ASSESSING THE CONTRIBUTION OF TRADITIONAL FISH SMOKING TO GREENHOUSE GAS EMISSIONS AMONG SOME SELECTED COMMUNITIES ALONG THE COAST OF GHANA

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Abstract

The concentrations of greenhouse gases in the atmosphere were relatively stable during the pre-industrial era keeping the Earth's temperature steady until the industrial revolution when the concentrations of these gases increased drastically. Major sources of GHGs include the combustion of fossil fuels and the burning of biomass fuels. Throughout the World, fuelwood is burnt as an important source of energy for cooking and heating. The fish smoking process is no exception as it primarily depends on fuelwood as its major source of energy. The study examined the contribution of traditional fish smoking along the coast to greenhouse gas emissions in Ghana. The study assessed annual fuelwood consumption during the major and minor fishing seasons and the preferences for specific fuelwood types used in fish smoking. The study was conducted in some selected coastal communities in the Western and Central Regions of Ghana. An explorative sequential method was employed as the study design. Focus group discussions and interviews were also conducted with fish smokers and fuelwood suppliers. A cross-sectional study was conducted from May to October 2022. The estimation of greenhouse gas emissions was done using the IPCC tier 1 methodology on stationary combustion. Measurements of GHGs from fuelwood combustions were also recorded using air quality sensors. Results show that the total quantity of fuelwood used by the communities under study was 18, 349.3 MT. As a result, the total amount of GHGs emitted was 30, 279.08 MT CO_2, 131.79 MT CH_4 and 0.91 MT N_2O. The average emissions of GHGs from fish smoking were significantly higher than the usual household biomass cookstoves emission. The findings also show that fish smokers prefer specific fuelwood types to enhance the aesthetics of the fish after smoking, the ability of the fuelwood to last longer in fire, the availability of the fuelwood in the locality and other important factors. The study recommends the field measurement of GHGs from other economic activities that rely on fuelwood in Ghana to

fill the gap in GHG emissions in Ghana and also improve the accuracy of emission factors used to calculate emissions from different biomass sources.

Aim and Objectives of the Study

The overall objective is to examine the contribution of traditional fish smoking ovens to GHG emissions in the coast of Ghana. The study would specifically:

1. Evaluate the preferences of fish smokers for fuelwood types.
2. Determine the amounts of greenhouse gases generated from traditional fish smoking.
3. Assess the emission of greenhouse gases from different types of fish smoking ovens used in the coastal communities.
4. Evaluate greenhouse gas emissions from different fuelwood types used in fish smoking.

Key Findings in the Study

1. The findings of the study revealed that the Chorkor oven is the most commonly used oven by fish smokers, accounting for approximately 93%, followed by the Traditional cylindrical mud oven at 6% and the Ahotor oven at 1%.
2. Reasons for the preference of specific type of fish smoking oven have to do with efficiency, convenience, the appearance of the fish after smoking, and the oven's longevity. Although improved ovens for fish smoking have emerged, these ovens are yet to be fully embraced by fish smokers.
3. The results show that, the amount of fuelwood necessary to smoke a certain quantity of fish depends on the type of oven used. The Chorkor and Traditional cylindrical mud ovens use significantly more fuelwood than the Ahotor oven.
4. Fuelwood species used for fish smoking are many, however some are preferred compared to others. Reasons for the preference include: the aesthetic of the fish after smoking; ability of the fuelwood to last longer in fire; ability of the fuelwood to dry the fish with ease; ease of flammability; the cost of the fuelwood; availability of the fuelwood in the locality etc.

5. Using the IPCC Tier 1, the study found that the total annual quantity of fuelwood used by the communities was 18349.30 MT emitting 30279.08 MT CO_2, 131.79 MT CH_4 and 0.91 MT N_2O of GHGs
6. The total amount of GHGs released though huge with reference to other cookstoves, it is negligible when compared to what is released from other sectors like the agricultural and energy sectors of the country.
7. The concentration of GHGs emitted were significantly higher than usual biomass dependent cookstoves used in households for cooking and heating.

Recommendations

The following recommendations are hereby proffered:

1. Strong collaboration between fish smokers and the developers of the fish smoking ovens is recommended to improve upon the acceptability of improved ovens that conserve fuelwood.
2. All organisations including NGOs and institutions that are engaged in the promotion of efficient and improved fish smoking ovens should include behavioural models toward fuelwood utilization.
3. Farmers, Forestry Commission, researchers and interested private organisations should collaborate to cultivate preferred fuelwood species to optimize efficient fish smoking to offset GHG emissions

INVESTIGATING THE SOURCES OF MICROBIAL CONTAMINATIONS IN THE POST-SMOKING PHASE OF ATLANTIC CHUB MACKEREL (*Scomber colias*) IN SELECTED COMMUNITIES ALONG THE COAST OF GHANA

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ABSTRACT

This study investigated the sources of microbial contamination in the post-smoking phase of Atlantic Chub Mackerel (*Scomber colias*). Atlantic Chub Mackerel were purchased from 15 fish processors/vendors in five communities along the coast of the Central and Western regions of Ghana. Bacterial and fungal loads were determined for three sampling stages and further investigations were undertaken to find out whether there were statistical differences in the different sampling times. Results show that microbial loads varied across the various communities, with higher loads in communities with marked levels of poor sanitary conditions. In the Western Region, higher loads were observed in samples from Shama and Kesewokan. Also, bacterial loads were predominantly within the tolerable range of 3 – 5 (5 $\log_{10}$ CFU/g) according to Ghana's Food and Drug Authority, with a few close to the unacceptable limits. Fungal loads were generally within the acceptable limits of 1-3 (3 $\log_{10}$ CFU/g) as compared to bacterial loads. The findings indicated that the samples had some levels of faecal contamination and the presence of *Staphylococcus aureus*, which are potentially dangerous to human health. Predominantly, first stage samples had relatively lower loads of contaminations as compared to the second and third stage samples. The study also found that microbial contamination varied significantly in the various sampling times.

The study recommends the need for organisations such as the Ghana Standards Board and the Foods and Drugs Board to develop standard procedures for fish processing especially smoking in Ghana. It is further recommended that the District Assemblies prioritised the environmental health of coastal communities through resourcing the Environmental Health Departments to maintain clean environments devoid of contaminants in coastal communities. They should also work at curtailing open defecation in coastal communities. There is the need for enhanced awareness creation and education on environmental health in coastal communities and

especially among women fish processors. It is important for these women to be educated on the appropriate handling and management techniques of fish products to reduce contaminations to ensure food safety.

Aim and Objectives of the Study

The study sought to investigate the source of microbial contamination in the post smoking phase of the Atlantic Chub Mackerel (*Scomber colias*).

Specifically, the study unravelled the following specific objectives:

1. To assess the bacterial load (E. coli, Salmonella and Staph. aureus) in fish samples
2. To estimate the fungal load (yeast and mould) present in fish samples
3. To compare the microbial loads at different stages of sampling (from the end of the smoking process, to cooling and transportation of final products to markets) in all communities
4. To identify characteristics that potentially affect microbial loads across all selected communities.

Key Findings in the Study

1. Microbial loads vary significantly among communities.
2. Microbial loads increased with every higher order of sampling along the processing chain.
3. Range of bacteria identified included *Staphylococcus aureus, Salmonella* spp., and *Shigella* spp., as well as some general coliform species. Predominant bacteria identified was *S. aureus,* which was present in samples from all vendors from the selected communities.
4. Moulds were the least observed groups of microorganisms.
5. Fungal species identified included *Neurospora crassa, Fusarium* spp., *Aspergillus niger, Aspergillus flavus, Muccor* spp., *Penicillium* spp., *Cladosporium herbarum,* etc. However, the most predominant species identified was *A. niger,* which was identified in more than 75% of the samples, in significant quantities.

Recommendations

Taking the findings of the study into account, the following recommendations were suggested;

1. There is the need for education in the form of local workshops for uneducated fish processors. To teach them improved management practices, particularly on how to handle the fish products before, during, after smoking and even during transportation to local markets as well. It is, therefore, imperative that management groups and NGOs intensify their efforts on not just training fisherfolks on appropriate management practices at landing beaches but also train fish processors on appropriate handling techniques such as optimum temperature ranges for the successful elimination of certain groups of microorganisms. This may go a long way to reduce contamination during and after the smoking process.
2. Education in different facets should cover the scope of the importance of the state of their environment. The immediate environment i.e., where the smoking is done, plays a key role since it is a potential source of contamination. There is, therefore, the need to keep a very hygienic environment without stray animals, since they are one of the primary sources of faecal contamination in smoked fish products.
3. There is the need for keeping the fish frozen until it is time to process it since Atlantic Chub Mackerel is usually purchased from cold stores and not caught in Ghanaian waters. The study also recommends proactive actions for using high enough temperatures when smoking in order to eliminate all forms of pathogens, shielding stored goods from damaging outside effects, and following excellent hygiene standards (Oduor-Odote, 2006; Adeyeye *et al.*, 2015).

AN ECONOMIC ASSESSMENT OF SOCIAL PROTECTION SERVICES AND IMPROVED FISH SMOKING TECHNOLOGY ON LIVELIHOODS OF FISHERFOLKS IN GHANA

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Abstract

Social protection service (SPS) and improved technologies have proven to be necessary tools for improving livelihoods. In an attempt to deliver these, the village savings and loan association (VSLA) and Ahotor oven for fish smoking have recently gained recognition as practical pathways to enahance social protection and fish smoking respectively. VSLA can alleviate credit constraints by facilitating savings, and access to loans. Ahotor oven on the other hand, has high-yielding capabilities and tolerance to health of women fish processors and the environment at large. In response, the Cerath Development Organisation (CDO) in collaboration with the European Union (EU) implemented the SPS as part of their "Power to the Fishers" project to tackle poverty and vulnerability as well as enhance sustainable livelihoods in selected fishing communities in Ghana. This study is an attempt to document the impact of the SPS and the Ahotor oven on the livelihoods of some coastal communities. Primary data was collected from 507 fisherfolks in five coastal communities in the Western and Central regions of Ghana. In studying the impact of VSLA, triple hurdle model was employed to examine the three separate stages of stochastic decisions or choices. The three stages involved the examination of: (i) the factors influencing participation, (ii) access to credit, and (iii) the amount of credit obtained. In addition, the impact of SPS on income and food security as a welfare intervention was evaluated using an endogenous switching regression model corrected for endogeneity. In addition, behaviour correlates of factors influencing adoption and use of Ahotor was analysed. The results indicates that majority (70.61%) are enagaged in fishing activities in their primary occupations. However, most (75.35%) do not own bank accounts, which may help them get access to credit or save towards resilience building. The study recorded 43% of participation in the SPS through the VLSA and 14% in terms of the adoption of Ahotor oven, in spite of an overwhelming (80.28%) awareness of the existence of these interventions. Also, the econometric model results confirmed that SPS through VSLA participation decisions of fisherfolks were significantly influenced by gender, experience, education level, family size and

access to credit. While access to credit facilities and amount of credit are significantly affected by age, education, access to credit services from other sources, extension contact, family size, and off-farm income. Whereas perceived attributes factors such as relative advantages, complexities, cost, and observability drive the adoption of Ahotor fish oven. On the impacts of the interventions, the study revealed a significant positive impact of VSLA on income and poverty reduction for participants compared to non-participants. Again, an additional amount of one cedi (GHS1) received as credit from participation in VSLA reduces food insecurity experiences by a greater magnitude relative to non-participation in the interventions. The results imply policy implications that could shape future interventions in coastal communities in Ghana.

Aim and Objectives of the Study

1. Determine factors influencing fisherfolks' decision to participate in social protection services

2. Examine behavioural factors influencing fisherfols intention to use improved fish smoking technology.

3. Evaluate the effect of social protection services on household welfare (income, food security, and nutrition quality).

Key Findings

- Relatively low participation in the VLSA and the adoption and use of Ahotor oven in spite of an overwhelming awareness of the existence of these interventions.
- Participation in VLSA among communities is significantly associated with factors such as gender, education, household income, membership of FBO, and awareness of the VSLAs.
- The adoption and use of Ahotor is significantly affected by factors such as educaion level, experience, extension contact, and membership of commumity-based organisation (CBO).
- Participation in these interventions improved income levels, reduced poverty,reduced food insecurity experiences as well as improved nutrition quality. It also provided improved quality of nutrition among participants.

Key Policy Recommendations

1. The study recommended that policies by NGOs and key stakeholders targeted at SPS should be broadened to include financial support as such demand-side will help achieve a universal coverage SPS.

2. Proposedly, the Ministry of Gender Children and Social Protection should revive the openness of social protection programs to include vulnerable households in coastal communities.

3. Also, revealing the importance of social relationships, the study recommends policies that foster social connectedness through CBOs to amplify the sense of belongingness and participation in interventions.

4. There is the need to implement behavioural change interventions targeted at coastal communities, especially males' (fishermen) participation in SPS and females' (fishmongers) adoption of Ahotor ovens.

ASSESSMENT OF LIVELIHOOD VULNERABILITY IN SELECTED COASTAL COMMUNITIES OF GHANA

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ABSTRACT

This study examined the extent of vulnerability of livelihood options of three (3) selected communities in the coastal areas of Central and Western regions of Ghana. Using the exploratory sequential mixed method, qualitative data was first collected using techniques of focus group discussion, in-depth interviews and key informant interviews. The qualitative data yielded information on the livelihood options as well as key variables measured in the quantitative phase of data collection. Six (6) focus group discussions were organised, twelve (12) in-depth interviews and four (4) key informant interviews from the three communities. In addition, structured interviews were administered to 411 household heads in the communities. Results revealed that numerous livelihood options existed in the communities and these could be grouped into fisheries-related (fishing-based) and non-fisheries-related (non-fishing-based) livelihoods. Fisheries-related livelihoods include fishing, fish processing, boat making, fish trading etc. while the non-fisheries related to activities such as agriculture, transport services, financial services, mobile money businesses among others. These livelihood options vary with respect to community. Factors that engender vulnerability of livelihoods include: (i) financial difficulties, (ii) climate change, (iii) low patronage of goods and services, (iv) lack of logistics, storage, road networks, (v) health related issues, (vi) bad governance and illegalities among others. On livelihood vulnerability, Shama had the highest indices of community vulnerability (0.6), for exposure (0.68), sensitivity (0.59), potential impact (1.3) and are able to adapt less (0.7). as compared to the other communities. Winneba had the community vulnerability of 0.47, exposure (0.62), sensitivity (0.54), potential impact (1.16) and adaptive capacity of 0.69, while Gomoa Dago had community vulnerability of 0.22, with exposure (0.53), sensitivity (0.57), potential impact (1.1) and adaptive capacity of 0.88 which is the highest compared to the rest of the communities. This study recommended that training services on prudent financial management should be extended to coastal communities by NGOs and government organisations.

OBJECTIVES OF THE STUDY

The study's goal is to determine how vulnerable various livelihood options are within selected coastal communities in Ghana.

The specific objectives of this study are

1. Identify the livelihood options available in selected coastal communities.
2. Determine the extent of livelihood vulnerability on coastal communities.
3. Determine factors that contribute to livelihood vulnerability
4. Examine the communities' perceptions on livelihood vulnerability
5. Identify the existing coping strategies to livelihood vulnerability.

STUDY FINDINGS

1. The livelihoods identified in the selected coastal communities were fisheries-related and no-fisheries-related.
2. Fisheries-related livelihoods constituted the highest form of livelihoods within the selected coastal communities.
3. Factors contributing to livelihood vulnerability are numerous and include exogenous factors such as climate change and other issues pertaining to access to and management of funds.
4. Livelihood vulnerability varies among communities with Shama being the most vulnerable community.
5. Issues bordering on governance and politics surrounding the distribution of premix fuel contributed to livelihood vulnerability.
6. Increase in illegal fishing activities involving foreign fishing fleet and vessels have contributed immensely to livelihood vulnerability
7. Coping strategies vary greatly by coastal community

RECOMMENDATION

1. NGOs, government of Ghana and other stakeholders should support in providing training on financial management to communities especially women.
2. Training Induction of more trades and handicrafts works (sewing and hairdressing) in selected coastal communities.

3. Stakeholders including Fisheries Commission, Ghana Ports and Harbours Authority etc. should endeavor to mount on all fishing vessels be it artisanal, semi-industrial and industrial Vessel Monitoring System (VMS) to check illegalities at sea.

A COMPARATIVE STUDY OF THE QUALITY AND SHELF LIFE OF FISH SMOKED USING TRADITIONAL AND IMPROVED OVEN IN GHANA

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Abstract

A number of traditional fish processing methods exist in Ghana, with the most common being smoking, using the Chorkor oven. Studies have, however, shown that smoking with Chorkor oven has both health and environmental implications through the release of PAHs and other compounds that are carcinogenic, and increased deforestation which accelerates climate change through excessive use wood of firewood. The Ahotor oven was developed to address the issues posed by the use of Chorkor oven. To enhance its adoption, a comparative study was carried out to determine the quality and the shelf life of products smoked using Chorkor oven and Ahotor oven. Two fishing communities, namely; Winneba and Shama-Kesewokan were selected as the study locations while Atlantic Chub Mackerel (*Scomber colias*) was the selected species. Fish samples at both sites were smoked using both ovens and analyzed with respect to quality and shelf-life. Data analysis was conducted using Microsoft Office Excel (2019) and Statistical Software for Social Sciences (SPSS) version 26 (SPSS, 26), analysis of variance (ANOVA) was conducted to find variations between the measured parameters. Results revealed that aroma, texture, moisture and protein varied significantly while appearance, taste, acceptability, ash content, fiber content did not vary significantly in quality and shelf life indicators of fish smoked using the two oven types at the two study sites. The Total Volatile Basic Nitrogen (TVB-N) and the Peroxide Value (PV) values obtained were both within maximum acceptable limits for smoked fish smoke with two ovens. PAHs for Chorkor oven smoked samples were higher than those smoked with Ahotor oven, however, they both exceeded the EU maximum residue limit of PAHs in smoked fish. From this research, it can be concluded that fish smoked with these two ovens are not significantly different in terms of quality and shelf life, however, there is the need for a standardized method of fish smoking.

Key findings

- There is no effect of the oven type on the proximate composition of the smoked fish.
- There is an effect of the oven type on the colour of fish, the browning index of fish smoked using Chorkor oven were significantly higher than those smoked using Ahotor oven.
- There is no effect of the oven type on the pH, brix and texture of the smoked fish.
- The peroxide value (PV), total volatile basic nitrogen (TVB-N) and Histamine content of fish smoked using Chokor oven were higher than those smoked using Ahotor oven
- The polycyclic aromatic hydrocarbons (PAHs) of fish smoked using Chorkor oven were higher than those smoked using Ahotor oven
- There is no effect of the oven type on the consumer acceptability of the smoked fish, however, flash profiling revealed a difference between fish smoked using Chorkor oven and Ahotor oven
- There is no effect of the oven type on the shelf life of the smoked fish

Recommendation

- Research institutions and interested scientists should conduct further studies using different fish species and at more fish smoking locations to offset the effect of the type of raw material on the quality and shelf life of fish smoked.
- Ghana Standards Board should lead in the development of standards for smoked fish in Ghana.