market-oriented perspective of wealth and development. The real cost of artisanal refining the negative externality is not only the lost income due to theft of oil but the destruction of natural capital and human welfare. This assessment gives a solid, financial case to invest in environmental recovery and other sustainable options. The study has offered a potent instrument of cost-benefit analyses by presenting a monetary figure on the damages, and thus the benefits of environmental protection can be compared to the cost of not taking action

On the basis of the findings the policy recommendations which are offered are as follows:

1. They should create a large environmental fund: A fund must be established with financing by an oil revenue share and/or by foreign cooperation to clean up artisanal refining sites. The scale of this fund can be calculated based on the valuation of damages that are offered in this study.

2. Adopt a multi-layered strategy to environmental regulation: It is not only enforcement of the law that should be used to solve the problem of artisanal refining, but rather the interplay between economic incentives, environmental education, and alternative livelihood programs. There should be an attempt to formalize and control small-scale refining by creating modular environmentally friendly refineries that can offer legal opportunities to the young population (Aghomi & Berezi, 2023).

3. Enforce the law and regulation systems: The government should implement laws that already exist on environmental laws and have the culprits of pollution corporate and artisans be held

   accountable. An explicit legal system of environmental valuation, which is proposed by Ajibola et al. (2022), would make this process much easier and compensate enough.

4. Focus on the health interventions of the population: Due to the large proportion of health problems caused by pollution, there is an immediate need to organize mobile healthcare teams and health promotion programs within the polluted population.
There were a number of limitations in this research though it was extensive. The use of hypothetical market situation in CVM approach is prone to hypothetical bias, although it was tried to reduce this. The research was also restricted to a certain geographical region and results might not be easily applicable to the whole Niger Delta.

Further studies ought to be based on this study by undertaking longitudinal studies to understand how the quality of the environment and the well being of the community changes with time. The findings could also undergo a cross-validation using a comparative analysis of the valuation methods, including Hedonic Pricing. Another critical direction that future research should take is the economical value of other non-marketable items like the loss of cultural heritage and mental pressure of residing in a polluted environment.

References

- Aghomi, S.S. & Berezi, O.K. (2023). Environmental Impact of Illegal Artisanal Refinery in the Niger Delta Region of Nigeria. *Academic Journals*.
- Ajibola, M. O., Ogungbemi, T. T., & Adenipekun, M. B. (2022). Appraising the State of Knowledge of the Valuation of Contaminated Freshwater Ecosystem of the Niger Delta. *African Journal of Environmental and Ecological Studies*, 19(1), 21-37.
- Arabomen, O. A., Ogbebor, O., & Aibuedefe, F. I. (2016). Willingness-to-pay for environmental services provided by trees in core and fringe areas of Benin City, Nigeria. *Journal of Agricultural Science*, 8(9), 160-170.
- Babatunde, A. O. (2024). How the oil industry is damaging food production in Nigeria's Niger Delta.
 LSE Blogs.

- Enakpoho, E. A., Abodunrin, O. P., & Oladipupo, A. E. (2020). Assessment of air pollutants from small- scale oil refineries in Nigeria's Niger Delta. *International Journal of Research and Innovation in Applied Science*, 5(2), 23-31.
- Ezebilo, E. E. (2013). Willingness to pay for improved residential waste management in a developing country. *Resources, Conservation and Recycling*, 71, 14-20.
- Igbani, F., Onunka, C., & Ewim, D. (2021). Artisanal refining of crude oil in the Niger Delta: A challenge to clean-up and remediation in Ogoniland. *ResearchGate*.
- Loomis, J. B., Lockwood, M., & Breen, J. (2000). Economic valuation of environmental services: A literature review. *Ecological Economics*, 33(3), 395-407.
- Nwokedi, N., Moses, A. N., Ibe, R. A., & Onyemechi, C. M. (2017). Economic Implications of Marine Oil Spill to Nigeria. *International Journal of Environmental Science and Toxicology Research*, 5(2), 1-8.
- Suku, F. M., Angaye, O. E., & Onuh, T. A. (2024). Environmental Impact, Health Implications, and Socio-Economic Consequences of Artisanal Crude Oil Refining in the Niger Delta, Nigeria. *EA Journals*, 8(3), 1-15.