Residents Perceptions on Artisanal Refining of Crude Oil and Its Impact on Air Quality in Rural Communities in Rivers State, Nigeria

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ABSTRACT

This study carried out investigation on residents' perceptions on artisanal refining of crude oil and its impact on air quality in rural communities in Rivers State, Nigeria. The study was based on descriptive (cross-sectional) research design to accomplish its objectives. The instruments used to gather information from the field were questionnaire, participant observer technique, Bosean multi gas finder, EG Air quality indicator, GPS gadget and met meter. From 6 local government areas, out of which 18 communities (3 from each LGA) were randomly chosen for the administration of questionnaire and assessment of air quality for both the dry and wet seasons. The discoveries of the examination reports that the study area of interest was engaged in artisanal refining of crude oil (74.5%). They affirmed that there was no other job opportunity they could be engaged with than the artisanal refining activity (74.6%) which they did in order to survive the suffering in the community (74.5%). However, some of the air pollutants such as CO, O_3, NH_3, $PM_{2.5}$ and PM_{10} were above the permissible limit of WHO air quality guidelines. It was recommended that, educating the public, especially in rural areas, about the sources of air pollution and its health impacts is crucial. This may include promoting practices such as the use of clean cooking technologies, responsible waste disposal, and reducing biomass burning as well as the stoppage of artisanal refining activities in the areas where it is being carried out.

Keyword: Artisanal Refining, Crude Oil, Pollution, Rural Area, Pollutants.

INTRODUCTION

Artisanal refining of crude involves limited scope, traditional methods to extract usable products like fuel, diesel, and other oil-based commodities. This frequently includes straightforward refining strategies, sometimes using makeshift equipment, and regularly finished in regions where admittance to present day refining offices is restricted. While it can give fundamental items locally, it might likewise be not so much productive but rather more naturally unsafe than the modern refining processes [16]. It is generally alluded to as "kpo-fire" in neighborhood speech, includes bubbling unrefined petroleum and gathering the resultant vapor, which are consolidated in tanks and used locally for lighting, fuel, and transportation purposes [19].

This action presents serious natural and wellbeing challenges because of absence of guideline and dangerous refining strategies. The training brings about huge air contamination, water defilement, soil debasement, which unfavorably influence respiratory wellbeing, increment disease dangers, and mischief biodiversity and customary jobs [19]. High quality refining arose because of a reaction to financial difficulties like neediness, joblessness, and an absence of admittance to formal monetary open doors as per [2]. This movement includes the rough and frequently dangerous handling of oil utilizing shoddy processing plants, prompting critical natural contamination and antagonistic wellbeing consequences for encompassing networks [20]. The far and wide commonness of distinctive refining has brought about the defilement of air, water and soil assets, presenting serious dangers to biodiversity and the strength of nearby populaces. In spite of being an essential financial action for some, this training has brought about an emotional decrease in biological system wellbeing and public prosperity, requiring earnest mediation [19].

LITERATURE REVIEW

Investigation on Air Quality at Artisanal Crude Oil Refinery Sites in Igia-Ama, Tombia Kingdom, Rivers State, Nigeria by [14], the review meant to determine the air quality around distinctive raw petroleum treatment facility locales arranged in Igia-Ama, Tombia Realm, Streams State, Nigeria. Consequently, air quality evaluation was done involving air quality sensor for physicochemical boundaries and settle plate openness for microbial boundaries, observed for both dry and wet seasons. As per their report, during the wet season, SOx, NOx, VOC, CH4, CO, CO2,O3, NH3, H2S, PM1, PM2.5, PM7, PM10, TSP, Clamor, Wind speed, Air temperature, Relative dampness fixation went from 0-0.05 ppm, 0.04 - 0.07 ppm, 1004.00 - 1320.00 ppm, 34.33 - 39.67 ppm, 1.33 - 3.00 ppm, 765.00-1556.67 ppm, 0.2 to 0.3 ppm, 0.05 to 0.10 ppm, 0.13 to 0.20 ppm, 15.73 - 0 21.50 µg/m3 , 33.53-34.17 µg/m3 , 55.47 - 55.93 µg/m3 , 64.30 - 67.50 µg/m3, 49.60 - 76.97 µg/m3, 45.63-48.37dB, 1.13 - 1.23 m/s, 28.30 - 29.73oC and 63.13 - 69.23 % individually [14].

Study on Spatial Distribution of Black Soot and Its Health Effects in Port Harcourt Metropolis, Nigeria, as conducted by [9], the review evaluated the wellbeing ramifications of dark residue utilizing a MiniVol air sampler. As per them, the MiniVol air sampler was utilized to gather PM from the encompassing air at six checking locales in Port Harcourt, Nigeria. It was uncovered that testing was led consistently for seven days, for 24 hours. The report maintained that $PM_{2.5}$ fixations at Uniport Intersection, GRA Intersection, Butcher Traffic circle, Abuloma Pier, Rumuomasi Traffic circle, and New Street Borokiri were 38.6 g/m^3, 28.3 g/m^3, 93.7 g/m^3, 72.9 g/m^3, 30.6 g/m^3, and 31.3 g/m^3, separately. Consequently, PM_{10} fixations went from 71.2 g/m3 to 60.6 g/m3, with 103.3 g/m3, 85.5 g/m3, 40.1 g/m^3, and 35.2 g/m3 was the most elevated [9]. Be that as it may, the degree of PM2.5 and PM10 contamination in the encompassing air was high across the six testing destinations, with mean $PM_{2.5}$ and PM_{10} fixations surpassing the WHO (2011) rule as per their report.

[10]. completed examination on Residents' perception of the effects of soot pollution in Rivers State, Nigeria the review embraced a cross-sectional methodology by means of a web-based overview among individuals living in the state who were educated and approached web empowered gadgets. It was asserted from the report that, most respondents (81.5%) knew about the ash contamination and saw the primary drivers of residue to be from distinctive refining of unrefined petroleum (87.8%) and consuming of seized unrefined petroleum and its items (76.5%). In this manner, greater part likewise apparent that the sediment had caused them persistent hack (69.9%) and disturbance to eyes, nose and throat (64.2%). Female respondents were fundamentally more probable (AOR=1.38 CI = 1.02, 1.86) to gripe of a wellbeing impact from residue contamination. The accompanying suggestions were made; the basic need to explore recognized wellsprings of ash and moderate conceivable effect, general wellbeing efforts ought to be sent off for sufficient gamble correspondence on the unfavorable impacts of residue, with consideration given to orientation delicate messages, significant specialists ought to foster rigid approaches to forestall ash contamination and further develop admittance to proper administrations to address the wellbeing impacts[10].

Effect of Soot Inhalation on Methaemoglobin and Oxyhaemoglobin Levels of some Residents of Iwofe, Port Harcourt Rivers state, Nigeria as researched by[6], The point of the review was to decide the impact of ash Oxyhaemaglobin, Synthetics inward breath on methaemoglobin and oxyhaemoglobin levels of person's occupant in both Iwofe, Port Harcourt (uncovered subjects) and Ihiala, Anambra state (control subjects). A sum of fifty (50) test tests were gotten. Thirty (30) control tests were gotten from subjects in Ihiala where unlawful petroleum treatment facilities and other significant method for residue age are not as similar to what is available in Port Harcourt and its environs. Methaemoglobin and Oxyhaemoglobin focuses were investigated utilizing spectrophotometric strategy. Consequently, the information acquired were dissected involving SPSS for illustrative insights (mean and standard deviation) and inferential measurements (t-test). As per report, there was a huge expansion in methaemoglobin fixations and diminishing in oxyhaemoglobin levels of uncovered subjects showing the impact of residue inward breath. Nonetheless, suggested that, exercises of unlawful petroleum processing plants (a significant wellspring of sediment contamination in the city) ought to be halted alongside different exercises like copying of tires, unpredictable consuming of squanders and gas erupting and so on [6].

[3]. completed an examination on Medical Effect of Emission from Unregulated Refineries at Rumuolumeni Community in Port Harcourt Rivers State Nigeria, the review explored air quality in the Rumuolumeni

environs, Stream State, Nigeria, what began in November 2016 when residue turned into a general wellbeing peril to date. In view of the report, it distinguished the reason for the sediment, as unregulated treatment facilities (known as kpoo fire), and looked at gushing from a managed processing plant and the source in the picked local area. The concentrate additionally certified that the number of inhabitants in the review region and its environs have seen unfavorable ecological impacts because of the emanations and amassing of unburnt carbon materials (ash) inside the initial four fourth of 2016. The review suggested that various neighborhood processing plants worked nearby by quacks ought to be wiped out in order to decrease natural contamination and general wellbeing perils further. All in all, the examination has additionally uncovered that the various home-made petrol treatment facilities are the significant wellsprings of dark carbon contamination, which has an immediate connection to the host local area and its environs [3].

A study of an Aerial View of a Black Man Suffering from the Menace of Crude Oil (The Black Gold) Soot by [1], it was closed in this way, "NNPC plays played fiery parts in the economy of Nigeria as far as income age, oil based commodities supply, improvement of petrochemicals and gas and so forth, through which the change of the economy was made conceivable. NNPC can assume more parts as an oil and gas organization to situate itself more significant both locally and universally in the stockpile of world energy blend both now and later on. At this point, NNPC has contacted the existences of all Nigerians and different nations in such countless ways", "We have been capable likewise to lay out that the Niger Deltans were carrying on with their typical lives before the approach of the oil business, which acquired the adamant threat to the locale like oil contamination and debasement, and so on. Rather than the Oil tracked down in the bounds of the Niger Delta District to be a wellspring of gift to individuals, and Nigerians, it somewhat went to catastrophe, disaster, distress, enduring, and demise to the general population of the Niger Deltans. The National Legislature of Nigeria ought to make healing strides in remedying every one of the irregularities making distress and endemic calamity the Niger Delta, as opposed to keep the Central Administration of Nigeria keep detached with shut eyes and ears to the dangerous results"[1].

Study on “Evaluating Some Factors Which Influence Air Pollutant Concentration around the Warri Refining and Petrochemical Company (WRPC) of Nigeria” by [5], The review evaluates potential factors which impact the convergence of air contamination around a point source. Seven classes of air toxins were checked around the Warri Refining and Petrochemical Organization (WRPC) of Nigeria, which included carbon monoxide (CO), unstable natural mixtures (VOC), Hydrogen sulfide (H2S), Nitrogen dioxide (NO2), Sulfur dioxide (SO2) and Particulate Matter (PM2.5 and PM10). Testing focuses were situated in the scope of 1.5 km to 16 km. Air quality was inspected discontinuously and week by week for one year. T-test examination was utilized to decide massive contrasts in air poison focus based on direction and irregularity while Relapse examination was likewise used to survey the impact of chosen indicators on contamination fixation around WRPC. It was accounted for in light of their examination that aside from H2S, the expectation models for CO, VOC, SO2, NO2, PM2.5 and PM10 were measurably critical with R2 upsides of 0.014, 0.215, 0.022, 0.582, 0.17 and 0.45, separately. While then again, it was uncovered that the convergence of contaminations was impacted by the blend of the elements (distance from WRPC, direction from WRPC, irregularity and climatic factors, for example, air temperature, relative moistness and wind speed), which filled in as the indicators in the model [5]. The review suggests that courses of action of modern and private land-utilizes by metropolitan arranging specialists ought to be designed, considering variables, for example, distance and direction from contamination point-sources [5].

Concentrate on Soot Pollution in Port Harcourt Nigeria: A Grand Societal Challenge by [13], The review examines ash contamination as a fabulous cultural test in Port Harcourt, Nigeria, and basically grasp the job of ecological administration (various partners) and initiative concerning ash contamination in Port Harcourt, Nigeria. Subjective technique (interview) was taken on in gathering information from eight (8) distinct partners; two delegates from government, oil organizations, common society, and the local area individuals separately. The substance and topical examination procedure was utilized to break down key witness interviews. the examination uncovered that ash contamination in Port Harcourt Nigeria is a mind-boggling issue and represents a few dangers to the general wellbeing, strategically, financially and the social climate [13]. It was additionally demonstrated that administration is quite possibly of the main calculate guaranteeing a manageable climate [13].

[7] did an examination on "Satellite Determination of Particulate Load over Port Harcourt during Black Soot Incidents", The HYSPLIT model created by NOAA and Australia's Agency of Meteorology was utilized to register airborne particulate burden, direction and scattering over the city. As per the report, least and greatest emanation fixations scattering across Port Harcourt went from 0.000035 mg/m3 to 0.18mg/m3 (0.035-180 µg/m3), individually, for the hours considered. The greatest worth got from these demonstrating results surpass the public yearly typical constraints of 40-60 µg/m3 by 77-85% for suspended particulate matter and dark smoke. Particulates outflows as seen from the HYSPLIT model stage shows that discharge sources south of Port Harcourt contribute immensely to the particulate burden across the lower climate of Port Harcourt and environs particularly during the evening and early long periods of sunrise. It was suggested that dynamic measures and serviceable arrangements be developed to protect the air nature of the city [7].

[12] did a concentrate on "Molecular Examination of Polycyclic Aromatic and Total Petroleum Hydrocarbons in Soot in Port Harcourt Metropolis Using Advanced Analytical Instruments", A transient report was done to nearly assess the polycyclic fragrant hydrocarbons (PAHs) and complete petrol hydrocarbons (TPHs) in ash dodging Port Harcourt and its environs. Tests were gathered from three (3) unique areas to be specific; Eleme Petrochemicals, Rumuodomaya Town, and College of Port Harcourt (Uniport) to decide the degree of remaining polycyclic sweet-smelling hydrocarbons and all out oil hydrocarbons in sediment as scattered from source to the lower atmosphere. The assessment was completed utilizing Gas Chromatography Fire Ionization Indicator (GC-FID) and Gas Chromatography-Mass Spectrometer (GC-MS). Sediment particles gathered from the different areas were caught in a tenax Gas Chromatography adsorbent cylinder for Gas chromatography examination. The absolute petrol hydrocarbons were examined by ASTMD 3911. The aftereffect of polycyclic sweet-smelling hydrocarbons got from Eleme Petrochemicals (0.04 mg/m3), Rumuodomaya Town (0.02 mg/m3), and College of Port Harcourt (0.01 mg/m3) were beneath the passable furthest reaches of World Wellbeing Association (W.H.O.) standard for work spot of 0.2 mg/m3. This shows that regions under study were liberated from polycyclic sweet-smelling hydrocarbons contamination. Be that as it may, the upsides of all out oil hydrocarbons which has no administrative breaking point for residue showed high upsides of 21.44 mg/m3 (Eleme Petrochemicals), 18.91 mg/m3 (Rumuodomaya Town), and 12.68 mg/m3 (College of Port Harcourt) (Odibo et al., 2022). This proposes that the heaviness of complete petrol hydrocarbons breathed in by people and kept on the body were risky. This study prescribes wellbeing measures to be taken to lessen emanations of this danger and moves toward be taken by the occupants to remain solid in Port Harcourt and its environs [12].

MATERIALS AND METHOD

This includes describing the ways of behaviour of a populace or peculiarity without controlling the variables. Thus, in this study, seasonal field assessment and subsequent description of the perceptions of the residents on the awareness of artisanal refining activities and the measurement of air quality in the respective rural communities were carried out in the field. Eighteen (18) rural communities from six (6) local government areas were considered for the study by the process of stratified random sampling techniques.

Study Location

The study area was rural communities in Rivers State. Rivers State is in South geo-political zone of Nigeria; it has its capital as Port Harcourt. It is limited toward the North by Imo, Abia, and Anambra States, toward the East by Akwa Ibom State, toward the South by the Atlantic Sea, and toward the West by Bayelsa and Delta States. The State lies at Scope 4o45' North and Longitude 6o50' East. It covers an area of 11,077 square kilometers[15]. Waterways State has a populace of 5,198,716 individuals of whom 2,673,026 were male and 2,525,690 were female. [11]. It is comprised of 23 neighborhood state run administrations regions implanted into 3 senatorial zones (Waterways South-East, Streams East and Streams West). It has a vegetation of tropical rainforests. In many spots, the predominant vegetation normally comprises of Elaeis guineensis which has the most elevated efficiency among all perceived oleaginous yields. The riverine some portion of the state has three hydro-vegetation zones, for example, ocean side edge, salt water and new water. Each zone has its qualities and organization, with the freshwaters incorporating the upper and lower floodplains of the Niger Delta [15]. The land surface of Streams State can be partitioned into three zones: freshwater swamps, mangrove swamps and waterfront sand edges. The freshwater zone expands northwards from the mangrove

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swamps. This land surface is by and large under 20m above ocean level. As a lower Niger floodplain, it contains a more noteworthy sediment and earth establishment and is more helpless to perpetual immersion by stream floods. The floodplain's complete thickness ascends to around 45m in the upper east and over 9m in the ocean side edge obstruction zones toward the southwest. On beach front sand edges, the dirts are for the most part sandy or sandy topsoils. Different harvests are upheld including coconut, oil palm, raffia palm and cocoyam. The drier upland district of Streams State covers 61% of body of land while the riverine regions, with a help scope of 2m to 5m, take up 39%.

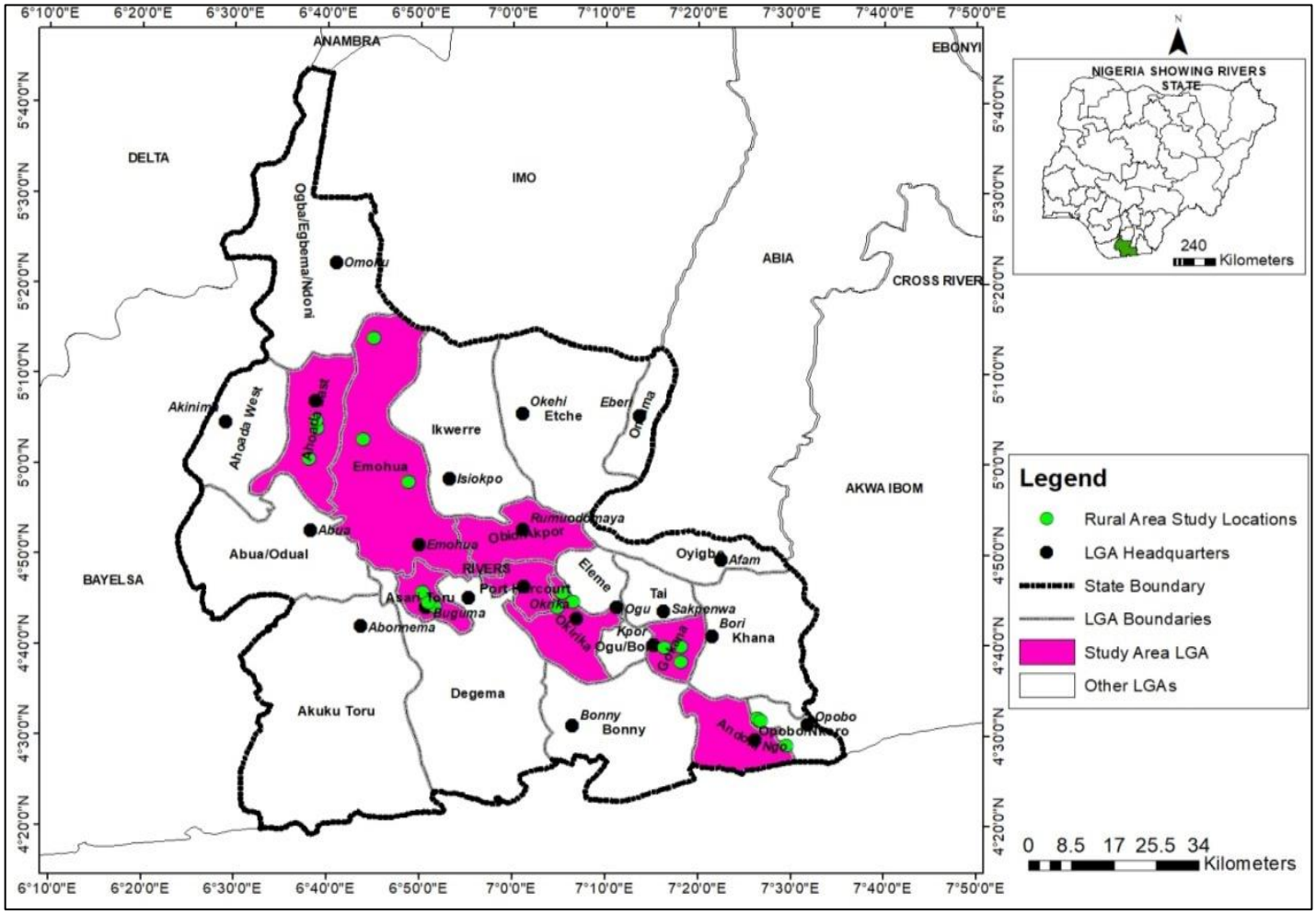

Fig. 1 Sample Locations in the Rural Communities

Fig. 1 shows the various sample locations in the rural communities where assessment of air quality and residents' perceptions on artisanal refining of crude oil in the study were carried out.

RESULTS AND DISCUSSIONS

Table I Questionnaire Distribution and Retrieval

S/NO	Questionnaire	Frequency	Percent (%)
	Administered	400	100
	Un-retrieved	23	5.75
	Retrieved	377	94.25
	Total	400	100

Table I presents the survey circulation and recovery. Here is the data on the survey that was controlled to the respondents in the review region to evaluate their perceptions on artisanal refining activities in the review region. From the table, 400 (100 percent) duplicates of the polls were directed, 23 (5.75%) duplicates were not recovered and the leftover 377 (94.25%) were recovered and utilized for the calculation.

Table II Demographic Variable of Respondents

S/NO	Demographic variables	Frequency	Percent (%)
1	**Gender**		
	Male	266	70.6
	Female	111	29.4
	Total	377	100
2	**Age**		
	Less than 35 years	147	38.9
	36-50 years	136	36.1
	51 year and above	98	24.9
	Total	377	100
3	**Marital Status**		
	Single	98	25.9
	Married	188	49.9
	Widowed	64	16.9
	Divorced	27	7.2
	Total	377	100
4	**Educational Level**		
	Primary Education	28	7.4
	Secondary Education	153	40.6
	Tertiary Education	196	51.9
	Total	377	100
5	**Occupation**		
	Farming	89	23.6
	Fishing	98	25.9
	Civil Servant	113	29.9
	Artisan	67	17.8
	Others	10	2.7
	Total	377	100

N=377

Table II presents the demographic profile of the respondents in the study area.

As noticed, the data on segment profile of respondents. The table uncovered that 266 respondents (70.6%) were male while 111 respondents (29.4%) were female. This infers that male respondents were of the larger part.

The data on age section of the respondents in segment 2 of Table II above shows that 147 respondents (38.9%) were inside under 35years, 136 respondents (36.1%) were inside 36 - 50 years, while 98 respondents (24.9%) were in somewhere around 51 years or more. This data shows that larger part of the respondents were inside the times of under 35 years.

Segment 3 of Table II shows the conjugal status of respondents. 98 respondents (25.9%) were Single, 188 respondents (49.9%) were hitched, 64 respondents (16.9%) is bereaved, and 27 respondents (7.2%) was separated. This data shows that wedded respondents are greater part.

Segment 4 of Table II above shows data on the respondents' degree of schooling. They were addressed as follows: essential instruction (28) (7.4%), auxiliary training (153) (40.6%), tertiary schooling (196) (51.9%). From the data it shows that respondents with Tertiary instruction are of the greater part.

Segment 5 of Table II records the control of respondents. 89 respondents (23.6%) are cultivating, 98 respondents (25.9%) are fishing, 113 respondents (29.9%) are government worker, 67 respondents (17.8%) are

Help. craftsman, 10 respondents (2.7%) were sorted as Others. This data shows that respondents who are government worker are of the larger part.

Table III Residents Response on Awareness of Artisanal Refining of Crude Oil in Rural Communities of Rivers State

S/No	**Awareness of Artisanal Refining of Crude**	Frequency/percentage					Total
		SA	A	D	SD	U	
1	There are many opportunities available to the people of the community in order to survive.	38 10.1	41 10.9	115 30.5	92 24.4	10 2.7	337 100
2	The people of the community deserve better to curb the hardship in the country.	155 41.1	170 45.1	17 4.4	15 3.9	20 5.3	377 100
3	One of the activities engaged by the community for survival is "kpo fire" (artisanal refining).	135 35.8	146 38.7	39 10.4	39 10.1	19 5.0	377 100

SA-Strongly Agree; A-Agree; D-Disagree; SD-Strong Disagree; U-undecided

Table III presents the residents' response on their awareness of artisanal refining of crude in the communities. Majority (74.5%) of the respondents agrees that one of the activities engaged by the residents in order to survive was artisanal refining of crude as many (54.4%) affirmed (disagrees) no much opportunity that is present in the community being the reason they engaged in the refining activity.

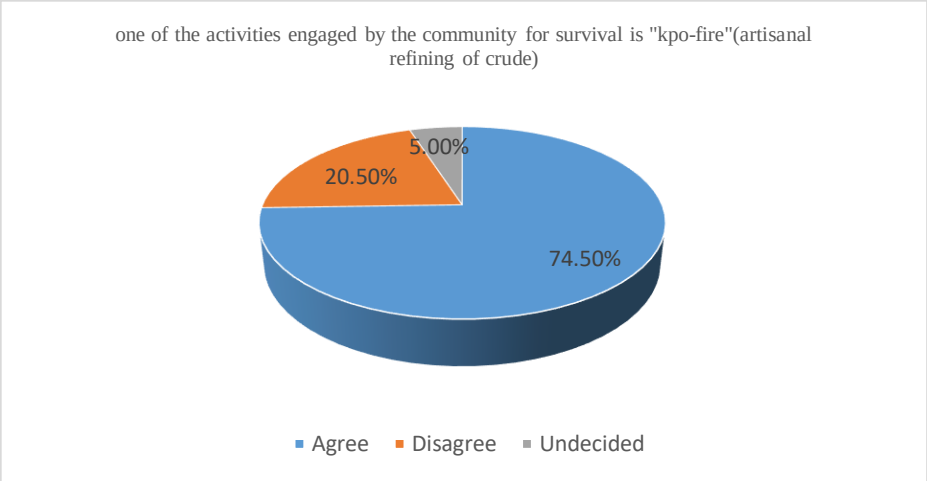

Fig. 2 Awareness of the residents on artisanal refining activities in the community

Fig. 2 displays the awareness of the residents on artisanal refining of crude. Greater number (74.5%) of the residents are aware of the activity, but according to them, they do so in order to survive.

Table IV Residents Response on the Reason for Artisanal Refining Activities in Rural Communities in River State

S/No	**Reasons for embarking on illegal refining of crude Oil**	Frequency/Percentage					Total
		SA	A	D	SD	U	
7	There is no other available job one could engage in to survive in the community, that is why the people engage in "Kpo fire" (Artisanal refining) activities.	150 39.8	131 34.8	41 10.9	36 9.6	19 5.0	337 100
8	In order for some of the youths of this community to survive, they have to involve themselves in "Kpo fire" (artisanal refining) activities.	148 39.3	133 35.3	36 9.6	42 11.1	18 4.8	377 100
9	"Kpo fire" (artisanal refining) activity is profiting and an easy way to making huge amount of money.	152 40.3	131 34.8	45 11.9	33 8.8	16 4.2	377 100

SA-Strongly Agree; A-Agree; D-Disagree; SD-Strong Disagree; U-undecided

Table IV presents the responses of the respondents on their reasons for their involvement in artisanal refining of crude in the community. Some of such reasons was as upheld by greater number (74.6%) of the respondents, unavailability of jobs for survival and that it is profiting and easiest way to make huge money according to majority (75.1%) of those who responded in this direction.

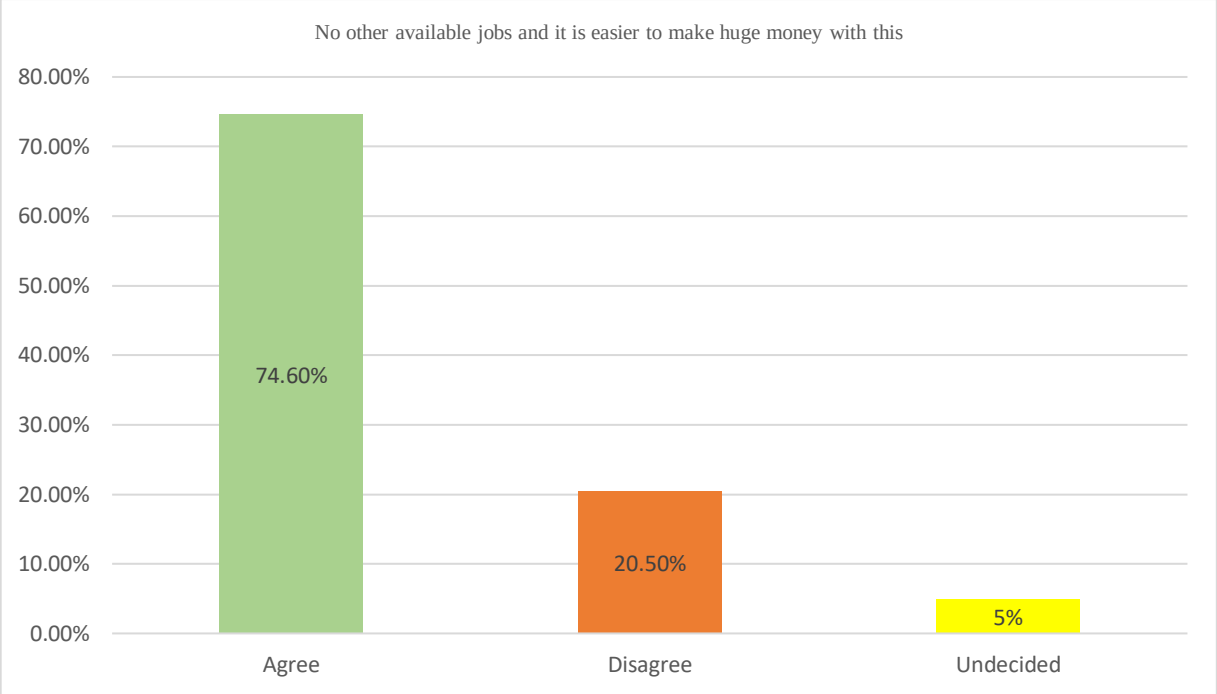

Fig. 3 Residents Response on their Reason for Artisanal Refining of Crude in the Community

Fig. 3 shows the response of the respondents on reasons for their engagement in artisanal refining of crude in the community. On the statement of "no other available jobs and the easier way to make huge money", 74.6% of the respondents agrees, 20.5% disagrees while the remaining 5% were undecided.

Table V Residents Response on the Consequences of Artisanal Refining of Crude Oil in Rural Communities of Rivers State

S/No	**Consequences of Artisanal Refining activities**	Frequency/Percentage					Total
		SA	A	D	SD	U	
10	The "Kpo fire" (artisanal refining) activities could be dangerous as it could lead to fire outbreak and consequently death of those involved.	67 17.8	77 20.4	98 25.9	86 22.8	49 12.9	337 100
11	The surrounding areas in this community where the crude oil is being cooked, always present with tick-dark flame which can be seen above ground level.	308 81.7	41 10.9	11 2.9	9 2.4	8 2.1	377 100
12	This community is always heated up at night which at times, makes it difficult for one to sleep at night.	219 58.1	52 13.8	69 18.3	28 7.4	9 2.4	377 100

SA-Strongly Agree; A-Agree; D-Disagree; SD-Strong Disagree; U-undecided

Table V presents the residents response on the consequences of artisanal refining of crude oil in the communities. On the statements on the agreement continuum of how dangerous the activity could be, 38.4% agrees with the statement, 48.7% of the respondents disagrees while the remaining 12.9% were undecided. What this mean was that many of the people involved in this does not know the danger-inherent associated with the activitiy.

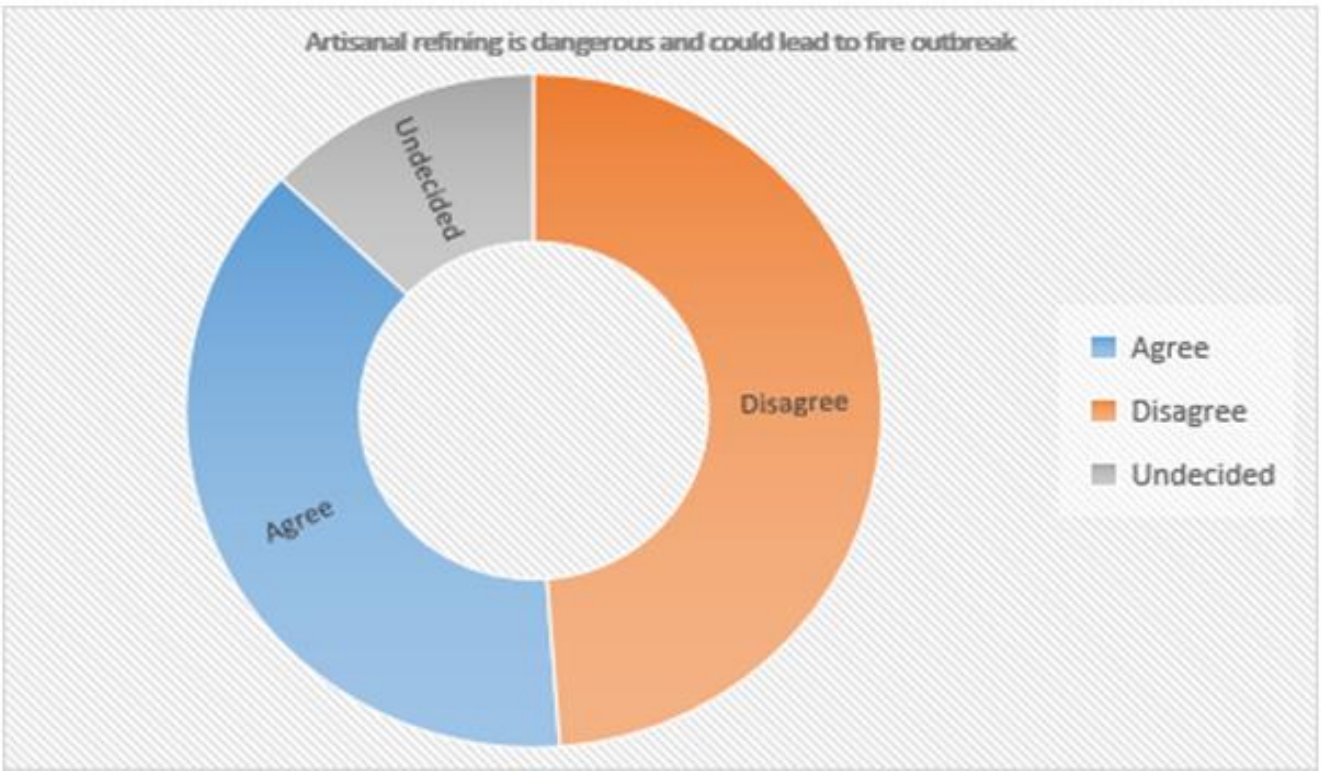

Fig. 4 Residents Response on the Consequence of Artisanal Refining of Crude

Fig. 4 displays the response of the respondents on the consequence of artisanal refining activity. From the figure, many do not know the danger involved in this activity. They embark in it with ignorance.

Table VI Mean Meteorological Variables during the Dry Season in the respective Rural Communities

Met. Variables/Locations	Temperature	R. Humidity	Wind Direction	Wind Speed
Egbeda	31	45	NE	0.1
Ibaa	30	45	NE	0.1
Rumuekpe	31.3	46.7	NE	0.13
Edeoha	32	45.7	NE	0.17
Okporowo	31.7	43.3	NE	0.53
RSU-Ahoada Campus	31.3	45	NE	0.27
Kedere	31.1	40	NE	0.17
Bera	31.3	42	E	0.18
Bomu	30.7	39	NE	0.53
Ogoloma	31.3	39.3	E	1.03
Abam	31.7	39	NE	0.4
Okochiri	32	41.3	E	0.37
Unyeada	35.2	40.8	SW	0.7
Asarama	34	41.2	NE	0.2
Ikuru-Town	33.4	45.2	NE	0.1
Buguma	29.4	45.2	NW	0.2
Abalama	30.8	41.6	NW	0.17
Ido	30.3	42.7	NW	0.6

Table VI presents the mean meteorological variables during the dry season in the rural areas of rivers state. The meteorological variables of interest were temperature, relative humidity, wind direction and wind speed. These were assessed across selected communities in six (6) local government areas. Here the ambient temperature was quite high with low relative humidity.

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Table VII Mean Concentrations of Meteorological Variables during the Wet Season in the Rural Area

Met. Variables/Locations	Temperature(°C)	R. Humidity(%)	Wind Direction	Wind Speed(m/s)
Egbeda	30.30	98.00	SE	0.60
Ibaa	27.70	92.00	SW	1.00
Rumuekpe	28.90	96.00	SE	2.30
Edeoha	31.30	71.30	SE	0.60
Okporowo	31.30	70.70	SE	1.80
RSU-Ahoada Campus	30.70	85.70	SE	1.60
Kedere	27.70	92.00	SW	0.30
Bera	23.30	89.00	E	1.00
Bomu	27.70	96.70	SE	0.40
Ogoloma	27.70	88.30	NW	0.60
Abam	26.30	100.00	NW	1.00
Okochiri	27.30	100.00	SW	0.80
Unyeada	27.70	95.00	NW	0.70
Asarama	27.00	93.00	E	0.40
Ikuru-Town	25.70	90.00	SW	0.20
Buguma	27.30	95.70	NW	0.50
Abalama	26.70	91.00	SW	0.20
Ido	27.30	91.00	NE	0.50

Table VII presents the mean meteorological variables during the wet season in the rural areas of rivers state. The meteorological variables of interest were temperature, relative humidity, wind direction and wind speed. These were assessed across selected communities in six (6) local government areas. As seen on the table, during this season, relative humidity was observably high with low temperature.

Table VIII Mean Concentrations of Air Pollutants during the Wet Season in the Rural Area

Parameters/Locations	SO_2	NO_2	CO	CH_4	VOC	H_2S	NH_3	CO_2	O_3	$PM_{2.5}$	PM_{10}	$PM_{1.0}$
Egbeda	0.16	0.05	0.57	0.018	0.27	0.005	0.27	628	0.02	20.0	21.0	17.0
Ibaa	0.3	0.06	1.4	0.017	0.332	0.005	0.23	624	0.02	22.0	27.0	19.0
Rumuekpe	0.2	0.03	1.5	0.03	0.094	0.003	0.4	632	0.03	32.0	36.0	31.0
Edeoha	0.03	0.02	4.7	0.018	0.165	0.004	0.23	638.3	0.027	36.7	39.3	26.7
Okporowo	0.047	0.055	4.7	0.028	0.056	0.005	0.37	583.3	0.037	16.3	21.3	13.0
RSU-Ahoada Campus	0.051	0.047	2.7	0.019	0.046	0.001	0.27	611.7	0.013	11.7	14.0	9.33
Kedere	0.04	0.053	5.3	0.023	0.207	0.002	0.2	636.3	0.02	31.7	27.7	21.7
Bera	0.04	0.007	4.0	0.026	0.093	0.0023	0.33	629	0.003	46.3	34.3	27.7
Bomu	0.03	0.04	4.7	0.0157	0.208	0.0023	0.33	636.3	0.027	26.3	24	18.0
Ogoloma	0.0013	0.027	1.6	0.0137	0.0137	0.0017	0.13	619	0.013	16.3	23.7	12.0
Abam	0.017	0.07	1.03	0.0157	0.0173	0.0013	0.27	646.3	0.02	15.7	17.3	12.3
Okochiri	0.027	0.05	7.3	0.0157	0.0177	0.0047	0.43	781.3	0.37	15.7	18.3	14.3
Unyeada	0.013	0.047	1.1	0.019	0.221	0.0013	0.27	612.7	0.013	29.0	22.0	16.3
Asarama	0.04	0.053	1.6	0.017	0.461	0.0017	0.33	620.7	0.037	34.0	27.7	19.7
Ikuru-Town	0.023	0.02	1.1	0.017	0.181	0.0023	0.13	617.7	0.027	95.3	25.7	26.7
Buguma	0.037	0.047	6.5	0.0343	0.226	0.0017	0.27	621	0.063	58.7	62.3	47.7
Abalama	0.027	0.033	4.3	0.0363	0.22	0.0013	0.133	597.3	0.0363	53.7	61.7	45.7
Ido	0.027	0.033	3.2	0.024	0.1483	0.0017	0.3	615.7	0.067	61.0	52.0	42.0

Table VIII presents the mean concentrations of air pollutants during the wet season in the rural areas. As seen on the table, the pollutants assessed were SO_2, NO_2, CO, CH_4, VOC, H_2S, NH_3, CO_2, O_3, $PM_{2.5}$, PM_{10} and $PM_{1.0}$ and the locations cut across six (6) local government areas in River State. As observed, some of the concentrations of the air pollutants were high in different locations. Such as CO in Okochiri (7.3ppm), Kedere (5.3ppm) and Buguma (6.5ppm) respectively.

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Table IX Mean Air Quality Concentrations during the Dry Season in the Rural Communities

Parameters/Locations	SO_2	NO_2	CO	CH_4	VOC	H_2S	NH_3	CO_2	O_3	$PM_{2.5}$	PM_{10}	$PM_{1.0}$
Egbeda	0.3	0.08	4.4	0.057	0.834	0.008	0.4	729	0.3	83	93	62
Ibaa	0.4	0.07	8	0.072	0.74	0.007	0.3	814	0.3	85	94	67
Rumuekpe	0.3	0.07	9.7	0.085	0.567	0.005	0.5	821.7	0.3	65	73	42.7
Edeoha	0.14	0.14	7.3	0.042	0.758	0.006	0.47	820.3	0.51	86.7	97.7	73
Okporowo	0.08	0.12	6.3	0.062	0.82	0.011	0.67	797.3	0.68	84.7	98.3	75.7
RSU-Ahoada Campus	0.06	0.1	6.3	0.086	0.65	0.025	0.77	650.7	0.03	63.7	77.7	55
Kedere	0.103	0.05	6.33	0.0573	0.878	0.004	0.53	993.3	0.037	66	70.3	53.3
Bera	0.07	0.073	6.3	0.0813	0.577	0.0027	0.43	949.7	0.047	60.7	69	52
Bomu	0.107	0.1	8.7	0.047	0.863	0.005	0.57	838	0.037	55.7	67.7	46
Ogoloma	0.067	0.057	5.5	0.0653	0.841	0.0063	0.43	723.3	0.27	67	79.7	61.7
Abam	0.047	0.067	7	0.0683	0.752	0.0043	0.43	680.7	0.047	61.3	73.3	58.3
Okochiri	0.073	0.13	9.7	0.0956	0.956	0.0067	0.77	838	0.27	90	98	75
Unyeada	0.05	0.063	8	0.145	0.331	0.0027	0.67	679	0.2	38	32	21.3
Asarama	0.05	0.057	9.7	0.158	0.354	0.0037	0.63	686	0.07	44.7	32.3	21
Ikuru-Town	0.047	0.047	6.83	0.077	0.194	0.0013	0.57	625.3	0.067	112.7	30.3	40.7
Buguma	0.053	0.063	8.3	0.054	0.647	0.032	0.37	694.3	0.06	91	93	67
Abalama	0.043	0.057	6.17	0.0636	0.429	0.0037	0.33	647.7	0.17	85	96	65
Ido	0.03	0.043	7.67	0.053	0.3497	0.003	0.3	676.7	0.08	83.3	95.7	64.7

Table IX presents Mean Concentrations of Air Quality during the dry season in the Rural Communities. This was assessed during the dry season. As seen in the table, the mean centralizations of the air toxins were on the increment and a portion of the boundaries were over the WHO air quality rules in similar areas. Here, the carbon monoxide fixations were high in the different tested areas. This is additionally found in contaminations like ozone, alkali and the particulates. Commonly, these rustic areas would have been supposed to record contamination focuses beneath WHO limit on account of the presence of regular highlights like amphibian climate and vegetation circulation. These are normal sinks for these contaminations which ought to have cut down their levels in the environment. Consequently, what this mean is that, is either these highlights were been obliterated or there are different exercises or practices, for example, distinctive refining that is continually bringing these contaminations into the air than the sinks can ingest.

Hypothesis Testing

H_0: There is no significant difference in the air qualities in the wet and the dry seasons of the rural areas of Rivers State

H_1: There is significant difference in the air qualities in the wet and the dry seasons of the rural areas of Rivers State.

Table X Analysis of Variance (ANOVA) on the Mean Difference of the Air Qualities in the Selected Rural and Urban Areas in Rivers State

Source of Variation	***SS***	***Df***	***MS***	**Rural**	**Urban**	**F-cal**	**F-crit**	**Decision**
Between Groups	970.922	1	970.922	**155.965**	**140.427**	.019	.889	Accept
Within Groups	23267369.698	466	49929.978					
Total	23268340.619	467						

Source: Researcher's Field Result, 2025

Table X shows Analysis of Variance (ANOVA) on the Mean ratings of the air qualities in the selected wet and dry season in Rivers State. The ANOVA results suggest that there is no significant difference in air quality between the wet and dry seasons in Rivers State. The F-calculated value (0.379) is less than the F-critical value

(81.075), and the p-value (0.538) is greater than the significance level of 0.05. As a result, the null hypothesis, which states that there is no significant difference in air quality between the wet and dry seasons, is accepted. Therefore, air quality does not significantly differ between these seasons in the rural area of Rivers State.

DISCUSSIONS

The investigation on the perceptions of the residents on artisanal refining of crude oil and the impact of the activity as it affects the air quality is vital as this will illuminate the overall public on the inhabitants' accessible information regarding the subject in view of reeducating them and perhaps decreasing future occurrence. High quality refining of raw petroleum is a broad practice in numerous provincial networks, particularly in oil producing country like Nigeria. It is an unregulated refining of crude oil to deliver fuel like diesel, lamp oil, and gas [19]. Numerous people group in the study region experience the ill effects of neediness and joblessness. This has made artisanal refining an alluring method of making money. At times, government-claimed processing plants are either non-useful or incapable to satisfy neighborhood need, making an underground market (black market) for refined products. This crude oil is frequently taken from pipelines prompting spills that pollute farmlands and water bodies. The course of this refining discharges poisonous and harmful gases and ozone depleting substances which adds to change in climate and subsequently, medical issues. Laborers and close by inhabitants breathe in poisonous gases causing respiratory illnesses. During this cycle, there is plausibility of biodiversity misfortune as in the consuming of wood and other material to drive this refining action subsequently loosing vegetation which act as home for some organisms. As recorded from greater percentage of the respondents through the agreement continuum, it was noted that artisanal refining is or had taken place before in these areas. This activity which according to them, was embarked as a result of lack of employment opportunities in the area. So, for them, in order for some of the residents to survive, they got themselves involved in the refining of crude oil without minding its negative consequences to the lives and the surrounding environment. Thus, the reasons for engaging in this activity by some of the residents was not enough to outweigh the consequences of their actions to the environment and the ecosystem at large. However, as upheld by the majority of the respondents, the people involved in this illegal refining do so, without their knowledge of the grave consequences associated with their operation. The air around the locations could be impacted leading to poor air quality which have deleterious effect upon inhalation and could contribute to greenhouse effect thereby changing the local climate. This artisanal refining activity has contributed to the pollution of the surrounding air which was evident in the recent assessment of the air quality in the study area. The concentrations of the majority of the pollutants like carbon monoxide (CO), ozone (O_3), ammonia (NH_3) and particulate matters ($PM_{2.5}$, PM_{10} and $PM_{1.0}$) were all above the permissible limit for WHO air quality guidelines. This report on air pollutant concentrations was in support of the submission of [8], [20], [2], [21] and [4].

CONCLUSION

Artisanal Refining of crude in rural communities is an exceptionally mind-boggling issue which is attached to economic survival, government disappointments and environmental degradation. Apart from its impact on the air quality, it also has potential effect on the sources of water as well as damages to agricultural land. These in the long run will lead to loss of the original livelihood of the people if unaddressed by the government and policy makers.

RECOMMENDATIONS

1. Research Improvements: - Implement longitudinal studies to track air quality changes over extended periods - Expand sampling to include more communities and seasonal variations - Integrate multiple environmental indicators (air, water, soil) - Develop more comprehensive health impact assessments
2. Policy and Intervention: - Educate the general public, particularly in rural communities, about air pollution sources and health effects - Promote clean cooking technologies and responsible waste disposal - Reduce biomass burning - Stop artisanal refining activities in affected areas

3. Economic Alternatives: - Develop sustainable employment programs for affected communities - Provide technical training for alternative livelihoods - Establish microfinance initiatives for small business development - Create formal partnerships with legitimate refineries for skills transfer
4. Environmental Management: - Implement regular environmental monitoring systems - Establish community-based environmental protection programs - Develop rehabilitation plans for degraded areas - Create emergency response protocols for environmental incidents.

The implementation of these recommendations requires coordinated effort from government agencies, community leaders, environmental experts, and local stakeholders to ensure sustainable solutions to the challenges posed by artisanal refining activities.

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