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Evaluation of Government's Efforts to Mitigate the Adverse Effects of Gas Flaring in Host Communities

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

Background: This is a 5th in the series on gas flaring in Niger Delta Nigeria and previous reports have highlighted health impact and comparison of communities, amongst others. Government have mitigation programs whose satisfaction in the communities of Niger Delta is unknown.
Objective: The objective of this study is to evaluate government's efforts at mitigation and adaptation whether there are age and/or gender differences
Methods: This was a quantitative survey cross-sectional study that used Likert scale questionnaire to generate views of the community on the behavioural change wheel (BCW) as well as mitigation and adaptation efforts of the government. Respondents were stratified into age groups and dichotomized in female or male and analysis involved multivariate analysis (MANOVA) to evaluate age and gender differences. Chi-Square tests were performed to assess associations between BCW components mitigation versus adaptation.
Results: A total of 435 respondents were included and the results show levels of inconsistent age and gender differences. Men tended to agree more on government's BCW albeit not significance achieved, while women agreed more mitigation and adaptation ($p < 0.02$). On age, the silent generation (>70 years old) group agreed more on BCW, but contrarily disagreed on mitigation and

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adaptation while younger generation agreed on the latter (0.001). Chi-Square tests show significance for association.
Conclusion: This report highlights divergent views of the community on the discourse of government's efforts at mitigation and adaptation of gas flaring in Niger Delta Nigeria, thereby providing empirical evidence of generational gap on environmental issue.

Keywords: Gas flaring; government awareness; mitigation and adaptation; negative health impacts.

1. INTRODUCTION

Nigeria is the largest oil producer in Africa however significant challenges such as food insecurity, lack of access to energy and high unemployment, illiteracy, malnutrition and diseases, amongst others, remain principal constraints on economic development and are of primary concern to the government [1, 2]. The Federal Government of Nigeria has been concerned with the growing trend of gas flaring in the country. This has led the Federal Government of Nigeria to put in place several measures to curb the menace of gas flaring and some are shown in the following timelines (Fig. 1).

Although these measures have led to a reduction in the volume of gas flared per the volume of gas produced, a lot still needs to be done to further reducing the volume of gas been flared. In 2017, 324 Billion Cubic Feet (BCF) of gas was flared in the country and perhaps have led to negative health impacts to those living around the flare sites. It has been reported that the Nigerian government has not enforced environmental regulations effectively because of the overlapping and conflicting jurisdiction of separate governmental agencies governing petroleum and the environment as well as non-transparent governance mechanisms [6]. In addition, due to weak regulation and enforcement, operators prefer to flare associated gas instead of separating it from oil to avoid the cost of harnessing the associated gas [7].

In 2016, the Minister of State for Petroleum Resources launched seven big wins for the Petroleum Industry in Nigeria, one of which is Gas Revolution. As a drive towards the gas revolution, the Nigerian Gas Flare Commercialization programme was developed, which is hinged on paragraph 35b of the Petroleum Act 1969 that gives the Government the right to take natural gas produced with crude oil by the licensee or lessee free of cost at the flare or at an agreed cost without payment of royalty. Furthermore, in July 2018, a Regulation was passed pursuant to this Act called the Flare Gas (Prohibition of Wastes and Pollution) Regulation 2018 [4].

What is known: Government has mitigation programs against adverse effects of gas flaring on community and environmental health (Fig. 1).

What is unknown: Whether the government's behavioural change wheel (BCW) and adaptation efforts are satisfactory or unsatisfactory to the people.

Research objective: To evaluate the people's views concerning government's efforts in mitigating the adverse effects of gas flare in gas flaring host communities.

Hypothesis: This study investigates 2 hypotheses

1. Views on government's efforts in mitigating the adverse effects of gas flaring differ when age and/or gender groups are compared in the community.
2. Other hypothesis is that mitigation and adaptation are dependent.

2. METHODS

Summary of design, data and statistical analysis are as follows:

2.1 Design

This was a quantitative survey method, using Likert scale questionnaire.

2.2 Questionnaire

The questionnaire collected data on 3 themes including government's behavioural change wheel, mitigation, and adaption (Table 1).

2.3 Selection Criteria

All participants who responded to the first 3 questions were selected to constitute dataset_1 for evaluation of BCW.

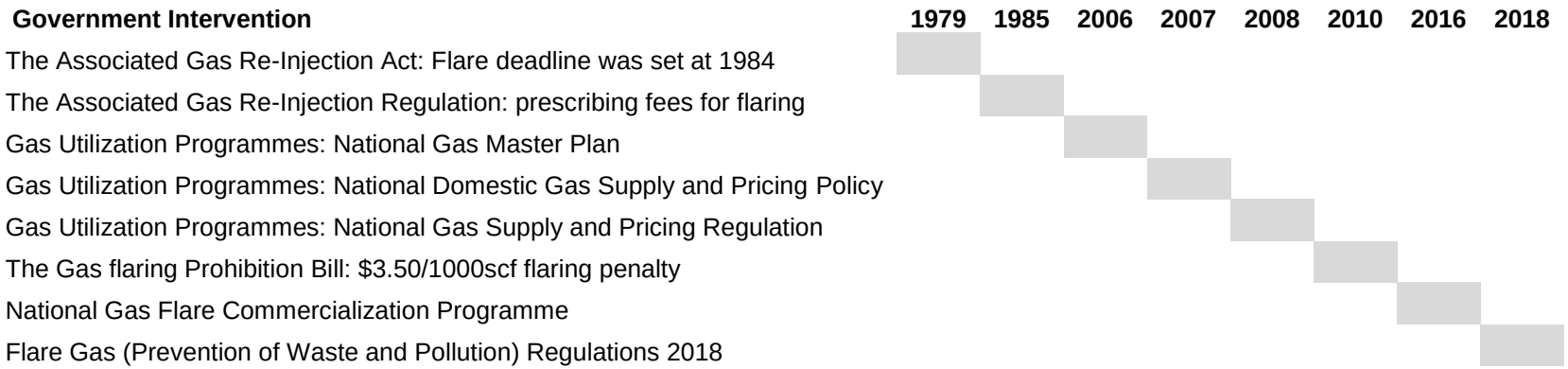

Fig. 1. Timelines of government intervention to end Gas flaring in Nigeria [3-5]

Table 1. Survey questions in themes

SN	Theme	Disease prevention & treatment programs - re: The government
1	Awareness/ Capacity	The government is aware of potential health problems in the community due to impact of gas flaring
2	Motivation	The laws or policies or regulations governing operation of oil companies are okay
3	Opportunity/ Practice	The current guiding laws for gas flaring are adequate to ensure effective enforcement
4	Mitigation	*has put measures in place to protect community from the impact of gas flaring
5	Mitigation	*has community health promotion policy regarding diseases/illnesses/injuries associated with gas flaring
6	Adaptation	*provides general educational info in regard to health impact of gas flaring in the community
7	Adaptation	*provides educational info regarding ways to prevent health impact of gas flaring in the community
8	Mitigation	*has programmes to alleviate the health effects of gas flaring in the community

2.4 Statistical Analysis

Besides descriptive analysis, 2 main analyses were performed. First was multivariate analysis (MANOVA), which involved age & gender subgroups on responses to BCW (Q1 – 3) as well as mitigation and adaptation (Q4 – 8) questions. Second analysis was Chi-Square tests for responses to motivation vs. opportunity as well as mitigation vs. adaptation i.e. (Q2 vs. Q3), and (summative '4+8' vs. '5 – 7').

3. RESULTS

Descriptive statistics show the frequency distribution of respondents to comprise 40.3% being in the 36 – 50 years bracket and 61.5% being males (Table 2). The averaged Likert scale values out 5 when converted to percentage show for all the 8 questions marginal agreements on mitigation and adaptation but mixed on BCW with value for awareness being statistically significantly lower relative to others (Fig. 2).

Comparison of stratified age groups shows statistically significant differences in the individual responses on BCW, but not on summated scale. Multivariate analysis shows values for the [>70 years] group is significantly different from those of [20 – 35], [36 – 50] and [51 – 70] years. The mean values also indicate <2.5 on question of awareness, but >3.0 on motivation and opportunity (Fig 3). In the responses on mitigation and adaptation, statistically significant differences were observed on all individual and summated scales with consistent lowest values observed in the [>70] years old group ($p < 0.001$), contrary to BCW where it is highest in 2 of the 3 questions. The results show that on average, respondents over 70 years old disagreed on all points while young adults 20 – 35 years old agreed (Table 3).

On comparison between gender, results show no difference in the responses on BCW, both individual questions and summated scale. However, cursory review shows consistently higher values for males than in females. Further, results show mean values indicating <2.5 on question of awareness, but >3.0 on motivation and opportunity (Table 4). In the responses on mitigation and adaptation questions, significant differences were observed on all individual and summated scale with consistent lower values in males than female ($p < 0.001$), contrary to BCW. Further critical review show on average, men disagreed while women agreed (Fig 4). Therefore 1st hypothesis is accepted that views of government's mitigation and adaptation effort differ with age and gender groups.

Chi-Squared tests show significance both asymptomatic and symmetric. The test between responses to questions on motivation and opportunity components of BCW was multiple group (Table 5). The test between mitigation and adaptation was based on their respective summated scales, which were categorized into agreement and disagreement (Table 6) and in both tests, Pearson Chi-Square is $p < 0.0001$. Therefore, the 2nd hypothesis is accepted that mitigation and adaptation are dependent of each other.

Table 2. Frequency distribution of participants into age and gender subgroups

Groups		Valid percentage
Stratified age groups	<20 years old	6.1%
	21 - 35	28.2%
	36 - 50	40.3%
	51 - 70	19.6%
	>70 years old	5.8%
Gender dichotomy	Males	61.5%
	Females	38.5%

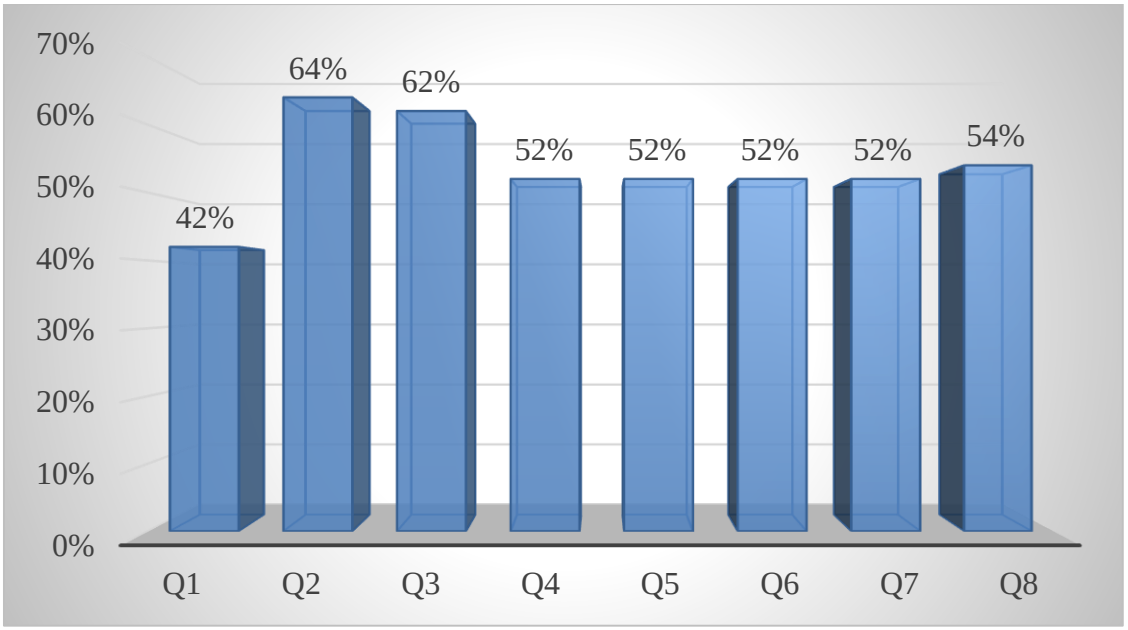

Fig. 2. Averaged Likert scale values for all 8 questions (ANOVA: p < 0.00001)

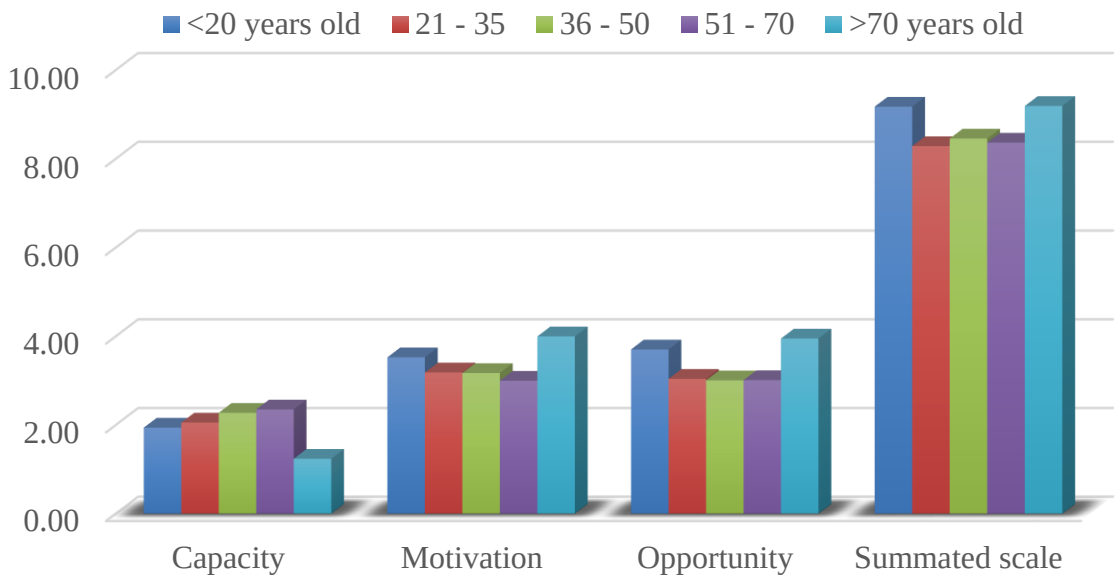

Fig. 3. Averaged summated Likert scale responses in age groups (MANOVA p < 0.14)

Table 3. Averaged Likert scale responses to questions on mitigation and adaptation

Age group	Q4	Q5	Q6	Q7	Q8
<20 years old	2.5000	2.6923	2.8077	2.8846	2.7308
20 - 35	2.9583	3.0250	2.9667	2.9083	3.0333
36 - 50	2.4942	2.4942	2.5291	2.5523	2.5349
51 - 70	2.4762	2.3929	2.4762	2.5000	2.5357
>70 years old	1.8800	1.7600	1.8400	1.7200	1.6800

Table 4. Descriptive statistics of BCW responses in gender groups (SPSS output)

Gender dichotomy		Mean	Std. Deviation	N
Capacity: Awareness of government	1.00	2.2304	1.56654	204
	2.00	1.9921	1.41702	126
	Total	2.1394	1.51345	330
Motivation: Existing laws, policy, & procedure	1.00	3.2157	1.37628	204
	2.00	3.1984	1.32677	126
	Total	3.2091	1.35558	330
Opportunity: Enforcement of laws & procedures	1.00	3.1078	1.34572	204
	2.00	3.0952	1.37654	126
	Total	3.1030	1.35550	330
Summated scale (Q1 - 3)/15	1.00	8.5539	2.87199	204
	2.00	8.2857	2.89788	126
	Total	8.4515	2.88046	330

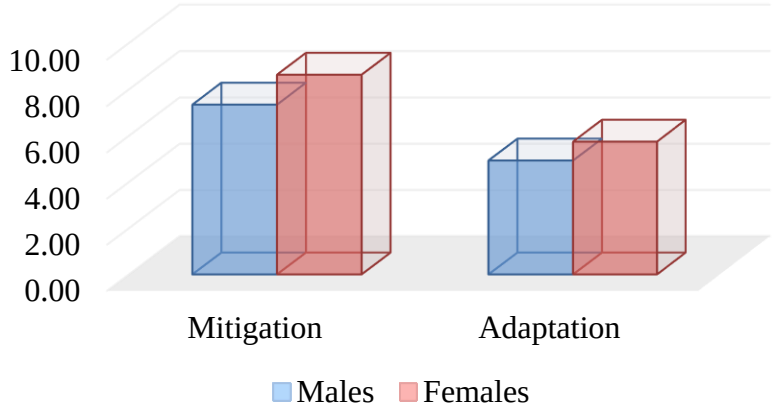

Fig. 4. Averaged summated Likert scale responses in gender groups (p < 0.001)

Table 5. Chi-Square of 2 & 3 Likert scale responses' tests (SPSS output)

A: Crosstab		Opportunity: Enforcement of laws & procedures					Total
		1.00	2.00	3.00	4.00	5.00	
Motivation: Existing laws, policy, & procedure	1.00	29	6	3	0	1	39
	2.00	21	38	24	2	0	85
	3.00	3	7	25	8	4	47
	4.00	4	2	6	61	13	86
	5.00	2	2	6	27	37	74
Total		59	55	64	98	55	331

B: Chi-Square	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	355.411[a]	16	0.000
Likelihood Ratio	339.167	16	0.000
Linear-by-Linear Association	191.044	1	0.000
N of Valid Cases	331		

Table 6. X^2 of mitigation and adaptation dichotomous categories' test (SPSS output)

A: Crosstab		Adaptation dichotomous categories		Total
		Agree	Disagree	
Mitigation dichotomous categories	Agree	198	20	218
	Disagree	35	182	217
Total		233	202	435

B: Chi-Square	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	243.950[a]	1	0.000		
Continuity Correction[b]	240.956	1	0.000		
Likelihood Ratio	275.428	1	0.000		
Fisher's Exact Test				0.000	0.000
N of Valid Cases	435				

4. DISCUSSION

Two contextual underpinnings of this work are mitigation and adaptation to gas flaring health impacts. The concept of mitigation versus adaptation is about the agenda to alleviate or stabilize versus adapting or adjusting to the occurring trend. This research acknowledged that Nigerian government has had several mitigation programs; and the objective was to survey if BCW and adaptation efforts are in tandem.

The first observation is that the level of government awareness is low and the averaged Likert scaled responses indicate disagreement on government's awareness, but marginal agreement on the other 2 BCW questions (Fig. 2). There is no gain saying that awareness or knowledge is power and on capacity, motivation, and opportunity; the implication is that the people believe government is motivated as well as has opportunity but lack the capacity i.e. to tackle gas flaring impacts. In terms of ability and willingness, the government is willing but unable and there are similar concerns from other parts of the world. For instance, the United States of America is among the world's top 5 countries involved in gas flaring and report has implied the American government is unaware of level of flare and associated pollution [8].

The second observation is on age and gender differences in responses. Figs. 2 – 4 corroborate that the people believe the government is willing and has prospect to offer services but lacks awareness of the magnitude of the public health problem. However, there are age and gender differences, including those >70 years being the influential age in differences observed. The result showed consistently lowest summated scale values in the [>70] years old group with statistical significance ($p < 0.001$). Thus, it can be inferred that age is strong factor as respondents over 70 years old disagreed on all points while young adults 20 – 35 years old agreed (Table 3).

The implication albeit worrisome is that there may be generational gap in understanding the role of government in mitigation and adaptation of gas flare impacts. Age differences towards climate change has been reported, for instance in Australia it has reported that the young generation have strong pro-climate views [9]. While the report indicates that younger generation cares more about climate change, this study is around industry-related environmental pollution and it is pertinent to note that:

- The elderly [>70 years] agrees more that government has willingness and chance, but contrarily disagrees more on the level of the government's capacity (Fig. 3).
- The elderly [>70 years] disagrees on all 5 questions about mitigation and adaptation of gas flaring while the younger 'generation' tends to agree albeit marginally (Table 3).

These observations draw attention to the general disposition of the young generation being more worried about climate change [10]. The observations imply that the disposition may not translate to care about industrial pollutions. In fact, there is conflict dispositions around baby boomers being more environmental culprits or friends; and the observation reported here is in agreement with a report from United States of

America of deep generational gaps on "…environmental priorities, and in terms of general values, it is the Silent generation that stands apart" [11].

Further, the evaluation for gender differences shows no statistically significantly difference on views regarding government BCW, though men tended to agree more (Table 4). On the contrary, there were statistically significant difference between gender and women agreed more on questions regarding government's mitigation and adaption efforts (Fig. 4). This observation is in agreement with the notion about gender gap on environment issues [12]. There is concern regarding gender roles in environmental pollution epidemiology, but data is limited [13]. What this report contributes is epidemiological data to advance age and gender perspectives in the discourse of gas flaring mitigation and adaptation agenda.

In the Chi-Square tests, first was on motivation vs. opportunity and this is meant to assess the general knowledge that motivation drives practice [14, 15]. The results show Pearson Chi-Square between the motivation and opportunity components of BCW to be large and significant as well as the mitigation and adaptation based on the respective summated scales agreement/disagreement categories. Therefore, the 2nd hypothesis is accepted that mitigation and adaptation are dependent of each other.

5. CONCLUSION

This study evaluated the people's views regarding government's efforts in mitigating the adverse effects of gas flare in gas flaring host communities and observed age and gender differences. Results revealed that men tended to agree more on government's BCW albeit not significance achieved, while women agreed more mitigation and adaptation ($p < 0.02$). On age, the silent generation (>70 years old) group agreed more on BCW, but contrarily disagreed on mitigation and adaptation while younger generation agreed on the latter (0.001). This report contributes additional data on gender and generational gap in the discourse of environmental issues.

CONSENT

Consent was implied by respondents returning their completed questionnaire.

ETHICAL APPROVAL

This study is part of a doctoral thesis at Charles Sturt University, Australia; with Ethics approval (protocol number H20004).

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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