

Environmental degradation and assessment in northern Ghana: From populist and classic methods to methodological triangulation approach

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ABSTRACT

As given in the Principle 17 of the Agenda 21, there is the need for environmental assessment for human developmental activities that are likely to have significant adverse impacts on the natural environment (UNCED, 1992). This article reviews various assessment methodologies and the reasons why methodological triangulation is a preferred choice to assess environmental degradation. Methodological triangulation is seen as the use of multiple methods in studying social science issues of concern so that to increase the study validity and or credibility. This implies that triangulation is the combination of two or more method approaches to assess social issues. The study reviews the applications of the populist and the classic approach in natural resource assessment, their advantages and disadvantages and methodological triangulation as a combination of both for neutralizing the flaws of the two approaches. Thus, to reap the benefits of the two approaches and minimizing the drawbacks, the combination of these two approaches has been advocated in this article as well. This study then tests the strength of methodological triangulation to assess environmental degradation in northern Ghana.

Keywords: Methodological triangulation, populist approach, classic approach, environmental degradation, environmental assessment.

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INTRODUCTION

Environmental degradation has now become a global phenomenon that needs to be researched and modified for human wellbeing and development. This arises because of the realization that the environment holds fundamental natural resources for economic and social development and should therefore be used sustainably (WCED, 1987; Briassoulis, 2000; EU, 2003). By protecting it and maintaining the intrinsic value, the environment will serve mankind's needs currently and future generations (UNEP, 1998; Stern, 2006). According to Dregne et al. (1991) and Solbrig and Young (1992), regions worldwide face unprecedented environmental degradation particularly in savannah environments of the developing countries where the natural environment is perceived to be under greatest threat.

Although natural processes such as adverse climatic

conditions, earthquakes, drought, tsunamis and hurricanes have been identified as major causes of environmental and resource depletion, human activities such as indiscriminate grazing, large and small-scale mining, sand and stone quarrying, periodic bush burning and firewood harvesting, have played an increasingly important role in driving the ecosystems of many developing countries far beyond their carrying capacity, causing unprecedented degradation and depletion of the natural resources (William, 1998).

Assessment of environmental degradation and natural resource depletion has therefore become a global issue for long-term management of the natural resources and the preservation of livelihoods that depend on them (William, 1998).

As proposed by Turner (1989), Pierce (1998), Reed et

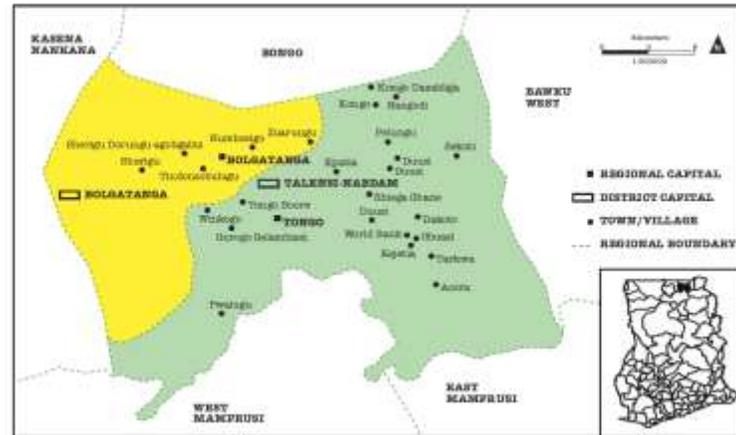


Figure 1. Map of tested area (Bolgatanga and Talensi Nabdam Districts).
Source: CERGIS (2010).

al. (2007) and Stringer and Reed (2007) key steps should be taken in the assessment of human caused environmental problems through research into the scientific and social determinants and the adoption of an appropriate environmental assessment procedure.

In recent years, for natural resource assessment, the use of populist and classic approaches in studying the same phenomenon has received significant attention among scholars and researchers (Stringer and Reed, 2007). This article reviews in detail these previous assessment methodologies, their advantages and shortcomings and the reasons for adopting methodological triangulation as the appropriate approach for assessing complex environmental related issues in most third world countries such as Ghana.

In effect, the study seeks to design a methodological framework for assessing environmental degradation and test the strength of the designed assessment methodology in a case study area (Bolgatanga and Talensi-Nabdam districts of northern Ghana).

Why Bolgatanga and Talensi-Nabdam?

Environmental resources in the area are characterized by a dry savannah climate and vegetation, poor soils, and irregular rainfall patterns leading to poor yields and levels of production (District Assembly, Bolgatanga, 2010). The area is one of the worst degraded regions in Ghana with high illiteracy rate, poverty stricken, complicated land tenure system and high population growth rate. It is perceived that socio-economic and cultural processes such as poverty, migration and loose land tenure system have motivated certain individuals or groups in the tested area engaged in activities such small-scale legal and illegal mining that put pressures on the environment beyond its carrying capacity (Figure 1).

The developed methodology would be tested for its

strength by answering the following research questions:

1. To what extent has the environment of Bolgatanga and Talensi-Nabdam districts of northern Ghana been degraded since 1990, how severe is the degradation in terms of reversibility and which areas in the two districts are mostly affected?
2. What socio-economic and cultural forces usually motivate individuals to take up activities that put pressures on the environment beyond its carrying capacities, how are they correlated, spatially distributed and ranked in terms of their relative importance?
3. What are some of the negative outcomes of the observed environmental degradation in the study area in terms of the physical, social and cultural impacts, how severe are the impacts, how are they spatially distributed, ranked and which groups are mostly affected?
4. How are the affected communities coping with the observed changes on the environment?
5. What are the possible responses to alter the impacts of stress on the local environment and their relative importance?

METHODOLOGY

This study adopts both primary and secondary data sourcing to achieve its aim. Primary data included spatio-temporal data on land-cover types; ground and community truthing data were utilized. Land-cover data were derived from satellite images processing and classification of 30 m resolution from the Landsat Thematic Mapper (TM) for 1990, 2000 and 2004, acquired from CERGIS (Centre of Remote Sensing and Geographical Information) of the University of Ghana in 2005. Ground and community truthing data were obtained through sampled ground truth points during field work at homogenous sites and through interviews, focus group discussions and direct field observations. The secondary data source aim to come out with advantages and disadvantages of the selected approaches and if a hybrid is the preferred choice for environmental degradation assessment. The proposed methodology is then tested at Bolgatanga, Talensi-Nabdam Communities of northern Ghana.

Classic approach

The classic approach applies science to assess environmental degradation with emphasis on quantitative research methods (Stringer and Reed, 2007). Like many global assessment methodologies for environmental degradation, greater emphasis has been placed on quantitative, modeled scientific indicators that are developed within the confinement of constricted scientific space (Thomas, 1997). According to Stringer and Reed (2007), scientific techniques such as GIS and satellite remote sensing (Ringrose et al., 1999), ecological assessment (Perkins and Thomas, 1993); economic analysis (Perrings and Stern, 2000), expert opinions (Oldeman et al., 1990) and scientific field surveys (Reed and Dougill, 2002) have all been positively used to assess environmental degradation. However, the sole adoption of such classic approach has its own shortcomings as they cannot always provide accurate solutions to complex environmental problems (Thomas, 1997). Another weakness of the classic approach is the requirement of detailed understanding of science, considerable data requirements and potential hidden errors that usually arise from inappropriate assumptions and approximations of adopted scientific models. A typical example is the use of conventional GIS for natural resource management without local ecological knowledge (Ministry of Housing, Spatial Planning and Environment, The Netherlands, 1984).

Populist approach

The *populist approach*, adopts stakeholder participation and local ecological knowledge in environmental assessment and with natural resource management (Hudson, 1991). The approach is based on Principle 10 of the Rio Declaration (UNCED, 1992) that stipulates grassroots participation on issues of environmental management and the UN Convention to Combat Desertification that emphasizes on active participation of local people on matters concerning the environment (UNCCD, 1994). The process of the populist approach is the way in which selected participants of a study location of different interest groups and backgrounds come together to contribute, through group discussions, and interviews on issues of interest (Hunter, 2004). Despite the many advantages of the application of the populist approach, it has been criticized on its validity. According to Reed et al. (2007), environmental decisions cannot be made solely on the basis of qualitative local knowledge due to the subjectiveness and unrepresentative nature of the issue been addressed. There is also a lack of scientific bases to substantiate claims usually solicited from local ecological knowledge. Interestingly, Kothari (2001) was of the view that the adoption of the populist approach through the empowerment of previously marginalized people may lead to unexpected conflicts with existing power structures.

Methodological triangulation

The resultant hybrid knowledge (Reed et al., 2007, cited in Fraser et al., 2006) often called the *methodological triangulation* or *neo-liberal approach*, stemmed on both the populist and the classic approaches. The approach allows interaction with scientific and local ecological knowledge to provide useful ideas on matters relating to the environment (Agyemang et al., 2007). Borrowing from the classic reductionist approach, methodological triangulation uses the idea that natural resources need to be assessed quantitatively to assess the nature and extent of environmental change (spatial) and from the populist approach, it borrows the notion that local ecological knowledge provides reasons why certain changes on the environment have occurred (aspatial) (Agyemang et al., 2007). This implies that triangulation is the combination of

two or more methodological approaches, theoretical perspectives, data sources, investigators and analysis methods to do appropriate study. However, there are mixed reactions on the use of methodological triangulation in natural resource assessment as some researchers argue that triangulation is just for increasing the wider and deep understanding of the study (Kimchi et al., 1991). While others have argued that triangulation is actually used to increase the study accuracy (Creswell and Miller, 2000). According to Denzin (1978), there are three types of data methodological triangulation: namely, time, space and person. These types of data triangulation come as the result of the idea that the robustness of data can vary based on the time data were collected, people involved in the data collection process and setting from which the data were collected (Begley, 1996). Theoretical Triangulation is defined as the use of multiple theories in the same study for the purpose of supporting or refuting findings since different theories help researchers to see a problem at hand using multiple lenses (Thurmond, 2001). The related competing theories can be used in formulating hypothesis for the purpose of providing broader and deeper understanding of research problem (Banik, 1993). The Investigator Triangulation is defined as the use of more than two researchers in any of the research stages in the same research work. It involves the use of multiple observers, interviewers, or data analysts in the same study for confirmation purposes (Denzin, 1978). The Analysis Triangulation is described as the use of more than two methods of analyzing the same set of data for validating purposes (Kimchi et al., 1991). It also involves the use of more than two methods of data analysis in qualitative and quantitative paradigms within the same study for both validation and completeness purposes.

Review of related studies

With the framework of their research project on capacity building for environmental management in Vietnam, Duong et al. (1997) carried out an extensive research on land-use changes and GIS-database development for strategic environmental assessment in Ha Long Bay, Quang Ninh Province. The database used contained information on the current status of natural resources (land cover, land cover use, topography, infrastructure, population, coal mining industry and tourism) and the development plan for Ha Long city. The study made use of diverse human land use categories and interpretation supported by ground truth checking via extensive GPS fieldwork. The study adopted the *classic approach* that assumes technical, scientific and deductive solutions to natural resource assessment and emphasized more on the quantitative techniques in the analysis and presentations of results. Based on the results of the findings, the study recommended that GIS when adopted in land-use analysis has the ability to store large multidisciplinary datasets, identify complex interrelationships between environmental characteristics, evaluation change over time, ability for systematically updating and use for different projects, input data sources for a variety of mathematical models and capability of storage and manipulation of three dimensional data. The results of the study are criticized due to the lack of qualitative data, in the research methodology, to support the issues raised in the quantitative findings.

Appiah-Opoku (1997), in his study on indigenous institutions and environmental assessment in Ghana, adopted more qualitative participatory research methods (formal and informal interviews) with randomly selected key informants within formal and indigenous institutions, village elders and non-governmental organizations to investigate the relationship of traditional knowledge, beliefs, practices, social norms and environmental degradation in Ghana. He hypothesized that many conceptual frameworks adopted for environmental degradation are "western" in their origin and are therefore not applicable to indigenous institutions in most

developing countries such as Africa. According to him, local ecological knowledge can be used as one-fold technique to assess environmental degradation without necessarily adopting any quantitative scientific data. Despite these barriers such as higher illiteracy, language problems, skepticism on the part of government officials and scientists and the difficulty in changing entrenched attitudes, the study found the use of local ecological knowledge capable in assessing environmental problems in developing countries such as Ghana. The research revealed that indigenous farmers are able to use color, texture, and appearance of their crops to distinguish between poor and fertile soils. They also know local climatic characteristics and when to prepare their farms for the rains or to mulch to conserve soil moisture with the aim to minimize exposure of the subsoil to the tropical climate. Similarly, the indigenous hunters have expert knowledge of the location of certain animals, plants, water bodies, forests, and other elements of the local environment.

The work of Williams and Dunn (2003) was an advanced form of both the Duong et al. (1997) and Appiah-Opoku (1997) research methodologies as it moves forward to the populist and classic approaches and adopted methodological triangulation to address the challenges of post-natural resource conflict settings in Cambodia. The aim was to investigate the potential integration of local and scientific knowledge to formulate and explore spatial activities among local populations in mine-contaminated communities through the identification of improved strategies for returning refugees in re-establishing their livelihoods in landmine contaminated areas. Their approach was a step towards using GIS to provide access to geographical information for the marginalized indigenous rural poor people rather than the upper circuit, high-capital experts. Their approach produced an informed baseline contamination survey, a detailed history that revealed which resources and activities were important to the viability of the villages, and specific spatial knowledge of the location of resources, features, mine-fields and the relationships between them. Villagers own clearance priorities were obtained by the researchers and the complex relationship between casualties and resource-use that could identify both direct and indirect means of addressing key development issues were unearthed. Even though the study is not yet subjected to research investigation, it is envisaged that the empowerment of the marginalized groups in the landmine areas may bring about potentially negative interactions or conflicts with existing structures as viewed by Kothari (2001) when he subjected methodological triangulation to criticism.

Methodological triangulation: The design

The assessment methodology involves the utilization of methodological triangulation to facilitate the adjustments of two discrete but complementary quantitative and qualitative techniques such as conventional GIS and participatory research appraisal). Even though closely related to Duong et al. (1997), Appiah-Opoku (1997) and Williams and Dunn (2003) in terms of basic results, it differs to some features as the proposed framework takes into consideration issues, such as causes and effects of relevance to environmental degradation.

The first phase of the proposed framework is the use of geographical information to create image maps that represent characteristic features of the study area. This is achieved through the use of satellite images. It concerns the issue of where and to what extent degradation has taken place over a period of time.

The second phase is a community based approach taken from Appiah-Opoku (1997) that seeks to examine, in a more qualitative way, the societal attributes of the driving forces, pressures, impacts and responses of observed changes on the environment analyzed in the first phase of the assessment methodology. It provides reasons for the changes observed on the environment over a

period of time. Borrowing from the adopted research methods of Williams and Dunn (2003), individual semi-structured key informant interviews, focus group discussions and unconventional GIS techniques were used in order to provide opportunities for participants to reflect on the complexity of the environment and engage in a more constructive discussion on the nature and what causes the environmental degradation (Figure 2).

The proposed assessment methodology was then structured using two distinctive but complementary techniques and of two phases: (i) the use of the classic approach to assess where degradation has taken place and the nature in terms of the extent and magnitude; and (ii) the use of populist approach to evaluate the causes of such changes, the impacts and coping strategies (Figure 3).

RESULTS

The strength of the assessment methodology is evaluated based on the extent on how the research questions, as stated above are accurately answered.

To what extent is the environment of Bolgatanga and Talensi-Nabdam districts been degraded since 1990, how severe is the degradation in terms of potential rate of recovery and which areas in the two districts are mostly affected?

The adoption of classic approach, as part of the assessment methodology, helped to produce important factual information based on what has actually happened to the natural environment of the study area during the period of study. It became clear that there have been phenomenal land-cover changes which have been manifest in the decline of 634 km² savannah vegetative woodland with corresponding increase of 208 km² of dense herb and various grasses and increase of 392 km² built-up and barren environment, all of which lead to environmental degradation. The degradation was severe in the Bolgatanga Township, Sherigu, Nangodi, Duusi and Pwalugu where there are many human activities taking place as well as infrastructural developments.

Research participants were given the opportunity to comment on the local ecosystem and the characteristics of environmental degradation in their area with the aid of image maps. These helped participants to focus their attention on issues presented and on the image maps to discuss the nature and the causes of environmental degradation in the study area. It was noted that without the provision of classified images and GIS statistics, any issues raised by participants regarding the environment would not have truly identified. The participatory exercises also helped participants to contribute to the spatial distribution of land-cover type changes in the study area for the period of study. The results obtained demonstrated how the adoption of methodological triangulation helped to map out the spatio-temporal changes on the environment of the studied area.

What socio-economic and cultural forces usually motivate

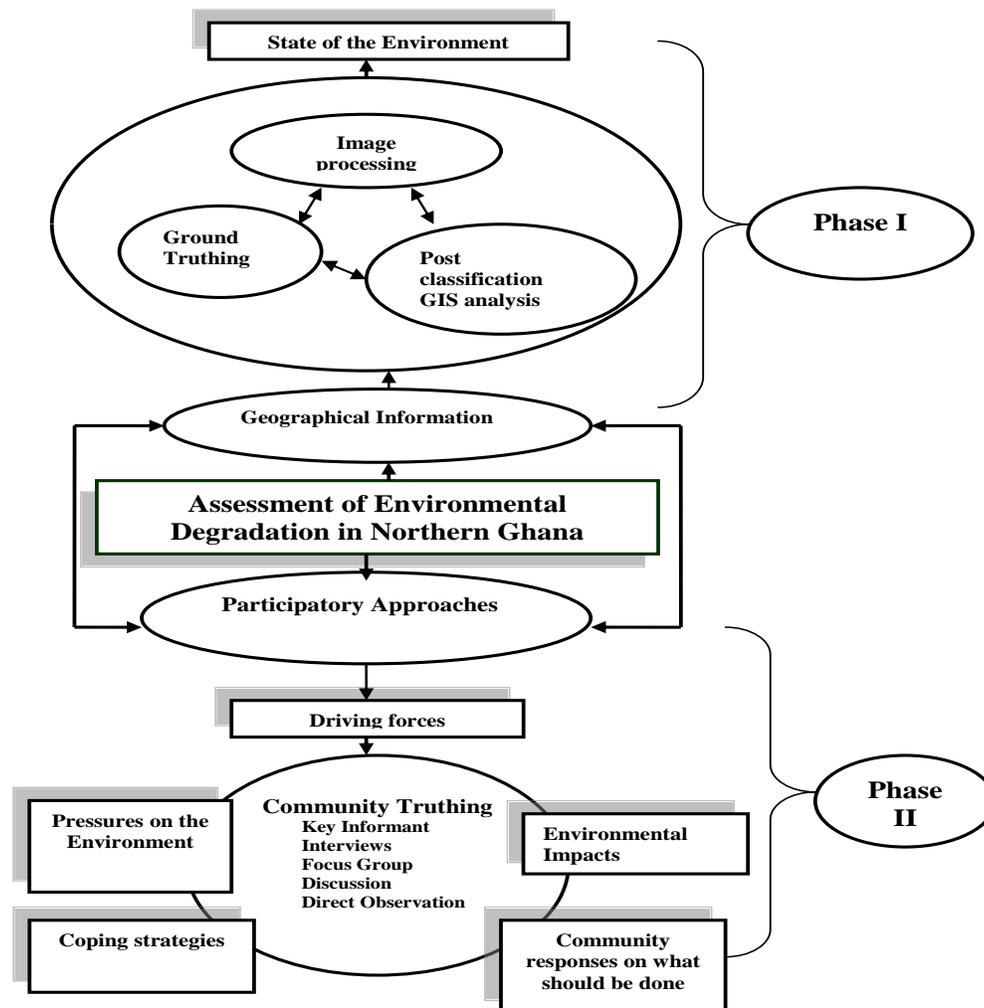


Figure 2. Research design. Source: Agyemang et al (Natural Resource Forum 2007).

individuals to take up activities that put pressures on the environment beyond its carrying capacities and how are they interrelated, spatially distributed and ranked in terms of their relative importance?

Results obtained through the adoption of the assessment methodology included the following: (i) the existence of small-scale illegal surface mining near Nangodi and Sherigu of spatial extent of 258 km²; (ii) the existence of small-scale legal underground mining near Duusi of spatial extent of 82 km²; (iii) the existence of quarrying and sand wining sites near Pwalugu and Kongo of spatial extent of 27.4 km²; (iv) the lack of spatial extent of grazing, bush burning and cultivation sites were due to the difficulty in defining their boundaries within the study area; and (v) the complex interplay of the various pressures and the dominance of the small-scale illegal mining industry resulting from a shift from the other informal sectors of the local economy during the recent

years. Research participants pointed out that forces such as harsh climatic conditions, policies for economic transformation, population growth, migration, land tenure system, poverty, urbanisation and infrastructural development and community level institutions were the main social processes that have directly and/or indirectly contributed to the observed changes on the environment. Even though participants commented on the interactions of the driving forces, most of them were of the opinion that the observed changes in the environment were due mostly to poverty which is endemic in the three northern regions. The results thus demonstrate the strength of the designed methodological triangulation for assessing the causes and effects of environmental degradation.

What are some of the negative outcomes of the observed environmental degradation in the study area in terms of the physical, social and cultural impacts, how severe are the impacts, how are they spatially distributed, ranked

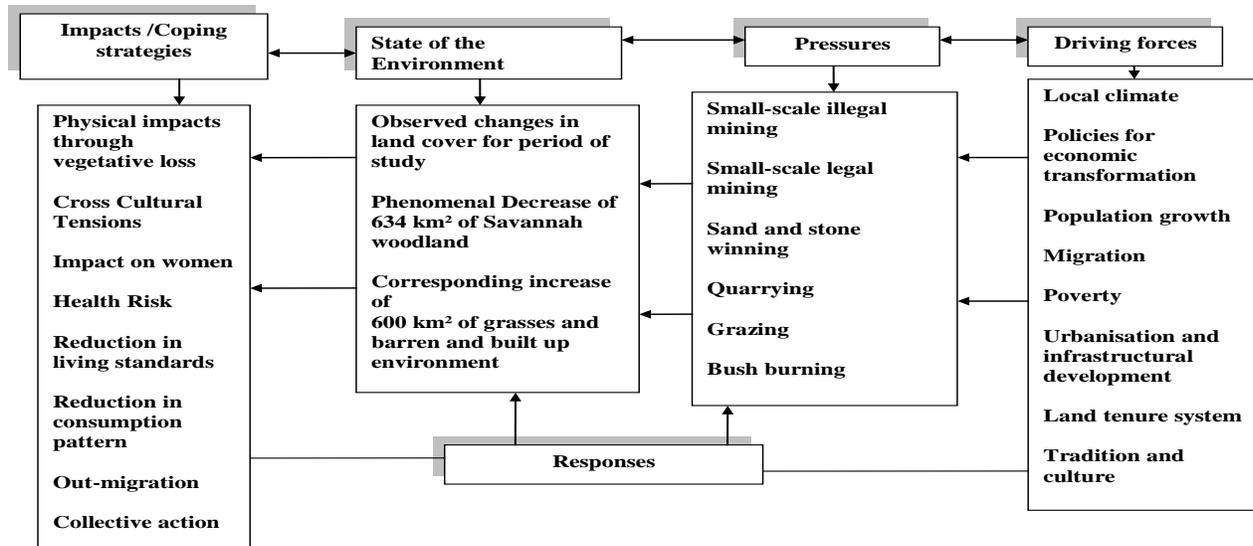


Figure 3. Summary of research findings. Source: Agyemang et al (Natural Resource Forum 2007).

and which groups are mostly affected?

Using the Bolgatanga and Talensi-Nabdam districts as a case study, Phase II of the design methodological triangulation was used to assess the impacts of the observed land-cover changes and subsequently evaluate coping strategies of the affected communities'. Results indicated that the impacts associated with the observed land-cover changes were vegetative loss, cross-cultural tensions, and impact on women in terms of working livelihood, health risk, and reduction in living standard. Spatially, loss of vegetative cover, health risks, impact on women and cross cultural tensions is found within the small-scale mining areas of Duusi, Nangodi and Sherigu. Loss of vegetative cover, food scarcity and health risks are also predominant in the Tongo and Pwalugu areas where they are noted for quarrying and stone cracking activities. In the urban areas of Bolgatanga, Zuarungu and Kombosigo, there are problems of cross cultural tensions, food scarcity and poor living standards. According to the participants in the study area, food scarcity has been the major problem due to the constant deterioration of the environment. It was also observed that women are the ones affected most as tradition demand them to stay home to care for the family as their male counterparts migrate to other places in search of jobs. It is worth noting that, despite the bias towards the populist aspect of the design methodological triangulation, results indicated the suitability of the methodology to assess the impacts and coping strategies of an environmentally degraded community such as the Bolgatanga and Talensi-Nabdam districts of northern Ghana.

How are the affected communities coping with the

observed changes on the environment?

It was revealed that most community members have adopted several ways to cope with the harsh environmental conditions. As commented by participants, reducing consumption pattern, alternative source of livelihood, migration, collective action and acculturation are the identified means through which community members are coping with the environmental stress. Spatially, acculturation, migration, alternative source of livelihood and reducing consumption pattern are more pronounced in the small-scale mining communities (Nangodi, Duusi and Sherigu) while collective action and alternative source of livelihoods are common coping strategies in the urban Bolgatanga area. According to research participants, reduction in consumption pattern is the commonest coping strategy followed by alternative source of employment.

What are the possible responses to alter the impacts of stresses on the environment and what is their relative importance?

Notwithstanding the bias towards the populist aspect of the design assessment methodology, it was realized that local people, when given the opportunity, are able to contribute effectively towards the realisation of a better environment. Most of the participants, especially key informants, opted for environmental awareness, conservation and preservation and driving forces reduction. With a few exception, most of the focus group participants agreed that a better environment could be realized if the government, foremost, consider mitigation measures in conjunction with environmental awareness and educational programmes and conservation practices.

As they explained further, if the affected individuals and communities are compensated adequately they would then be able to consider awareness and educational programmes.

The above detailed answers to the research questions were realized based on the fact that the proposed assessment methodology helped to bridge the differences among participants by transforming the independent and abstract thoughts of participants into concrete real issues and has provided the means through which participants can understand issues of environmental problems in their various communities and respond with solutions for a healthier environment. This was possible because the methodology provided a framework which participants were encouraged to participate in discussions regarding issues of their environment.

CONCLUSION

The methodology triangulation design and test in this article highlight the importance of using contextual analysis and scientific evidence to assess environmental degradation. The results indicated that by integrating classic and populist approaches detailed understanding of the causes, the effects and the spatial distribution of environmental degradation could be studied. This made clear as the state of the environment was assessed as well as the social processes that motivate individuals to take on activities that exert pressures on the environment beyond its carrying capacity. The approach also evaluated the impacts and coping mechanisms as resulted from the change on the environment. Using the assessment methodology, research participants were able to deliberate extensively on what ought to be done to realize a better environment. This article thus demonstrates the importance of using methodological triangulation for assessing environmental degradation which has been tested for its robustness at Bolgatanga and Talensi-Nabdam districts of northern Ghana.

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