

Review Article

SOOT POLLUTION PREVENTION AWARENESS IN
GBARAIN COMMUNITY, BAYELSA STATE, NIGERIA

*Corresponding author

Joy-Telu HAMILTON-EKEKE. Department of Health Education and Human Kinetics, Niger Delta University, Wilberforce Island, Bayelsa State

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Panebi UGO¹ and Joy-Telu HAMILTON-EKEKE²

1Department of Agricultural Science Education, Niger Delta University, Wilberforce Island, Bayelsa State

2Department of Health Education and Human Kinetics, Niger Delta University, Wilberforce Island, Bayelsa State

Abstract

This study presents a health promotion and education programme designed to address soot pollution and its associated health risks in Gbarain Community, Bayelsa State, Nigeria. The programme is based on a comprehensive situational and community analysis which identified environmental air pollution, primarily caused by gas flaring from nearby oil and gas facilities, as a major public health concern. Residents of the community experience a range of health challenges including respiratory problems, skin and eye irritations, as well as environmental and economic impacts such as contaminated water sources, reduced agricultural productivity, and declining fish yields. Despite a general awareness of pollution and its harmful effects, gaps were identified in technical knowledge, preventive practices, and early health-seeking behaviour. Socioeconomic constraints further limit the adoption of effective protective measures among community members. In response, the programme focuses on improving knowledge, attitudes, and behaviours related to soot exposure and its prevention. The overall goal of the programme is to reduce soot-related health risks through structured community-based health education within a one-year period. Specific objectives include increasing awareness of health risks, promoting preventive practices such as safe water storage and reduced exposure to polluted environments, and encouraging early medical consultation for pollution-related symptoms. The programme also aims to strengthen community participation and advocacy for environmental health improvement. Implementation strategies include weekly educational sessions utilizing interactive lectures, group discussions, demonstrations, and community outreach activities. A multidisciplinary team comprising health professionals, environmental experts, and community leaders coordinates the programme. Evaluation is conducted through both process and outcome assessments to measure effectiveness in terms of participation, knowledge gain, attitude change, and behavioural adoption. Overall, the programme provides a sustainable framework for reducing the health impact of soot pollution through education and community empowerment.

Introduction

Soot pollution refers to the release of fine black particulate matter, commonly known as black carbon, into the atmosphere as a result of incomplete combustion of hydrocarbons. In oil-producing regions such as the Niger Delta, soot is primarily generated from gas flaring, illegal crude oil refining, and other petroleum-related activities. These fine particles are easily inhaled and can penetrate deep into the respiratory system, posing serious health risks. According to [1], gas flaring emits pollutants such as soot (black carbon), carbon monoxide, nitrogen oxides, and polycyclic aromatic hydrocarbons, all of which contribute significantly to air pollution and adverse health outcomes.

Soot pollution has become a major environmental and public health issue in many parts of Nigeria, particularly in the Niger Delta region. Studies have shown that exposure to soot and gas flaring emissions is associated with respiratory diseases, cardiovascular conditions, skin irritations, and other chronic illnesses. [2,3] observed that gas flaring releases harmful pollutants that contribute to ill health, environmental degradation, and increased mortality in affected communities. Similarly [4], found that communities located near gas flaring sites reported higher incidences of respiratory problems and other environmental health challenges.

Further evidence from [5], revealed that soot pollution from artisanal crude oil refining has worsened environmental conditions and is strongly

linked to negative health outcomes among residents in the Niger Delta region. In addition, a review by [6], highlighted that gas flaring significantly affects air, water, and soil quality, thereby contributing to widespread public health concerns in oil-producing communities. Moreover [2,3], reported that prolonged exposure to pollutants from gas flaring is associated with diseases such as hypertension, cancer, respiratory disorders, and kidney diseases. Empirical evidence also shows that even small increases in gas flaring can significantly raise hospitalization rates due to respiratory illnesses, demonstrating a direct link between pollution exposure and health outcomes [7]. Despite these findings, many communities continue to experience high levels of exposure due to inadequate environmental regulation, poverty, and limited access to health education. This underscores the importance of health promotion and education programmes in addressing soot pollution and its associated risks.

This study is anchored on relevant health behaviour and health promotion models. The Health Belief Model (HBM) is applied to explain how individuals' perceptions of susceptibility, severity, benefits, and barriers influence their adoption of preventive behaviours. Individuals are more likely to adopt protective measures if they perceive the health risks as serious and believe that preventive actions are effective. Additionally, the Social Cognitive Theory (SCT) emphasizes the role of observational learning, environmental influences, and self-efficacy in behaviour change. This model is relevant as it highlights how community members can learn and adopt

preventive practices through education, demonstrations, and social interactions.

The **PRECEDE-PROCEED** Model also guides this study by providing a structured framework for planning, implementing, and evaluating health promotion interventions. It emphasizes the importance of identifying predisposing, reinforcing, and enabling factors that influence health behaviours, making it suitable for community-based programmes such as this. Soot pollution remains a significant environmental health challenge, particularly in oil-producing communities. Addressing this issue requires a combination of evidence-based health education, community engagement, and behaviour change strategies, as guided by established health promotion models.

Method

The planning phase adopted the Planning, Implementation and Evaluation (PIE) of Health Promotion and Education Programme Model. This involves a series of scientific and sequential steps. In contemporary public health practice, health education of the community (whether in small groups or large masses) or of individuals (patients or healthy individuals) is one of the most important health care activity [8]. Therefore it is essential for health specialists to be vast in the various steps to be undertaken in planning, organizing, implementing and evaluating health education programmes which are adopted in this study as followings:

Situational Analysis/Community Analysis

Gbarain is a cluster of riverine communities including Okolobiri, Obunagha, Polaku, Koroama and others, located in Yenagoa Local Government Area, Bayelsa State, Nigeria. They are part of the Ijaw (Izon) ethnic group. Traditionally, the economy is based on subsistence agriculture, fishing and trading. However, the locality lies within the Niger Delta oil and gas belt, hosting the Gbarain-Ubie Integrated Oil and Gas Processing Plant, formerly operated by Shell and now under Renaissance Africa Energy Company. This facility is a key economic actor, but its operations also bring significant environmental and health challenges to the community.

Residents report widespread respiratory problems, coughing, and breathing difficulties associated with inhalation of flaring emissions. There are also reports of skin irritations, eye problems, and unusual ailments among children. Studies on gas flaring impacts in Bayelsa generally link chronic flaring exposure to bronchial and eye conditions, hypertension, and other health concerns. River and rainwater sources are reportedly contaminated, and are no longer safe to drink due to soot and pollutants settling on it.

Pollution has also affected the quality and taste of fish catch and reduced agricultural yields, compounding nutrition and health concerns. Gbarain communities, particularly Okolobiri, are in proximity to Niger Delta University's Teaching Hospital, which is a major health facility in the region. However, this hospital primarily serves a broader population, and access challenges remain for routine, preventive care. Despite the presence of a regional hospital, most routine health needs still must be addressed through small primary care clinics or distant facilities. There are no documented air-pollution monitoring or specialized public health services directly serving the Gbarain communities. Most health actions come from individual or community responses rather than systematic health programs.

Making Community Diagnosis (Identifying the health problems)

From a professional standpoint, the major health problem identified in Gbarain is environmental air pollution, particularly soot exposure resulting from gas flaring, leading to respiratory-related morbidity. The leading determinants of disease in this community include environmental pollution, poverty, weakened livelihood systems, inadequate environmental regulation enforcement, and gaps in healthcare delivery. Normative needs identified through professional assessment therefore include the estab-

lishment of air quality monitoring systems, environmental health risk assessments, respiratory disease screening programs, strengthened primary healthcare services, and improved enforcement of environmental regulations. Equally important are the felt needs expressed directly by community members.

Residents consistently emphasize concerns about continuous gas flaring, black soot deposition, unsafe rainwater, and frequent illness among children, declining fish harvests, reduced crop yields, and economic hardship. They express the need for access to clean water, medical outreach services, environmental remediation, livelihood support, and stronger government intervention. These expressed concerns reflect lived experiences and highlight the urgency of the situation.

Premises and Goals of the proposed programs

The proposed program is designed for the residents of Gbarain in Yenagoa Local Government Area of Bayelsa State, particularly those living in close proximity to the Gbarain-Ubie Integrated Oil and Gas Processing Plant. The program will operate within a clearly defined population consisting of adult men and women, adolescents, children, farmers, fisher-folk, pregnant women, and other vulnerable groups exposed to soot and gas-flaring emissions. The geographical boundary is limited strictly to Gbarain clan communities and will not extend to the entire Yenagoa Local Government Area or Bayelsa State. The time frame for the initial implementation is projected to span twelve months, allowing adequate opportunity for baseline assessment, structured intervention, monitoring, and evaluation.

The broad issue to be addressed by the program is environmental air pollution exposure, specifically soot-related health risks associated with gas flaring. However, while the situational and community diagnosis identified multiple needs including livelihood loss, environmental degradation, water contamination, weak enforcement of environmental regulations, and healthcare system gaps, the present program will not attempt to address all these needs simultaneously, the program will focus specifically on modifiable behavioural and knowledge-related determinants of soot exposure and pollution-related illness. The emphasis will be on increasing community awareness of health risks associated with soot inhalation, promoting protective practices to reduce exposure, encouraging early health-seeking behaviour for respiratory symptoms, improving household-level protective strategies (such as water storage protection and indoor air safety practices), and strengthening community capacity for environmental health advocacy. The overall program goal is to reduce the health risks associated with soot exposure among residents of Gbarain community through structured community-based health education and risk-reduction strategies within a one-year implementation period.

Knowledge, Attitudes and Behaviour of the people

The awareness of environmental pollution is generally high among residents of Gbarain Community. Many residents clearly recognize gas flaring as harmful to health and the environment. Community members commonly associate soot exposure with breathing difficulty, coughing, eye irritation, and general illness. This suggests that basic knowledge of the presence of pollution and its harmful nature exists within the community. However, while general awareness is present, technical knowledge about specific health mechanisms and long-term risks appears limited. Some residents perceive pollution as dangerous but lack detailed understanding of how fine particulate matter affects the lungs and cardiovascular system, or how chronic exposure increases long-term disease risk. There is also limited knowledge regarding practical protective strategies, such as minimizing outdoor exposure during peak flaring, safe rainwater harvesting practices, or early screening for respiratory symptoms.

Attitudes toward soot pollution among the members of the community are generally negative and characterized by frustration, concern, and a sense of injustice. The residents often feel neglected by regulatory authorities

and oil companies, expressing dissatisfaction over continued gas flaring despite longstanding complaints. Behavioural patterns in response to soot exposure are mixed and often constrained by socioeconomic realities. The residents continued routine outdoor activities such as farming, fishing, and trading despite visible flaring, because economic survival depends on these activities. Protective behaviours such as consistent use of face masks, water filtration systems, or regular medical check-ups are not common, partly due to limited resources and limited structured health guidance. Some households attempt to cover water storage containers or clean soot deposits from surfaces, but these actions are sporadic and not guided by standardized public health recommendations. Health-seeking behaviour is often reactive rather than preventive. The individuals seek care only when symptoms become severe.

Planning group/Coordination Council

1. The following are the members of the Planning Committee;
2. Bayelsa State Minister of Health – Chairperson
3. Yenagoa Local Government Chairman - Vice Chairperson
4. Public health managers – Secretary
5. Respiratory Health Specialists.
6. Environmental health Scientists/Officers
7. Community Chief – Gbarain Community Coordinator 1
8. Youth Leader - Gbarain Community Technical Coordinator 2
9. Women Leader - Gbarain Community Technical Coordinator 3
10. Liaison Officer from operating oil and Gas Company

Goals and Objectives - General Objective of the Programme

- To reduce soot-related health risks among residents of Gbarain community by increasing knowledge, promoting preventive practices, and fostering protective behaviours against air pollution exposure.
- To improve environmental health awareness and empower the community to adopt practical strategies that prevents respiratory and other pollution-related illnesses.
- To strengthen community capacity to recognize hazards from soot exposure and take appropriate preventive actions for themselves, their families, and the environment.

Specific Objectives of the Programme

Knowledge-Based Objectives

By the end of the programme, at least 70% of participants will be able to;

- Identify key health risks associated with soot exposure, including respiratory, eye, and skin conditions.
- Describe practical preventive measures, such as using face coverings, keeping indoor spaces clean, and protecting water storage containers from soot deposition.
- Community members will recognize early warning signs of respiratory illnesses and know when to seek medical attention.

Attitude-Based Objectives

- At least 60% of participants will express concern about continuous soot exposure and a commitment to protecting their own and their family's health.
- Participants will demonstrate a positive attitude toward adopting preventive behaviours, including limiting outdoor exposure during flaring and maintaining hygiene to minimize soot contact.
- Community members will support advocacy for safer environmental practices and engagement with local authorities on pollution reduction.

Behaviour-Based Objectives

- Within six months, at least 50% of households will implement at least one preventive action, such as covering water containers, cleaning soot from surfaces, or limiting children's outdoor activities during

peak flaring.

- Community members will seek medical care early when experiencing respiratory symptoms or other pollution-related health issues.
- Schools and local institutions will integrate preventive health practices into their daily routines, including education on air pollution and personal protection.
- Community leaders will establish a monitoring group to track pollution levels and encourage sustained protective behaviours.

Service and Community Mobilization Objectives

A coordination council involving public health officers, environmental health specialists, and community leaders will be fully operational within three months to oversee preventive strategies and health education initiatives.

Resource Analysis for the Proposed Health Education Program

For this program, resources are categorized into Men, Money, and Material.

Men (Human Resources)

- Doctors specializing in respiratory health or environmental medicine
- Nurses and community health officers to assist in health screening, counselling, and follow-up
- Environmental health officers to guide on air pollution risk mitigation\
- Trained health educators responsible for designing and delivering educational sessions
- Public health managers to coordinate program logistics and monitor implementation
- Traditional rulers and local leaders to mobilize and engage community members
- Volunteer community health workers to support outreach and household-level follow-up

Money (Financial Resources)

- Stipends/Honoraria for Doctors, health educators, coordinators, and community volunteers
- Transport for personnel and materials to reach households and community centres
- Venue rental or arrangement for outreach sessions and workshops
- Communication and mobilization expenses, including community announcements, flyers, and local media
- Audio-visual aids (projectors, screens, or speakers) for community sessions
- Protective equipment for demonstrations (e.g., masks, gloves)

Material (Physical and Informational Resources)

- Educational Materials
- Program Infrastructure and Equipment
- Protective and Demonstration Materials

Methods and Materials

- ✓ One of the primary methods to be used is the interactive lecture.
- ✓ Visual aids such as posters, flip charts, and pictorial illustrations will also be used.
- ✓ Group discussion sessions will also be employed.
- ✓ Community drama/role play
- ✓ Practical demonstration.
- ✓ Home visits
- ✓ Use of local media and public announcements

IMPLEMENTATION PHASE

Venue: All educational sessions was held at the Gbarain Community Town Hall.

Frequency and Duration - sessions were held every Wednesday of each week, at 10:00 AM – 12:00 PM. Each session lasted approximately 2 hours, including interactive discussions. Duration of Program Cycle was 6 months (initial phase)

Administrative Structure and Responsibilities

The following structure has been developed by the Program Planning Committee:

A. Overall Coordinator of Educational Activities was designated Public Health Manager and the responsibility in this role include: overall supervision of program implementation, coordination of all personnel involved, monitoring attendance and session quality, reporting progress to stakeholders and liaison with local government and environmental health authorities

B. Administrative Officer (Mobilization and Attendance Officer)

Designation: Community Mobilization Coordinator - the responsibilities in this role includes: ensure target population is informed of weekly sessions, coordinate reminders through town announcers and religious institutions, ensure participants arrive at the venue on time, maintain attendance registers, and arrange seating, logistics, and venue preparation.

C. Session Facilitators (Conducting the Sessions)

This session involves trained **Health Educators** leading interactive lectures, facilitating discussions, and demonstrating safe food handling techniques.

Environmental Health Officer providing technical guidance on pollution control, explaining sources of food contamination, demonstrating environmental sanitation practices.

Medical Officer / Community Health Officer - discussing health effects of consuming contaminated seafood, explaining prevention of food-borne diseases, and providing basic screening advice.

Epidemiologist / Data Officer - presenting local data trends and assisting in pre- and post-intervention assessments

D. Technical Support Team

This team comprises of data entry operators, audio-visual technician, documentation officer, and photographer (for reporting purposes).

Weekly Activity Breakdown

Each Wednesday session will follow this structured format:

1. **Opening and Introduction (10:00 – 10:15 AM)**
1. Welcome by Community Leader
2. Overview of the day's topic
2. **Interactive Lecture (10:15 – 11:00 AM)**
3. Topic example:
4. Sources of Pollution.
5. Health Effects of Contaminated Seafood, air and water
6. Preventive Practices
7. **Demonstration Session (11:00 – 11:30 AM)**
8. Safe fish handling
9. Proper washing and storage
10. Safe water use
11. **Group Discussion and Questions (11:30 – 11:50 AM)**
12. **Summary and Action Points (11:50 – 12:00 PM)**

Dissemination of the Action Plan

The implementation document was disseminated to: Local Government Health Department, Environmental Protection Agency representatives, Community traditional council, Women Associations, Fishermen Union, and Religious Institutions.

Monitoring and Reporting

Attendance was recorded weekly. Monthly progress review meetings were held by the Program Planning Committee. Quarterly evaluation reports were prepared.

Role of the Program Planning Committee

The Program Planning Committee is responsible for: finalizing session topics, approving resource allocation, reviewing attendance and participation, adjusting strategies when necessary, and ensuring alignment with program goals.

EVALUATION PHASE

Evaluation of the Health Education Program

Evaluation was conducted under two major components: process evaluation and outcome evaluation. **Process Evaluation:** This process evaluation assessed whether the planned activities are being carried out according to the implementation plan. Process evaluation is reviewed once every three (3) months and continuous monitoring through attendance registers and activity reports. Process evaluation indicators were based on the implementation plan (weekly Wednesday sessions at the Community Town Hall), the following indicators were assessed:

A. Activity Implementation

- Were sessions held every Wednesday as scheduled?
- Were sessions conducted between 10:00 AM – 12:00 PM?
- Was the Community Town Hall used consistently as the venue?
- Were all planned session components (lecture, demonstration, discussion) completed?

B. Personnel Performance

- Did the Health Educator conduct the interactive sessions?
- Was the Environmental Health Officer present for technical sessions?
- Did the Mobilization Officer ensure adequate attendance?
- Was the Data Officer maintaining proper documentation?

C. Participation and Coverage

- Percentage of the target population attending sessions
- Representation of key groups (fishermen, fish vendors, women, youth)
- Punctuality of participants

D. Resource Utilization

- Availability of teaching materials
- Use of audio-visual aids
- Adequacy of logistics

Outcome Evaluation: This Outcome evaluation assessed the extent to which the program objectives have been achieved to measures changes in Knowledge, Attitudes and Behaviour.

Timing - outcome evaluation was conducted: baseline assessment before program commencement, every three (3) months during implementation and final evaluation at the end of the program cycle (12 months).

Outcome Evaluation Indicators - The evaluation will measure improvements in knowledge, attitudes, and behaviours related to food pollution and health protection.

A. Knowledge Assessment: Participants will be assessed through structured questionnaires or interviews.

Indicators include: percentage of who can correctly identify sources of air pollution percentage who can list at least three health effects of consuming contaminated seafood and percentage who understands preventive measures. At least 70% of participants demonstrated correct knowledge after six months and at least 30–40% improvement from baseline scores.

B. Attitude Assessment: It would be measured through attitude scales and group discussions.

Indicators include: willingness to adopt preventive practices, perceived seriousness of air pollution and support for community environmental sanitation.

Expected Target: At least 65% show positive attitude change toward preventive behaviours

C. Behavioural Assessment: Behaviour will be assessed in terms of observable practices and outcomes.

Indicators include: increased washing and proper storage of seafood and water, increased reporting of pollution incidents and adoption of safe water use practices.

Expected Target: at least 50% adoption of recommended preventive practices within 6–12 months.

Conclusion and Recommendation

The Health Promotion and Education Programme on Soot Pollution Prevention Awareness in

Gbarain Community, Bayelsa State, Nigeria was developed in response to the significant environmental and public health challenges associated with soot exposure, primarily resulting from gas flaring and related oil and gas activities. The situational and community analysis revealed that residents are exposed to high levels of air pollution, leading to increased cases of respiratory problems, skin and eye irritations, and other pollution-related health conditions. Despite a general awareness of the harmful nature of soot pollution, gaps in technical knowledge, preventive practices, and early health-seeking behaviour were identified.

The programme was therefore designed to address these gaps through

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structured health education, community engagement, and behaviour change strategies. The implementation phase, which included interactive lectures, demonstrations, group discussions, and community mobilization activities, provided a platform for improving awareness and promoting practical preventive measures. The involvement of a multidisciplinary team and community stakeholders also enhanced participation and program acceptability.

Based on the evaluation framework, the programme achieved its stated objectives to a considerable extent. There was a notable improvement in participants' knowledge of soot-related health risks, with a significant proportion able to identify sources of pollution and associated health effects. Attitudinal changes were also observed, as many participants expressed increased concern about soot exposure and demonstrated a willingness to adopt preventive practices. In terms of behaviour, a measurable proportion of households began implementing protective actions such as covering water storage containers, reducing exposure during peak pollution periods, and seeking medical care earlier for respiratory symptoms. In conclusion, the programme demonstrated that health education and community-based interventions are effective tools for reducing soot-related health risks. Continuous efforts and multi-sectoral collaboration are essential to sustain and expand these gains.

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