ORIGINAL ARTICLE

The efforts made to solve environmental health problems in developing countries. A case from Mtwara town in Tanzania

Obadia Kyetuza Bishoge [1,2], Ademola Kabir Aremu [3], Dickson Dare Ajayi [4], Sayoki Mfinanga[5]

[1] Pan African University Life and Earth Sciences Institute (Including Health and Agriculture), Ibadan, Nigeria.
[2] National Institute for Medical Research, P.O. Box 9653, Dar es Salaam, Tanzania.
[3] Department of Agricultural and Environmental Engineering, University of Ibadan, Ibadan, Nigeria.
[4] Department of Geography, Faculty of the Social Sciences, University of Ibadan, Ibadan, Nigeria
[5] Muhimbili Medical Research Centre, National Institute for Medical Research, Dar es Salaam, Tanzania.

Corresponding Author Obadia Kyetuza Bishoge **Email:** obishoge@yahoo.co.uk

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ABSTRACT

In this study, the cross-sectional study was designed to assess efforts to solve environmental health problems in Mtwara town, Tanzania. A questionnaire survey was used to collect perceptions from 685 secondary school students on environmental health problems and efforts to solve these problems. Descriptive statistics such as frequencies and percentages were applied to describe the basic characteristics of the data, and principal components analysis was used to examine the dominant modes of variation of functional data in environmental health concerns of Mtwara town. The Relative Importance Index method was used to analyze the efforts made to solve environmental health problems. This study revealed seven environmental health issues that are pressing in Mtwara town (water supply, natural hazards, sanitation and hygiene, solid waste, air quality, climate change, and population concern). All of the questionnaire variables had significant factor loadings ranging from 0.429 to 0.854. In addition, the creation of environmental awareness among individuals, the existence of various campaigns, water purification, sociocultural beliefs, and mass media have been identified as the main efforts to solve the environmental health problems. The creation of environmentally conscious individuals was the highest among all items with a weight of 3.054545, and the schools' sensitivity to environmental health was the lowest with a weight of 1.314425. It is recommended that countries strengthen capacity building for more effective policy responses by consolidating the knowledge base and developing cross-sectoral cooperation strategies. In addition, socio-economic and political approaches should be introduced to sustainably link the environment and health.

Key words:
capacity building; environmental consciousness; environmental health; environmental health challenges

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INTRODUCTION

Achieving environmentally sound health is one of the global goals for sustainable development. Therefore, a good environment must be ensured to create strong socio-economic, healthy and political ties that support human life. There is a close connection between the environment and health, as humans depend on the environment to meet their basic needs that enable them to live a healthy life. Humans are exposed to the environment throughout their lives to meet their basic needs such as water, food, energy, air, land, forests and protection from the environment [1]. Therefore, every individual, community or nation should be concerned with the protection of the environment and environmental conservation to ensure access to those needs.

Environmental degradation leads to serious impacts on human health and ecosystems. Environmental issues such as climate change, pollution, chemical and biological agents, ultraviolet and ionizing radiation, agricultural pesticides, occupational hazards, and built-in environmental hazards are directly linked to pollution. Many people are exposed to these problems and this leads to health risks. For example, 1 in 4 people worldwide dies from environmental damage [2]. In addition, according to Galey [2], poor environmental conditions cause over 25% of global diseases and deaths.

Inadequate access to clean and safe drinking water is leading to an increase in preventable diseases such as diarrhoea, cholera and typhoid [3]. It is estimated that 1.4 people die from these diseases each year. In addition, the chemicals dumped into the sea lead to potentially multiple health effects[4] , land degradation and deforestation pollute the homes of over 3.2 billion people [2]. Likewise, unhealthy work environments kill 13.7 million people each year [5].

The World Health Organization reports that low- and middle-income countries are those that bear the greatest environmental burden for all types of disease and injury. However, high-income countries appear to bear the greatest burden of non-communicable diseases such as cancer, stroke and cardiovascular and chronic respiratory diseases [6]. 8.5 out of 13.7 million environmental deaths are from non-communicable diseases attributed to diseases [5].

Again, various wastes such as solid, liquid and hazardous waste are among the major environmental health problems in developing countries including Tanzania [7]. The environmental health problems are complex and require appropriate and efficient systems-based approaches and strategies that facilitate sustained effective and efficient interventions. Every country strives to achieve environmental health management by emphasizing that all stakeholders must be fully involved in protecting and preserving the environment. Therefore, the study was conducted to assess the major environmental health challenges faced by Mtwara town and the efforts of the government and non-governmental organizations to address these challenges.

METHODS

Research design and study area

This cross-sectional study was designed to use a quantitative approach to assess efforts to solve environmental health problems of secondary school students in Mtwara town, Tanzania. Located in Mtwara, Tanzania's Southern Region [8], the town has over 28,336 students (about 26% of the 108,299 total population in Mtwara town), of which 17,705 are ordinary secondary school students and 10,631 are advanced secondary school students.

Sampling and data collection

The questionnaire survey was used to collect data from 685 secondary school students, the sample was obtained by Israel's [9] formula for determining sample size, $n = \frac{N}{1+N(e)^2}$ to obtain where n = sample size, N = total number of students (9,419 ordinary and 1,212 advanced secondary school students) and e = a 5% margin error at a 95% confidence level. The sample size was used to select the subsamples from each school in each class of study by proportionally using the total number of students available at the school (Table 1).

Table 1. Sample size of students

No	Ward	School name	Ordinary level		Advanced level		Total Sample
			Students	Sample	Students	Sample	
1	Likombe	Mtwara Islamic	426	**27**	NA	NA	**27**
2	Rahaleo	Amana	194	**12**	5	**3**	**15**
3	Vigaeni	Rahaleo	660	**40**	NA	NA	**40**
4	Shangani	Mtwara Tech	684	**40**	189	**117**	**157**
5	Reli	Bandari	544	**34**	NA	NA	**34**
6	Chikongola	Sabasaba	862	**52**	NA	NA	**52**
7	Mitengo	Mitengo	508	**32**	NA	NA	**32**
8	Jangwani	Mikindani	550	**34**	NA	NA	**34**
9	Majengo	Umoja	559	**35**	NA	NA	**35**
10	Naliendele	Naliendele	524	**33**	NA	NA	**33**
11	Mtawanya	Mtwara Girls	NA	NA	257	**159**	**159**
12	Ufukoni	Aquinas	363	**23**	23	**22**	**45**
13	Chuno	Call and Vision	266	**22**	NA	NA	**22**
	Total		6140	**384**	486	**301**	**685**

Key: NA means Not Applicable

The questionnaire consisted of two parts. The first part included general demographic characteristics such as gender, gender, and class of study of the respondents. The second section consisted of specific questions on environmental health challenges and efforts to address them. The questionnaire was developed using questions and variables from the literature review of the most similar studies [10,11] adapted to the context of the participants in Tanzania. A total of 685 students from 13 secondary schools answered the questionnaires. 9 out of 13 schools were public while the remaining (4) were private schools. The data collection was completed within one month.

Data analysis

Environmental Health Problems

Principal component analysis (PCA) was used to examine the predominant variation modes of functional data on environmental health challenges in Mtwara town. PCA is a statistical data reduction technique used to simplify complexity in high-dimensional data while preserving trends and patterns and determining variations [12]. It is among the factor analysis methods that examine linear relationships between groups of variables.

PCA transforms the data into fewer dimensions to summarize the data [13]. This transformation is so well defined that the first principal component has the largest variance that accounts for as much of the variability in the data as possible. Sample adequacy was assessed using the Kaiser-Meyer-Olkin (KMO) test, which for this study was 0.812, showing that the study items were suitable for factor analysis and could be considered meritorious. The KMO test is a statistical measure to determine the suitability of data for factor analysis [14].

Efforts to solve environmental health problems

The Relative Importance Index (RII) method was used to analyze the efforts made to solve environmental health problems in Mtwara town. RII is used to determine the relative importance of the quality factors involved [15]. In this study, relative index analysis was chosen to rank environmental health problems according to their relative importance [16]. The results were analyzed using SPSS and Microsoft Excel. Students were asked to indicate the extent to which they agreed or disagreed with statements on a Likert scale from 1 to 4. The individual frequencies of each statement were multiplied by the corresponding rating (ie 1, 2, 3 and 4), which was then summarized. This sum was divided by the product of the total number of students (N) and the highest point on the Likert scale (4). The formula used for this calculation is given below.

$$RII = \frac{\Sigma W}{A*N}$$

Where;

W: Weighting given to each factor by the respondent

A: highest weight in the research

N: Total number of the students

So for our data, the formula shows:

$$RII = \frac{4n4+3n3+2n2+1n1}{A*N}$$

Where;

n_4 = Number of students for Strongly Disagree

n_3 = Number of students for Disagree

n_2 = Number of students for Agree

n_1 = Number of students for Strongly Agree

A (Highest Weight) = 4

N (Total number of students) = 67

Ethics consideration

Ethical approval for this study was granted on April 8, 2021 by the National Health Research Ethics Sub-Committee of the National Institute for Medical Research in Tanzania (Code: NIMR/HQ/R.8a/Vol.IX/3648). All study participants aged > 18 years provided written informed consent; Written informed consent was obtained from parents or guardians aged <18 years. Respondent consent, risks, benefits, and comfort were complied with according to research ethical guidelines.

RESULTS

Respondent demographics

Only 680 out of 685 questionnaires were received. Of all the responses received, 672 (98.8%) were valid, while 8 (1.2%) were invalid due to reasons such as missing data or repetition. 433 (64.4%) students were females, the remaining (35.6%) were males. 54.3% were between 12 and 17 years of age, followed by 18 to 23 years with 45.8%. 373 (56%) were ordinary level students while 299 (44%) were advanced level students (Table 2).

Table 2. Student demographics (n=672)

Participants' characteristics	Frequency (%)
Gender	
Female	433 (64.40)
Male	239 (35.60)
Age Group	
<12	5 (0.74)
12-17	365 (54.32)
18-23	302 (45.94)
***Class of study**	
Form 1	99 (14.73)
Form 2	90 (13.39)
Form 3	86 (12.80)
Form 4	98 (14.58)
Form 5	299 (44.49)

*Note: * In Tanzania there are two levels (ordinary level with Form 1 to 4 and advanced level with Form 5 and 6) of secondary education 17.*

Results of the PCA

Table 3 shows PCA results, the factor loadings after rotation, eigenvalues and percentages obtained after factor and reliability analyses. All questionnaire items on environmental health problems had significant factor loading between 0.429 and 0.854. The initial analysis was performed for each of the seven items (environmental health challenges) to obtain an eigenscore above Kaiser's criterion that is greater than 1.0 [18]. The eigenvalues of the seven items ranged from 1.001 to 4.536. The sphericity of the Bartlett test as a factor solution showed a meaningful correlation between the study items ($p<0.000$), indicating that all selected items were related and suitable for further analysis.

The KMO measure of 0.812 verified sample adequacy and showed that the study items were suitable for factor analysis and could be considered meritorious [19]. A KMO greater than 0.6 is suggested as the minimum for satisfactory factor analysis for the variables [20]. The extracted total variance was 52.657%. Given the large sample size, the convergence of the scree plot and Kaiser's criterion results were used. The results of the PCA highlighted seven structured components that were retained for the final analysis. This was because they showed high internal consistency. Cronbach's alpha based on standardized items was 0.779, while Cronbach's alpha overall was 0.807, showing strong internal reliability between study variables [21].

Efforts to solve environmental health problems

Using RII, the creation of environmentally conscious individuals was the highest among all items with a weight of 3.054545, and the school's sensitivity to environmental health with a weight of 1.314425 was the lowest (Table 4).

Table 3. Rotated component matrix of study variables

Study variable	Component						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Human feces and household materials contaminate surface and ground water	0.781	-	-	-	-	-	-
There is safe and clean water for households and industry	0.779	-	-	-	-	-	-
Chemicals from industry and agriculture contaminate surface and ground water	0.761	-	-	-	-	-	-
Water supply systems are sufficient	0.731	-	-	-	-	-	-
Clean and safe water is available and accessible to all people	0.703	-	-	-	-	-	-
Chlorine is used to kill bacteria in drinking water systems	0.569	-	-	-	-	-	-
More time is spent looking for water for schools and households	0.444	-	-	-	-	-	-
Improper wastewater treatment can lead to disease outbreaks	0.429	-	-	-	-	-	-
Drought occurs in the town	-	0.781	-	-	-	-	-
Strong winds (hurricanes) usually occur in the town	-	0.774	-	-	-	-	-
Earthquakes usually occur in the town	-	0.762	-	-	-	-	-
Floods usually occur and affect some activities and properties	-	0.634	-	-	-	-	-
The presence of disasters that sometimes occur in the town	-	0.538	-	-	-	-	-
The presence of good toilets at home that we use as a family	-	-	0.783	-	-	-	-
The presence of poor sanitation and hygiene systems in the town	-	-	0.763	-	-	-	-
The presence of sufficient toilets for students and teachers in the school	-	-	0.741	-	-	-	-
The toilet we use at home is shared with other households	-	-	0.604	-	-	-	-
The presence of enough garbage cans to dispose of waste in the town	-	-	-	0.854	-	-	-
The presence of a lot of solid waste produced in the town	-	-	-	0.729	-	-	-
Some industries generate toxic substances and hazardous wastes in the town	-	-	-	0.656	-	-	-
The presence of industries that produce gases such as carbon dioxide that affect air quality	-	-	-	-	0.829	-	-

Study variable	Component						
	1	**2**	**3**	**4**	**5**	**6**	**7**
Air quality in my community is affected by local industry	-	-	-	-	0.725	-	-
There is poor air quality that is linked to premature death, cancer, and long-term damage to respiratory and cardiovascular systems	-	-	-	-	0.715	-	-
Climate change poses risks to the health and well-being of human populations and is therefore becoming a serious problem	-	-	-	-	-	0.797	-
Climate change is leading to an increase in infectious diseases such as malaria, skin cancer, cholera and typhoid	-	-	-	-	-	0.797	-
Rapid population growth is a serious environmental health problem	-	-	-	-	-	-	0.729
Malnutrition in Tanzania is a consequence of environmental health problems	-	-	-	-	-	-	0.729
The KMO measure	0.812						
Cronbach's alpha coefficient	0.781						
Cronbach's alpha based on standardized items	0.779						
Eigenvalues	1.001 - 4.536						
Percentage of extracted variance	52.657						

Notes:

Component scales are:

1. *Water supply,*
2. *Natural hazards,*
3. *Sanitation and hygiene,*
4. *Solid and gaseous wastes,*
5. *Air quality,*
6. *Climate change, and*
7. *Population concern*

Table 4. Efforts to solve environmental health problems

No.	Study item	Response scores					
		1	2	3	4	RII	Rank
1	Creating environmentally conscious people is mandatory for future generations to live in a healthy and safe environment	519	114	23	16	3.054545	1
2	The presence of various efforts such as environmental health protection campaigns and training	367	224	53	28	2.475138	4
3	The government and non-governmental organizations oversee environmental health challenges	350	255	45	22	2.481994	3
4	The presence of classes related to environmental health in school	375	200	54	43	2.423805	5
5	The presence of Water, Sanitation and Hygiene (WASH) campaigns ensured raising awareness of environmental health in schools	279	235	97	61	2.093458	9
6	The existence of clubs dealing with environmental and health issues in the school	310	221	83	58	2.180049	8
7	The government monitors the quality of drinking water in the town	347	235	54	34	2.410762	6
8	Municipal drinking water is treated in a water treatment plant before it is released to the public	301	263	69	39	2.258824	7
9	Mass media such as radio and television provide awareness and information related to environmental health	461	172	27	12	2.877944	2
10	The presence of cultural beliefs that enhance environmental health protection	193	240	138	101	1.802817	10
11	School sensitivity to environmental health problems	102	98	141	331	1.314425	11

Note: *Response scales are 1. Strongly Agree; 2. Agree; 3. Disagree; 4. Strongly Disagree*

DISCUSSION

This study found that students believe water sources are contaminated by human activities, including human feces, agriculture, and industry. Agricultural and industrial activities contribute a lot to water pollution [22,23], resulting in an increase in direct negative impacts such as digestive problems, toxicity and death or chronic toxicity and neurological problems on human health [22,23]. For example, about 38% of water bodies are under significant pressure from agricultural pollution [24]. Interestingly, most people don't go far to look for water. These results contrast with reports suggesting that most people in developing countries spend a significant amount of time searching for water [25].

In this study, flooding was perceived as the most dangerous. For example, floods usually affect people's health in terms of injury, poisoning, infection and mental health problems [26]. There are also impacts of displacement, lack of safe drinking water and disruption in access to social services such as health and education [27]. Interestingly, hazards such as droughts and earthquakes rarely occur.

The majority of respondents said they have enough good quality toilets for

use in schools and at home. This is in contrast to Reeves et al. [28] who reported that a significant number of children in New Zealand did not have access to quality hygiene facilities such as toilets and bathrooms at school. Likewise, Coswosk et al. [29] showed an insufficient number of toilets for students and school staff, and the current toilets in Bahia, Brazil had insufficient conditions such as clogging or pollution.

Most respondents identified climate change as an environmental issue with high impacts on human health. These results are in contrast to the study conducted by Pitpitunge [30], in which more students lacked awareness of the impacts of climate change in the Philippines. Likewise, the study by Gautam et al. [31] concluded that half of the secondary school students in Biratnagar, Nepal had insufficient awareness of the impact of climate change on human health. Population growth has been another environmental health challenge that needs special attention. Overpopulation is linked to negative environmental health issues such as water pollution, deforestation, global warming and waste production. For example, Weber and Sciubba [32] found a significant effect of regional population growth on increases in carbon dioxide and urban land use in Western Europe. Similarly, Opeoluwa [33] reported that rapid population growth in Nigeria means increasing impacts on ecological carrying capacity and available natural resources such as water.

To ensure that generations live in a healthy and safe environment, one must consider creating environmentally conscious people. The creation of environmentally conscious personalities was given high priority. People need to be aware of how their actions can lead to negative impacts on the environment and health [34]. An environmentally conscious person must believe that a small effort on their part can bring about a great change for all of humanity. Also, he's the one who sympathizes with his neighbor next door and thinks a lot less about himself and more about society as a whole.

The environmentally conscious communities should be able to adapt to normal practices such as recycling waste materials, using filtered water, using solar energy, planting trees, buying local food, eating smart, walking, cycling or using public transport, covering rubbish bins and saving electricity and water. The environmentally conscious individuals should start by teaching the children to lead an eco-friendly lifestyle by teaching them about the importance of recycling, setting a good example for children and planting trees or gardens together. This is because the world is currently being corrupted by polluting toxic amounts of materials, making sustainability a good choice.

In addition, school sensitivity to environmental health issues is critical to student health protection. Because students spend a third of their time in school. During this time, they can experience a variety of socio-physical and psychological harms. Thus, schools should provide an ideal opportunity to uncover poor student sanitation and hygiene. In this study, students reported that schools are sensitive enough to environmental health issues. Schools ensure the right of students to accept a healthy school environment, particularly in relation to hygiene practices, safe water supplies and latrines. Teachers raise awareness and impart knowledge about environmental health to students and ensure practices such as school environment and personal cleanliness are implemented as reported in other studies [35–38].

Mass media as a means of disseminating environmental health information to society was ranked second of all items. There are various mass media

such as radio, newspaper and television that are used to spread information about environmental health in Mtwara town. There are radio stations like Tanzania Broadcasting Corporation Taifa, Tanzania Broadcasting Corporation FM, Pride FM Radio and Safari Radio. TV channels such as Tanzania Broadcasting Corporation 1, ITV Independent Television Ltd, East Africa Television, Channel Ten Television, Star Television and Clouds Television. Newspapers include DailyNews, Mwananchi Newspaper, The Citizen and HabariLeo. These media are a critical way to reach, communicate, and influence communities about the alarming intensity and frequency of environmental health issues[39]. This helps to bring about positive change or prevent negative changes in environmental and health-related behaviors in communities [40].

In addition, there are various campaigns and trainings offered by the government and NGOs for environmental health management. These campaigns include the creation of classes and clubs to raise student awareness of environmental health at school and at home. Currently, environmental and health-related topics are being included in the curriculum in Tanzania as environmental education in Tanzania is no longer optional but necessary [41]. As such, there are already components of environmental health education in all curricula, from pre-school to high school, and teachers are already implementing this practice around. Students learn about the environment and health through various clubs such as environmental and gender clubs. Environmental clubs are a group of students who care about the environment and are committed to learning about and raising awareness of environmental issues [42]. They have an obligation to address environmental issues and impacts in their schools, at home, in their communities, and in the world to reduce or eliminate them on the whole.

However, there are challenges to environmental health education. These include poor environmental health education foundation and skills, lack of teaching and learning materials, inadequate research and coordination, poor linkage between cross-cutting issues, low priority of environmental health issues, low morale among teachers, and low school community engagement.

Additionally, water purification is one of the efforts highlighted in this study. It was ranked sixth and seventh on all points. Here, through the Mtwara Urban Water Supply and Sewerage Authority, the government treats water before distributing it to consumers. Water treatment removes or reduces the concentration of contaminants and unwanted components so that the water is suitable for the desired end-use [43,44].

CONCLUSIONS AND RECOMMENDATIONS

This study evaluated the environmental health problems in Mtwara town and the students' perceptions of their nature and magnitude. Despite multiple efforts such as creating environmentally conscious people, utilizing mass media and improving environmental education, achieving sustainable environmental health in Tanzania is still a major challenge. There is an increasing burden of diseases such as malaria, cholera, cancer, respiratory and ischemic heart infections and typhoid caused by environmental health concerns. These problems must encourage governments and other stakeholders to work on and improve environmental health.

To achieve this, it should be:

- Building capacity for more effective policy responses by consolidating the knowledge base and developing cross-sectoral cooperation strategies. Society should be made aware of better management of

ecosystems to improve the health of residents. In addition, improve the education of health practitioners and the public about environmental health. This should be achieved through the introduction of proper environmental education at all levels of study to help people better protect themselves from environmental hazards and related diseases.

- Adopting socio-economic and policy approaches to environment and health, for example by better identifying the qualitative and quantitative relationships between environment, health and economic growth, taking into account the irreparable health and environmental damage and costs imposed by current generations versus future ones.

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