Risk perceptions of environmental and health problems associated with Artisanal Crude oil Refining in Bayelsa State, Nigeria

Abstract

When crude oil is artisanally refined, it releases compounds that contribute to environmental pollution and health problems. The perceptions regarding these problems could be instrumental in tackling the involvement in these illicit activities. This study thus assessed the perception of the environmental and health risks associated with artisanal refining of petroleum products in communities in Bayelsa State.

The study was conducted among 615 adult residents of 3 selected communities in Bayelsa State. Multistage sampling was applied in selecting the respondents who provided responses to the administered questionnaires. Necessary ethical considerations were made during the conduct of this study.

Results from the study indicate that respondents had good perception regarding the possibility that environmental and health risks could occur as a result of crude oil artisanal refining activities (Criterion mean: 2.5 (62.5%); Grand mean [environmental risks]: 3.25 [81.15%]; Grand mean [health risks]: 3.13 [78.32%]) respectively.

The study found that the communities have good perceptions of environmental and health risks associated with the artisanal refining of crude oil in Bayelsa State. There is therefore need for sustained health education to maintain good perceptions of the health and environmental risks associated with petroleum-related artisanal refining.

Keywords: artisanal refining, crude oil, health effects, environmental problems, perceptions

INTRODUCTION

The exploration and exploitation of crude oil in Nigeria has gone on for years and these have largely contributed to the economy and development of the country at the expense of destructive effects on the environment and the occurrence of health problems. These problems have been linked to the occurrence of accidental oil spills during the oil exploration and transportation activities, gas flaring, fire outbreaks at exploration sites as well as illegal oil bunkering activities (Kadafa, 2012; Odalonu, 2015). Illegal oil bunkering usually involves sabotage to oil pipelines and the diversion of crude oil from these pipelines for commercial gain (Obenade & Amangabara, 2014; Odalonu, 2015). This illegally obtained crude oil at certain times undergoes illicit refining which is done by unlicensed persons and is known as crude oil artisanal refining (Amangabara & Njoku, 2012).

This refining process is regarded as being highly inefficient due to the inability to refine as much as 80% of the heavy end of the crude and the tendency to produce refined petroleum products of low quality (Amangabara & Njoku, 2012). During the refining process, part of the oil seeps into the ground with the potential consequence of contaminating the underground aquifer (Amangabara & Njoku, 2012). In addition, dense clouds of soot, gaseous compounds and particulate matter are produced and released together with the unrefined portions into the environment. These contribute to the release of black carbon and soot in large amounts into the environment. A major carcinogenic constituent found in both black carbon and soot is polycyclic aromatic hydrocarbons (PAHs) which have been implicated in the occurrence of a number of health problems (Amangabara & Njoku, 2012; Howard et al., 2017; Niranjan & Thakur, 2017; Nwankwoala et al., 2017). Artisanal refining activity has been adversely attributed to affecting soil micro-organisms (Douglas & Cornelius, 2018), destroying the wetland ecosystem (Asimiea & Omokhua, 2013; Yabrade & Tanee, 2016); They also contribute to the severe depletion of biodiversity and the aesthetic scenery of forests, destruction of wildlife habitats as well as the disruption of water cycles and aquatic life (Asimiea & Omokhua, 2013).

A report by the United Nations Development Programme has stated that majority of the Niger Delta populace is uneducated, poorly informed, and deficient in relevant technical skills needed for productivity (Obenade & Amangabara, 2014). This limitation, combined with high unemployment rates and the perception of not benefiting from the revenue proceeds of oil production prompts the local population especially the youths, to be involved in acts which promote restiveness and violence (Obenade & Amangabara, 2014). These acts include pipeline vandalism and crude oil theft which involves illegal bunkering and refining of crude oil which are facilitated by the large-scale local and international crude oil trade which provides quick and profitable gains (Daura, 2000; United Nations Environment Programme, 2006). Their ignorance of the harmful effects of these illegal bunkering and refining activities could be an important factor contributing to the sustained involvement in these activities. This holds as true despite efforts by the Nigerian government to eliminate these activities (Daura, 2000; Obenade & Amangabara, 2014; United Nations Environment Programme, 2006).

Researchers have found major perceptions of the environmental effects of oil spillage and gas flaring activities to include air pollution (72.4%) (Obafemi et al., 2012) as well as the destruction of agricultural and aquatic life which adversely affects various sources of livelihood of the affected populace. (The-Strategic-Partnership-on-Lobby-&-Advocacy-Programme-in-Nigeria, 2020). In Rivers State, during the soot pollution incident, it was reported that most respondents perceived that soot pollution to have caused chronic cough (69.9%), irritation to eyes, nose and throat (64.2%) as well as skin irritation (32.6%). Coincidentally, most of the respondents perceived that the pollution was caused by artisanal crude oil refining activities as well as burning of seized crude oil and artisanally-refined products (Whyte et al., 2020). This kind of studies have been scantily conducted in Bayelsa State which is also one of the States playing host to numerous oil and gas activities. In order to understand the perceptions of the residents in this

State regarding the environmental and health problems that could arise as a result of the activities of artisanal refiners of crude oil, it is necessary to conduct this study. This study thus aims to determine the perceptions of the communities on environmental and health risks associated with the artisanal refining of crude oil in Bayelsa State, Nigeria.

MATERIALS AND METHODS

This is a descriptive study conducted in three selected communities located in Bayelsa State, Nigeria. The study population included adult residents in these communities for a period not less than two years. A sample size of 615 respondents were selected from the communities to provide responses to questions regarding their perceptions of environmental and health risks associated with artisanal refining of crude oil. The sample size was equally distributed across the 3 selected communities and multistage sampling was used in the selection of the study respondents from these communities.

The first stage was simple random sampling to randomly select wards in the Local Government Areas (LGAs) by balloting. Second stage was simple random sampling by balloting, to select communities within each selected ward and the third stage involved simple random sampling to select houses within selected communities. Each house formed a cluster, and everyone who met the inclusion criteria were recruited. Where more than one household was present in a house, simple random sampling by balloting was used to select only one household. During the course of sampling, when any respondent chose not to participate in the study, sampling was extended to compensate for that. Sampling continued until the minimum sample size was attained.

A structured self- and interviewer-administered questionnaire was used for data collection and comprised three sections (A to C). Section A elicited data on the sociodemographic characteristics of the respondents, sections B and C elicited data on the perception of environmental and health risks associated with artisanal crude oil refining respectively. The questionnaire was adapted from existing templates of previous studies (Kponee et al., 2015; Nriagu et al., 2016; Okonkwo et al., 2018) and responses to the questions were placed on a 4-point likert scale ranging from strongly agree (4) to strongly disagree (1).

The instrument was prepared in English language and translated into English-based pidgin which is a common means of communication within the Niger Delta region of Nigeria (Akande, 2010). This was as a result of the anticipation of language barriers to some residents of the study communities whom may not understand the questionnaire items written in English language. In order to ensure that the translated questionnaire retained its original meaning, it was translated back to English language. After this was done, it was ensured that the original meaning was retained after both translations. The study questionnaires were pre-tested among 20 respondents. The completed questionnaires were assessed for adequacy, understandability and ease of application. The instrument was appropriately modified to enhance these aspects of the validity of the instrument. The reliability of the completed questionnaire in this study was assessed using

the index of internal consistency calculated with the Cronbach's alpha coefficient which was 0.937 which showed that the instrument was reliable for use in the present study.

3 field assistants were recruited and appropriately trained prior to commencement of data collection for 1 day. Training was done at a designated meeting point and was anchored on the following training objectives: eliciting accurate answers without suggestions, eligibility criteria for recruitment of study samples and the description of sampling techniques to be applied. Others included understanding the procedures for data collection, appropriate translation of questionnaire items and ethical considerations to be applied during data collection. Initial training was given at first and followed by practice sessions as well as evaluation and correction of any misunderstood training objective.

RESULTS

Out of the 615 respondents who took part in this study, 205 of them were selected from each community. It was found that the majority of the respondents were male 318 (51.7%) and majority of whom were aged between 18 and 44 years 490 (82.9%) with a mean age of 32.77±11.13 years. The largest proportion of the respondents had an income of less than 500 naira per day 234 (38.6%), were single 281 (45.7%) and were self-employed 290 (47.2%). Most of the respondents had received secondary school education 319 (52.3%). These details are shown in Table 1.

Table 1: Demographic data of respondents

Variables	Frequency	Percentage (%)
Sex		
Male	318	51.7
Female	297	48.3
Total	615	100
Age (years)		
18-44	490	82.9
45-60	90	15.2
>60	11	1.9
Total	591	100

Income (naira)

<500	234	38.6
500-1000	165	27.2
1000-2000	59	9.7
2000-3000	33	5.4
>3000	116	19.1
Total	607	100

Marital status

Single	281	45.7
Married	270	43.9
Divorced	17	2.8
Widow(er)	8	1.3
Cohabiting	39	6.3
Total	615	100

Employment status

Unemployed	208	33.9
Self-employed	290	47.2
Employed by others	116	18.9
Total	614	100

Educational qualification

None	30	4.9
Primary	27	4.4
Secondary	319	52.3
Tertiary	206	33.8
Vocational/Technical	28	4.6
Total	610	100

Perception of risk of environmental problems due to artisanal refining of crude oil

Assessment of the respondents' perception of the risk of environmental problems associated with artisanal refining of crude oil showed that altogether most of the respondents had a good perception regarding the occurrence of these risks (Criterion mean: 2.5; Grand mean: 3.25 [81.5%]). This good perception among the respondents was as a result of majority of them agreeing or strongly agreeing with the eight positively-directed questionnaire items asked to elicit their perception of the associated environmental risks. Some of these included that pollution from artisanal mining was an environmental risk (81.46%), that could cause water pollution (82.15%), air pollution (81.34%), contamination of fish (81.99%), destroy farmlands (80.24%) as well as cause soil infertility (81.14%).

On the assessment of the respondents' perception of the risk of health problems associated with artisanal refining of crude oil, it was shown that altogether most of the respondents had good perception regarding the possibility that these risks could occur (Criterion mean: 2.5; Grand mean: 3.13 [78.32%]). This good perception among the respondents was as a result of majority of them agreeing or strongly agreeing with the eight positively-directed statements asked to elicit their perception of the associated health risks. These included that pollution from artisanal refining of crude oil was a health risk to themselves (83.33%), their families (82.11%) as well as to the general population (81.50%). Others included that crude oil pollution or bi-products following artisanal refining of crude oil could distort child development (73.90%), cause breathing problems (77.80%), insomnia (74.47%) as well as problems with digestion (74.02%). This data is shown in Tables 2 and 3.

DISCUSSION

An assessment of the respondents' perception of the risk of health and environmental problems associated with artisanal refining of crude oil showed that most of the respondents had reasonable perception of health and environmental risks from the pollution caused by artisanal refining of crude oil. The finding of this study is in agreement with the findings of studies by other authors (Obafemi et al., 2012; Whyte et al., 2020) who have assessed risk perceptions among respondents in oil-producing areas within the Niger Delta region of Nigeria.

Another study conducted in Rivers State, in 2020 which assessed the perception of residents regarding the health effects of soot pollution due to artisanal crude oil refining activities as well as burning of seized crude oil and artisanally-refined products. The study showed that most of the respondents perceived the soot to have caused chronic cough, irritation to eyes, nose and throat as well as skin irritation (Whyte et al., 2020). Another study conducted to assess the interplay between livelihoods in the Niger Delta and artisanal refining found that as much as 60.4% of the respondents reported that their livelihoods (largely agriculture-based) had been affected by oil spills from artisanal refining and other related activities (The-Strategic-Partnership-on-Lobby-&-Advocacy-Programme-in-Nigeria, 2020). The implications of having such good perception levels in the present study could be as a result of the quality of information regarding these pollutant effects, that had been made available to the respondents over time. These risk perceptions could also be influenced by various economic, social and cultural characteristics of the respondents (Ferrer & Klein, 2015; Signorino & Beck, 2014).

Researchers in a study conducted to assess respondents' perception of environmental pollution in Warri, Nigeria also reported that major perceptions of the respondents regarding environmental effects of oil spillage and gas flaring centred on air pollution (Obafemi et al., 2012). In others studies conducted in Delta State, Nigeria; it was also reported that the respondents were aware that the flared gas in their communities contributed to air pollution by black carbon which caused detrimental human health and environmental effects. The awareness of these human and

environmental impacts was reported to increase with increasing proximity to the gas flare site (Akuirene et al., 2019; Edino et al., 2010). It has been stated that in the general population, individuals are able to differentiate among varying specific threats when forming risk perceptions. Individuals who possess optimistic risk perceptions regarding a looming threat have been found to be more likely to minimize the threat's severity and are also less likely to seek additional health information (Ferrer & Klein, 2015). Risk perceptions involve the incorporation of numeric information about a threat and this has a direct consequence on the formation and application of risk perceptions which is evident in highly numerate individuals being more likely to retrieve and use numerical principles in decision-making. This inadvertently renders them less susceptible to bias related to risk perception and decision-making, and they are less likely to incorporate irrelevant information into risk perceptions.

The present study and other supporting studies suggest that the perception of health and environmental risks, from artisanal refining and gas flaring activities by the respondents in affected communities is high (Ferrer & Klein, 2015; Sheeran et al., 2014). This notwithstanding, the problems of artisanal refining activities still persist and could be related with the desire of the youthful residents in oil-producing communities to be involved in acts which promote restiveness and violence. This is further complicated by the perception of not benefiting from the revenue proceeds of oil production, lack of education, high unemployment rates and the desire to make quick financial gains (Daura, 2000; Obenade & Amangabara, 2014; United Nations Environment Programme, 2006).

Conclusion

The perception regarding the possibility that health and environmental risks could occur as a result of the pollution caused by the activities of artisanal refiners of crude oil in this study was found to be good. There is however the need for sustained health education to maintain these good perception levels. The populace can also be educated on the positive environmental impact associated with using environmentally-safe methods for cooking, energy and general domestic use.

Ethical Approval and Consent :

Ethics approval for the research was obtained from the Research Ethics Committee of the University of Port Harcourt (Approval number: UPH/CEREMAD/REC/MM72/097) and permission to conduct the research was obtained from the Bayelsa State Ministry of Health (Approval number: BSHREC/Vol. 1/21/02). Permission to conduct this study was also sought from necessary authorities of the Communities involved. Every part of the research protocol was explained to the respondents and their consent was sought before commencement of instrument administration and health assessment.

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Table 2: Perception of the risk of environmental problems associated with artisanal refining among the respondents

Perception of risk of environmental problems	SA (4)	A (3)	D (2)	SD (1)	Σf	Σfx	μ	μ %	Remark
• Pollution from artisanal mining is an environment	201 (32.7%)	379 (61.6%)	28 (4.6%)	7 (1.1%)	615 (100.0%)	2004	3.26	81.46	Good perception

al risk

Water pollution can be caused by crude oil pollution or its bi-products following artisanal refining of crude oil	195 (31.7%)	404 (65.7%)	13 (2.1%)	3 (0.5%)	615 (100.0%)	2021	3.29	82.15	Good perception
Air pollution can be caused by crude oil pollution or its artisanally refined products	186 (30.2%)	403 (65.5%)	22 (3.6%)	4 (0.7%)	615 (100.0%)	2001	3.25	81.34	Good perception
Fish contamination can be caused by crude oil pollution or bi-products following artisanal refining of crude oil	193 (31.4%)	404 (65.7%)	15 (2.4%)	3 (0.5%)	615 (100.0%)	2017	3.28	81.99	Good perception
Destruction of fishing sites can be caused by crude oil pollution or	182 (29.6%)	410 (66.7%)	19 (3.0%)	4 (0.7%)	615 (100.0%)	2000	3.25	81.30	Good perception

bi-products following artisanal refining of crude oil

Item	SA	A	D	SD	Total	Sum	Mean	Mean %	Remark
• Farmland destruction can be caused by crude oil pollution or bi-products following artisanal refining of crude oil	167 (27.2%)	416 (67.6%)	26 (4.2%)	6 (1.0%)	615 (100.0%)	1974	3.21	80.24	Good perception
• Destruction of the beauty of nature can be caused by crude oil pollution or bi-products following artisanal refining of crude oil	165 (26.8%)	407 (66.2%)	34 (5.5%)	9 (1.5%)	615 (100.0%)	1958	3.18	79.59	Good perception
• Soil infertility can be caused by crude oil pollution or its artisanally refined products	181 (29.4%)	408 (66.3%)	22 (3.6%)	4 (0.7%)	615 (100.0%)	1996	3.25	81.14	Good perception
Grand mean/mean %							**3.25**	**81.15**	**Good overall perceptio**

y agree (SA),   Agree (A), Disagree (D), Strongly Disagree (SD); μ: Mean value; μ%: Mean percentage

Table 3: Perception of the risk of health problems associated with artisanal refining among the respondents

Perception of health risk	SA (4)	A (3)	D (2)	SD (1)	Σf	Σfx	μ	μ %	Remark
• Pollution from artisanal refining of crude oil is a health risk to me	244 (39.7%)	340 (55.3%)	23 (3.7%)	8 (1.3%)	615 (100.0%)	2050	3.33	83.33	Good perception
• Pollution from artisanal refining of crude oil is a health risk to my family	217 (35.3%)	363 (59.0%)	28 (4.6%)	7 (1.1%)	615 (100.0%)	2020	3.28	82.11	Good perception
• pollution from artisanal refining of crude oil is a health risk to the general	199 (32.4)	383 (62.3%)	27 (4.4%)	6 (1.0%)	615 (100.0%)	2005	3.26	81.50	Good perception

populatio
n

Statement									
Distortion in child developm ent can be caused by crude oil pollution or bi-products following artisanal refining of crude oil	150 (24.4%)	299 (48.6%)	155 (25.2%)	11 (1.8%)	615 (100.0%)	1818	2.96	73.90	Good perceptio n
Breathing problems can be caused by crude oil pollution or bi-products following artisanal refining of crude oil	165 (26.8%)	363 (59.0%)	78 (12.7%)	9 (1.5%)	615 (100.0%)	1914	3.11	77.80	Good perceptio n
Inability to sleep well can be caused by crude oil pollution or bi-products following artisanal	143 (23.2%)	327 (53.2%)	134 (21.8%)	11 (1.8%)	615 (100.0%)	1832	2.98	74.47	Good perceptio n

Item	SA	A	D	SD	Total		μ	μ%	Remark
refining of crude oil									
• Health problems can be caused by crude oil pollution or bi-products following artisanal refining of crude oil	167 (27.2%)	393 (63.9%)	52 (8.5%)	3 (0.5%)	615 (100.0%)	1954	3.18	79.43	Good perception
• Problems with digestion can be caused by crude oil pollution or bi-products following artisanal refining of crude oil	134 (21.8%)	339 (55.1%)	126 (20.5%)	16 (2.6%)	615 (100.0%)	1821	2.96	74.02	Good perception
Grand mean/mean %							**3.13**	**78.32**	**Good overall perception**

Strongly agree (SA),   Agree (A), Disagree (D), Strongly Disagree (SD); μ: Mean value; μ%: Mean percentage