UNIVERSITY OF CAPE COAST

INDIGENOUS KNOWLEDGE IN FRESHWATER RESOURCE GOVERNANCE OF LAKE BOSOMTWE, GHANA

MARIAN AMU-MENSAH

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BY

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Thesis submitted to the Department of Geography and Regional Planning of the Faculty of Social Sciences, College of Humanities and Legal Studies, University of Cape Coast in partial fulfillment of the requirements for the award of Doctor of Philosophy Degree in Geography and Regional Planning

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the results of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:……Date……

Name: Marian A. Amu-Mensah

Supervisors' Declaration

We hereby declare that the preparation and presentation of the thesis were supervised in accordance with the guidelines on supervision of thesis laid down by the University of Cape Coast.

Principal Supervisor's Signature……Date……

Name: Prof. S. B. Kendie

Co-Supervisor's Signature…… Date…….

Name: Prof. K. B. Antwi

ABSTRACT

Indigenous knowledge (IK) plays an essential role in reducing degradation and support structures for improving livelihood in freshwater resources. It is asserted that local knowledge helps to build stable governance structures and policies to control abuse and misuse of freshwater resources. The study, therefore, sought to examine institutions and institutional arrangements that govern Lake Bosomtwe. In-depth interviews, focus group discussions and questionnaires were used to solicit data from five hundred and twenty respondents in the communities around the Lake. The qualitative data were analysed using QDAS NVIVO to bring out the themes and patterns for coding and transcription. SPSS was used in addition to CRAMER'S V test and STATA to analyse and test the questionnaires. The results show no clear participatory approach to policy formulation and implementation. The findings revealed a dual governance system operating around the Lake, making it difficult for rules enforcement. It was established that IK was essential to freshwater conservation, yet the meaning of IK and practice could only reveal its usefulness to freshwater conservation. Based on the findings, it was concluded that the lack of leadership and control in enforcing formal and informal rules and regulations are not helping to conserve the Lake. It was also resolved from data that IK in freshwater governance is acceptable to almost all the local communities, for its usefulness to be allowed to dwindle. Recommendations were that IK practices should be examined by both local and government authorities for better understanding and use in freshwater policy formulation and implementation. Additionally, all local people irrespective of the gender, education or class must be allowed to contribute their ideas at all levels of Lake Bosomtwe's governance.

KEYWORDS

Anthropogenic

Cognitive Process

Common Pool

Conservation

Embedded Knowledge

Freshwater Degradation

Ghana

Symbolism

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DEDICATION

In memory of my late, father Joseph Amu, to my mother Victoria, my extended and nuclear family, Leonard, Daniella, Saraphina, Fredlyn and Frederick

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LIST OF ACRONYMS

AC	Activity Profile
GCEA	Ghana Country Environmental Analysis
ACP	Access and Control Profile
EUCEP	European Union Country Environmental Profile
CIT	Contextual Interactionist Theory
CPR	Common Pool Resources
CREMA	Community Resource Management Area
CSIR	Centre for Scientific and Industrial Research
GOOF	Government Official
Das	District Assemblies
DPO	District Planning Officers
EPA	Environmental Protection Agency
FGD	Focus Group Discussion
GMA	Ghana Meteorological Agency
HAF	Harvard Analytical Framework
IDA	Irrigation Development Authority
IK	Indigenous Knowledge
IMF	International Monetary Fund
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
MDGs	Millennium Development Goals
MWWH	Ministry of Water Works and Housing
MESTI	Ministry of Environment Science, Technology and Innovation

DDT	dichloro-diphenyl-trichloroethane
Mg/L	milligramme per litre
µg/L	microgramme per litre
Mg/g	milligramme per gramme
Cfu	coliform forming units
DO	Dissolved Oxygen
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
SS	Suspended Solids
NH3	N and PH- Ammonia Cal Nitrogen.
SHT	Stakeholder Theory
MESTI	Ministry of Environment Science, Technology and Innovation
MMCE	Metropolitan and Municipal Chief Executive
MWRWH	Ministry of Water Resources, Works and Housing
NDPC	National Development Planning Commission
NESSAP	National Environmental Sanitation Strategy and Action Plan
OECD	Organisation for Economic Cooperation and Development
PHC	Population and Housing Census
PNDC	Provisional National Defence Council
SDGs	Sustainable Development Goals
SHT	Stakeholder Theory
SI	Symbolic Interactions
ST	Stewardship Theory
TDS	Total Dissolved Solids

UNCED	United Nations Conference on Environment and Development
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNGA	United Nations General Assembly
UNWWAP	United Nations World Water Assessment Programme
US	United States
VRA	Volta River Authority
WARM	Water Resources Management
WBG	World Bank Group
WKS	Western Knowledge System
WRC	Water Resources Commission
WRI	Water Research Institute
WSSD	World Summit on Sustainable Development

CHAPTER ONE

INTRODUCTION

Background to the Study

Globally, freshwater degradation is seen as a governance crisis. A freshwater body is universally known as the essential natural resource for the sustainability of human life (World Water Assessment Programme [WWAP], (2012). The abundance and diversity of freshwater throughout the world include lakes, ponds, rivers, streams and a wide range of wetland complexes (Usher, et al., 2005 & Rautio, et al., 2011). Freshwater resources provide prime areas for human settlement, commercial activities for income generation and habitation for other living things. Global freshwater available for the support of human life is 2.5 percent and 30.1 percent of this is groundwater, which is deep beneath the earth's surface in underground aquifers. Another 68.6 percent is locked up in the Arctic as ice, and the only 1.3 percent of the total freshwater on earth is in surface water sources such as lakes, rivers, and streams (Scheffers & Kelletat, 2016).

Crisis in governance is regarded as the result of the inability of the current governance system, to control or prevent degradation of water resources (De Stefano, Svendsenb, Giordano, Steeld, 2014; Pahl-Wostl, Conca, Kramer, Maestu, & Schmidt 2013a; WWAP–UNESCO, 2003; Aylward et al. 2005; Bauer, 2004). In the writers' opinion, uncertainties about the ineffective freshwater governance system are due to incompatible knowledge in freshwater policy formulation and implementation. Incompatible knowledge in freshwater governance according to Berkes, Colding and Folke (2000b) and Smith (2013) is the knowledge that is not derived from the context

of the waterbody's environment, such as local or indigenous institutions and structures.

The study narrows into the main subject area of freshwater, which are lakes. Specifically, the study is about Endorheic Lake, which is also regarded as closed lakes (Rast & Straškraba, 2000). Research shows that most endorheic lakes are susceptible to pollution activities (Graichen, 2011; Rast & Straškraba, 2000). Therefore, such water bodies are depleted at faster rates, due to man's exploitive activities, in the quest for better living conditions and many economic gains. These human activities in the face of minimal sources make freshwater governance imperative and critical to human existence.

Armitage et al. (2015) describe freshwater governance as an institutional structural process where local communities or indigenes are allowed to voice out their interest in the formulation and implementation processes of freshwater resource's access, use and control. Governance is defined as an ordered arrangement of actors, resources, mechanisms, and procedures, which control society's access to freshwater (Franks & Cleaver, 2007). Therefore, the freshwater policy should encompass the local contributions of the social institutions and structures namely political, economic, educational, religious and social arrangements that are the rules and regulations in formulating policies for water governance.

Before the use of European or Western system for policy formulation and implementation of freshwater, in many parts of Africa, had a decentralised structure. Where the allocation of resources mainly by heads of communities such as lineage grouping, community elders and spiritual leaders of freshwater resources, more of an integrated and participatory approach (Aniah,

Aasoglenang & Bonye, 2014; Kendie & Abane, 2001; Opoku-Agyeman, 2001). Freshwater resources governance was based on communal resources ownership (common pool resources to common property resources or open access). The cultural and religious traditions and norms, demarcation of sacred areas, myth, rituals, and allocation of totems helped to conserve the freshwater resources, using necessary rules and sanctions (Aniah et al., 2014; Murombedzi 2003; Opoku-Agyeman, 2001).

Indications are that current knowledge processes towards policy formulation and implementation in freshwater are not derived from its context emphasising an adaptive approach to water governance (Smith, 2013; Berkes, Folke, Colding 2000a; Giliba, et al., 2011). Consequently, knowledge derived for governance policy, is incompatible with the nature and knowledge structure of actors in the resources environment, quoting (Keavey, 2009; Smith, 2013 & WWAP, 2012).

To emphasise, the global lack of appropriate governing principles, Giffin (2013) and Painter (2015) reported that, despite efforts by the United States government and Europe to reduce the deterioration of water bodies for years, degradation still exists. For example, the Aral Sea formerly the world's second-largest closed lake has also shrunk through the concentration of anthropogenic activities and increased population growth. Likewise, the Walker Lake's level in the year 1800 decreased to almost 150 feet, which is from 10 million acre-feet to less than 2 million acre-feet, (Umek, Chandra, & Brownstein, 2009). Citing the case of the Great Lakes of North America's deterioration, Pollard and Cousins (2008), contend that the Western system of governance has significantly contributed to their degradation. John (2017) also

reaffirms this finding of the deterioration of the Great Lakes. John pointed out that the participatory approach to water governance, which include local knowledge has brought some improvement to the Great Lakes conservation.

Globally, the issue of freshwater governance has been addressed from a variety of perspectives; however, solutions to water problems have seen minimal achievement and are less effective (United Nations Environment Programme [UNEP], 2011; Pahl-Wostl et al., 2013a). Even though considerable efforts have been made towards solving freshwater problems, the trade-offs between man's health, food, and energy security, urbanisation, industrial growth on the freshwater resource are increasing (Afroz, Masud, Akhtar & Duasa, 2014). Besides, the writer explains that there is also the unsustainable population growth around freshwater resources. Afroz et al. (2014) demonstrated that increased exploitative and unregulated human needs and wants for socio-economic gains, as well as aspirations for higher living standards, are leading to the degradation of freshwater resources.

Nonetheless, freshwater policy formulation and implementation have evolved through several approaches to the Integrated Water Resources Management (IWRM). IWRM uses the welfare approach within the interactionist theory, in response to these challenges. Integrated water resources management (IWRM) is acceptable as a means to ensure equitable, economic and environmental sound freshwater conservation practices. (Matysek, Stratford, & Kriwoken, 2006; WWAP, 2012).

In Africa, the World Bank Group (WBG), (2016) report indicates that Lake Chad, which serves four countries in West Africa, has shrunk by 92 percent compared to its size in the 1990s. Conversely, the surface area has also

decreased from 25,000 square kilometres to approximately 1,350 km2 through anthropogenic activities. In Kenya, for example, available water is estimated to drop from 650m3/year to 359m3/year. Kithiia (2012) reported that Lake Victoria transports several effluents from many factories, causing its pollution and degradation. Potvin & Bovarnick, (2008) also emphasised that forty countries from West Asia, to Sub-Saharan Africa will face water stress. The report projects that population increase a particular area with its growing demands on freshwater bodies would push many countries into freshwater crisis.

Equally, various studies by Akrong (2006); Berkes, Colding, and Folke (2000b); Dorm-Adzobu and Ampomah (2013); Keavey (2009); Kendie and Abane (2001); Pahl-Wostl et al. (2013a); Smith (2013) and WWAP (2012) have attributed the inadequacies and lack of adherence to Western rules and regulations. From their perspective, the governing principles are closely tied to the context in which knowledge or data is developed in Western countries. Until now, the state of freshwater resources does not indicate reversals in major freshwater trends of degradation (Maganga, 2003; Global Water Partnership [GWP] (2003); Rogers & Hall, 2003; Connor, 2015).

Knowledge in Africa, and process in freshwater governance policy, has experienced several modifications through global influences (Opoku-Agyeman, 2001). Western rule brought about a departure from local or the indigenous system of freshwater governance. Different declarations and approaches have been adopted. These include the Rio and Dublin Conferences in 1992, which emphasises Dublin principles to address the need to regard water not only as an economic good but also as a social good. Others are Rio

+ 2020 resolution 64/236 of 2009, which sought to advance integration in water governance, as well as its Resolution 66/197 of 2011, which was adopted in 2012 by the General Assembly. There is also the recently adopted ratified United Nations Declaration on the Rights of Indigenous Peoples (Barelli, 2009). This declaration is expected to support the improvement of IK in freshwater governance as a human rights concept.

According to Roger and Hall (2003), the concept IK helps to stress the need to redress discriminatory practices, through improving participation and integrity, which are critical to better participation in water governance. Other forums, agendas, and goals such as Ghana's Shared Growth and Development Agenda (GSGDA) and Sustainable Development Goals (SDG's) 6 and 13 also ensure good governance and respect for human rights.

In similar forums, indigenous knowledge is receiving global attention in freshwater resources governance (Berkes, et al., 2000b; Douglas, 2011; Holmes, 1996; Kapiyo, 1991; Nickels, 1999; Connor, 2015; Oldham, & Frank, 2008). Researchers like Awuah-Nyamekye (2009), Berkes et al. (2000a) and Jill & Riewe (2006) throw more light on the fact that IK practice, on the contrary, has spiritual undertones. They explained that IK is not positivist and materialistic like western knowledge system structures.

Suggestions by Kendie and Guri (2013) and Odame-Ababio, (2003) showed the basic principle for water used before the Western era exhibits equity and participation. Accordingly, water to the African and for that matter the Ghanaian means free access that is a "collective right", so long as the intent of the collectiveness is not degraded. An empirical study reaffirms IK's ability to reduce anthropogenic and environmental issues (Connor, 2015 & Abreu,

Clusener-Godt, & Salinas, 2016). In the above perspective, IK's role is portrayed as a possible solution in freshwater governance and conservation.

Freshwater governance in Ghana since 1999 to date identifies with the concept of Integrated Water Resources Management (IWRM) approach to reducing crisis. This relationship is in respect of the policy under which the Water Resources Commission (WRC) of Ghana operates to ensure freshwater resources efficiency, use, and conservation (Odame-Ababio, 2003). WRC is under the Ministry of Water and Sanitation in Ghana. The institutions for the formulation and implementation freshwater policy in Ghana are state institutions, namely, Water Resources Commission (WRC), under the Ministry of Water Resources and Sanitation, Water Research Institute, Ghana Meteorological Agency, and the quasi-institutions under the ministry at the district assembly level. Therefore, the Lake Bosomtwe which is the case study, is also structured under the same formal governance set up of the WRC as indicated by MacPherson and Agyenim-Boateng (1991); Odame-Ababio, (2003).

Given the significant trends in freshwater resources degradation, evidence suggests that IK or indigenous freshwater governance is better placed to deal with the freshwater crisis. Based on Daniels (2008) perspective IK is best characterised within the stakeholder's approach, which is also pragmatic. This emphasis the positions of Bressers and de Boer (2013); Daniels (2008) and Organization for Economic Cooperation and Development [OECD] (2015) that, IK supports the reduction in resources degradation since the cognitive processes of the knowledge is generated carefully in connection to humans and the resources environment.

Against the general background of the thesis, Lake Bosomtwe in Ghana finds itself in similar governance crisis, following indications of the degradation of the Lake (Amu-Mensah, Akrong, Amu-Mensah & Darko, 2014a, Abreu et al. 2016; Yamba, 2016). Accordingly, the stakeholder governance approach in principle emphasises effectiveness and practicality in the context of the resources environment in helping reduce degradation. It also takes into consideration the symbolism of indigenous or local knowledge in freshwater governance. Although the management of Lake Bosomtwe is currently in practice through the stakeholders, the method is expected to be a participatory governance approach. Yet, the lake is under serious threat from human activities.

Statement of the Problem

Most freshwater resources, like Lake Bosomtwe, are the source of livelihood for the survival of its stakeholders and the entire Lake's ecosystem. Currently, the Lake is going through degradation based on human activities around the Lake's catchment area. Erosion is approximately 2,674 metric tonnes per annum, considering the reports of Amu-Mensah et al. (2014a) and Prakash et al. (2005). Prakash et al. (2005) also estimated pollution loads of more than 50,000kg/year for nitrogen and 6,000 kg/year for phosphorus into the Lake due to farming activities. E.coli count for the Lake is 54 cfu/100ml instead of 0 cfu/100ml with a water quality index which has changed from grade 11 in 2010 to a grade 111 (49.8%) in 2011.

Through unplanned lumbering, construction of infrastructure and farming almost all the streams that feed into the Lake are dried up confirming Amuquandoh, (2009) finding on unexpected development in the area. The

local communities are currently farming in the bed of the stream because the soil is fertile. Besides, farming on the hills and about four feet to the Lake have further exposed the land to erosion through rainfall (Amu-Mensah, 2017; Abreu et al., 2016).

Rainfall over the Lake has reduced considerably, and pollution concentrations in the Lake are expected to increase with evapotranspiration. As reported by Gyau-Boakye, (2012), previous estimated average annual rainfall is 1,260 mm in the Ashanti region and currently, estimated rain is 340 mm in the year 2013 which possess a challenge in adherence to rules referencing Amu-Mensah, Amu-Mensah, and Obirih-Opareh (2014b).

These challenges are seen as the inability of western institutions and institutional structures to reduce resource degradation. As indicated in the literature, crises in water governance lead to degeneration, based on the unavailability of sound principles in the adaptive approach to the governing process. According to De Stefano et al. (2014); Pahl-Wostl et al. (2013a) and UN-WWAP (2015) deterioration of freshwater resources is an indication of a breakdown of the governing processes, and resource's system. Thus, a failure in the resource system is based on the way western policy system is formulated and implemented without the consideration of the thought process of the resource owners and the resource environment.

Western knowledge systems eulogise science and recognise the natural resources as the primary source of wealth creation through technological innovations. This perception is based on secular knowledge in pursuit of economic efficiency, confirming Briggs (2014) and Lawas (1997), that the western system extensively uses natural resources, thereby leading to

ecological deterioration. Such freshwater exploitation brings about socio-economic hardship in developing communities, contributing to severe environmental changes all over Pahl-Wostl, et al. (2013b) & Scott (1998). The study focused on how policies could be formulated to include the concerns of the local communities. That is incorporating the tacit knowledge such as the concerns and experiences of how to use and conserve freshwater resources, which Briggs (2014) and Pahl-Wostl et al. (2008) believe is difficult to teach through language because the expressions and symbols would be lost.

Freshwater is under pressure. The study recognises that because IK is not allowed to influence decision making, this exacerbates, the problems of freshwater resources. That is the reasons why IK is being revisited to ascertain how we can bring to bear the elements in policy formulation to help conserve the freshwater resources. Furthermore, empirical studies also show that IK is not only being applied in rural communities of the world as suggested by (Briggs, 2014) but also IK's impact in other countries is contributing to freshwater conservation. IK is seen as a support system in areas where western system alone has failed (Smith, 2013; Johns, 2017 & Scott, 1998). Meanwhile, the problem remains, what the local communities have to offer, in terms of knowledge on freshwater conservation.

Undoubtedly, policies and practices in the governance of freshwater bodies provide vital institutional perspectives crucial to the sustainability of all forms of life, in the ecosystem. Government's present adaptive approach administration coupled with unregulated human activities is estimated to contribute to additional sediment load into the Lake Bosomtwe.

To ensure good governance of the ecosystem (freshwater) resources, Ghana has been part of different on-going reforms like the Ghana Water Forums for socio-economic development in 2009, 2011 to date, among others. Since 1996, Ghana recognises the Integrated Water Resources Management (IWRM) governance approach towards efficient use and freshwater conservation. IWRM is internationally accepted as a breakthrough in freshwater conservation. IWRM use the stakeholder participatory concept (Global Water Partnership [GWP], 2007). Nonetheless, these reforms may be working in a limited to a particular group, associated with certain regional or political regimes in water conservation (Sullivan & Meigh, 2007).

The conservation of Lake Bosomtwe in Ghana is not exempted from the different reforms and the IWRM governance approach adopted by Ghana. The two district assemblies around Lake Bosomtwe are, Bosome-Freho and Bosomtwe District Assemblies, have oversight responsibilities in the area. The district assembly facilitates the implementation of government policies and programmes at the district level through other quasi-agencies of government whiles, ensuring good governance. To decentralisation and ensure grassroots' participation, the district assembly has been demarcated into four council areas. These are Bosomtwe East Area Council, Nsuta Area Council, Bosomtwe Area Council and Bosome-Freho Area Council (Ghana Statistical Service, [GSS] 2014a & GSS, 2014b; Ministry of Food & Agriculture [MOFA], 2017). The Water Resources Commission has a legislative instrument to make regulations in facilitating a proper governance structure for its mandated functions at Lake Bosomtwe (Abreu, et al. (2016); MOFA, 2017). Lake Bosomtwe since 1903, has experienced several governance approaches mostly Western-imposed

systems of governance, more of an adaptive strategy in practice is citing Akrong, (2006) & Odame-Ababio, (2003).

Despite these approaches, the governance system around Lake Bosomtwe has not been successful in reducing degradation. Meanwhile, man's over-exploitation and indiscriminate use of the resources, have somewhat increased the crisis in the governing system emphasising Giddens (1984) and Durkheim (1893)'s perspectives. Crisis in the governance system is leading to an increase in unplanned residential structures. These unexpected structures have come about through to the concentration of population growth and tourist traffic despite governance reforms and some presence of the traditional authorities (Amuquandoh, 2009 and MOFA, 2017).

Traditional level of governance has been in practice before the colonial government and the current governance systems of IWRM. The traditional governance structure is enforced through customs and cultures at the grassroots level by family heads. Enforcement is achieved through a hierarchical order, which starts with the family-head, sub-chiefs, paramount chiefs and finally to the overall leader of Asante. This traditional freshwater governance approach is inclined towards a participatory and integrated governance system approach, where the concerns of the local communities are included in policy formulation, from the grassroots. Due to the imposition of the western system of governance, the traditional system is dying out because the governing authorities did not allow the local freshwater system to develop alongside the Western system, which is an adaptive approach. Most of the rules are not adhered to because the local communities do not understand the operational terms of the governance system, structures and institutions (Akrong, 2006;

Smith, 2013). For example, Lake Walker in the United States according to Johns, (2017) has improved through the participatory approach and the inclusion of local knowledge, which is well understood by the locals. Xu et al. (2005) in China, for example, pointed out that indigenous knowledge places a high value on protecting forests additionally. Apraku-Gyampoh et al. (2011). In Northern, Upper East and Upper West Regions of Ghana, people depend on their knowledge and experience for their weather decisions and plans, so they do not rely on the Ghana Meteorological Agency climate predictions. Yet the traditional system around Lake Bosomtwe currently deals with purely traditional affairs concerning customs and stool land administration. The government is the formulator and enforcer of rules, values and regulations on natural resources (GSS, 2014a & GSS, 2014b; Schmidt, 2005).

Undoubtedly, the norms and values, which seem to be the only rational form of governing structures, are lost to the Western system of governance, which is not accessible to the local community for the protection of the Lake (Akrong, 2006 & Smith, 2013). The few indigenous knowledge helping to protect the Lake is not adhered to due to the spiritual connotations attached to them. As Christians, no one is expected to be identified with the traditional practices and so most of their practices affect the quality and quantity of the Lake's waterbody.

As already indicated in the problem statement by WRC (2012 a), & (2012b) as well as Darko, Ansa-Asare, & Paintsil (2013) reported that the Lake Bosomtwe's quality has deteriorated from a quality index of 56.3 a grade II in 2010 to 49.8, a grade III in 2011. The quality shows a clear manifestation of a departure from the governing structures, thus emphasising Fairhead and Leach,

(2016) & Smith, (2013). Since Lake Bosomtwe is an endorheic lake, it is susceptible to all forms of waste and unguarded anthropogenic activities. Although the governing structures have gone through several changes, due to inadequate resources such as the required knowledge and infrastructure, the institutions are not able to enforce the rules and regulations. Further, it has been Akrong (2006); Smith (2013) Pahl-Wostl, et al. (2013a); WWAP (2012) and Keavey (2009) postulated that without comprehensible knowledge and planning in freshwater policies, governance in freshwater's destination is bound to decline and possibly collapse.

Similar decline and possible collapse were encountered by the Aral Sea formerly the world's second-largest closed Lake, which shrunk through the concentration of anthropogenic activities and increased concentration of population growth (UNEP-IETC, 2002; WWAP, 2012). Given this situation, it would be proper to help provide a governance system that takes into consideration the cognitive processes of the local communities to conserve the resources. The study, therefore, tries to understand the symbolism of knowledge in local freshwater governance system at Lake Bosomtwe.

Understanding the knowledge within the local governance system would provide informed decisions generated from the cognitive processes of the local communities and their interaction with the Lake's ecosystem. It would also offer informed knowledge towards the efficient use of the Lake, as well as the support and goodwill of the local community. Also, several research, have been done on indigenous knowledge governance by Lawas (1997), who indicated that in knowledge acquisition, a person's cognitive view influences the person's behaviour and response towards the environment. Therefore, the

addition of new information, depends on changing the environment, new goals and factors such as historical influences, introduced from outside forces like in the case of colonialism

Further to this, Woodley (2002) suggested that new information is the impact of globalisation, which has replaced traditional knowledge. Therefore, knowledge acquisition and transfer mechanisms from the elderly to the young are dis-embedded, occurring outside the context of the resource's ecosystem and consequently, the change in behaviour towards resources. Lawas (1997) interaction model shows that the action of the stakeholder is presumably induced by their motivation. Therefore, the response of the individual in the community depends in part to their cognitive view of the environment. Additionally, their motivations, needs and want to survive as well as the emotional attitude actions are also affected.

This contention on motivation to survive may pertain to European countries. Yet, in Africa where colonial rule imposed certain governance systems irrespective of local ones, the driving forces are needs (food, clothing and shelter). This local knowledge is dying out because people do not understand the usefulness of the knowledge since the cognitive process is broken. Governance of freshwater resources is characterised by imposed knowledge that is difficult to comprehend and therefore not easy to comply with (Opoku-Agyeman, 2001 & Kendie and Mensah, 2008). Secondly, the resources and infrastructure that goes with the Western System of governance are not in place, considering the long-term implications of providing proper management.

The question is, will current policies and practices in freshwater governance support the Lake in reducing the escalating pressures to ensure water and food security for the next generation. Freshwater stakeholders have asked this question, experts and researchers alike, but a definite answer remains out in the open. Hence, this research would help expand existing knowledge on the governance of similar resources towards the conservation of the Lake.

Objectives of the Study

The main objective of the study is to assess the usefulness and role of indigenous knowledge in freshwater governance, around Lake Bosomtwe Ghana.

Specific Objectives

1. Examine the institutions and institutional structures that govern Lake Bosomtwe;
2. Assess the perceptions of stakeholders on the challenges encountered with the access, use, and control of the freshwater resources;
3. Examine the relevance of indigenous knowledge system and practices in freshwater governance of Lake Bosomtwe and evaluate the general perceptions of relevant stakeholders on using IK in water governance
4. Recommend strategies to improve the management of Lake Bosomtwe

Research Questions

1. Based on concerns recounted in the problem, the overarching questions that require answers are;

2. What are the institutions and institutional structures in the governance of Lake Bosomtwe (strengths and weaknesses?)
3. What challenges do stakeholders encounter in the access, use, and control of the freshwater resources of Lake Bosomtwe?
4. How relevant is IK governance to the conservation of Lake Bosomtwe?
5. What strategies can help in improving the governance of Lake Bosomtwe?

Significance of the Study

The study, in theory, and policy, would help contribute to the understanding of the root and symbolism of IK in freshwater. Additionally, it would support freshwater conservation, which is a gap identified in freshwater governance. It would also contribute to the support of SDG 6 and 13. Additionally, a better or improved freshwater policy would also be derived from the study to help reduce freshwater deterioration.

Delimitation of the Study

The study is limited to communities within 60 metres of the Lake Bosomtwe's catchment area as far as the study of the governance of Lake Bosomtwe and IK is concerned. The study, focused on the challenges within the institutions and institutional structures, governing the Lake. It also examines the perception of respondents on the governance of Lake Bosomtwe and the use of IK system as part of management. More so, the study also assesses how these issues vary across their background characteristics.

Definition of Terms

In this study, the following key terms are defined as follows:

Water Degradation: The quantity and quality decline of water to a lower state. Alternatively, a change in water quality to a less respected state, through misuse and pollution form human use.

Institutions [Noun action]: They are recurring patterns of behaviour (custom, practice, relationship, or behavioural pattern of importance) in the life of a community or society that are established, be it subjective or general

Institutions [Noun]: An organisation, establishment, foundation or group and community devoted to the public promotion of enacted patterns of behaviour for a particular cause (Governance).

Structures [Noun Action]: A pattern of behaviour or action that ensures a particular social practice (Norms) the structured ways of doing things in a group.

Environment: The entire surroundings and conditions, within a natural resource functions, in part or as a whole. These things influence resources.

Cognitive processes: The mental process of identifying changes or differences around us, storing, remembering and making a decision based on our environment or based on the result of our perception, learning and reasoning.

Ephemeral streams: Streams that do not last long (Short-lived) these streams are temporal because the surface flow ceases during dry periods.

Erratic streams: Streams that carry tons of sediment objects to lower elevations

Catholic Brother: Is an ordained member of the Catholic tradition, following the vows of prayer, poverty, chastity, obedience, etc.

Organization of the Study

This thesis is organised into seven chapters. Chapter one sets the tone for the study by providing a background to freshwater governance, freshwater degradation, as well as indigenous knowledge in freshwater governance, as an academic pursuit. Chapter two, which is the literature and empirical review, discusses essential themes in the literature on cognitive processes, governance, indigenous and Western systems of knowledge, integration, participation and policy formulation. The chapter traces the trends in freshwater policy formulation. The chapter continues with a look at the theoretical underpinnings of these concepts and discusses some empirical works on the concepts identified and literature review. The chapter concludes with a short history of the Bosomtwe communities and recognises the interrelationships between issues within policy formulation and the cognitive process of locals or indigenous framework. Chapter three discusses the research methodology by outlining its ontological and epistemological underpinnings. The chapter also describes techniques for data collection and analysis. Chapters four, five, and six discuss the main themes emerging from the interview transcripts in the light of the four study objectives. The final chapter, seven is the concluding chapter, which makes recommendations for future research.

Chapter Summary

This chapter introduces the research problem, details the objectives of the study, as well as its significance. It begins with a discussion of the background of the study by tracing the historical and philosophical origins of the host discourse in the social science literature and discusses it as a hybrid subject with influences from hospitality, sociology and anthropology. The

background then gives an overview of the volunteer tourism phenomena globally and in Ghana. Next, the nexus between host perspectives and volunteer tourism is discussed. The next chapter begins the literature review by exploring the conceptual and theoretical issues underlying the study.

CHAPTER TWO

EMPIRICAL LITERATURE REVIEW ON FRESHWATER GOVERNANCE

Introduction

This chapter gives the empirical basis of the study, paying particular attention to the freshwater crisis and the anthropogenic aspect of water governance. These are the theory of cognitive knowledge production and decision making in good governance. The theory of overpopulation as a threat to freshwater degradation is reviewed considering the effect of human activity on freshwater bodies. The study reviews the state of freshwater resources in Ghana; nature of lakes and effect of socio-economic activities, on lakes; crisis in lakes and governance; freshwater governance and concept of freshwater governance. The study also examines the concept of good governance, characteristics of good governance in freshwater, principal elements of good freshwater governance, trends in freshwater governance, history of freshwater governance, indigenous knowledge of freshwater governance, indigenous knowledge and water governance, and concept of indigenous knowledge. The chapter ends with the conceptual model for the study.

Overpopulation as a Threat to Freshwater Degradation

In Malthus theory on population growth and natural resources extraction, it was observed that the human population doubles up while food production is by the repeated addition of a uniform increase (Hardin, 1968). Thus, growth in food production is in each uniform interval of time at an arithmetic rate. This predicts a

future where humans would have no resources to survive on and therefore proposes controls on human population (Hardin, 1968). Alternatively, Boserup (1981) suggested that human innovation and technological advances through reasoning would keep up food production with population growth.

The current state of freshwater resources is continuously being threatened by overpopulation, climate change vulnerability, in addition to increasing demand, exploitation and degradation through anthropogenic activities. In retrospect, Kofi Annan in the year 2000 stated that for twenty years, the consumption of global freshwater rose six-folds in 1990 and 1995. He indicated that this was twice more than the rate of population growth, with an already water-stressed population of about one-third of the worlds. Research shows that freshwater resources, mostly endorheic lakes, are susceptible to pollution activities (Graichen, 2011; Rast, & Straškraba, 2000). Therefore, such water bodies are depleted at a faster rate, due to man's activities, in our quest for better living conditions and countless economic gains (www.safewater.org). Other activities also are population increase and exploitative consumption of freshwater resources over the past twenty-five (25) to thirty (30) years. Meanwhile, water governance practices are unable to protect or reduce exploitative practices on freshwater resources (Onuoha, 2008; Richards, Sorenson, Steele & Swanson 2000; Welch, Work, & Rabinovitch, 2014; United Nations Population Fund [UNPFA] 1999).

As explained by Onuoha (2008) although population increases, translate into increased pressure on the freshwater resources, unguarded human activities around lakes, rivers, and streams that put pressure on the resources. Besides, the growing human needs and that of their livestock for survival contribute to over-

exploitation for socio-economic gains or higher living standards, thus increasing pressure on freshwater resources (Afroz et al., 2014).

Globally, increase in population, is about one billion every thirteen years. Similarly, in sub-Saharan Africa, it is estimated that with a total population of over 140 million people and a growth rate of 3.2 percent, the number of people will double in size in twenty-two (22) years (Mirkin, 2014; Welch, Work, & Rabinovitch, 2014).

"Fact Sheet: World Population Trends in 2012" reported that the world population grew to 7.06 billion in the middle of 2012, with developing countries accounting for 97 percent of the growth. Conversely, if these projections are correct, then with a total population of over 140 million people as the report indicated, and a growth rate of 3.2 percent, the number of people in sub-Saharan Africa, will double in size in 22 years. Therefore, if population increase translates to increase pressure on freshwater resources, it means that there would be a significant freshwater pressure within the next twenty-five (25) or fifty (50) years signalling danger ahead.

In Ghana, the 2010 Population and Housing Census (PHC) showed a total growth rate of 3.4 percent, compared to the 3.2 percent of all of sub-Saharan Africa. Table 1, represents the growth rate in Ghana, Ashanti Region, and Bosomtwe, the study area, see Appendix B. The population on Bosomtwe area is not very representative due to the differences in administrative areas over time. Taking into consideration the growth rate around Lake Bosomtwe and increase population rate from the literature review it is expected that the future human impact on Lake Bosomtwe would be detrimental. That is if human activities or

development increase is linked with population increase and the right freshwater policy measures are not in place to check over-exploitation and degradation of the resources.

Although population does have an impact on freshwater degradation, the degradation as the literature indicated is a crisis of governance. Notably, Ransel (2015: 4) points out that:

> *"China's one-child policy has been hailed as an environmental measure… (but this) …ignores that China's population control has hardly solved that country's growing environmental problems."*

Angus and Butler (2011) also reiterate that no amount of reduction in Canada's population, through fewer births, or via reduced immigration, would have any effect on the impact of the oil industry's extraction of oil from the Alberta Tar Sands. Invariably, no reduction in the population of the United States would have any effect on the massive military spending of the Pentagon, which is the number one consumer of the world's oil. Nevertheless, oil extraction is degrading freshwater bodies, at an alarming rate, because the policies governing its extraction are not able to reduce the degradation (John, 2014).

The Interactionist Perspective on Knowledge and Governance

Just as the interactionist perspective puts it, the minority elite in society would continue to exploit the environment for their personal interest, until it becomes extinct (Angus & Butler, 2011; Bressers et al., 2013). This could happen if the appropriate policies to protect the freshwater resources are not in line with

knowledge grounded in the people and the environment (Tuhiwai, 2002; Cleaver, Franks, Boesten & Kiire, 2005).

Knowledge grounded in the people is said to be socially constructed knowledge, which has its principles connected to the human and the environment or freshwater resources (Ostrom, 1990) while helping to protect freshwater resources. Unlike the western formal knowledge, systems and concepts of water governance, which is the current freshwater governing system, rules and regulations, are mostly separated from its context (Bressers et al., 2013; Smith, 2013). This separation is especially true, in its application since the rules or policies are imposed on the indigenes, this is emphasised in the theory of the contextual interaction by Bressers et al., (2013); Smith, (2013). The writers Angus & Butler, (2011) and Afroz et al. (2014) explain that such imposed policies leads to excessive exploitation of the resources for selfish gains and is having an effect on natural resources as described in the stewardship approach to governance.

Therefore, the exploitation of freshwater exhibits a disconnection of the actor from the freshwater resources (Davis, Schoorman & Donaldson, 1997; Pahl-Wostl et al., 2008). Most of such freshwater policy decisions and interests are based on wealth creation, and politically charged reasoning regardless of the context and environment (UN-Water WWAP, 2006). Even though the conflict approach would have been appropriate for such a study, as it focuses on power, wealth creation, in pursuit of profit, extravagant living conditions, and structuralism, the study reflected on the interactions that support the idea of wealth creation. It also considered the demand and negative orientation (consumption and waste) on freshwater, which is already well beyond the capacity of scarce

freshwater. From the literature, an approach that disconnects the individual would eventually lead to the degradation of the resources.

Effect of Human Activity on Freshwater Bodies

In an attempt to meet the increasing demand for human needs like food supply, industrial production and other technological gadgets for a fast-growing population, the quality and quantity of freshwater resources are reduced. The detrimental effect of unclean water, according to Arthur (2013), Hinrichsen, and Bryant (2000) come along with poor sanitation and health. The WWAP (2012) and Hinrichsen et al. (2000) emphasised that freshwater degradation or pollution kills over 12 million people each year. Mostly in developing countries, less than 3 million people are killed by air pollution yearly (WWAP, 2012). Nonetheless, heavy metals and chemicals, found in freshwater bodies, as well as other contaminants, are effects by human activities in their pursuit to increase wealth and better living conditions. Meanwhile, these contaminants and chemicals cause widespread health problems while stifling socio-economic growth and development (WWAP, 2012).

Human activities also affect the volume of freshwater for human use (Taylor, Van Wieren, and Zaleha, 2016), for example when the quantity of water is reduced, it results in a reduction of water available for drinking, irrigation and other livelihood activities. Usually, a higher concentration of pollutants and salinity in lakes or freshwaters increase with the decrease in water quantity in lakes or freshwaters. This will cause a reduction in biodiversity of plants and animals while human health is at risk due to the deterioration of the resource (Kraemer et

al. 2001). Many of these health-related implications due to the quality of water include cholera, diphtheria, and typhoid (UN-Water WWAP, 2006).

Globally, the extraction of freshwater supplies is projected to increase by at least 50 percent by the year 2025. This situation may severely constrain the availability of freshwater for all purposes; particularly for agriculture, which currently accounts for 80 percent of water use in developing countries. Unsustainable agricultural, as well as growing industrial production is likely to increase water pollution as well as reduce the quantity of water use. Experts predict that climate change and variability, particularly the foreseen increases in the frequency and severity of extreme events, will worsen freshwater scarcity to crisis levels in many parts of the world. It is estimated that by the year 2025, more than two-thirds of the world's population will live in water-stressed regions, whiles about 460 million Africans would face water stress (Falkenmark, 1989; Potvin & Bovarnick, 2008). It is believed that water scarcity is likely to become the primary cause of conflict (WWAP, 2012).

Problems of freshwater scarcity in Africa is attributed to the quest in attaining an industrialised status as well as changes in development goals to suit the western style of living (Kithiia & Khroda, 2011). In Kenya, for example, available water is estimated to drop from 650m3/year to 359m3/year. Kithiia, (2012) reported that Lake Victoria transports several effluents from many factories, causing its pollution and degradation. A study by Kithiia (1992) shows a high-level concentration of mercury and lead, which is above the WHO a standard guideline of mercury 0.03 – and lead, which is 0.1 mg l-1. Besides, pesticide residues in particularly, DDT, "Ambush", and "Ridomil", "Malathion"

etc., also exceeded the WHO and the Kenya standards for drinking water. Dichloro-diphenyl-Trichloroethane (DDT) was measured 0.000086 mg l-1, “Ambush “0.1413 mg l-1, “Ridomil” 0.147 mg l-1 and “Malathion” 0.00039 mg l-1 respectively. Kithiia (1992) further explains that the nature and degree of human activity determine the extent and nature of pollution as well as the deterioration of water quality.

The 2002 World Bank Report, for example, explains that the Niger River in Africa, which is one of the longest rivers in Africa and the ninth largest river basin in the world, is threatened by growing human activities. The threat is due to unsustainable development as well as the inability of governance policies, to maintain the natural resource for human’s need and other biodiversity issues. This untenable development has led to conflicts between farmers and herders from the Niger basin on scarce water and food. The historical record of Lake Chivero in South Africa, shows a rise in the concentration of dissolved phosphorus from 0.2 to 1.6.mg/L in 1988 to 2002 respectively Magadza, (2003: p.4), indicating a hyper-eutrophic state, due to intense human activities. The reduction is attributed to sedimentation from unguarded human use.

Studies by Baa-Poku, Asante and Amakye, (2013); Agrawal, Nepstad and Chhatre, (2011); National Environmental Sanitation Strategy and Action Plan (NESSAP), (2010) and Ziem, (2015) show declining trends at an alarming rate, in the quality and quantity of Ghana’s freshwater bodies. According to the writers, such decline is mainly due to human activities in the environment and most especially around the freshwater bodies. There are three central river systems in Ghana. These are; the Volta river system, comprising Oti and Daka rivers; the

Black and White Volta rivers; the Pru, Sene and Afram rivers, whose basin occupies about 70% of Ghana's area. There is also the Southwestern river system: that is the Bia, Tano, Ankobra, and Pra rivers covering 22% of the country's landmass. The third is the coastal river system made-up of the Ochi-Nakwa, Ochi Amissah, Ayensu, Densu, and the Tordzie rivers, covering 8% of the country area (Agrawal, et al., 2011; Gordon & Ansa-Asare, 2012; NESSAP, 2010). In addition, there are other streams and lakes: the largest natural lake being Lake Bosomtwe, a large Crater Lake, which is the focus of the study. All these freshwater systems have important sociological, ecological and hydrological functions toward the protection of lives.

State of Freshwater Resources in Ghana

According to Baa-Poku (2013), freshwater resources in Ghana have not been managed properly. This situation has resulted in the degradation of freshwater resources with high levels of pollution and sedimentation. Degradation is evident mostly in areas located near human settlement, farmlands and industrial regions (European Union Country Environmental Profile [EUCEP], 2012; Freshwater Country Profile Ghana (2004); Country Environmental Analysis [CEA] (2006); Bank (2006) indicates the cost to the state is about US $520 million annually (6.0% of Ghana's annual GDP) that results from natural resources overexploitation and degradation (Bank, 2006).

EUCEP (2012) predicts a general reduction in annual river flows in Ghana by 15-20 percent for the year 2020 as well as 30-40 percent for the year 2050; considering the rate of forest decline in Ghana, which was estimated at 2.24

percent between 2005 and 2010. Recent total forest cover in Ghana, according to NDPC, (2014) has deteriorated from 32.7 percent of total land area in 1990 to 21.7 percent in 2010. The clearance of forest, vegetative cover, erodes the soil into rivers and lakes. The eroded soil increases the sedimentation load of rivers and lakes (Bruijnzeel & Hamilton, 2000a & Bruijzeel, Hamilton 2000b). To confirm the seriousness of the state of our water bodies, in 2014 the Member of Parliament for Kade, Ghana Mr Ofosu Asamoah in a news item commented: "Ghana is in a water crisis!" (Quarshie, 2014).

Indications are that the rainforest and the coastal savannah zones would receive the highest reduction in rainfall. Kuchment (2004) indicates that forests account for about 15- 20 percent of water evaporation globally, yet nearly 65 percent of rain on land can be attributed to it. The author emphasises that a lower level of atmospheric water vapour reduces the cloud cover and amount of rainfall. Therefore, if the forest is removed, rainfall into the rivers and lakes are also reduced substantially. Studies by Bubb, May, Miles, and Sayer (2004) explain that rainfall which is the major source for replenishing rivers and lakes are estimated to reduce between 1.1 and 3.1 percent throughout all the six agro-ecological zones in Ghana by 2020 (NDPC, 2014). Decreases in rainfall and increases in mean annual temperature according to WRI/CAR (2010) signify danger in the reduction of freshwater in both the northern and southern belts of Ghana (Gyau-Boakye, 2012).

Pesticide and chemical contamination in rivers and lakes, as well as illegal small-scale mining, has been identified as one of the major sources of freshwater degradation. These create health dangers, which possess threats to human life and

the existence of aquatic life. Also, irresponsible spillage of cyanide according to reports by Adombire, Adjewodah and Abrahams (2013), Gordon, and Ansa-Asare (2012) indicated that huge mining companies also contribute enormously to the pollution of rivers, streams, and lakes. For example, high arsenic levels of between 40.5 to 1,290 mg/L have been observed in the Pra and Tano Basins in Ghana (EUCEP, 2012). The Subin River is one of the most polluted freshwater bodies in Ghana, with faecal coliform counts ranging between 21 x 103/100ml and 44 x 1011/100ml, instead of zero cfu/100ml, the standard level (WRC, 2012a). In addition, the Subin River has been found to contain over 2000mg/L of Total Dissolved Solids (TDS). Besides, 5,067 kg/day of suspended solid loads was found in the Birim River (Ministry of Water Resources, Works and Housing [MWRWH], (2010). This state is attributed to the dumping of domestic waste as well as industrial and agricultural waste (Adombire, Adjewodah, & Abrahams, 2013; EUCEP, 2012; WRC, 2012b & 2012c).

Meanwhile, in 2005, Ammonia Cal Nitrogen NH3 -N levels of the Pra basin, was lower than that of 2006, an indication of increased human and agricultural activities (Gordon & Ansa-Asare, 2012). Bantama and Kaase Guinness rivers also showed phosphates concentration levels of 0.233 - 1.6 mg/g, which is quite higher than the WHO acceptable limit of 0.062 - 0.186 mg/g. This can be attributed to the occurrence of farming activities in the catchment area. The high concentration of arsenic has also been detected at Ampunyasi where values of about 1300µg/L were measured in the dry season and 200µg/L during the rainy season (Adombire et al., 2013).

According to the report, by the authors, arsenic levels between 40.5 to 1,290 mg/L have also been observed in Pra and Tano Basins due to mining activities. Meanwhile, the permissible standards by Ghana Standards Board are 0 to 0.1 mg/L (for manganese) and 0 to 0.3mg/L. The concentration of such toxic chemicals kills a large number of fishes (Woodford, 2013). Ministry of Environment Science and Technology [MEST], (2012) emphasises that the pollution of Pra and Birim freshwaters, from mining and agriculture activities, has led to the inability of people using the water.

Most of Ghana's freshwater resources have deteriorated since 2011. Based on the approved water quality index, only 55 percent of freshwaters are found in the class three grade. These freshwater bodies, according to WRC (2012a), scored below the poor water quality index*; Lake Bosomtwe, Twifo-Praso River, Pra, Dunkwa and Offin, and Ampansie. The high level of pollution in Ghana's freshwater resources is also an indication of data or information gap in governance to protect the freshwater bodies (Akrasi & Ansa-Asare, 2008; NESSAP, 2010; & Mensah, 2010).

The Odaw River and Korle Lagoon in the Greater Accra Region as well as the Subin River in the Ashanti Region are examples of poor water governance policies. This condition has resulted in the high levels of pollution due to anthropogenic activities like infrastructure construction, industrial (including mining) and estate waste disposal, as well as agricultural projects (Mensah, 2010). Consequently, if concentrations of waste exceed the capability of what rivers and lakes can handle, then water-borne and water-based diseases like bilharzia, enteric infections, and intestinal worms become widespread (Karikari & Ansa-Asare,

2006). Invariably sick people carrying viruses in the sewage they produce send those viruses into the freshwater body. Therefore, it is possible to be infected by illnesses such as hepatitis, typhoid, and cholera from river, streams, and lakes if the class range of pollution is < 25 as seen in Table (1)

Table 1: Criteria for Classification of Surface Waters

Class Range Description	State of pollution
I > 80	Good / Unpolluted or recovering from pollution
II > 50–80	Fairly good
III > 25–50	Poor quality
IV < 25	Grossly polluted

*Source: WRC (2012).

Invasive alien species are also a result of the degradation of most of Ghana's freshwaters. Due to anthropogenic activities, most of the freshwaters in Ghana have been covered with water hyacinth (waterweeds) ranging from 35 to 70 percent coverage (Akapbey, 2012 & deGraft-Johnson, Blay, Nunoo, & Amankwah, (2010). An example is the extent of coverage of freshwater weeds in the Lower Volta and Tano River, which is more than 5000 ha of water surface (EPA, 2010). It is estimated that the spread in River Tano is at 12 ha per annum (EPA, 2000).

Until 2010, freshwater weeds were absent in the Lower Volta, yet due to human activities, a large area of the water surface is occupied with freshwater weeds. Most freshwater bodies located near industrial areas like Korle, Chemu, and Gao Lagoons are dying due to nutrient enrichment and eutrophication. These lagoons are also the sources of intense stench and nuisance in their locations. The

presence of nutrient from waste is likely to enhance eutrophication, which would lead to depletion of oxygen available in rivers and lakes. For instance, chemicals from human activities are washed into drains during heavy rains and eventually, into rivers and lakes.

Through ineffective water governance, sewage and fertilisers that end up in lakes can cause increases in nutrients or eutrophication and proliferation of algae and water hyacinth growth. Most waterweeds are harmful because the decaying plant uses up oxygen from the freshwater, killing other forms of life (Woodford, 2014). In addition, when the waterweeds die, they accumulate as solid at the bottom of lakes. The Centre for Aquatic and Invasive Plants Report emphasised that waterweed or plant decomposes and sinks to the bottom of the river or lake, leaving behind a deposit of sediment (Cole, & Weihe 2015).

High sediment yield, in freshwater, affects the quality and quantity of water supply. The vegetation, which protects the soil from being eroded during heavy rainfall, is rendered ineffective. Sedimentation, according to Kusimi, Amisigo and Banoeng-Yakubo (2014), is the net result of erosion and deposition processes of sand, debris etcetera, within a basin. With the clearing of forest cover for infrastructure, logging, and other exploitative agricultural activities, the soil is eroded, with the heavy rains. Sand and debris are washed up into the river or lakebed, filling it up to reduce the volume of freshwater. Sedimentation is a threat to reservoir lifespan and a danger to flood control, irrigation, navigation, fishing, tourism, hydro-power generation, river channel morphology and stability of the freshwater resources (Alam, Uddin, Ahmed, Cacovean, Rahman, Banik, & Yesmin, 2007; Schwartz & Greenbaum, 2009).

Sediment yield within a catchment, according to Kusimi et al. (2014), is a result of anthropogenic and other physical factors. These include infrastructure construction, farming, mining, the nature of the slope, basin area as well as rainfall intensity. The Pra Basin was found to be very high in suspended sediment concentration and sediment yield, resulting in a high annual specific suspended sediment yield. Riverbank material accounted for over 60 percent of suspended sediment loads (Kusimi, Yiran, & Attua, 2015). With time the sediment, which has accumulated at the bottom of the lake, causes the lake to become shallow, and the lake may die (Cole, & Weihe, 2015).

According to Akrasi (2011), suspended sediment yield for Ghana's southwestern and coastal basins is between 11 and 50 km^2– year. Meanwhile, siltation and sedimentation is the major cause of the drying up of freshwater bodies like the Densu (Ministry of Environment Science and Technology [MEST], 2012). According to Kraemer et al. (2001) and UN-Water WWAP (2006), such pollution in lakes can result in degradation and extinction if the required measures or knowledge base to control its use is not met.

Nature of Lakes and Effect of Human Activities on Lakes

There are two types of lakes, that which are formed by nature, the humans constructed lakes (artificial lakes) by building dams, and an example is the Volta Lake in Ghana. Natural lakes may be formed through earth movement (also called Tectonic movement) examples are the African Rift Valley Lakes, Lake Nukuru, Lake Victoria of Kenya and Lake Turkana of Kenya. Others are and Ethiopia domes as well as Lake Malawi (UNEP, 2004; UNEP-IETC, 2002).

Some are formed through volcanic activities, which produce depressions in the earth, and examples are Lake Baikal in Russia, the world's deepest lake. In most temperate areas, lake formation is through "glacial sour" where slow movements of massive volumes of glacial ice, produce depressions in the surface of the land. These depressions are eventually filled with water, and examples are the North American Great Lakes, Lake Superior, Michigan, Huron, Erie and Ontario in the United States of America. There are different sizes normally bowl-shaped depressions, ranging from the size of a pond to large quantities of freshwater stretching for over hundreds of kilometres, usually with the deepest part of a natural lake at the centre.

Meteorite lakes as indicated by Reimold, Brandt & Koeberl. (1998) and Koeberl & Reimold (2005) are formations created by the impact of meteors on the earth's surface. The impact forms a depression, which is eventually filled up with water (Kumar, 2005; Rast, & Straškraba, 2000). According to Bermosa (2012), such lakes are also called impact crater lakes. Some examples of such lakes are Lakes Lonar located in Lonar, India, and Maharashtra also in India with a mean diameter of 1.2 km while the meteor crater rim is about 1.8 km. Siljan Lake, which is located in Dalarna, Sweden, has an area of about 354 km2 and a maximum depth of 161 meters. Others are West Hawk Lake in Manitoba Canada, Kaali Crater or Kaali lake nine-meteorite crater, located in the island of Saaremaa in Estonia, with the largest diameter of 110 m and a depth of 22m.

Lake Bosomtwe, which is the only natural meteorite lake that exists in Africa, is located in Kumasi, Ghana. It is about 8km across with the diameter of crater 10.5 km. The lake originated from a meteorite impact about 1.3 million years

ago, Lake Manicouagan, also known as Manicouagan reservoir which is an impact crater lake located in Quebec, Canada, with an area of 1,942 km², it has a volume of 139.8 km³ making it the 5th largest lake in the world by volume (Bermosa, 2012).

Some lakes are formed at the lowest points in the land surface; therefore, when rainfall eventually fills up the lowest depressions, the freshwater's journey into the sea is terminated. This condition, unlike all other water bodies, such lakes or "endorheic water bodies" do not have direct access to the sea (Scott, 2015). Endorheic lakes, as explained, have no natural drainage outlets into the sea and are sometimes called "terminal" or sink lakes. Such lake is found in all continents, and they are often saline (salty) that is 0.008percent salt, with the Caspian Sea containing about 70percent of the world's inland salty waters (UNEP-IETC, 2002).

A study by UNEP-IETC (2002) indicates that it is difficult for such salty lakes to sustain life because they are not fresh open lakes. The report also suggests that closed lakes by their characteristics form in areas where evaporation is more significant than rainfall (Schultze, Boehrer, Wendt-Potthoff, Sánchez-España, & Castendyk, 2017).

Yet as the report indicates, the sources of closed lakes are runoffs, actually obtained from regions with higher rainfall than the area around the lake itself. This situation is usually a depression in the land, as indicated in the literature (UNEP-IETC, 2002). Endorheic lakes as indicated do not have direct access to the sea. Therefore, their inflows subsequently flow into dry watercourses, or they are evaporated leaving minerals as well as other inflow erosion products to

concentrate at the bottom of the lake (Acheampong, 2009; UNEP-IETC, 2002). In addition, materials carried in the runoffs, settle at the bottom of the natural lakes forming sediments, which will slowly cause the water bodies to cease to exist over time, as increased human activities also, increase the sedimentation processes.

Thomas, Meybeck and Beim (1996) explain that closed lakes or endorheic lakes' watersheds are often restricted within a mountain range or a natural geological feature that has disconnected their direct linkage to the sea (Acheampong, 2009; UNEP-IETC, 2002). Thus, this renders such lakes very sensitive to pollution causing the quality of the liquid freshwater to reduce as well as the capacity to carry freshwater (Scott, 2015). Usually, evaporation and seepage are the major outflows for endorheic lakes, leaving the water saline and polluted with excessive, chemicals, fertiliser and pesticide use by humans and causing significant human health impacts as well (Scott, 2015; UNEP-IETC, 2002; Lakes, 2008). Examples of endorheic lakes are the Dead Sea in Jordan, Israel, and Palestine, Lake Bosomtwe in Ghana; Great Salt lakes in Utah; Mono Lake in California; the Caspian Sea in Eurasia; the Aral Sea in Asia; and Pyramid Lake in the western United States (UNEP-IETC, 2002).

Lake Bosomtwe, in Ghana, can be classified within two unique lake categories, as an impact crater lake as well as an endorheic lake (Acheampong, 2009, UNEP-IETC, 2002). As discussed earlier, the major causes of the lake's quality degradation and reduction in quantity are from humans and unguarded human activities as shown in Figure 1.

Figure 1: Channel or Stream leading to Lake Bosomtwe engulfed with rubbish

Sources: Amu-Mensah (2016)

Here Lake Bosomtwe finds itself in the category of lake formation that is most susceptible to pollutants, which could lead to its extinction. For example, Lakes Superior, Huron, Michigan, Erie, and Ontario are amongst the world's largest freshwaters of about 24,600 cubic kilometres of water equivalent to 20% of the world's freshwater. Geologically, Lakes Victoria and Tanganyika in Africa and Lake Titicaca in Latin America are relatively shallow, with some of the largest lakes having a maximum depth of 1.5km at their most in-depth end, examples being Lakes Baikal and Tanganyika. A relative comparison of the bottom of Lake Bosomtwe with a maximum depth of 78m, indicates Bosomtwe to be very shallow, thus making it susceptible to pollution and sedimentation activities. Consequently, such lakes become vulnerable to excessive exploitation. Such situations lead to pronounced eutrophication, sedimentation, microbiological and chemical pollution. Hence, deterioration is through the ineffective system of liquid freshwater governance (Fairhead & Leach, 2016). Even the Pyramid Lake in North

America with no outflow has its levels reduced to almost 150 feet since 1800 due to unguarded human activities.

According to Umek, Chandra, and Brownstein (2009), the total dissolved solids (TDS) has increased from 2500mg/1 to more than 19,000mg/1. With the longest freshwater coastline in the United States, over 11,000 inland lakes and extensive wetlands, it is reported that Michigan, in particular, is susceptible to the impacts of invasive plants. Toxic TDS levels in Walker Lake have eradicated other native fishes such as Lahontan cutthroat trout (Umek, Chandra, & Brownstein, 2009) thus, highlighting careless human activities that are threatening the lakes. Africa is gifted with about 677 lakes with 88 being principal lakes. Lake Chad, Africa's fourth-largest lake is shrinking due to persistent drought and human activities. Its surface area has decreased from 25,000 sq. Km to approximately 1,350sq.km. It is estimated that between 1966 and 1975, the lake shrank by 30 percent. Out of this, five percent was due to water withdrawals for irrigation. Between 1983 and 1994 excessive irrigation withdrawals increased by fourfold, contributing to 50 percent in the lake's surface loss (Servant & Servant, 1983; World bank, 2014 & Odada, Oyebande, & Oguntola, 2006).

Similarly, concerns have also been raised for Lake Turkana's degradation; human settlement and community modification have been cited as the cause, leading to freshwater degradation. According to Tenywa (2013), Lake Victoria, the second largest lake in the world and the largest in Africa, with a maximum depth of 80-90 m that is quite shallow, has concerns of pollution from industries and unsustainable exploitation of fish causing its degradation. Lakes Atlas, Tanganyika and Malawi have also been cited as suffering the same fate (UNEP,

2010). The levels of most closed lakes are unstable because they depend on runoffs from rainfall, which means that with fewer rainfalls; the water balance of a closed lake is altered reducing its volume of water (Scott, 2015, UNEP-IETC, 2002).

Currently, this is the cause of the reduction of the Aral Sea, once the world's largest second closed lake due to excessive human activities. Such activities as overfishing, pollution, conversion of forests and wetlands into farmland thus removing the vegetation cover from the soil, which resulted in a considerable erosion, siltation, sedimentation, and eutrophication of lakes. Such is the extent of damage, man's effort to increase food production, infrastructure while improving living conditions has caused freshwater bodies. In the cause of raising the standards of living, to a particular state, through industrialisation, technological innovations and production have reduced some freshwaters into extinction (Afroz et al. 2014; Guppy and Anderson, 2017).

For the African, the lake's resources or water resources were not only necessary as a source of food and other livelihood products; it is also the very source of religion and cultural beliefs, which has helped to sustain the freshwater bodies (Appiah-Opoku & Hyma, 1999; Tenywa, 2013). However, human's insatiable nature and nature of governance have greatly hastened the natural ecological processes, of lakes by increasing the rate at which nutrients, pollutants, and other chemicals, enter liquid freshwater bodies, from their surrounding catchment areas (Moss, Ryszard, & Measey 1998).

Newsghana (2014) reports the alarming situation of Ghana's freshwater resources, which has been classified as under stress. Similar reports by Baidoo (2014), BDA (2006) and Freiku (2013), indicates that Lake Bosomtwe's fish stock

is declining as pollution, erosion, and sedimentation levels rise. This condition because policies or rules to reduce overexploitation of the resources are not being adhered to (Pahl-Wostl et al., 2008; Tuhiwai, 2002). It is obvious that critical issues facing lakes include fast riparian population growth, and most importantly, lack of compliance and adherence to water governance policies. Such government policies are detached from the community member's freshwater resources. That is in terms of the application of protected knowledge on freshwater bodies, as well as power and right to water policy formulation, management and its use by the local people (Appiah-Opoku et al., 1999; Kendie & Mensah, 2008; Pahl-Wostl et al., 2008; Tuhiwai, 2002).

Crisis in Lakes and Governance

Globally, the crisis in freshwater governance would ultimately emanate from the contamination of the environment. Besides, changes such as unsustainable exploitation of freshwater resources suspended soils from an intensification of agricultural activities, deforestation "commercial quantities" and expansion of infrastructure, construction, industries, and modifications are all contributing factors. Hecky and Bugenyi (1992) report these changes or crisis affecting freshwater resources, as threatening the survival of lakes as places for human heritage, which could permanently alter the functions of their ecosystem and biodiversity at large. Reports by Sanchez, Carlos and Roberts (2014), demonstrate that radical changes in the ecosystem affecting freshwater bodies began in the nineteenth century. Seven decades of extractions, rendered the Dead

Sea level to opened sinkholes, causing other environmental problems (Rosenberg, 2011).

Lake Erie, the smallest, warmest and shallowest of the Great Lakes, for example, went through severe eutrophication due to extreme agricultural practices and phosphorous in detergent, from domestic effluent in 1960. Without the nutrient, this process takes thousands of years, yet unguarded human activities caused the process to occur in only twenty-five years due to inadequate water governance (Safewater, 2016).

Human activities, like major engineering projects, also altered the natural hydrology of the Great Lakes' basin during the early twentieth century. This was the region with a hothouse for industrialisation and the manufacturing of steel and automobile. Meanwhile, pulp and paper, as well as the chemical industries, were flourishing. The most famous example is said to be the Chicago Diversion, freshwater from Lake Michigan was used to serve the Chicago metropolitan area's industrial processes and as a means for transportation. Whiles the effluent from by-products and wastes, human sewage in particularly as well as from factories and other businesses were discharged through the Chicago Sanitary and Ship Canal into the Mississippi River Basin (Pebbles, 2014). Meanwhile, chemical and nutrient support for agriculture also intensified, thereby increasing the pollution loads from the agricultural sector, while paying little attention to the ecology of Lake Michigan's freshwater resources.

Governance of the Great Lakes Basin is being shared among two federal governments and eight states of the United States these are (Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania and Wisconsin). The second

example is the Canadian provinces of Ontario and Quebec, where in addition to several regional institutions with more than a hundred Native American and First Nation authorities, there are thousands of local units of government working together. This situation sheds light on the stakeholder's approach towards freshwater governance in the Great Lakes Basin. According to Pebbles (2014); WWAP (2012) & Pahl-Wostl et al. (2013b), the key environmental problems affecting lakes throughout the world are as follows:

1. Low water-level and reduction in lakes water quality are caused by the deterioration of the ecosystem and overexploitation.
2. Accelerated siltation of Lakes due to an increase in soil erosion from over-exploitation of the catchment through intensive agriculture and infrastructure
3. Acidifications of lakes are also due to mining activities and acid precipitation, which results in fish extinction and the degradation of ecosystems.
4. Contamination of the lakes, are also through sedimentation of the Lake beds, and the decaying of other living organisms as well as the introduction of toxic chemicals from agriculture (pesticides) domestic and industrial wastes.
5. Eutrophication of lakes, are through the introduction of nitrogen and phosphorus compounds. These compounds come from industrial effluents as well as domestic, agricultural activities and road surfaces leading to a decrease in biodiversity.

6. In extreme cases, there is extinction or a complete failure of the lake's ecosystem.

Crisis in freshwater governance both in Africa and in Ghana leads to unclean or filthy water, which is difficult for human use. Polluted lakes or liquid freshwater resources are the world's major risk to health and other development issues, especially in developing countries. For example, Ghana's water degradation is contributing to 70% of diseases in the country (Ministry of Environment, Science and Technology [MEST], 2012). Yet, good quality freshwater, in right quantity brings about a healthy environment and for most communities, it is a source of improvement on their livelihood and existence.

The problem is the nature of knowledge in water policy for water governance, which helps to regulate or manage the situation, which is causing the degradation and loss of these sources of health and livelihood (WWAP, (2012). Studies by Pahl-Wostl et al. (2013a), Smith (2013), WWAP (2012) and Keavey (2009) dwell on the mismatched knowledge underpinning freshwater governance policies, as the cause of water degradation. The writers explain that policies do not ensure compliance with water rules and regulations since it is not easy to understand and work with what you have not experienced. Indigenous rulers, before the western system of governance, had systems to ensure the maintenance of rules and regulation on resource use (Appiah-Opoku et al., 1999; Kendie & Mensah, 2008).

Fairhead and Leach (2016) and Smith (2013) indicated that this situation of departure, further alienated people from the local ways of maintaining and using the water resources. Colonial rule in Africa was the inception of the western

system of water governance, taking away the resources and power to rule from the indigenous institutions to local government structures (Appiah-Opoku et al., 1999).

In developing countries, freshwater governance policies for solving freshwater problems as indicated from the review are replicas of western freshwater governance approaches. Meanwhile, the contributions of indigenous communities or local communities as indicated by Professor Farhad Analoui are ignored.

> *[Professor Farhad Analoui of the Bradford University, Faculty of Social Sciences, during a conversation in 2016, said, "indigenous knowledge looks at the reality as experienced by the participant and as a social construct.*
>
> *He explained that meanings are given to practices in water governance, which considers the symbolism or representation of IK by the local community. These meanings, he indicated, have been socially constructed and are socially sustained by the people through culture from generation to generation. The professor emphasised that the people create IK gradually so that everybody in the community can understand and use it, since it has been perpetuated through culture. This position means the understanding and meaning behind the symbols, thus making it an everyday practice in the community to protect or govern the waterbody].*

This position reinforces Kendie and Mensah's (2008), Fairhead and Leach 2016)’s thoughts.

Such has been the governance of freshwater situation in Africa since the 1970s and '80s (Pollard & Cousins, 2008; Gandy, 2006). For example, using the western system of governance, Lake Chad in Africa is estimated to have shrunk from persistent human activity and drought; its surface area has decreased from a peak of 25,000 sq.km to approximately 1,350 sq.km from 1966 to 1975 respectively (Andersen, 2003; Giffin, 2013). Andersen (2003), reports that more than 20 million people depend on the lake for their livelihood whilst governance measures to reduce the degradation is limited by regional poverty. Meanwhile, the most affected group is the small-scale local fishers. Regional workshops undertaken as part of the mitigation process identified the threats as coordination and collaboration in their actions and work with local communities, thus calling for an integrated approach to water resource management at the national and basin levels.

According to Graichen (2011), Lake Naivasha like many of the great East African lakes, which is of international biodiversity value, is spreading with water hyacinths due to the enrichment of the lake water with nutrients from human activities. Meanwhile, many of the Ethiopian Rift Valley Lakes (ERVLs) are categorised as endorheic and therefore, do not drain further (Ramsar, 1992). The Ethiopian national water policy has set the stage for integrated, collaborative and participative management approaches with local stakeholders.

A number of informal institutions, governing the water resources can be attributed to ethnic and cultural groups in Ethiopia, and an example is the "gadaa" system in the Oromia region. Integrated Water Management (IWM) uses the most effective way to manage existing water resource, mainly with diverse stakeholders

(Graichen, 2011). Yet there is no indication of the local contributions towards the freshwater management, that is their indigenous knowledge or practice, which is a gap identified in International Water Management Institute [IWMI] in Ethiopia. Meanwhile, IK according to Appiah-Opoku et al., 1999; Smith, 2013 has been used by local or indigenous communities, to maintain and govern freshwater bodies (). Graichen (2011) report, therefore, concluded that deterioration of the African Great Lakes has resulted from some major causes being:

1. Lack of adherence to and application of rules governing environmental pollution and the method of fishing
2. Rapid population growth in riparian communities, coupled with technological innovations, various productions and modifications and rapid expansion in infrastructure.
3. Weak regional integration of accepted policy, institutional and implementing mechanisms for sustainable management of the ecosystems
4. Low level of community involvement in ecosystems management due to lack of education and public dissemination of issues
5. Universal prevalence of endemic disease, like malaria; HIV/AIDS; typhoid; cholera and tuberculosis has reduce the productivity of people.
6. Large demand for export markets for fisheries with no improvement of fish handling capacities and technologies

It is evident from such degradation of lakes that there is the need for a more effective approach in context, towards freshwater resources governance, if the maintenance, as well as the reduction in the degrading of freshwaters, is expected to improve.

Freshwater Governance

The section tries to explain governance and freshwater governance; it also examines trends in global water governance as a whole and developments in freshwater governance in Africa and Ghana, while identifying gaps in these systems of governance. Finally, the study examines the role of traditional belief systems, and indigenous knowledge has played in the governance and management of freshwater resources. The study examines how water governance relates to the embedded knowledge of the past that helped to conserve water. The concept of governance, of course, is not only about rules and regulations, but it also encompasses institutions that relate to government policies and actions, to domestic activities. It also includes and to networks of influence, including international market forces, the private sector and civil society in freshwater governance (Rogers & Hall, 2003).

In understand freshwater governance, it is essential to consider the different definitions from several dimensions, used by authors in different subject areas of governance. In a broader sense, the word governance brings to mind how the government directs its affairs. Webster's Third New International Dictionary (1986:982) defines governance as a synonym of government; it is defined as the process of governing or using your authority to direct and control. Equating governance with the government is common characteristics by many writers. This association puts attention on the process of using power, to direct and control in governance, thus focusing on the supervisory aspect of government. The above explanation is also in line with a lead financial institution's definition (Africa

Development Bank (AfDB), 1999), which focuses on how a country's economic and social resources are managed using power to ensure progress.

However, this definition of associating governance with the government, reduce the scope of the concept governance to the practice of government (Grindle, 2002), whiles emphasising on the effectiveness of the decision making an aspect of government. In Grindle study of 20 countries, the author uses the six principles of governance participation fairness; decency; accountability; transparency and efficiency to determine government performance. See Appendix F. The indication from the study was that when governments perform poorly, "resources are wasted and services go undelivered, while citizens especially the poor are denied social, legal, and economic protection". Meanwhile, governance is more effectively used as a basis for thinking about new and emerging ways in which society orders its affairs, rather than as a way of helping the government to function better (Hamm, 2001).

WWAP-UNESCO (2003) also defines governance as a system comprising only of the higher-level decisions that establish the background for day-to-day decision-making. This situation creates a distinction between the high-level decision-making in governance and low level practical operational decision making, which is management (De Stefanoa, et al., 2014). The definition emphasises the aspect of governance from the critical institutional perspectives. Cleaver (2015) suggests that governance offers a rich understanding of how they shape individuals shape institutions and in turn. Tricker (2009) also makes a more apparent distinction of management from governance, as the author suggested that management concerns the day-to-day operation of the system. In this context, he

explained, are the strategies, policies, processes, and procedures that have been put in place, by the governing body. Additionally, the author explains that whereas governance is concerned with "doing the right thing," management is concerned with "doing things right."

A definition that distinguishes governance from management is what is employed in the framework of governance for the study. The thesis also builds on Franks & Cleaver's (2007) definition, of governance as the way stakeholders in society alter its relationship, to direct their affairs. The authors explain that the government is only one aspect, among the key stakeholders in the process of governance. This definition is similar to the Hamm (2001) definitions of governance, as 'the exercise of economic, political, and administrative authority to manage a country's business at all levels' (Hamm, 2001). These assertions, from the various authors' definitions, encompass the mechanisms, processes and institutions by which people and groups express their interest while exercising their legal rights. It also emphasises the ability of stakeholders to fulfil their responsibilities as they reconcile their differences.

The Mo Ibrahim Foundation defines governance as "the provision of the political, social and economic public goods and services that every citizen has the right to expect from their state and that a state has the responsibility to deliver to its citizens". The overall four key components, as useful indicators of governance, for the Ibrahim Indicator for Africa Governance (IIAG) are Safety & Rule of Law, Participation & Human Rights, Sustainable Economic Opportunity and Human Development (Ibrahim, 2017).

These indicators have sub-categories created to provide a quantifiable tool to measure and monitor governance performance in African countries. It is expected that these tools would help to assess progress over time and to support the development of effective and responsive policy solutions.

Although the advisory council is made up of mainly Africans, the standards, ethics, and methodology for measuring African countries are Western. It is thereby considering the situation that these indicators have emerged from the SDG and the World Bank's ideas on governance (Lenton & Muller, 2012; Guppy & Anderson, 2017). IIAG focuses on measuring outputs and outcomes of policy, rather than declarations of intent. It does not look at the quality of the relationship between the people and its leaders, but exercises power and exerts influence in managing economic and social resources. Notwithstanding, Africans need to understand their system of operation, to be able to contribute their thoughts in support of the framework provided to develop.

Concept of Freshwater Governance

The concept of freshwater governance came about as one of the areas to improve on the sustainability of freshwater resources and to respond to the global freshwater crisis. Although there is an abundance of freshwater resources to satisfy human needs, there is a crisis in the system of actors, resources, mechanisms, and processes which reconciles humans' access to freshwater and its use by all.

Concept of Governance

Governance is used in many different contexts, be it international, national, corporate or local, within economic, political, ecological etcetera, and governance of the ecology includes the water resources. Governance can be formal and informal, and this depends on the actors involved in the application of knowledge acquiring for decision-making and implementation. This study focused on formal and informal actors who are involved in the acquisition and provision of knowledge for the decision-making process in freshwater governance.

In defining governance and Good Governance, the study does a systematic review and critic, of the different definitions from some international institutions and writers, instead of selecting one definition. This will help identify the differences in the components of good governance and variations in the definitions to make out a working definition, which could be used in the particular case of Lake Bosomtwe communities.

Most definitions are built on how political and economic institutions bring about economic and not environmental development. UN's definition seeks to ensure that institutional (Ministries and Parliament) processes are transparent. This process indicates the standard for a country's integrity and respect (Good). In other words, good governance is expected to stimulate equity, participation, multiplicity, transparency, accountability and the rule of law, in a way that brings about effectiveness and efficiency for the present and the next generation (López-Claros, and Mata, 2010; Lenton, & Muller, 2012).

UNDP's definition considers institutions or systems in authority that are capable, responsive, inclusive, and transparent. All countries, developed and

developing, need to work continuously towards better governance. Good, or democratic governance as it is called by UNDP, entails meaningful and inclusive political participation. That is good governance should ensure that the local communities are involved in decisions, which shape their lives (Clark, 2013).

The International Monetary Fund (IMF) focuses on accountability, transparency, efficiency, effectiveness, responsiveness forward vision and the rule of law (IMF, 1997 p. 3). Good as in providing continues environmentally or ecological achievements or economic achievement or a mixture of both for the benefit of the people and future generation. Based on the definitions provided, the study conceptualises governance as to how recurring patterns of social, economic, political, religious and administrative behaviour are established to control the access and use of a resource efficiently.

The Concept of Good Governance

The World Bank first introduced the word Good governance, in 1989 to describe the crisis in governance arrangement better. It is currently a conditional requirement of performance or measure (good governance) as a prerequisite from aid recipient governments, especially to Sub-Saharan Africa (Schmitz, 2013; Krueger, 1998). Good governance was supposed to reinforce accountability of donor funding to institutions, in developing countries. Good governance as a barometer, denote the kind of governance that exercise power and authority to influence decisions and pass policies for a community's, socio-economic development and resource conservation. Therefore, governance is epitomised or characterised by predictable, open and open-minded policymaking instilled with

eight bureaucratic tenets mainly; (a) participatory, (b) consensus-oriented, (c) accountable, (d) transparent, (e) responsive, (f) effective and efficient, (g) equitable and inclusive whiles following the rule of law (Mikic, 2013). The outline of various definitions provided help to analyse the concept of good governance:

The former UN Secretary-General, Kofi Annan, defines "Good governance" as, ensuring respect for human rights and the rule of law; strengthening democracy; promoting transparency and capacity in public administration." To implement, the UN goals follows eight characteristics that are consensus-oriented, participatory, the rule of law, effective and efficient, accountable, transparent, responsive, equitable and inclusive.

However, the standards, as mentioned above, are common to Western democracy as measures of "goodness". From the perspective of Poluha and Rosendahl, (2002, p. 2-9), goodness in government is different from the local context since the local content is not included. The 2009 report of the United Nations defines governance as the process of decision-making and the process by which decisions are implemented. Here good governance is expected to be the participatory, consensus-oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law while it ensures a reduction in corruption while incorporating the views of the minority in decision making for the present and future needs.

Warren and Visser (2016, p. 277–286) point out the differences in theory and practice of incorporating the views of the minority. This difference is unclear in the decision-making processes, implementation as well as hierarchical practices, for both formal and informal considering the relationship between the government

and the community. In addition, Grindle (2004) emphasised that good governance is a poor guide for policy. Grindle explains that it is unrealistic and ad hoc, not to include the context of the local user, and planned, without the order of historical development in mind. At the same time, it ignores the institutional differences across well-governed states (Andrews, 2008).

A United Nations Development Programme (UNDP) report by Helen Clark, in Khalid (2013) defined governance as "the exercise of political and administrative authority in the management of a country's affairs at all levels. It comprises of complex mechanisms, processes and institutions through which society articulate their interests, mediate their differences and exercises their legal rights and obligation" (Khalid, 2013; UNDP, 2003, p.18). Meaning the governing structures should be capable, responsive, inclusive and transparent, with more people having a say in the decisions, which shape their lives. The level of participation or local engagement is not significantly seen in its application. It also ignores institutional variation across governed states (Pritchett & Woolcock, 2004).

Grindle (2010) explains that governance is expected to be relevant to the conditions of individual countries. Taking into consideration historical evidence, sequence and timing. Additionally, these should be selected carefully in terms of their contributions to particular ends, such as poverty reduction and democracy. In other words, governance should encompass the institutions, systems, "rules of the game" and other factors that determine political and economic interactions and structures in decision-making and resources allocated. Grindle's definition is more of a critique of good governance. The author believes the critical problem of good

governance agenda in practice, is the burdens, its duration places on countries that are in the worst position to respond to them. The elites who dominate such governments are not always interested in improving governance, as this could easily limit their power and access to rents and resources. Yet the study does not take into consideration much of the social system or local institutions in context. Additionally, its implication to freshwater governance is not considered.

Franks and Cleaver (2007) focus on water governance as 'the system of actors, resources, mechanisms, and processes which mediate society's access to water. Yet it is not clear, on the kind of mechanisms, processes and who implements what in the ecosystem. Although it takes into consideration the local context, the type of mechanisms and procedures may not help to mediate community's access to water if it does not apply to a common property resource or the environment. Pahl Wostl, (2013a, p. 2) specifies that governance is a system that manages environmental flows. It also emphasises Durkheim (1997) thoughts that phenomena in a system is a function and not an idea of the mind, but the reality that exists in terms of observable external characteristic in a particular society.

These systems are adaptive, flexible, and it should provide the capability to learning from experience and responds to unexpected developments. Also, Pahl Wostl explains that governance requires structural characteristics of the governance system, to support implementation and the features of the implementation processes themselves. The author further explains that there is a shortfall in research, in the area of the economics of environmental flows concerning short and long-term cost-benefit impact assessments of policy implementation.

The study does not critically consider the root of IK in government policy or its meaning and their implications to governance. Although the definition emphasises on the characteristics of the governance system, it is more inclined towards the Giddens Structuration Theory where government institutions work for the owners to maximise profit for the government. World Bank report on South, World Bank (2018) and Mundial (1992), on good governance is also characterised by, predictability, open and tolerant policymaking. Besides, it is also characterised by the type of political regime in force, the process and authority that is exercised in the management for the public good, the rule of law, transparent processes and strong civil society participation in public affairs.

The World Bank definitions highlight the reform of economic and social resource control. The description takes into consideration state responsiveness and accountability as well as the impact of these factors on political stability and economic development. Also pioneered and dominated by particular agencies with particular mandates to determine how the concept translates into practice. It makes demands for some requirements that the World Bank itself does not adhere to, like society participation in public affairs and respect for the rights of others. Nonetheless, it is more of a political regime in which power is exercised to govern resources for economic benefit. Without the clear definition in the scope, governance is allowed to choose their own sets of rules just like in the stakeholders' theory where a network of relationships is put together to help stakeholders. Yet from the literature review, equality in networking is a challenge.

The difficulty here is the cognitive aspect of the principles of good governance. The cognitive aspect includes the understanding and interpretation of

the management of the resources by the implementers and the owners. It also does not identify issues to improve the synergy between owners and implementers of good governance. The different knowledge systems and rules which has evolved from a different context ("how" and "whys") are also not provided. As indicated by Giddens (1998) power would create restraints within the structure of the resources.

From the International Monetary Fund (IMF) point of view, good governance by the International Monetary Fund- Organization for Economic Co-operation and Development [IMF/OECD] (1997), p. IV & 3. In the definition of IMF, good governance focusses on particular principles accountability, transparency, efficiency, effectiveness, forward vision and the rule of law for economic advancement. The definition does not consider inclusiveness, which is more of a mechanical approach towards corporate governance (Abdullah & Valentine, 2009). Here the issue of self-interest and opportunistic behaviour raised by Daily, Dalton, & Cannella (2003) in the literature review also stands out, since knowledge is derived from a different context. It also does not consider the cultural structures that take into consideration property, ownership and user rights. The definition is inclined towards the stewardship theory, where power in the hands of government's management puts restraints on the local users during water policy implementations.

In analysing the concept of "Good Governance", (Grindle, 2010) says that if the structure and function of institutions are closely tied to the context within which they are developed, and then the search for institutional blueprints and practices can be misleading. This is the view of a number of researchers who have

used in-depth analyses of specific countries or regions to reason that distinct development paths can be accredited to unique experiences, particularly, international contexts. These include the historical development of relationships between economic and political elites or between elites and masses and other specific experiences. For example, China, Sweden, Denmark, Norway, Bangladesh, Tanzania, Algeria, and India are distinct in their governance policies and institutional relationship yet these countries have impressive records for consistently high growth rates and poverty reduction.

It is evident from the literature review that, the definition of water governance, its assessment, and principles of sustainability or conservation has been built upon the definition of governance. In the same way, the fundamental principles of good governance are adapted to promote measure and assess the quality of freshwater governance. Biswas and Tortajada (2010) argue that the term water governance has replaced the terms' sustainable water management' and 'integrated water resources management' (IWRM) which were the main paradigms in freshwater conservation, from the 1980s to 2000.

From other perspectives and writers like Rizal, Juahir, & Lananan (2019), relates water governance to the range of political, social, economic and environmental systems that regulates decision-making in the use of water. For instance, Pahl-Wostl et al. (2008) take a global and behavioural style by defining freshwater governance as the development and implementation of norms, principles, rules, incentives, educational tools, and infrastructure to promote a change in the behaviour of actors at the global level in the area of water governance.

From a comparative approach, Saleth and Dinar (2005) examines the lack of consensus in the definition of water governance among three countries using water law, policy and administration as indicators among countries. More so writers from the systemic perspective (Wiek & Larson, 2012; Franks & Cleaver, 2007) focus on how the actors, through a transparent and accessible dialogue on the values of the resources, provide comprehensive goals to facilitate societies access to freshwater as governance. Other scholars take into accounts the full range of decisions made in water governance, from policy setting to managing service delivery, in their discussion of water governance (Lenton, & Muller, 2012).

Although the different definitions of water governance portray different perspectives, these decisions or policies are expected to develop and conserve water resources at different levels of society, without threatening the natural functions of the ecosystems. The authors, emphasis that, freshwater governance is about how, by whom, and under what conditions decisions are made, than the decisions themselves (Lenton, & Muller, 2012).

Freshwater governance is, expressed in terms of transparency, accountability, and information sharing in decisions making. Here good governance is expected to promote equity, participation, pluralism, transparency, accountability and the rule of law. It can be argued that freshwater governance should be addressed in a manner that is effective, efficient and enduring to conserve the natural resources, based on catchments for socio-economic and environmental stability (Lenton, & Muller, 2012). It also debates the need for clear roles of government, civil society, and the private sector as well as their responsibilities regarding ownership, management, and administration of

freshwater resources and services (Rizal, Juahir, & Lananan, 2019). Good governance brings up a series of questions about what needs to be done when it needs to be done, how it needs to be done and who needs to get it done (Grindle, 2016).

Characteristics of Good Governance in Freshwater

Freshwater resources governance or good governance is expected to bring social, economic and environmental benefits to humankind (Rizal, Juahir, & Lananan, 2019; Lenton, & Muller, 2012). However, while these definitions present subtle differences in meaning and provide administrative principles and policy implications, it is difficult to see a way forward in its implementation towards the achievement of such benefits to humankind. Freshwater governance is typically implemented through the principles of good governance as presented in appendix B. The thesis takes into consideration, the formal understanding of governance by Franks and Cleaver (2007); OECD (2015); Rizal, Juahir, & Lananan (2019); Hamm (2001) and Baumgartner & Pahl-Wostl (2013). This definition helps to separate governance from management. The study is therefore restricted to a subgroup of all the decisions made about freshwater governance. Table: (2), gives an empirical overview of freshwater governance in other countries and the methodologies used.

Table 2: Empirical Studies on the relevance of Indigenous Knowledge (IK)

Author /Date	Title	Country	Methodology	Relevance	Gaps identified
Odero, (2011)	The Role of Traditional-, Local- and Indigenous-Knowledge in Responding to Climate Change: Local-Global Perspectives	Kenya/ Eastern Africa	Case studies and documentary analyses of IK	IK is the resource readily available to smallholder farmers, pastoralists, fishing communities and forest dwellers to deal with the negative impacts of climate change	The morality and spiritualty that enables the people to conduct themselves well
Cookey, Darnswasdi, & Ratanachai, (2016)	Local people's perceptions of Lake Basin water governance performance in Thailand	Songkhla Lake Basin, Thailand	Case study and Mixed Method	Locals directly and indirectly connected to the Lake Basin and are affected by its management) yet they usually do not receive due consideration in the decision-making of the governance process.	The study does not address the meaning behind the knowledge or contribution of the local people.
Apraku-Gyampoh, Asante, Douglas, Adu-Acheampong, Assimeng, (2011)	Mapping and Documenting Indigenous Knowledge in Climate Change Adaptation in Ghana	Ghana West Africa	Mixed Method survey, Observation, Participatory Rural Appraisal (PRA): key informant interviews and Focus Group Discussions (FGD) Questionnaires administration	People had their own knowledge and experience from which their weather decisions and plans are dependent on. Results showed that they do not rely on the Ghana Meteorological Agency (GMet) to plan their activities due to weather or climate changes. The study was on indigenous adaptation climate change and variability.	The study was on indigenous adaptation climate change and variability. Gap identified IK that prevents or could reduce or help to reduce the impact of climate changes like taboos, myths, etcetera (spirituality)

Table 2 continued

Wahyudi and Ploeger, (2014)	Indigenous Knowledge (IK) of Water Resources Management in West Sumatra, Indonesia	Indonesia/ Asia	Mixed Method (observation and discussion, including an in-depth interview, life history, semi-structure questionnaire, pictures, mapping, and expert interviews)	The result shows that the awareness of the people and scarcity of water conditions has allowed the people to face this challenge with wisdom (water resources controlled and regulated by custom)	The symbolism behind their practices was not captured
Spoon, Jeremy (2014)	Quantitative, qualitative, and collaborative methods: approaching indigenous ecological knowledge heterogeneity	Nepal Himalaya and Great Basin/ Asia	Case studies, quantitative, qualitative, mixed methods approach and collaborative methods	For example, in the Sherpa case, the mixed methods approach yielded information also on macro trends occurring within the population and the character of the knowledge/practice collections at that time.	Documentation Meanings given to symbols Interpretations of IK symbols but not there implication to water conservation
Kangalawe, Noe & Tungaraza (2014)	Understanding of traditional knowledge and Indigenous Institutions on Sustainable Land Management	Kilimanjaro Region/ Tanzania	Mixed Method	The relevance of traditional knowledge and indigenous institutions in natural resource governance helps to support the reduction of current land degradation issues and supports its integration into informal policy process.	The study addresses IK in land degradation issues but does not include freshwater resources degradation

Table 2 continued

Xu, et al. (2005).	Integrating Sacred Knowledge for Conservation: Cultures and Landscapes in Southwest China	China/Asia	Used photography or photo voices of their own cultural expressions and expert or specialists interviews	Results showed that indigenous knowledge places a high value on protecting forests, landscapes, and water catchments while preserving biodiversity.	The study did not address the symbolism of IK in the protection of the ecosystem or the preservation of biodiversity.
Yeshambel Mulat, (2013)	Indigenous Knowledge Practices in Soil Conservation at Konso People, Southwestern Ethiopia	Ethiopia	Interviews, Focus Group Discussions and Document Review and Analysis (Mixed Method)	Results indicated that farmers' perception of soil erosion problems were inversely related to the size of the farmland. Indigenous knowledge in soil conservation of the Konso people is exceptional and considered as the best experience in the world and registered in UNESCO	The study did not take into account the implication of the roots of IK in reducing soil erosion. It also did not identify the knowledge and its implications toward soil conservation
Egeru, (2011)	Role of Indigenous Knowledge in climate change Adaptation: A case study of the Teso sub-Region	Uganda	Mixed Method; Semi-structured interviews, focus group discussion and informal observation	Indigenous knowledge helped to predict and confirm changing weather patterns	The usefulness of Indigenous knowledge was not examined
Abah, Masheba, Denuga, (2015)	Prospects of integrating African Indigenous Knowledge Systems into the Teaching of Science in Africa	Namibia	Mixed method: Open-ended questionnaires, Discussions, Practical laboratory observation	Knowledge transfer through education showed that IK evolves to suits the needs of a particular environment or community	The gap identified was the need to understand the roots of IK before the transfer

Principal Elements of Good Freshwater Governance and the Neo-Liberal Perspective

In analysing freshwater governance, Rizal, Juahir, & Lananan (2019) describes the principal elements of good freshwater governance as:

Principles of equity and efficiency in water resource and services allocation and distribution, water administration based on catchments, the need for integrated water management approaches and the need to balance water use between socio-economic activities and ecosystems, especially at local levels;

Principles that relate to creating ownership and accountability at different subsidiary levels through stakeholder-led participatory approaches to planning, decision-making, and implementation of water resources management;

The formulation, establishment, and implementation of water policies, legislation and institutions that enable water management and water governance at different subsidiary levels, notably at watershed and local community levels and

Clarification of the roles of government, civil society, and the private sector and their responsibilities regarding ownership, management, and administration of water resources and services at different subsidiary levels, including the local community level".

All stakeholders who are affected by the result should be equally identified and inclusive in decision-making. Additionally, their responsibilities, core motivations, and interactions should be clear. In current freshwater governance, there is a shift in the idea of "participation" to the concept of "engagement". Thus ensuring individuals, groups and organisations have the opportunity to take part in

the decision-making processes for policy implementation and not the typical involvement of individuals and groups in the design, implementation and evaluation of the policy on issues that will affect them, or in which they have interest (Afro-Barometer, 2016; OECD, 2015; Lenton, & Muller, 2012).

It is important to note that engagement processes cannot be easily replicated from one context to another, taking into consideration the relationship between the different worldviews, for example, the local community or indigenous and western ideas of governance (Alcorn, 1993). Yet, following the principles can assure opposing views and fears whiles providing orientation to encourage governments to set up agenda for result-oriented stakeholder engagement whiles making good practices more visible (OECD, 2015).

Improving freshwater governance also contributes to the SDG 5, "Achieving gender equality and empower all women and girls through adequate local water governance"; SDG 6, "Ensure availability and sustainable management of water and sanitation for all" through good local water governance and innovative sustainable technologies; SDG 13, "Take urgent action to combat climate change and its impacts" by closely linking water resource management and climate change resilience, and while all actions as described in this knowledge book contribute directly or indirectly to SDG 15, states, "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss" (Rizal, Juahir, & Lananan, 2019).

The reviews suggest how important local or indigenous freshwater governance, sustainable and innovative indigenous water knowledge, clearly linking "Good Freshwater Governance" with water conservation helps to meet the SDGs. Governments at all levels have a critical role to play in creating the enabling environment for result-oriented, effective and impactful stakeholder engagement. However, efficiency and effectiveness of responsiveness here is an indication that government should possess the ability to anticipate future problems and issues based on current trends and data for policies that take into accounts future cost and anticipated changes in all areas of life.

Nevertheless, this introduces political conditions and imposition of Western liberal models of democracy (Nanda, 2006; New Partnership for Africa's Development [NEPAD], 2007: 4) thereby instituting the very context or process of inequality that does not ensure inclusiveness; the "one-way-best model" of the West (Kendie & Mensah 2008). Matysek et al. (2006) also explains that the indiscriminate and narrow application of modern scientific tools and technologies contribute to the loss and degradation of water. Meanwhile, Warren et al. (2016) and Saunders (2014) from the Neo-Liberal perspective, contend that socio-economic inclusiveness in development and conservation practice becomes a concern, where growth is dependent on running down natural resources. The writers explain that the regulators of conservation are those who are directly dependent on the resources and therefore, cannot effectively enforce governance policies.

Meanwhile, resources depletion ends up harming the deprived in the community since those with significant capital, mostly do not come from or do not live in the community. Besides, such people can move their business elsewhere when the resource is depleted, and therefore, information for decision-making is geared towards wealth creation. Poluha and Rosendahl (2002) also contested that the standards of governance are familiar to western democracy as measures of "goodness" in government is different from the local context. Here the elite becomes the primary source of information for decision making on freshwater resources conservation, an indication that hierarchical complexity is a weakness of good governance.

This situation shows that failure in conservation achievement and livelihood empowerment through institutional regulations, show that there is no straightforward solution to the protection of freshwater resources. From the above studies on good governance, freshwater conservation would be difficult to achieve without embedded knowledge from the local context, despite numerous participatory initiatives. This discussion has implications for this study analysis because it shows how people with locally embedded knowledge are treated as passive users of resources. In this case, local participants would not be able to provide the required information for the good practices in freshwater governance (Matysek, et al., 2006).

Trends in Freshwater Governance

Freshwater degradation is seen as a crisis of governance. In defining freshwater governance, it is essential to understand the story behind governance.

Today, humanity faces a severe challenge as freshwater bodies are being destroyed through the quest of humans to exploit the natural resources for economic gain. Over the last two decades, this realisation has prompted individuals, policymakers, professionals and NGO's, locally and internationally, to seek solutions to freshwater degradation.

In this context of degradation, a recap of water history becomes more than an ideal intellectual pursuit. It may be argued that conditions today are so different from those in the past that a study of water history is irrelevant. Yet such an argument would overlook the important trans-cultural structures, continuities, and principles that inform human actions. Even within todays technologically and scientifically dominated water management systems, a hydrologist functions within a socially constituted tradition, shaped by an overall scientific and engineering paradigm as well as a collective historical and legitimised principles and 'facts' (UNESCO/IHP, 2011).

To ensure freshwater resources conservation, several freshwater forums and agendas by the United Nations have played a collective role in Good Governance fundamental of a post-2015 agenda. These include suggested Sustainable Development Goals (SDG's) and targets, categorised around issues of Enabling Environment: Good governance and respect for human rights, settings of peace and stability, and more modern and greener digital and physical infrastructure are enabling factors important enough to be elevated to the common goal.

Notions of freshwater governance have evolved. Former thinkers on water governance were based on highly centralised systems that emphasised the role of

governments in water management (Cooley et al., 2013). Moreover, the extent to which rules and regulations are followed varies spatially and across scales: local, catchment, basin and trans-boundary. The use of a specific water governance system or institution may be limited to a particular ethnic or language group, associated with specific political regimes, or used only for certain kinds of water resources (Sullivan & Meigh, 2007). Some systems emerge from local experience and then spread to other areas; other systems may be imposed by state decree and enforced at local levels.

Different imposed decrees, from agendas, summits, fora, writers and initiatives, globally have sought different ways of governing freshwater as a response to reducing degradation. The study examined some efforts by both internationally and locally institution, see Appendix B. Although most of these forums and summits were concern with developmental needs, it does not compromise on the ability of the next generation to meet their own need in freshwater. On the other hand, the fora do not critically consider the significance or the symbolism of the local knowledge on its merit.

There is no doubt that freshwater summits, conference forums etcetera have played significant roles in establishing global principles and policy priorities. Yet, ownership of the resources and what is being integrated here is not discussed in the principle of good governance is not considered. Knowledge, generation (whose knowledge), which is a major issue in policymaking is not explicitly indicated. Knowledge generation could involve the collection of new information and/or the integration of available, fragmented evidence from different sources.

The main issue of concern is the process in the translation of the data, into valid and legitimate "knowledge" that is having a shared meaning for the various actors in the freshwater governance (Jasanoff, 2004).

Antwi (2009) and Burns's (2011) studies, on community-based principles and negotiating water-rights, shows that the principles are mainly based on inferences, assumptions and priorities from the "Top-down approaches. In effect, these accentuate centralised government authority and control, thus limiting effectiveness in freshwater governance. It is clear that scientific knowledge is the argument in addressing evolving freshwater resources problems. The missing link or gap is the gradual generation of comprehensive knowledge over the years, which is essential for establishing a factual knowledge base on the influence of humans on freshwater bodies and its potential impacts on water resources.

History of Freshwater Governance in Ghana

Before presenting the methodological aspects of this research, it is necessary to highlight some concepts on water governance a little more. The Ghana water sector is complex, and to understand some of the notions in this study, some aspects require a more detailed description. These aspects, as well as other factors, determine how institutions have emerged. It also indicates how the water policy in Ghana has developed over the years into its current state. A brief historical overview of water governance, the past and present state of Ghana's water sector, is presented. First, a short history of water management and governance in Ghana and developments in the water sector is outlined, followed by the advent of different

water governance structures, explaining the most significant actors, formal relations between these actors and present policies and institutions.

The top-down approaches to freshwater governance can be traced to the colonial settlers during the pre-independence period. This period created a gap in freshwater knowledge generation, towards its conservation, due to the interruption in the system of governance (Aniah et al., 2014; Odame-Ababio, 2003). This new era or modernisation of the governance system created negative perceptions out of the stringent measures on freshwater conservation by the colonial settlers.

There was, therefore, a disconnection between the law or rules and the local people (Meer & Campbell, 2007; Smith, 2013). This situation arises because, knowledge about these laws, strained government relationship with members of the community who have the right to enforce their system of freshwater conservation. After independence, the continuation of these structures did not help the local people to construct new conservational structures or maintain the old ones. The disconnection and the gap created were driven by changes in freshwater resource rights to control, use and own.

Pre-colonial Freshwater Governance

In many parts of Africa, the pre-colonial structure was mainly decentralised, with the allocation of resources by heads of communities such as lineage grouping, community elders and spiritual leaders of freshwater resources. These groups of people carried out an allocation of resources and were involved in law-making as well as social control (Aniah et al., 2014; Opoku-Agyeman, 2001).

Besides, the low technological advancement, coupled with products, which were much easier to dispose of, helped with freshwater conservation practices. The population density in most communities around catchment areas was low; meanwhile, the nature of farming, fishing, and resource extraction tools caused fewer disturbances of the soil structure to have any meaningful impact on the freshwater resources (Adams, & Mulligan, 2012). Global trade before technological advancement was negligible, and there was relative abundance of natural resources to ensure that communities met their needs without damaging the freshwater resources. Moreover, certain levies and permits were instituted to reduce over-exploitation (Mackenzie, 1988).

In Ghana, customary laws and practices based on indigenous knowledge systems have existed over the years as freshwater conservation measures. Reverence for Chiefs, village community queen mothers and age-sets helped to give protection to freshwater bodies. The kinship environment has respect for ancestors and belief in the spiritual power of water combined with preserving nature and for that matter, the water resources (Dorm-Adzobu & Ampomah, 2013; Kendie, 2008). It was the ancestors, on behalf of the earth or water deity, who always kept watch to see that the land is secured and are sensibly used (Opoku-Agyeman, 2001).

With the inception of the colonial administration, freshwater governance was vested in the state at the central level. To Schmidt (2005) this was without the proper coordination of the formal and informal systems of knowledge resulting in a disjointed state of freshwater governance. The thesis also argues that the

cumulative and on-going effects of this crisis on indigenous knowledge that forms the context of present freshwater governance within local communities today.

Giddens's Structuration Theory and Freshwater Governance

Colonial Freshwater Governance

The emergence of colonialism adversely transformed the relationship between local communities and their freshwater resources as well as the environment. The significant effect of colonialism was the cultural disruptions that intensified the effects of dispossession through the creation of total dependency on the state, a reference to state property and stewardship theory in the literature review (Giddens, 1998).

Osei-Hwedie (1993) explains that most sub- Saharan African societies were organised around friends and relations before colonialism. This governance system was accomplished with authority exercised through a system of chieftaincy, clan elders and heads of families as explained earlier. Similarly, Kottak (1994) also emphasise the governance system in the form of indigenous governance through tribes, chiefdoms, or band politics. It is assumed that colonialism; consists of resource exploitation of indigenous lands; residential school syndrome; discrimination; expropriation of natural resources and denial of rights; worship and welfare dependency (Smith; 2013 & Akrong, 2006).

Nevertheless, specific important structures established through colonialism were sets of imposed externalities that limited the local person's freedom or right to be part of the governing processes of their freshwater bodies based on their experiences over the years. In addition, Akrong (2006) explains that

it was difficult for communities to understand the language let alone the principles of colonial knowledge in freshwater governance more so when it came to the governing principles or structures of the European freshwater governance system. In the structure and agency theory, Bhimani (2008), Bressers et al. (2013) and Giddens (1998) emphasise that even their understanding of risk differs in their approaches. The implication is that it is due to the separation of powers to ownership and control.

Matowanyika (1991) concludes that while colonialism tried to replace African institutions with European ones, African water governance systems survived into the colonial period because of their fundamental relevance in perceptions and uses to the conservation of freshwater resources. This situation is what Giddens (1998) expressed in the structure and agency theory. The author indicated that some individuals continue to maintain the social structure, irrespective of change, which explains traces of the previous indigenous social structure.

Somehow, the colonial past has stunted the growth and further development of IK and the capacity of Africans to solve their problems using locally developed knowledge. This position is not to argue that IK was without problems since freshwater resources were contested over between lineages and clans (Lentz, 2006). The writer describes an overfishing incidence, where fishes were all taken out of the pond before the dry season. Yet this study sees the situation described by Lentz (2006) as a way of ensuring that the fishes do not go to waste during the dry season since the water would dry up and the fishes would

eventually die. Meanwhile, this practice, according to Lentz (2006), does not impact significantly on the water bodies because, the next rainy season, fills up these ponds and naturally stocked again. This statement indicates an apparent misunderstanding of an indigenous practice or an experience as touted by Lentz (2006).

In Ghana, changes in the governance system under colonial rule were largely an ideological action and orientation that characterised the thoughts of Europeans (Schmidt, 2005). The restructuring was intended for Europeans to succeed in the exploitation of natural resources and to usurp power and control from the local authorities as a means to an end (King, 1976). These changes in the governance system created neglect of the local system, which eventually created knowledge gaps on a spatiotemporal scale (Pacey & Cullis, 1986).

Some effects of colonialism, as indicated, include:

a. Land expropriation which drastically changed the structure of social control on freshwater resources; bureaucratic rationalisation of the chieftainship which weakened political support for traditional cultural or religious activities (King, 1976);

b. Christianity which questioned the religious and traditional bases for water protection, instead the basis for conservation was a myth of nature which developed from the scientific processes of exploration, mapping, documentation, classification, and analysis;

c. The colonial administration itself and the rationalist interpretations of ecology as well as land conservation were based on the European Enlightenment's

dualism among humans and nature. Here, the freshwater is seen as a resource for human use and wildness or unused nature as a challenge for the rational mind to conquer (Murombedzi, 2003; Adams & Mulligan, (2012) & Thrupp, 2006). In effect, most of this indigenous knowledge and practices diminished in importance, through colonialism by the 1950s (Smith, 2013; Nasirudeen & Allan, 2014; Schoffeleers, 1979; Von Der Porten & De Loë, 2014).

After the Congo Conference, held in Berlin in 1885, the Europeans colonised Africa. The British, French, and German masters regulated trade in West Africa without consideration of ethnic or natural boundaries such as rivers, watersheds, and mountain ranges. An example is the Volta River, which under the British colony in the Gold Coast, now Ghana, was subject to a common law system. (Buah, 1998; Lautze et al., 2008, Odame-Ababio, 2003). Ghana was not exempted from the colonial effects, the Rivers Ordinance (1903, Cap 226) passed in the Gold Coast was the first attempt to comprehensively control the use of water other than for domestic use. The role of these traditional institutions however was, not recognised during the colonial rule, although they serve as a useful intermediate effective water management (Schmidt, 2005).

Intending to subdue and occupy, water governance under colonial rule as expressed by King (1976) was an ideological issue. The primary purpose was mainly to achieve economic and political goals. The objective was to subdue the local powers and to hand over that authority to the queen of England, through aggressive economic and political policies, which would ease the exploitation of natural resources in furthering trade for their benefit.

In the Ashanti Region of Ghana, the area of study, had its political power suppressed, which symbolised the denial of Kumasi the capital of Ashanti, as an independent source of power (King, 1976). Although some attempts were made to develop and improve the freshwater sector, the exploitation or expansion and the taxation policy of the colonial government, considering the potential revenue extractable from local markets, caused the locals to refuse to cooperate. Meanwhile, the lack of political continuity and attention to local conditions aggravated problems of land pressure and ecological deterioration (Roncoli, 1994).

Besides, ownership of these reservoirs remained unclear. However, the local communities initially retained tasks such as water and land distribution, dam maintenance or measures to prevent soil erosion. Using the western knowledge systems and controlled by traditional local authorities, through the earth priests or chiefs to reduce degradation (MacPherson & Agyenim-Boateng, 1991).

Another law that was enacted was the Forestry Ordinance of 1927, which made provisions for catchment protection and control of water abstraction in forest reserves, and the Land Planning, and Soil Conservation Ordinance of 1953 that helped to check soil erosion while controlling the watercourses. It also enabled the regulation of water development and management activities in the 1940s (Odame-Ababio, 2003).

Post-colonial Freshwater Governance

The conventional command-and-control or welfare dependency approach to freshwater governance paradigm that dominated much of 20th-century

freshwater policy was premised on a belief in the ability to control and forecast freshwater resource systems (Akrong, 2006; Odame-Ababio, 2003). The colonial institutional mechanisms or imposed externalities, following Ghana's independence, were in pursuit of economic efficiency and relied on positivist science. Yet it limited local people's place and right to freedom, which Lawas (1997) and Odame-Ababio (2003), explain as imposed externalities, disrupted their cognitive process or state of mind and behaviours towards conservation. This condition has contributed to the lack of adherence to rules and regulations since they do not understand the western systems of freshwater governance. Even the MMDAs find it challenging to provide the required by-laws or policies to enforce water rules and regulations (Akrong, 2006; van Edig, Engel, & Laube, 2002).

Difficulties in comprehending and dealing effectively with the western systems of freshwater governance were the source of indigenous people disempowerment. It also contributed to current ignorance and neglect of indigenous/ traditional knowledge in freshwater governance (Adjewodah & Beier, 2004; Akrong, 2006; Pahl-Wostl, Gupta & Petry, 2008). For example, the western knowledge systems of freshwater resources governance, contradict the hierarchical /paternalistic traditional knowledge system of freshwater resources governance. The situation arises because a district chief executive may be the "servant" or son of an elder or chief and traditionally it is disrespectful for such a person to instruct or order an elder or chief in Ghana.

Ghana is still using part of the enacted Rivers Ordinance law (CAP 226 of 1903). Section 10 of this ordinance states that it shall be unlawful to pump, divert

or by any means cause water to flow from any river, for purposes of irrigation, mines or factories or to generate power. The implication is that one could not use water without a licence from the Minister in charge of water resources. This puts the control of water use in the hands of the government (Opoku-Ankomah et al., 2006; Odame-Ababio, 2003).

One of the first of national water institution was the Volta River Authority (VRA) established in 1961, which was responsible for the operation, and maintenance of the then newly built Akosombo Dam on the Volta Lake. Ghana Water and Sewerage Corporation in 1965, followed. Their job was to provide, distribute and conserve Ghana's water resources for the public, domestic and industrial usage. Irrigation Development Authority (IDA) was the next established, in 1977 to develop irrigation for farming, livestock improvement, and fish culture.

A research institution was set up to provide research data and information for the above institutions in their provision of policies to regulate and manage the water resources, (Lautze et al., 2008; MacPherson & Agyenim-Boateng, 1991; Odame-Ababio, 2003). Some institutions established to help sustain Ghana's water resources are listed in Table 3. These institutions have mandates that are in line with western knowledge and ideology.

Many colonial governing instruments were carried over to the new government to avoid rising opposition against the first president of Ghana, Kwame Nkrumah. From 1957 until 1966, he cooperated with local chiefs which helped reduced their mistrust against the newly independent state. Nkrumah's vision was

to develop the economic value of the natural resources and because of this the misappropriation of land, during the colonial administration, was not repealed but replaced by the State Property and Contracts Act of 1960.

Table 3 Major water-related agencies established by Ghana

Institution	Responsibility	Legal Setup
Volta River Authority	Mines and Energy	Act 46 of 1961
Ghana Water and Sewerage Corporation	Works and Housing	Act 310 of 1965
Water Resources Research Institute*	Research (Environment, Science and Technology)	NLCD 293 of 1969
Institute of Aquatic Biology*	Environment, Science and Technology (Aquaculture Research)	NLCD 293 of 1969
Volta Lake Transport Company	Transport and Communication	Registered under Company Code of 1970
Forestry Commission	Lands and Forestry	NRCD 239 of 1974
Irrigation Development Authority	Agriculture	SMCD 85 of 1977
Meteorological Services Department	Weather Communications	Administrative
Water Resources and Sanitation	Hydrological Services Division	Administrative
Environmental Protection Agency	Environment, Science and Technology (Environmental protection)	Act 490 of 1994
Water Resources Commission (WRC)	Regulate, Manage and coordinate government policies	Act 522 of 1996

* Two institutions now merged in 1996 as Water Research Institute.

Source: Ministry of Works and Housing, Ghana, (1998).

This act allowed Nkrumah to access land for development purposes (Laube, 2007). Regional conflicts between ethnic groups could not be reduced but were instead intensified (Lentz, 1993; Massing, 1994; Laube, 2007). With the overthrow of Nkrumah, the role of the chief in natural resources management became even stronger in some areas.

In 1981, under President John Jerry Rawlings, the constitution of the Provisional National Defence Council (PNDC) was put in place, and decentralisation and political participation in governance came into force. With the declaration of the Local Government Law in 1988, district, municipal, and metropolitan institutions, were created with planned, legislative and administrative powers. Traditional authority (chiefs and traditional rulers) had no place in the new western governance system (Buah, 1998). This was a major setback in an attempt by Rawlings to include the marginalised into the decision-making processes.

While on the one hand, powered political decisions were shared through decentralisation, the empowerment of elected local representatives and governmental bodies were called into question. Indication from literature shows that funds mainly in the hands of the central government and were not shared with traditional governments. (Holtkamp, 1993; Massing, 1994). Thus, incentives for the rural population to participate in decision-making in the water sector in the early 1990s remained inadequate even though there was a quest for more public participation.

Ghana adopted a new constitution in 1992, and these constitutional requirements changed the legislative and institutional framework for freshwater resources governance. With the new legislative instrument, of Water Resources, Works and Housing were created for policy direction; now the Ministry for Sanitation and Water Resources. An act of Parliament established the Water Resources Commission to regulate and manage the use of freshwater resources. The CSIR, WRI, prepared the water use regulations, LI 1692, 2001. (Ayibotele,

2008). According to Ayibotele, none of the laws referred to ownership of the freshwater resources.

In conclusion, successive governments, committed to the notion that traditional, or indigenous cultures and knowledge belong only to the past, made no provision for the well-being of these cultural values and norms in the present or future. According to Kirmayer and Valaskakis, (2009), those who resisted or refused the benefits of assimilation of government policies were not spared certain indignities. It was to assimilate and be like us or suffer the consequences. Cultural dislocation has led to despair, but the actual loss is the erosion of the ethics of universal respect and responsibility that used to be the hallmark of indigenous societies and knowledge.

The material conditions of local community life, pressures exerted on indigenous people from colonial masters or settler societies and the state of overall dependency, created a reality characterised by strife, which is experienced daily in the life of most indigenous communities. Maracle (1996) describes as "systemic rage" so common among colonised peoples. The self-hating, inward turn of this negative energy in reaction to colonisation is one of the most damaging aspects of the problem, which explains how western knowledge systems of water governance are embraced. It is still visible in the way local communities accept or rejects government support or developmental projects in water resources. That is the reasons for the numerous failures of new western knowledge, in freshwater governance strategies (Akrong, 2006; Odame-Ababio, 2003). Ghana now opts for integration or bricolage of freshwater governing systems.

The Current State of Water Resources Management in Ghana

Today, Ghana recognises the concept of Integrated Water Resources Management (IWRM) towards the efficient use and conservation of freshwater resources. Since 1999, the country's experiences with IWRM are with the interpretation of the concept and application of the principles in practice. Through IWRM, local community stakeholders and user associations have been established in the Densu Basin, White Volta Basin and other freshwater Boards (Ministry of Water Resources, Works and Housing, [MWRWH] 2011; Ayibotele, 2008).

The focus was on the use of statutory legal systems to regulate the use of freshwater resources. Most colonised countries, however, have pluralistic legal systems. In some cases, different aspects of the legislation and institutions regulate land and freshwater resources; these include statutory law and customary laws of different ethnic groups.

Forming a Water Resources Management (WARM) in 1996 to promote an integrated approach towards freshwater management was a breakthrough (Global Water Partnership [GWP], 2007). The consultative workshop of the WARM had participants from a broad spectrum of stakeholders in the public and private segments. The "Yjere" were women representatives, researchers, media personnel and the public. It identifies common issues and strategies that would promote an integrated approach to freshwater resources management.

According to Rogers and Hall (2003), it is the internationally accepted means of ensuring an equitable, economical and environmentally sustainable way of managing freshwater resources. The findings and recommendations of the

WARM study provided a sustainable institutional framework. Yet it is not designed for contributions or participation in terms of how to incorporate indigenous knowledge, as the Kyoto freshwater convention stipulated (Roger et al., 2003). A more holistic and coordinated approach to water management is essential for interactions between politics, laws, regulations, institutions, civil society and the public (Global Water Partnership [GWP], 2015). IWRM's principles are expected to provide an open forum for problem solving, where stakeholders promote dialogue, whiles facilitating joint structuring processes through which decisions are made.

This concept and principles of IWRM were expressed at the International Conference on Water and Environment held in Dublin in 1992 and Chapter 18 of Agenda 21, a consensus document from the United Nations Conference on Environment and Development (UNCED), held in Rio also of 1992. The strengths and weaknesses of three elements of freshwater governance for IWRM partnership, which were decentralisation, coordination, and participation, were reviewed.

The IWRM principles, which have significant global influence, stipulate that river basins or catchments are a more appropriate unit for managing water than the administrative boundaries of political systems. By these competing uses a balance could, be attained.

The key principles, according to the Global Water Partnership (2007) include:

1. Water should be treated as an economic, social, and environmental good;

2. Water policies should focus on the management of water as a whole and not just on the provision of water;
3. Governments should facilitate and enable the sustainable development of water resources by the provision of integrated water policies and regulatory frameworks;
4. Water resources should be managed at the lowest appropriate level and
5. Women should be recognised as central to the provision, management, and safeguarding water.

Integrated Water Resources Management and Freshwater Governance

1. The application of IWRM as a philosophy, policy and implementation guideline can go a long way in addressing issues in good water governance and assist in addressing these gaps:
2. Need for improved water governance and increased coordination and collaboration among various water sectors, such as drinking water supply and sanitation, irrigation, and ecosystem maintenance;
3. Potential competition and conflicts among different stakeholders from all sectors and among individuals, communities, and governments;
4. Environmental degradation is threatening all life on the planet;
5. Gender and social disparities in terms of equitable access to and control over resources, benefits, costs, and decision making between women, men and
6. There is the need for a sustainable water resources development as a key to poverty eradication.

IWRM principles in addressing issues in governance.

1. *Transparency and openness*: Information should flow freely within society. The various processes and decisions should be…open to scrutiny by the public. In practice, this requires demonstrated the willingness by governments to share information related to water sector policy, legal and regulatory changes, development plans, water allocation decisions, water resources status and uses, and the like;
2. *Participation*: All citizens, both men, and women, should have a voice, directly or through intermediate organisations representing their interests, throughout water governance policy formulation and decision-making. In practice, this requires the demonstrated willingness by the government to solicit and consider input from stakeholders in civil society and elected legislators. It also requires the demonstrated willingness of government leaders to make changes and adjustments to proposals based on input received;
3. *Accountability and integrity:* Governments, the private sector, and civil society organisations should be accountable to the public or the interests they represent. In practice, governments and other organisations active in water governance should openly disclose their actions and the results of government decision-making and should practice subsidiarity, mandating that decisions be taken at the lowest competent level. Governments should also undertake actions to reduce corruption and illicit personal gain in water sector decision-making;

4. *The rule of law:* Legal frameworks should be fair and enforced impartially. In practice, decisions should be made in conformity with specified laws, practices and procedures and
5. *Responsiveness*: Institutions and processes should serve all stakeholders and respond appropriately to changes in demand and preferences, or other new circumstances. In practice, governments should monitor and note the changing conditions of water supply and demand and respond appropriately.

Concerning good governance IWRM principles help to address issues in good governance, these two are compared in Table (4):

Table 4: IWRM Key Principles Compared with Good Governance

	IWRM Principles	Principles of Good Governance
1	Water should be treated as an economic, social, and environmental good.	*Transparency and openness.* *Information should flow freely within a society. The various processes and decisions
2	Water policies should focus on the management of water as a whole and not just on the provision of water.	*Participation.* All citizens, both men, and women should have a voice, directly or through intermediate organizations representing their interests, throughout water governance policy formulation and decision-making
3	Governments should facilitate and enable the sustainable development of water resources by the provision of integrated water	*Accountability and integrity.* *Governments, the private sector, and civil society organizations should be accountable to the public or the interests they represent

Table 4 Continued

	policies, and regulatory frameworks.	
4	Water resources should be managed at the lowest appropriate level.	*Rule of law.* *Legal frameworks should be fair and enforced impartially.
5	Women should be recognized as central to the provision, management, and safeguarding of water.	*Responsiveness.* *Institutions and processes should serve all stakeholders and respond properly to changes in demand and preferences, or other new

Sources: Author's Compilation (2016)

Governments should also regularly review and assess their water-related policies, structure, programmes and the resulting outcomes and make appropriate revisions (De Stefano et al., 2014). From the above principles, it is clear that the attributes of good governance are related to the decision-making processes in IWMI (Opoku-Ankomah, Dembélé, Ampomah and Somé, 2006). Therefore, these should include the different dimensions of thoughts processes from the different groups of people, which bring in gender issues. Making women and men's issues in the water a strategic concern helps to assess the implications of both, in any freshwater-related planned action (design, implementation, monitoring, and evaluation) and policies in all areas and at all levels. The main aim is to ensure equal benefit since different individuals and groups control different levels of power, wealth, influence and the ability to convey their needs, concerns, and rights (Lenton, & Muller, 2012). Ajzen, (2005) links people's activities around water resource use with beliefs, perceptions, and attitudes this assertion is affirmed by

(Clarke and Brown, 2006) who indicated that attitudes and perceptions also influence water user's behaviour.

As freshwater resources degrade, there is also a competition for its use, in the interim. Those at the lowest end of the power scale, poor women and men, old and children, would go without water. Applying gender implications helps the freshwater governance policy processes to derive a better policy to meet the needs of different women and men and marginalised groups to ensure equity.

Gender is defined as the different roles, rights, and responsibilities of men and women as well as the relationship between them (Lenton, & Muller, 2012). The report shows that the term does not just refer to your nature as women or men. However, it is the way their qualities, behaviours, and identities are decided based on the way they are socialised. Gender is generally associated with unequal power, control and access to choices and resources, which place women in a disadvantaged position.

To conclude, it is believed that proper participation should assist in identifying ways to allow and support participation. Yet if participation is not executed properly, local communities may miss the opportunities for participation, and influence reducing freshwater degradation. More empowering participation may also offer encouragement towards stakeholders' effective contribution (Burns, 2011).

Burns explains that those who transfer power, money, and other means fail to look at the risks of local misapplication, inequities, overexploitation of freshwater resources and other problems. Consequently, indications on “who", and

"what" constitutes participation in good governance the principles do not say. It is also not clear about the credibility of the different groups and honesty concerning right and final decisions.

Rather than restricting interaction and participation in decision-making, conventional approaches like formal public hearings, decisions on participation and interaction should be agreed on by the different parties or stakeholders since the formal style may not help to bring out the local knowledge. Accordingly, interest in freshwater or the symbolism of their practice or language would be lost. Such situations call for a better understanding of IK to ensure equity in the participation of freshwater resources policy formulation and implementation.

Gaps Identified in Freshwater Governance

Lack of consistent information and variations concerning their freshwater resources and social, the environmental context has been identified. Data collected identified the following gaps in the level of indigenous knowledge in policy and the extent of local involvement in water governance processes and practice.

1. Interpretation of the symbolism in local knowledge and practices or structures;
2. Removal of power from the grassroots enforcers of freshwater rules and regulations;
3. Current integration and participation is based on the western system of governance and
4. Spirituality or respect for God's creation (freshwater bodies and the environment) is absent.

Therefore, local myths and religion, which dominated the indigenous knowledge, which was used to regulate or conserve freshwater resources, are dying.

The Role of Traditional Authorities in Freshwater Governance

The traditional level of governance has been in practice before the colonial government and the current governance systems of IWRM. The traditional system deals with purely traditional affairs concerning customs and stool land administration. The method of governance is through a complex local network system, of traditional chiefs and elders. Each community has a chief, hierarchically from Odikro (chief) to Omanhene (paramount chief) to the Asantehene as the only king or leader of the Asante. Representatively it is like having a president for the country. Each chief has "divisional chiefs" with portfolios, similar to the national President and Ministers (GSS, 2014a & b). The ascension into chieftaincy (except Nkosohene) is through the matrilineal structure. The Bosomtwe District has one paramount chief that is Kuntanase Traditional Council with about thirteen (13) divisional chiefs (Abrempong) and Bosome-Freho is under the jurisdiction of the Kokofu Paramountcy. Dadease and Asakyiri are other notable stools in the District (Abreu, et al., 2016; GSS, 2014a & GSS, 2014 b).

Asante is the dominant ethnic group in the district. There are also other tribes such as the Ewe Dagomba, Kusasi, Gonja, among others, including foreigners. The primary language spoken in the district is Ashante Twi. The chiefs and people of the Districts also recognise sacred days like Akwasidae, Fofie, and Awukudae, which are mainly observed on, Tuesdays and Fridays. If Akwasidae

falls on a Sunday, it is celebrated as Adaekese, where no farming activity is undertaken, yet this day could be used for communal labour (GSS, 2014a & b).

The Role of the District Assembly in Freshwater Governance

In 1988, Ghana changed from the local authority system of administration to the district assembly system. In that year, the then-existing 140 local authorities were demarcated into 110 districts (MoFA 2017). The District Assembly and the Traditional governance systems are identified as the two governing systems in the Bosomtwe area.

The Lake Bosomtwe was initially under Bosomtwe Atwima-Kwanwoma District at Kuntanase and Amansie East at Bekwai, the communities constituting the Bosomtwe districts were later changed and named the Bosomtwe and Atwima-Kwanwoma District. The area was later divided into two districts, the Bosomtwe Districts and the Atwima-Kwanwoma Districts in 2008 by LI 1922. Again another creation was done, which is the Bosome-Freho District, created out of the former Amansie East District, with its capital at Asiwa. The current Bosomtwe and Bosome-Freho District Assemblies are constitutional bodies established by the Local Government Act 1993, (Act 462), National Planning Systems Act 1993 (Act 480), the Civil Service Act 1993, the Local Government Service Act 2004 (Ghana Statistical Service [GSS], 2014a; MOFA, 2017).

To ensure decentralisation processes at the grassroots, government has the assembly has been demarcated into four area councils, and these are Bosomtwe East Area Council, Nsuta Area Council, Bosome Area Council and Sunso Freho Area Council. The District Assembly is administered by the District Chief

Executive as the political head, the Presiding Member, who is the Chairman of the General Assembly and one person from each of the electoral areas within the districts. It is the highest policy-making body of the district, which represents the entire political, administrative, and planning authority of governance at the district level. The assembly is responsible for the facilitating and implementation of government policies and programmes at the district level whiles ensuring good governance. The district assembly is administratively supported by government decentralised departments and other quasi-agencies of (GSS, 2014a & b).

Under the Water Resources Commission Act 522 (1996) Section 35(f), the Water Resources Commission (WRC), by legislative instruments, make regulations to facilitate a proper operational environment for its mandated functions at Lake Bosomtwe. There is also the recently created by-law establishing the Community Resource Management Area (CREMA) in charge of the management of the area (Abreu et al., 2016).

The Concept of Indigenous Knowledge

Initially, indigenous knowledge (IK) studies considered local people's knowledge, in agricultural development, yet new perspectives have moved into other areas of development and conservation. Writers like Nickels (1999) and Stevenson (1999) consider the difficulty in defining the status of "indigene" and therefore prefer the use of local or traditional knowledge. These writers believe that IK is developed from new experiences and not through empirical or logical conclusions. IK is therefore, seen as unorganised, closed, and not universal rather

than investigative, bearing no general conceptual framework (Agrawal, 1999 and Banuri & Marglin, 1993).

Indigenous Knowledge System and Governance

Nickels (1999) indicates that the expression, traditional knowledge" (TK) instead of IK is more appropriate because it expresses the ancient roots of the knowledge as well as the way it is transmitted from generation to generation (Burkett, 2013; Boamah, 2015; Miller, 2006a; Hobson, 1992 & Brant Castellano, 2000; Smith, 2013). However, Stevenson (1999) explains the term is not empowering to the people. He explains that IK is perceived as a past issue, which does not indicate dynamism in current knowledge. Warren et al. (1995) refers to indigenous knowledge like local knowledge that is unique to a given culture or society. Indigenous knowledge or indigenous system is, therefore, knowledge derived from ideas, experiences, practices, and information. From the definitions, it can be seen that the people in a particular place and time have generated IK systems. IK has also been transformed and transmitted from generation to generation as a way of life (Senanayake, 2006).

However, Kapiyo (1991) adds to this view by referring to IK as, skills and techniques, which naturally belong to a particular people and have evolved through their practices, conceived and generated by original inhabitants of the place to solve real-life problems. Yet this view is not upheld by Awori (1991) who argues for the portrayal of a difference in indigenous and traditional knowledge. In the author's view, IK is original and evolves out of a sheer need to survive. Nevertheless, the question is, how can knowledge be derived out of just sheer need

when accidental discoveries are made. The definition for tradition, according to Merriam-Webster Dictionary (1828), is defined as a cultural continuity indicating a continuous process and not a onetime derivation.

From the Merriam-Webster dictionary, three definitions can be derived from it; 1. Tradition or IK is seen as being transmitted in the form of social attitudes, beliefs, principles, and conventions of behaviour and practice derived from historical experience and transmission of customs or beliefs from generation to generation"; 2. It is an inherited, established, or customary pattern of thought, action, or behaviour (such as a religious practice or a social custom) or a body of beliefs or stories relating to the past that are commonly accepted as historical, though not verifiable; 3. It is the handing down of information, beliefs, and customs by word of mouth or by example from one generation to another without written instruction".

Yet societies have changed over time whiles symbols, and practices are continually going through adaptation, making it difficult to define the extent of change which would affect the definition and therefore, many prefer the term IK. Apraku-Gyampoh, Asante, Douglas, Adu-Acheampong, and Assimeng (2011) and Pareek & Trivedi (2011) observed that IK systems are based on observation of the environment and in dealing with natural hazards.

Flavier and Erickson (1995), affirm the Merriam-Webster Dictionary (1828) definition, by indicating that IK is not homogenous, but that it varies from one society to the other. The authors further explain that IK is not static since it develops from a range of resources. In addition, traditions to current innovations

towards the future, making it part a dynamic mixture of old of the lives of the society.

It is also the skills, understandings, and experience of the community; therefore, it reflects different meanings to different people at different places and time. IK is believed to be embedded in culture and practices of the people and transmitted through rites of passage, oral tradition in songs, poetry, proverbs, riddles, folklore, and others. It is also spread through drama, dance, drumbeat, taboos, myths, legends, initiation into adulthood and other social gatherings (Xu, Ma, Tashi, Yongshou, Zhi, & Melick, 2005). Kelbessa (2001) emphasises that IK is mainly subjective and qualitative and that it is an unwritten form of knowledge. IK is useful within the natural environment of agriculture and aquaculture; animal husbandry; hunting; fishing and gathering; health; naming and explanation of natural phenomena; local flora and fauna, conservation and strategies to cope with variation in the environments and others (Nakashima, Prott, & Bridgewater, 2000; Warren, 1991). From the literature, it is clear that IK is the knowledge base for communication and decision making at the basic level in society.

Critiques of IK indicate that the knowledge only concerns with the immediate need of people's daily livelihood more of subsistence and not for large scale issues and fixed to a particular group (Agrawal, 1999; Banuri et al., 1993). From Agrawal (1999) and Banuri et al. (1993), generalisation and commercialisation of issues within the environment are what is currently causing the degradation of the environment (Scott 1998). Therefore, its nature does not make it any less important or significant than another. Unless its significance is

based on knowledge, the idea of importance is seen through "Western" lenses (Luthfa, 2006). For example, Masipiqueña, Gerard, Persoon and Denyse (1997) in Ellen, Parkes, and Bicker, (2000), explain that IK has little scientific validity, which harms the environment through practices such as the use of fire to clear the fields and misuse of natural resources.

IK is said to be unorganised, closed, holistic rather than analytical without a general conceptual framework. Also, its developments are based on new experiences and not on deductive logic (Banuri et al., 1993). The report shows that this idea of over-exploitation could be a misconception, the case of the northern region of Ghana, shows that all the fishes are taken from the pond before the dry season. This practice was seen as exploitative, but an understanding of the roots of the practice helps to bring to the fore that the fishes would eventually die when the pond dries up. Nevertheless, western knowledge is also regarded as exploitative (Grenier, 1998 & Scott, 1998).

Moreover, if knowledge defined by de Groot (1969) as an idea of cognition, including observation, supposition, expectation, testing, and evaluation is anything to go by then Banuri et al. (1993) 's idea of IK, should not be just holistic but also analytical just like Sundar (2000) emphasises. Others also perceived IK as savage and superstitious. For example, the subsistence practices in local knowledge were regarded as wasteful and misuse of resources or being indifferent to the environment rather than a consequence of poverty or insufficient resources (Ellen & Harris, 2000). The Western knowledge system (WKS) is regarded as the international knowledge system created by universities, research

institutions and some private institutions (Berkes et al., 2000b; Warren, 1991). It is believed to be superior to indigenous knowledge (Howes & Chambers, 2016).

Such were the views by many scholars with the modernist approach to civilisation until the crisis in modernist approach and failure of the top-down Western system of governance using science and technology manifested (Grenier 1998; Scott, 1998). An example is the green revolution technology and development plans. The technological innovations were putting pressure on the resources, thus causing ecological deterioration leading to the socioeconomic decline in local communities (Scott, 1998). In the area of freshwater governance, several forums and conferences have been held to help resolve the crisis in governance. Examples are the 2001 Bonn International Conference on Freshwater, the World Summit on Sustainable Development (WSSD) 2002 in Johannesburg and 2005, the 13th session of the Commission on Sustainable Development in New York (Tropp, 2007).

The achievements of Cuba and China in agriculture, industrial production, and massive national schemes to offer widespread access to adequate food, housing, education and health care inspired critiques of the modernisation paradigm since they did not rely exclusively on the Western system (Howard, 1994). Escobar (1995: p.13) puts it this way; "development has relied exclusively on one knowledge system, namely, the so-called modern Western one. The dominance of the Western knowledge system has dictated the marginalisation and disqualification of non-Western knowledge systems".

Knowledge system (KS) is defined by Gill, Stewart, Treasure and Chadwick (2008) and Lemos (2012) as a set of actors, networks or organisations which are expected to work in a synergy to support the knowledge processes that improve the correspondence, between knowledge and environment. The control, provided through technology use, in a given domain of human activity.

Scientific knowledge (SK) or the Western Knowledge System is critiqued as being positivist and materialistic, in contrast to IK, which is spiritual, empirical and sacred (Nakashima & Roué, 2002). The writer further explains that SK is objective and quantitative. Others argue that since SK is open, systematic, objective and analytical, its spread is based on rigorously building on achievements. It is disconnected from an epistemic framework or philosophising, in the search for universal validity (Banuri et al., 1993, p. 11-13). This condition arises because SK ignores the social, political and cultural contexts in which governance or water governance is implemented.

Yet, Agarwal (1998) believes it is not divorced from the lives of people. Emeagwali (2003) also, believes it is based on experimentation through trial and error or otherwise. The main concern is how SK dominates the governance system since the knowledge or information constructed in a different context is being applied for a purpose for which it was initially generated. For example, Pahl-Wostl et al. (2013b) illuminate that freshwater governance policies are enforced with little consideration to the environmental consequence.

Soon the new view of IK has come to the fore of governance and development, as Western scholars try to identify and use IK for development and

natural resources conservation. Briggs (2014) points out that the use of IK has been seen by many as an alternative way of promoting development in poor rural communities in many parts of the world. The author suggests some problems originating from the focus on the factual knowledge and differences in power relation between western science and indigenous knowledge systems. Besides, there is also the issue of "context-free" of the indigenous knowledge according to Briggs. Yet the empirical studies show that IK is not only being applied in only poor rural communities of the world as suggested by (Briggs, 2014).

For example, factual or secular knowledge such as names of plants and animals have been shared through language and not experience. Secondly, tacit knowledge such as experiences of how to conserve water or planting and harvest times Briggs (2014) believes it is difficult to teach IK through language but not by doing, which is through experience. Thirdly, knowledge as a belief, which is implicit, where knowledge is implicit or unspoken, and it is also associated with spirituality, rituals, and relationship with the supernatural, is difficult to teach except through experience. Yet this study believes that names of plants and animals were acquired through experience with nature and it can easily be written and taught. In the same way, experiences in the laboratory could be written and taught. This study tries to show that tacit knowledge could also be written and taught, except that in practice, just like in factual knowledge, it would not be in context. In other words, as Banuri et al. (1993) posit, it would be disconnected from an epistemic framework or philosophising.

Indigenous Knowledge and Water Governance

As indicated earlier, before the Europeans colonised Africa, IK or local knowledge was used to conserve the environment (freshwater resources). Although the application of IWRM can help in addressing issues in good water governance, it does not provide the environment for local knowledge to be integrated (GWP, 2007) as it is expected to reduce overexploitation of the water resources. There is the need to redefine the context of freshwater resources governance for a significant integration. To be able to relate well with indigenous knowledge and its characteristics as a source of knowledge for conservation, there is the need to define the concept and attempt to give empirical evidence of its abilities to preserve the environment. From the review, it can be seen that there is no agreed definition of IK, and there are several definitions, based on the author's environment or discipline.

The standard definition of IK is that it is data from innovations and practices of people through their ancestral relationship with the environment to the current generation. Indigenous knowledge of freshwater resources is passed on through language and practices. In the many regions of the world, there is a long history of IK related to the evolution of current water resources, their sources, and catchment, which are related to medicine, food and other consumables.

Gender and Local Knowledge

Indigenous Knowledge (IK) is a collection of individual groups' thoughts and ideas, whose control is at different levels of power, wealth, influence and those who can express their concerns, desires, and rights in society. This indicates that

there are different dimensions to knowledge created through the experience of different gender participants. Therefore, women and men's concerns or cognitive views become an integral part of the design, implementation, monitoring, and evaluation of policies and programmes in all spheres of life (freshwater governance). Therefore, women and men can benefit equally without inequality being perpetuated especially in participation in decision-making. Unequal power relations put women in a disadvantaged position (Coffey International Development [CID], 2014a & 2014b; Manzungu, 2004). Hitherto, incorporating the different cognitive views provides policies that help to meet the different needs of women and men and marginalised groups (Hunt, 2004) since invariably women are considered in the burden of water collection and therefore, the custodians of indigenous freshwater knowledge according to IWMI in Opoku-Ankomah, Dembélé, Ampomah and Somé (2006).

Giordano, Samad, & Namara, (2006) explain that IWMI presents a deliberate need to ensure that issues that affect women and men or their cognitive views are part of policy development processes and implementation the data collection was mixed. The differences between women and men influence how individuals respond to changes in water resources management. Understanding gender roles, relations, and inequalities can help explain the choices people make and their different options. The educational levels also affect the choices and intentions to conserve water (Asfaw, 2012; Gilg and Barr, 2006; Lam, 2006). This idea, confirms Clay et al. (2007) and Mahler et al. (2013) in a case study showed

that knowledge and education in water conservation practices enhance its use to reduce degradation using the mixed method.

Presenting the cognitive views of the different gender groups would also ensure an on-going commitment to reducing freshwater resources degradation. Malik (2014) reports that in every year Africa, women and children spend up to 40 billion hours for water walking. Accessing water is usually in an unsafe environment thereby makes them vulnerable to sexual assault and other accidents, which are not taken into consideration in freshwater policy formulation processes (Malik, 2014 & Britwum, 2017).

As indicated in the construct for the IK model for positive freshwater governance, the different groups in society are influenced in the knowledge creation by historical, religious, economic and cultural realities, although these relationships change over time. The term gender recognises the intersection of women's experience, taking into consideration discrimination and violation of human rights. These are based on not only gender but also on other power relations that result from race, ethnicity, caste, class, age, marital status, ability/disability, religion, position in the family, and a multiplicity of other factors including whether they are indigenous or not.

Gender is defined by the biologically determinate, which is a facility to give birth and the physical body structure. Women and men are defined in different ways in different societies and time based on the socially prescribed gender roles (Kholif & Elfarouk 2014). Institutions such as the family, legal systems, religious or economic, determine these definitions. Such definitions influence how people

respond or participate individually and collectively when faced with different problems and how they draw on different resources to construct and overcome issues in their environment (Freshwater).

Focusing on gender relations in knowledge processes and not just women but also men have been identified as a gap in freshwater governance literature. Although many analyses draw attention to women, the study's focus is on the differences in gender knowledge, which considers the relations (differences, inequalities, power imbalances, differential control and access to resources). This situation arises because generally women who go through disadvantages. In addition, it is also women's views that tend to be overlooked in discussion processes. Meanwhile, the position of women cannot be understood in isolation from the broader relationships or interactions between women, men, and the environment (freshwater bodies). Who makes what decisions? Whose knowledge should be included; what systems or structures facilitate or hinder women's participation in freshwater governance especially young women and teenage pregnancy due to their inability to educate themselves (Britwum, Akorsu, Agbesinyale, & Aikins, 2017; Kholif & Elfarouk 2014).

Sacred Knowledge and Freshwater Governance

Sacred knowledge is another gap identified in the review of literature in freshwater governance. Authors like Smith (2013) and Baumgartner & Pahl-Wostl, (2013) give clear indications that societies, especially in Africa, were conscious of the need to protect the freshwater bodies or environment. Nonetheless, these practices are shrouded in spirituality because religion

permeates almost all aspects of African life (Anane, 2015; Awuah-Nyamekye, 2013). Some aspects of sacred knowledge were only known to the herbal doctors and religious leaders (Okomfo) in Akan, Ghana, (Lamas) among the Tibetans or (Dongba) in Naxi society of Tibert. This group of people acts as intermediaries between the spiritual and the material world (Anane, 2015; Awuah-Nyamekye, 2013). The use of religion Awuah-Nyamekye (2013) emphasises, ensured judicious use of the resources (both natural and human).

A conversation Awuah-Nyamekye had with a chief in his write-up, shows how the natural resources were conserved to achieve growth in life and for the next generation. For example, the Akans of Ghana, for instance, say "adi di daa ye kyen adi di preko" (meaning one should ensure that there is enough for the survival of the next generation's sustainability). This knowledge emphasised the awareness and need to take just what you need for survival. Until now, values and ethics are overlooked for exploitation and enriching the self to ensure control and authority over others.

Generally, waterbodies, land, forest, mountains, some animals and seas were seen as abodes of the gods. Therefore, as divinities, human activities that stained their beauty were considered taboos, which served as a means of regulation toward conservation (Smith, 2013; Awuah-Nyamekye, 2013).

Taboos, totemism and sacred groves were used as a means of conservation (Awuah-Nyamekye, 2013). Knowledge of the environment was generated through their experience and interactions with the others and the eco-system. Knowledge was passed on through socialisation of the children as they worked with their

parent. These children are now found in the western educational system, thereby reducing the time and space within which parents and others in the community could interact and educate the children to ensure continuity of IK.

Religion, supported by the cognitive view, served as the primary enforcement agency and not the police (Appiah-Opoku et al., 1999; Tenywa, 2013). This situation does not mean that there were no deviants in the society because the Nananom (traditional rulers) also serve as a deterrent to other community members sanctioned such people. Sometimes the fear of the death of the entire family and fear of the unknown also served as deterrents.

Christianity has been accused of negatively influencing on IK's demise towards enforcement or its support of water conservation (Awuah-Nyamekye, 2013; Gumo, Gisege, Raballah, & Ouma, 2012). In the meantime, Genesis 2:15 (New International Version) reads, "The LORD God took the man and put him in the Garden of Eden to work it and take care of it". Nevertheless, in Genesis 1:28 (NIV) ', and it reads, “God blessed them and said to them, be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground." Yet the "subdue" in the sentence has been misconstrued to mean 'reduce' or 'diminish' or 'exploit'. However, most religion calls for the protection of man and the environment.

According to Strathern (1992: 194), "The cultural construction of nature is the necessary condition for establishing knowledge". In emerging knowledge globally, the ability to mobilise a country's knowledge system is in its context or

indigenous knowledge (Rao, 2006). This includes skills, experiences, and insights of people, applied to maintain or improve their livelihood. As indicated in the literature, globalisation is triggering much indigenous knowledge to become extinct (Agrawal, 1999; Baumgartner & Pahl-Wostl, 2013). This is due to the invasion of foreign technologies or development concepts that promise short-term gains or solutions to problems without being capable of sustaining them (Agrawal, 1999). With regards to problem solving, IK is losing its meaning in resource conservation and livelihood development. Conversely reports from Zafrin, Rosier, & Baldwin, (2014); Nakashima, McLean, Thulstrup, Castillo, and Rubis, (2012 p.100) states that, "Indigenous observations and interpretations of meteorological phenomena have guided seasonal and inter-annual activities of local communities for millennia".

Decentralisation has become a key mechanism in sector reform since the concept of subsidiarity; with the governance of freshwater resources at the lowest appropriate level in society where IK could be used. Within the Dublin Principles in 1992, the concept of decentralisation, which refers to the transfer of political, financial and administrative authority, including decision-making and management, from central government to lower levels, has been reinforced. In Africa, the change from top-down to the bottom-up approach in the water sector in decision-making is with excessive central control over sector revenues and intergovernmental transfers.

In the end, it becomes clear that the stated intentions of development agencies and researchers to incorporate IK are often not achieved in practice

because of misinterpretation and misuse of IK. This condition arises because they do not understand the knowledge-driven by 'outsiders', like the development practitioners, and is that which fits within a western governance resources framework. These selections are the elements of IK, which are understood only within the dominant scientific paradigm.

Such information may be useful in some aspects of governance situations, but not so useful if not all the people it represents understand IK. Furthermore, the particular roots or symbols that are important to indigenous peoples are not respected in their own right. This creates the position serving as a significant constraint to effective and transparent freshwater policy planning. Consequently, the value of IK for perceiving and responding to changes in freshwater resources has been acknowledged in several ways of which examples are found in the empirical study presented in the empirical review.

From the empirical review, it is evident that diversity is generally beneficial for the production of knowledge. Yet it can also pose challenges, as scholars and practitioners seek to build theoretically rigorous and practically useful knowledge concerning the conservation of social-ecological systems (Epstein et al., 2015). Knowledge has a social meaning and a legal character, the difference is how it was acquired, and how it fits into the context within which the knowledge is applied. Therefore, improved freshwater governance can be viewed as a pre-condition also for the achievement of the SDG number six.

A Short History of Lake Bosomtwe

Oral traditional point out that several years ago a hunter (Akora Bompe) on a hunting expedition one Sunday came across the Lake Bosomtwe. It is said that a wounded antelope he had shot and was running after jumped into pond-like water and vanished the hunter realised that in the pond near a big stone were a variety of fishes namely "Papari"; "Akaabire"; "Komfo"; "Apatere Fufuo" and "Adwene" in Akan. The hunter reported the event to the Asantehene after his dog had survived from eating some of the fish. Similarly, another hunter Kwakye Dopowa from Bosome Omanso near Kwakyeman in Akim Swedru had also made a similar discovery and had reported his findings to his chief.

After a war ensued over the ownership of the place, the Ashante won, and the Asantehene put the Lake under the care of the Asamanhene, who later called on other chiefs who had helped him win the war to support and protect it from the Akims. Currently, Nana Kuntansehene, Nana Kokofuhene and Nana Asamanhene are in control of land around the area with the Asamanhene in charge of the Lake; holding it in trust for the Asantehene (Ofosu-Elliot, 2006; Appiah-Kubi II, undated)

Akora the hunter named the Lake "Bosom" meaning something that is precious and "Otwe" meaning antelope. The "Bosom' lost its real meaning from Precious to Fetish in English, ("one of the many problems of the Akan translations into the English language" according to the catholic Brother; IDI (2016). Following Amu-Mensah et al. (2014a), Abreu et al. (2016) and Watson, (2010) reports, the Asantehene (King of the Asante), is the ultimate custodian of the Lake.

The Asantehene is said to have entrusted the Lake to Asamanhene who reports to the Asantehene on issues on the Lake (Appiah-Kubi II, undated). McCaskie (2003) and Appiah-Kubi II, (n.d.) stress that the Asantehene is responsible for enforcing prohibitions and officiates at the annual rites which involve the sacrifice of the cow, fowls, and dogs at the Abrodwum stone 'Taakofi' at Abrodwum village in Figure 2. This stone signifies the spirit of the Lake and the purification sacrifice is performed to ensure bumper fish harvest (Müller, 2013 & Ofosu- Elliot, 2006).

Figure 2: The Abrodwum Stone (Taakofi)

Source: Amu-Mensah (2016)

Traditionally, law enforcement is upheld through experiences, beliefs and traditional practices of the people in the protection of the Lake. Furthermore, the rich cultural heritage of the communities also supported the conservation of the Lake (MoFA 2017). Such indigenous knowledge and practices freshwater conservation was a potential source of contribution to its conservation through

taboos, totems festivals and observation of certain rest days (Ofosu-Elliot, 2006 & Appiah-Kubi II, n.d.).

These are the prohibition of fishing in the Lake on Sundays, the use of the traditional wood plank ("Padua") as a boat for fishing and woman in her menstrual period is not supposed to enter the Lake. Besides, the cow sacrifice offered to the Lake by the Asamanhene of Kokofu Asaman on behalf of the Asantehene and the prohibition of washing in the Lake, especially black metal cooking pot or very dirty things.

The Conceptual Framework of the Study

The conceptual framework guiding this study is thus based on four main theories, symbolic interactionist that provides a channel for examining meanings generated through interaction with the resource and resource environment. It provides the bases that knowledge or actions dependent on symbolic interactions & interpretations according to Blumer (1969) which in effect, provides the skills, ideas, experiences and practices leading to an informed decision-making. Giddens structuration theory offers the opportunity to examine the ordered arrangement and processes towards the control, access use as well as the constraints these ordered arrangements or institutions presents to the people and the resources. The Common Pool Resources (CPR theory or Malthus theory), is based on Hardin's (1968). The theory provides the window to consider man as a thinking being who has the ability to make a rational choice according to (Sanders, 2014) and not an irrational choice to create the situation whereby increases in population, increases the use of the resources at a multiplying scale leading to a reduce the functionality

and efficacy of the resources. Moreover, this is possible if a man refuses to think or if the cognitive process of man is curtailed abruptly. Such a situation could occur through the imposition of new knowledge that is not linked to the context of natural resources.

The Social Cognitive Theory provides the lens to explain and identify changes or differences around us. This situation takes into consideration, the mental process of storing, remembering and taking an informed decision based on the environment and the result from our perception, learning and reasoning. It also takes brings to attention how imposed externalities disrupted or create restraints in the environment affecting the cognitive process of the individual to make choices (Giddens, 1998; Lawas 1997 and Woodley, 2002).

Consequently, these choices influence the meaning or interpretation of information or knowledge available make meaning of their experiences to regulate person access, use and control of a resource (De Stefano et al., 2014; Pahl-Wostl et al., 2013a; Abreu, Clusener-Godt, & Salinas, 2016). The concept of knowledge shows that data or information acquired by an individual is based on the person's perception and interpretation of reality in a given situation at a particular time since there are multiple interpretations to information (Kaiser & Fuhrer, 2003 & Brouwers, 1993).

There are different ways of knowing, the three most significant is propositional knowledge: which is knowledge of facts or real intentions, that is to say, knowledge or statement that affirms or denies something. Secondly, acquaintance knowledge implies that one is acquainted with someone or

something. One can have a great deal of propositional knowledge about someone without having contact or acquaintance knowledge. Finally, there is the "how to" knowledge, implying that one has the sense to do something but does not have what it takes or ability to do it (Audi, 2010). However, many philosophers are most concerned with propositional knowledge. Therefore, it can be said that knowledge is derived from ideas; experiences; practices; intuition and information that has been generated by people in a particular place and time.

According to de Groot's (1969) idea of cognition, knowledge includes observation, supposition, expectation, testing, and evaluation. This means that the local person or owners of the resources are involved in obtaining, storing, using and working on information during a cognition process. Furthermore, these processes are assumed to result in the formation of one's mental image or cognitive view for the particular freshwater resources to be able to understand the principles and processes that work within the catchment area of the freshwater resources.

Therefore, in drawing up public policy, or making rules to guide or conserve the resources, would depend on the person's interaction with the freshwater resources. This condition is achieved through the mental process and a cognitive symbol of the freshwater body. These cognitive processes include sensing, perceiving, remembering, imagining, judging and making a decision. Therefore, it can be concluded that if a person does not understand the symbolism of a particular system in an environment, it would be difficult to draw up an appropriate policy to improve the environment. Giddens (1998) explains this situation as the externalities or improvised knowledge-creating restraints within the structure or

resources environment. This situation arises because the thought processes are coming from an interpretation of a different environment, which might not fit, into a different system or environment.

The argument is that knowledge is not static because as the environment changes, the thought processes change with it. The needs of people are what motivate the person to go through the process of attaining a particular objective. Therefore, such stimuli influence the person's views, actions, and reactions towards the freshwater body. Woodley (2002), also states that the changing environment across space and time brings about new goals and factors such as historical and global influences, which have helped to replaced traditional knowledge.

In Lawas's (1997) view, the cognitive view or thoughts and response behaviour of a person is assumed to be induced by motivation or emotion and attitude, among other things as reproduced in Figure 3. The responses or behaviour of a person is dependent on the cognitive view of the environment or freshwater resources. This indication shows that their behaviour towards freshwater resources is a reflection of the resource environment. This also means that this view and thinking can change as the person continuously interacts with the freshwater resources or environment.

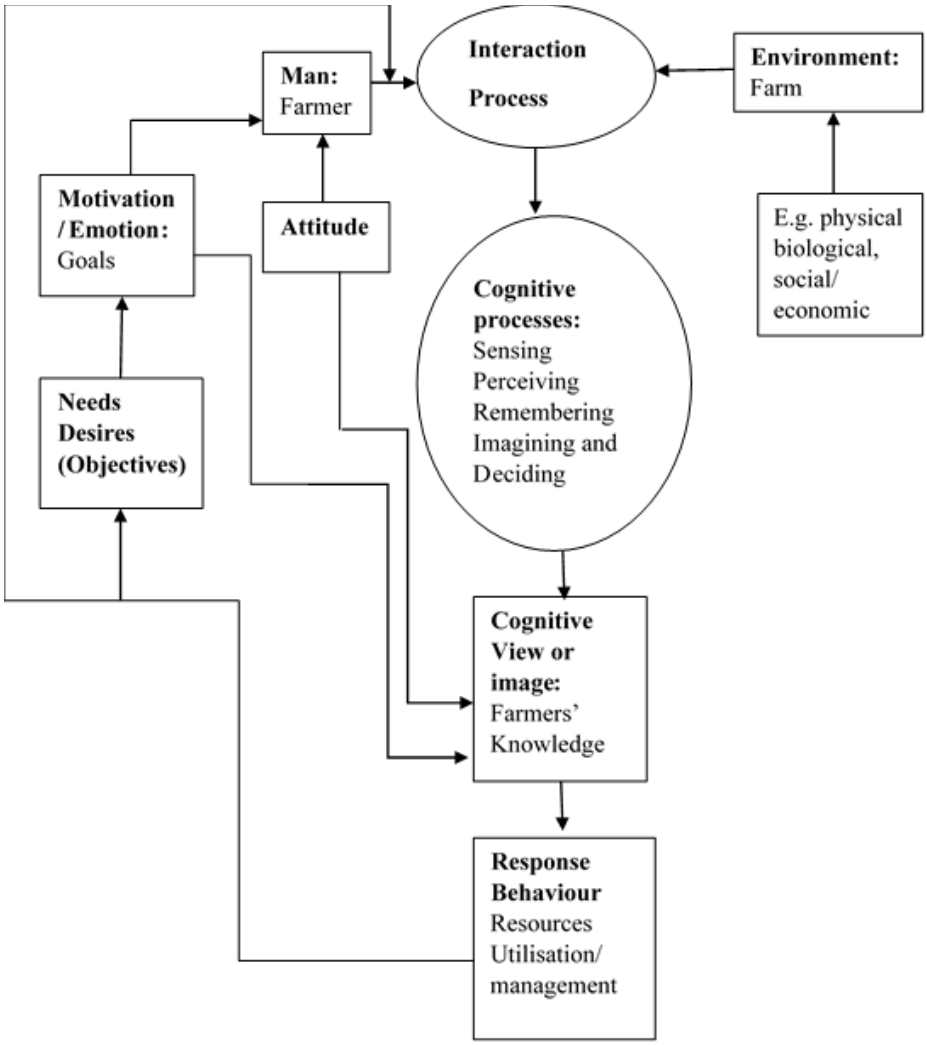

Figure 3: A Model of Knowledge Development

Source: Lawas (1997)

A change could be dependent on the acquisition of new information, the changing environment, new goals and other factors such as historical influences, introduced from outside forces like in the case of colonialism. In the situation of Lawas, the different cognitive views that is what the person perceives, remembers and imagines, as well as the emotions, goals, desires, socio-economic need, political influence and the attitude of the person, impacts on the person's response and behaviour toward the environment.

The conceptual framework or model in Figure 3, shows the influence of the individual, based on the spiritual value of the resource to the participant or local person and not just the economic, motivation, and emotions as indicated in Lawas (1997)'s framework.

Such change or dynamism could be a refinement, modification, or a complete change of previous response behaviour. In this respect, there is a cyclical process involved in locals' knowledge development (Lawas, 1997). Knowledge is the data or information acquired by an individual based on a person's perception and interpretation of reality in a given situation at a particular time. As Kaiser & Fuhrer (2003) and Brouwers (1993) put it, knowledge is an individual's classification in understanding reality as people make meaning of their experiences.

From the knowledge model and literature on freshwater governance, it can be deduced that current knowledge on freshwater governance at Lake Bosomtwe has gone through modification and therefore the behaviour or response of the local is a reflection of their cognitive view. As the saying goes, "Wrong Diagnosis, Wrong Cure" (Friedman, n.d.). Based on the idea of cognitive view, IK is seen as firmly founded in tradition or culture, and its representation is descriptive.

Positive Knowledge Relationship in Freshwater Governance

The developed models help to differentiate between the cognitive view, which represents indigenous knowledge and factual view or western knowledge of freshwater governance. Consequently, construct in Figure 4, tries to show the interrelationship of IK between the physical, biological, social and spiritual

environment of the people, which gives sound advice for effective governance. It can be recognised that IK is constructed for everybody in the community to use because it is part of their being. IK is such that it has been perpetuated through culture, and therefore it is the reality, as experienced by the participant's cognitive view.

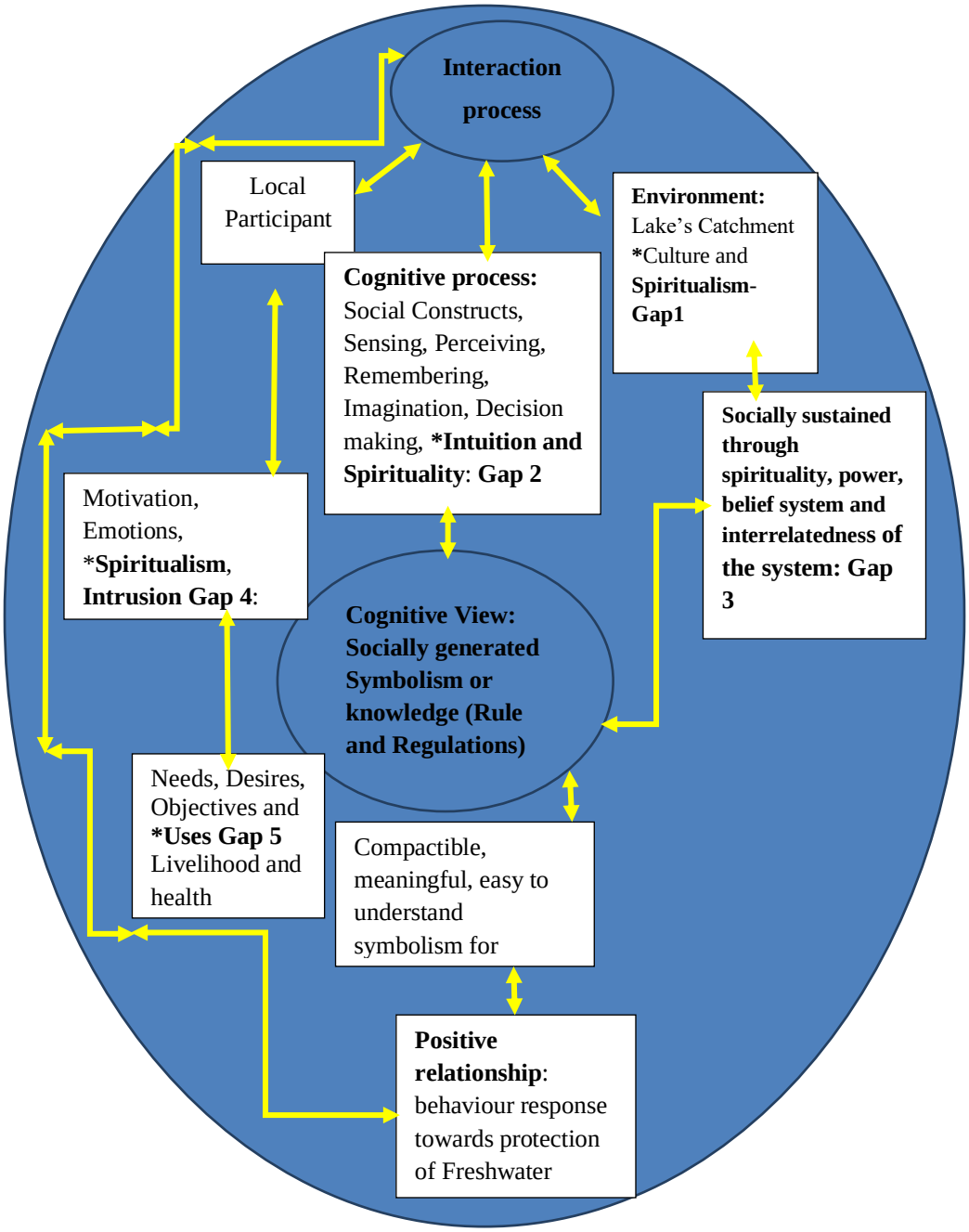

Figure 4: IK model for positive freshwater governance

Source: Modified from Lawas (1997)

The conceptual framework or model in Figure 4, shows, influence based on the spiritual value of the resource on the participant or local person and not just the economic, motivation, and emotions as indicated in Lawas (1997)'s

framework. Unlike Lawas model within the environment, culture and spiritualism helped to support the resources and that was a gap identified. The individual is also influenced or informed by intrusion or historic (Gap 2) influences like new knowledge from colonialism. This situation according to Giddens (1998) and Woodley (2002) creates restraints within the resources environment. Also, the individual's health (Gap 5) and not just the needs and desires also inform the individual choices which impact on the resource. Additionally, within the cognitive process, the person's intuition which was also a gap identified, informs the person's choice and behavioural response towards the freshwater resources. Most importantly, the choices are sustained spiritually and morally, based on the groups' belief system and interrelatedness to the resources. Choices are also dependent on the structured social institutions or rules as identified as Gap 2.

Since it is socially constructed, it uses social meanings, such as the symbolism of local knowledge as well as spiritualism, to provide environmentally sound rules. Therefore, using IK in freshwater governance is sustained socially and supported by spiritualism. This generates a positive knowledge relationship leading to the protection of the freshwater body.

From the model in Figure 4, it can be seen that the cognitive process in the environment as well as spiritualism, which helps to sustain the freshwater, influences the local participant's interactive process. The cognitive process provides a condition where decisions are taken through the interaction with the resources. Consequently, the process provides an embedded and meaningful, easy

to understand symbols (positive knowledge) through the everyday life of the resident to the environment and the water resources.

Although the participant's emotions; motivations; needs; desires, and objectives influence the interaction processes the spiritual aspects of life and intrusion does have influences on a person's choice. The positive relationship response helps to supports and sustains the interaction process. Here Sanders (2014) and Daniels, Haynes, Stupnisky, Perry, Newall, (2008) points out that the structural institutional capacity from the grassroots help the individual to make a rational choice to reduce overexploitation of the resources. The CPR theory and Daniels et al.'s, (2008) submission on pragmatism emphasis that the nature of knowledge, language, concepts, meaning, and belief are best viewed in terms of their practical needs or environment.

Negative Knowledge Relationship in Freshwater Governance

The scientific or western paradigm of freshwater resources governance is an externally imposed system of governance. Its knowledge generation is only meaningful and understandable to the generator of the symbols. Hitherto the cognitive views are disconnected from the physical and social environment, as well as from the participant's, informed cognitive view leading to negative response as shown in the broken lines.

In the case of negative knowledge relationship, as presented in Figure 5, the cognitive process or perception, learning and reasoning aspects are truncated. The broken lines represent the interaction process to the cognitive process and the resources environment. Because the cognitive process is disrupted or replaced with

an improvise knowledge, interaction with the environmental and spiritual symbols are disrupted. The improvised symbols are difficult to comprehend for an effective relationship.

The scientific or western paradigm of freshwater resources governance is an externally imposed system of governance. Its knowledge generation is only meaningful and understandable to the generator of the symbols. Hitherto the cognitive views are disconnected from the physical and social environment, as well as from the participant's, informed cognitive view leading to negative response as shown in the broken lines.

In the case of negative knowledge relationship, as presented in Figure 5, the cognitive process of perception, learning and reasoning aspects are cut short. The broken lines represent this from the interaction process to the cognitive process and the resources environment. Because the cognitive process is disrupted or replaced with an improvise knowledge, interaction with the environmental and spiritual symbols are disrupted. The improvised symbols are difficult to comprehend for a productive relationship.

This condition leads to negative behavioural response since the environmental or spiritual symbols do not support the emotions, motivations, needs, and desires in context. The participant has informed decisions on the resources, therefore, leads to its degradation. In this situation, Smith (2013) argues that the difficulty here is in the recognition, understanding, and interpretation of the improvised symbols. Thus, rendering the symbols unfriendly, insufficient, less productive and out of context for practical resources governance. This point is also

emphasised by Giddens (1998) that, these externalities or improvised knowledge create restraints within the structure or environment. Consequently, the semiotics in the language and the grammatical nuances creates restraints in the understanding of the rules for implementation.

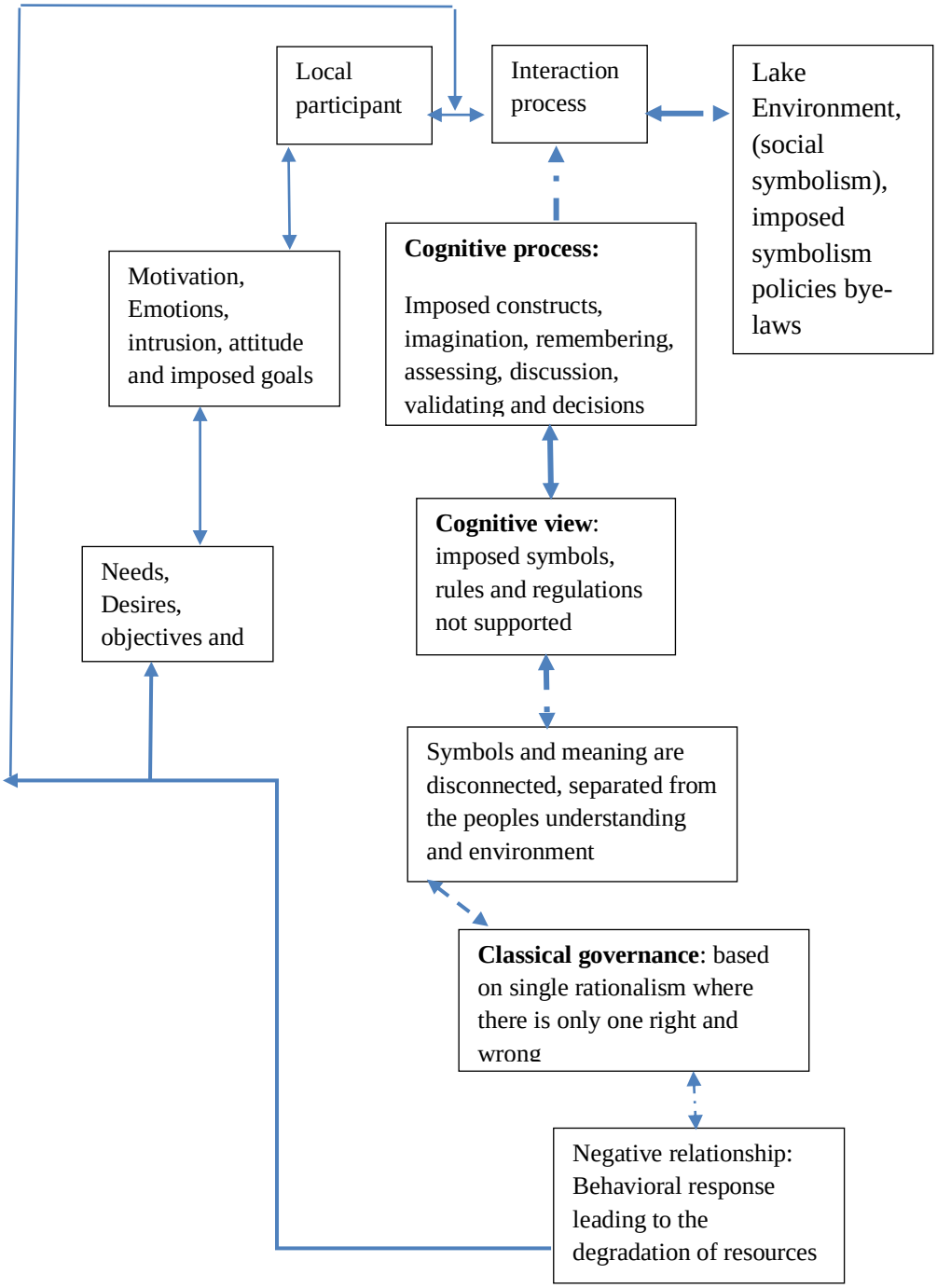

Figure 5: Negative knowledge relationship in freshwater governance

Source: Modified from Lawas, (1997)

Contributions to Knowledge Based on the Conceptual Framework of the Study

From the concept of knowledge and literature on freshwater governance, it can be deduced that current knowledge on freshwater governance at Lake Bosomtwe has gone through modification and therefore the behaviour or response of the local is a reflection of their cognitive view. As the saying goes, "Wrong Diagnosis, Wrong Cure" (Friedman, n.d.). Based on the idea of cognitive view, IK is seen as firmly founded in tradition or culture, and its representation is descriptive, mainly qualitative as in Figure 4. Therefore, knowledge can be said to derive from ideas; experiences; practices; intuition and information that has been generated by people in a particular place and time.

According to de Groot's (1969) idea of cognition, knowledge includes observation, supposition, expectation, testing, and evaluation. This circumstance shows that the local person or owners of the resources are involved in obtaining, storing, using and working on information during a cognition process. Furthermore, these processes are assumed to result in the formation of one's mental image or cognitive view for the particular freshwater resources to be able to understand the principles and processes that work within the catchment area of the freshwater resources.

Therefore, in drawing up public policy, or making rules to guide or conserve the resources, would depend on the person's interaction with the freshwater resources. This condition is achieved through the mental process and a cognitive symbol of the freshwater body. These cognitive processes include

sensing, perceiving, remembering, imagining, judging and making a decision. Therefore, it can be concluded that if a person does not understand the symbolism of a particular system in an environment, it would be difficult to draw up an appropriate policy to improve the environment. Considering that, the thought processes from an interpretation of a different environment, which might not fit, into a different system or environment.

The argument is that knowledge is not static because as the environment changes, the thought processes change with it. It also goes to say that people's needs are what motivate them to go through the process of attaining a particular objective. Therefore, such stimuli influence the person's views, actions, and reactions towards the freshwater body.

As reproduced from Figure 5, the cognitive view or thoughts and response behaviour of a person is assumed to be induced by motivation or emotion and attitude, among other things is repeated in Figure 6. The responses or behaviour of a person is dependent on the cognitive view of the environment or freshwater resources. This situation shows that their behaviour towards water resources is a reflection of the resource environment. Implying that this view and thinking can change as the person continuously interacts with the freshwater resources or environment based on the person's spiritual inclination.

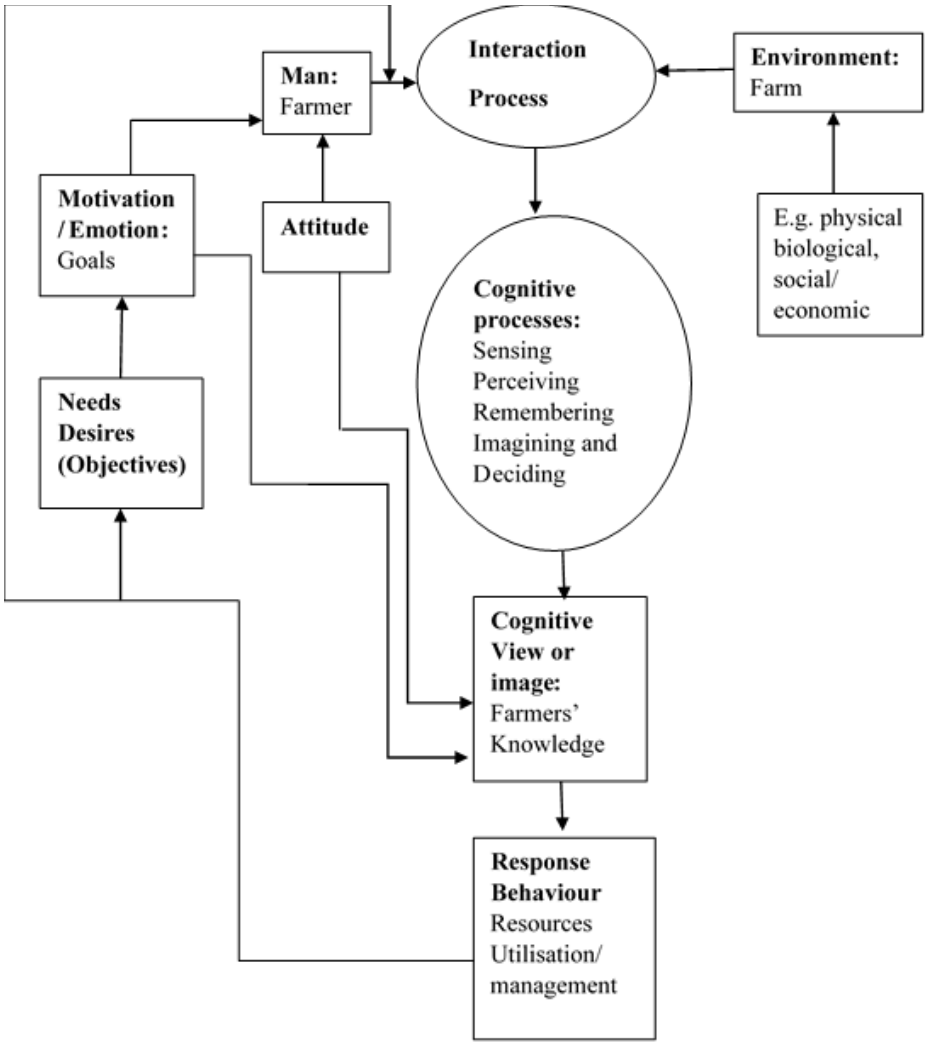

Figure 6: A model of knowledge development

Source: Lawas (1997)

Chapter Summary

This chapter has examined empirical studies in the area of freshwater water governance and indigenous knowledge in freshwater governance, conservation and development literature. It also provided a conceptual framework for the knowledge generation process. From the empirical review, it is evident that diversity is generally beneficial for the production of knowledge. Yet it can also

pose challenges, as scholars and practitioners seek to build theoretically rigorous and practically useful knowledge concerning the conservation of social-ecological systems. It is apparent that recognition for power and control in the governance of resources, in an overpopulated area also contributes to freshwater degradation. Existing facts on knowledge show that knowledge is power and the main contributing factor to freshwater governance. Meanwhile, the empirical literature reviewed on knowledge in freshwater governance also introduced approaches in the mixed-method in their case studies, although the qualitative approach was also employed. Concerning policy formulation, local perception of water governance, interactions, attitudes and perspectives, literature shows a similar preference for mixed-method research design even in some case studies.

CHAPTER THREE

METHODOLOGY

Introduction

The methodology of a study helps to determine the procedure for sampling, data collection, and analysis to facilitate the drawing of conclusions to raise recommendations for policy implementation. That methodological approach would enable the reader to gain insight into the processes involved in a study. This chapter focuses on the methodological approaches by describing the research design, the profile areas of the study, data and sources, target population, sampling and sampling procedures and the data collection instruments used in the study. The data collection procedure, pre-testing, challenges encountered in the field, data processing and analysis, ethical consideration forms part of the issues to be discussed in the chapter.

Research Design

Case Study Design

A case study offers the opportunity for a researcher to use a range of tools on one subject that is Lake Bosomtwe. It also uses questionnaires to evaluate participants' levels of satisfaction and to identify the relationship of variables identified at the end of the case study or the beginning of a study (Creswell, 2016; Greene and Caracelli, 2003; Salmon, 2017 & Morgan, 2007). According to Mills, Durepos and Wiebe (2010), a case study design, allows interviews on studies that require government interventions. Mills et al. (2010) also observed that the case

study design comes in handy when the investigator has little control over the phenomenon or activity being studied or a contemporary incidence in a real-life situation as it is in the case of Lake Bosomtwe. He explains that selecting data collection methods is essential in helping you answer the research question. Mertens (2010) and Revez and Borges (2019) applied the mixed method in their case studies, which presents an excellent approach to the pragmatic paradigm. In other instances; Guyotte and Sochacka, (2016); Mahler, et al. (2013) also in a case study showed that knowledge and education in water conservation practices enhance its use to reduce degradation using the mixed method. Case study research design according to Hancock and Algozzine (2006) and Yin (2018) accommodates a wide range of research methods, be it qualitative or quantitative, but the research should be purposive also confirming Creswell (2016). It also uses questionnaires and surveys to evaluate participants' levels of satisfaction and to identify the relationship of variables identified at the end of the case study or the beginning of a study (Creswell, 2016; Greene and Caracelli, 2003). A case study allows for an experiment, survey, history, or analysis of archival records.

Therefore, the common notion that a case study is only for exploratory research, according to Yin (2018) and Creswell (2016) is a misconception. Patton (2015), Zaidah (2007) and Tellis (1997) also emphasise that the use of case study in mixed method data helps explain both process and outcome of a phenomenon, in this case, freshwater degradation through complete observation and analysis of cases or issues under investigation. This position is contrary to the assertion by Denzin & Lincoln (1994) that a case study is a significant or acceptable variant in doing qualitative research.

A case study approach was used because it provided the best opportunity for an in-depth examination of the socially constructed nature of freshwater knowledge applied to the conservation of Lake Bosomtwe. The Lake Bosomtwe presents a unique feature as the only endorheic and a Meteorite Lake in Africa. The approach enabled the researcher to describe the structure and functions of the embedded nature of IK and principles used in the governance of the freshwater water resources of Lake Bosomtwe (Miller, 2006a). It also helped in identifying the significance, magnitude of the relationships. The case study also helped in the processes of inclusion and exclusion in as much as it helped stresses the issues of empowerment and in-depth study of social control by the agency and compliance to rules and regulations.

Research Philosophy

The historical and philosophical origins of resources governance are derived from institutions and institutional structures (Giddens, 1998 & Miller, 2006b). As a result, the field of social science helped with the themes and models to understand the problem from a sociological perspective. The research philosophy guiding this study is pragmatism. It is associated with both the scientific/positivist approach and the interpretive and constructivist approach. The approach helps to identify the need for a more systematic process to assess the effectiveness of management systems. Miller (2006b) contended that pragmatism takes into consideration the symbolism of indigenous knowledge of local people.

The pragmatic paradigm, through which indigenous knowledge (IK) water governance systems are tested, is closely connected to the man and its environment

(Bressers et al., 2013; Daniels, 2008). Miller, (2006b) emphasised the need for one to understand the nature of the indigenous knowledge of local communities. Hence, to understand the nature of the indigenous knowledge in local communities like the residents around Lake Bosomtwe, the pragmatist approach was followed.

Since the pragmatism approach is normally associated with mixed methods techniques, the study combined both quantitative and qualitative approaches (mixed methods) (Teddlie & Tashakkori, 2009). The approaches and methods used helped to solicit for complementary responses from the local people living in and around Lake Bosomtwe (Creswell, 2016; Greene and Caracelli, 2003 & Salmon, 2017). Although the primary methodology of the study is qualitative, nevertheless, the study used the mixed-method approach that is both qualitative and quantitative methods to help gain wide-range of information about freshwater governance in a local community. The qualitative method was not chosen as an opposing means of research. It rather helped to even out the negatives of each method (Creswell and Clark, 2007).

The quantitative method was used to collect and analyse responses of questions on how respondents use resources in the basin. The qualitative method was employed to gather and analyse responses from key informants such as one who supervises the actors and directs the action in Water Resource Commission (WRC), as well as other government and local establishments in the Bosomtwe communities.

Profile of Study Area

Location

The study area is Lake Bosomtwe, found in the Ashanti Region of Ghana. It is located between longitude 0.15°W and 2.25°W, and latitude 5.50°N and 7.46°N. It is located 90-250 km inland from the sea and shares its administrative boundary with the Eastern, Central, Western and Brong-Ahafo Regions. The Lake has a crater, which rises to heights above 350m with varying slopes all of which are rather steep (Amu-Mensah et al., 2014a). On the south of the basin lies the Obosum Range, with a peak of 710m (Asamoah, et al., 2015). Lake Bosomtwe is located about 30km south-west of Kumasi in the forest zone of the Ashanti Region of Ghana. Lake Bosomtwe is enclosed within two administrative districts, Bosomtwe District and the newly created Bosome-Freho District in 2007.

Until recently, it was within the Bosomtwe/Atwima/Kwanwoma District, and this was changed. The Bosome-Freho District has a population density of 106.2 persons per square kilometre, whiles the Bosomtwe District has a population density of 222.3 persons per square kilometre. The districts cover a total land area of about 630 square kilometres with the North-South stretch from Bosomtwe District to Adansi South District (Ghana Statistical Service [GSS], 2014a & 2014b). A summary of the physical characteristic of the detailed features of Lake Bosomtwe is seen in Table (5) and Figure (7)

Table 5: Summary of the physical features of Lake Bosomtwe

Location	***Ashanti Region, Ghana***
Coordinates	*6^0 30.3'N, 1^0 24, 5' W*
Lake Type	*Impact Crater Lake*
Primary Inflows	*Rainfall*
Primary Outflows	*None*
Catchment Area	*400km^2*
Basin Country	*Ghana*
Max Length	*8.6 km*
Max Width	*8.1 km*
Lake Surface	*49km^2*

Source: Bosomtwe LakeNet (2015)

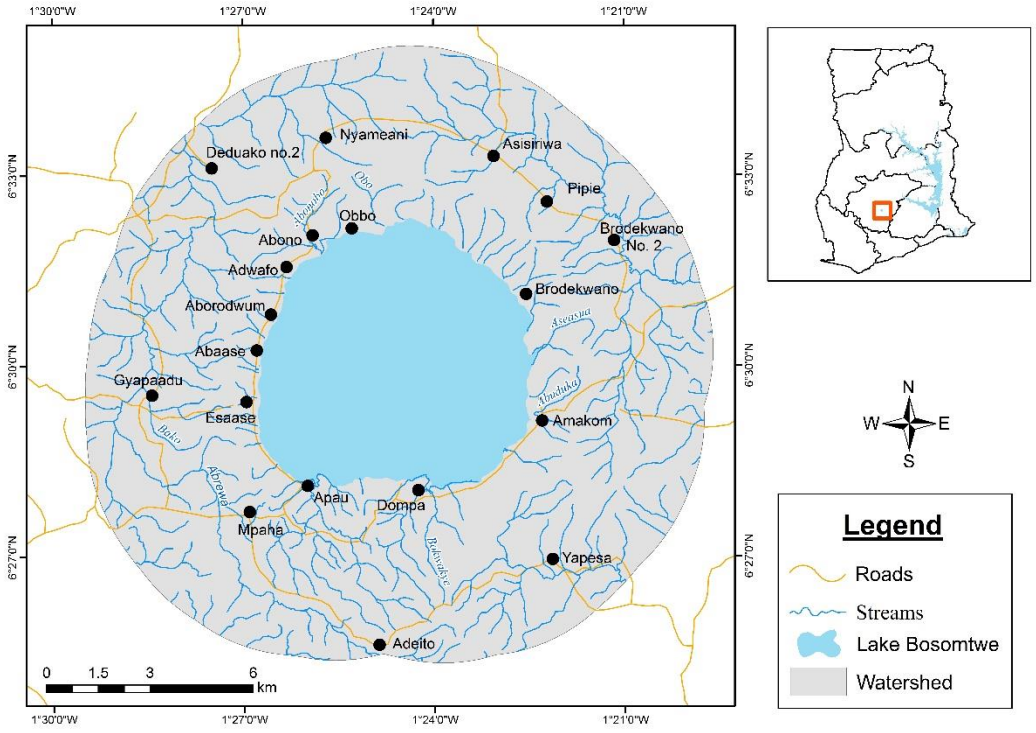

Figure 7: Map of Lake Bosomtwe

Source: Remote Sensing Cartographic Unit, University of Cape Coast, (2016)

Climate

The study area lies in the equatorial part of the semi-deciduous forest agro-ecological zone of Ghana. Shanahan et al. (2015) indicate that the area is characterised by two rainfall seasons. The major rainfall season starts in March and ends in July whiles the month of June experiences the highest rainfall. The minor season also starts from September to November and peaks in October. The study area falls within an annual rainfall range of 1300-1260 mm yr-1 with Lake Bosomtwe amongst the areas of highest rainfalls (Shanahan et al., 2015). The months of March to November are relatively humid with rainfall satisfying evapo-transpiration rates from a minimum of 71 percent to a maximum of 197 percent. The mean annual long-term rainfall and evapo-transpiration data recorded from 1956 to 1995 were 1,419.8mm, and 1,454.3mm was respectively indicating significant humid periods within each year (Amu-Mensah et al., 2014a).

The temperature of the area is uniformly high throughout the year with relatively moderate humidity, but this is quite high during rainy seasons and early parts of the mornings (Ghana Statistical Services [GSS], 2014). The monthly mean temperatures range from 30oC in March, to about 24oC in August. In addition, relative humidity varies from 90 to 95 percent in the rainy season, in the dry season it is 75 to 80 percent. Rainfall deficits occur in the region because of the high evapotranspiration rates, in November to March (Amu-Mensah et al., 2014a; Ministry of Food Agriculture (MoFA), 2017). In December to March, the area experiences the dry season coupled with the dry and dehydrating harmattan winds. The highest mean temperature follows just before the major wet season in

February, while the mean minimum happens during the minor wet season (Ministry of Food and Agriculture, 2017).

Vegetation

The natural vegetation of the area is characterised by plant species and has a cetis-triplochetol relationship. It ties up to an open and closed tropical forest with grasses; bare surfaces; built up or residential areas; agricultural lands and several ephemeral streams (Abreu et al., 2016). A close upper canopy characterises the forest with heights of about 9m combined with several growing soft-wooded trees and a few hard trees or timber and has an undergrowth of spiny shrubs (MOFA, 2017). Thicket corresponds to forest areas with the relatively impenetrable mass of shrubs, climbers, coppice shoots and young trees, which are difficult to clear. The mass is dominated by *Chromolaena odorata* locally called Acheampong Weed. Other plant species are *Trema senegadensis*, *Alchomea cordifolia*, *Accasia pennata*, *Mallotus opposotifoluis, Ficus Spp., Elaesis guinnensis* with bits and pieces food crops of cassava, plantain, cocoyam etcetera. The Vertiva grass is found growing along the backs of the Lake as seen in Figure 8.

Figure 8: Vertiva Grass along the Lake Bosomtwe and the wooden plank used as boats

Source: Field data, Amu-Mensah (2016)

An evaluation of the area by satellite imagery from 1990 and 2010 shows an increasing trend of plain built-up surfaces and areas at the cost of forest and other vegetation in the area (Abreu, et al., 2016). About thirty-five (35) tree species including three (3) Scarlet species are disappearing through overexploitation, while three (3) red species are significantly under pressure from exploitation were also identified (Abreu, et al., 2016). Consequently, such exploitation would threaten any conservation practices around Lake Bosomtwe.

Drainage

The drainage pattern around the Bosomtwe district is dendritic and centripetal in outlook (GSS, 2014a & 2014b; Turner, Gardner and Sharp, 1995). Around Lake Bosomtwe, there is internal drainage where the streams flow from surrounding highlands into the Lake in a centripetal fashion. Bosomtwe currently has no outlet, it is an endorheic lake although it did overflow in the recent geologic past (Turner, Gardner & Sharp, 1996a). The inflows are detached from the general drainage system of the rest of Kumasi or Ghana due to the high crater rim surrounding it (Koeberl, et al. 2007). According to Whyte (1975), thirty-seven (37) streams flowing into the Lake during rainy seasons nonetheless only five precisely, Abono bo, Abrewa, Ebo Kwakye, Bo Twiwaa, and Konkoma were believed to be permanent but with no outflows.

Currently, only two of the supposed five permanents steams (Abrewa stream lying between Banso and Apewu villages) and Abono bo at Abono, appears to be perennial. Although sometimes there is no surface flow at Abonobo and in certain places, the channel beds are however moist, indicating some subsurface flows in both cases (Whyte, 1975; Amu-Mensah et al., 2014a). As mentioned earlier, a significant amount of rainwater runoff over the land occurs during March and July (Amu-Mensah et al., 2014a). Since the streams do not have outflows, the Lake exhibits two different chemical environments; the dilute inflowing streams and a concentrated soda like Lake (Whyte, 1975; Karikari & Bosque-Hamilton, 2004). According to Turner, Gardener, Sharp & Blood (1996b), the Lake Bosomtwe has closed-drainage hydrology, since the basement impact breccia and

successive deposition of lacustrine sediment have restricted groundwater exchange.

Geology

The Bosomtwe and Bosome-Freho Districts are associated with Precambrian rocks of the Birimian and Tarkwaian formations. These are associated with granites and metamorphosed sediments of phyllites and schilts rock type. The soil type in the district has developed from a wide range of highly weathered parent materials such as granite, Tarkwaian and Birimian 2.2–2.1 old supra crustal rocks (Abreu, et al., 2016 & Turner et al., 1996b). The Birimian supergroups, comprise mainly metagraywackes, shales, and mica schists. These formations occur in the form of several broad metasedimentary and metavolcanic belts (Karikari, Ferrière, Koeberl, Reimold, & Mader, 2007). A characteristic feature of the supra crustal rocks is a northeast-southwest fabric trend with steep dips either to the north-west or southeast (Reimold, Brandt & Koeberl. 1998). Granite intrusions, perhaps connected with the Kumasi batholith, are also present in the Bosomtwe region (Koeberl & Reimold 2005). An outcrop around the north, northeast, east, and west sides of the Lake, an example is the Pepiakese granite is on the northeast side of the Lake (Jones, Wilson, & McHardy, 1981; Koeberl & Reimold, 2005; Moon & Mason, 1967).

Numerous narrow dykes of biotite granitoid occur at the basement exposures in the crater rim (Koeberl & Reimold, 2005; Reimold et al., 1998). The crater is which is almost filled by Lake Bosomtwe, is associated with one of only four known tektite strewn fields [the Ivory Coast tektites] (Deutsch &

Langenhorst, 2015; Koeberl, Reimold, & Moon, 2005). This situation is confirmed by the recent details on the geology of the Bosomtwe drilling project that was supported by Koeberl, Milkereit, Overpeck, Scholz, Amoako ... & King, (2007) and Abreu, et al. (2016).

Socio-economic Activities of Inhabitants around Lake Bosomtwe

The uniform distribution of temperature and rainfall enhances the cultivation of many foods and cash crops including, cocoa, plantain, cassava, cocoyam, maize. In addition, vegetables such as cabbages, pepper, tomatoes, okra and garden eggs are cultivated. The dominant method for preparing the land is slashing and mulching, especially areas close to the Lake. However, the culture is dying (Amu-Mensah et al., 2014a; Yamba, 2016). Mulching is a traditional on-farm activity among smallholder farmers, which helped to protect and improve the soil (Yamba, 2016). The current method for clearing the land is the application of weedicides as well as the slash and burn method (Amu-Mensah et al., 2014a; MOFA, 2017). Such unregulated agricultural activities like slash-and-burn method end up destroying portions of land, which was initially not designated for clearing thus exposing the land to torrential rainfall as it causes the soil to erode (MOFA, 2017).

Also, animal rearing is a significant agricultural activity around Lake Bosomtwe, faecal materials from sheep, dogs, pigs, ducks, and fowls are washed into the Lake, consequently increasing the bacteria load in the Lake. Chemicals (fertilisers and herbicides) used on the farms to increase crop yield and sludge enter the Lake just like runoff from crop and animal residues. Threats from the

animals are a health concern because certain strains, such as E. coli 0157: H7, may cause illness, yet such E. coli count in the Lake Bosomtwe ranged from 0 - 400 cfu/100ml with a mean count of 54 cfu/100ml. The presence of E. coli in water indicates recent faecal contamination and may indicate the possible presence of disease-causing pathogens, such as bacteria, viruses, and parasites (Abreu, et al., 2016).

E. coli is normally found in humans and animal intestine (Amu-Mensah et al., 2014a). Other anthropogenic activities around the Lake Bosomtwe are hunting, unplanned infrastructural development for tourism, residential and commercial activities due to tourism. As more and more of the hills are developed, this exposure further exposes the land to erosion, resulting in the degradation of the area (Abreu, et al., 2016). Increased soil erosion due to the physical disturbance of the soil, as well as the removal of vegetation due to land clearing and logging activities, contributes to pollution and siltation of the Lake (Amu-Mensah et al., 2014a; Boamah & Koeberl, 2007; Abreu, et al., 2016).

Besides, there is increased waste disposal from residents, hotels and tourism activities as well as other purposes of the Lake such as bathing, washing of clothes, pots, and pans, further impacting on the quality of the lake water (Amu-Mensah et al., 2014a; Abreu, et al., 2016). The Water Resources Commission [WRC] (2012a & 2012b) and Darko, Ansa-Asare, & Paintsil's (2013) report on Bosomtwe indicate that the Lake's quality has deteriorated from a quality index of 56.3 grade II in 2010, to 49.8 grade III.

Religious Activities of Inhabitants around Lake Bosomtwe

The main religion of the local inhabitants of Lake Bosomtwe is Christianity. The vicinity where the Lake lies has a population of about 84.1%. Islamic Religion has 6.7%, traditional religion 4.3%, animist religion 0.9% and other religions 3.0%. There is also the emergence and proliferation of churches from the orthodox to the charismatic churches. Meanwhile, the practice of Traditional African Religion is giving way to Christianity and Islam (GSS, 2014a & 2014b).

The Lake is of great religious importance to all the communities as indicated in a study by Amu-Mensah, Amu-Mensah, Akrong, Darko, and Addico, (2017) that the spiritual and economic significance and benefit have helped to reduce the destruction of the Lake.

Population growth around Lake Bosomtwe

An indication of the trend of human population in and around the Lake Bosomtwe from the year 1960 to 2010 and the growth rate of 3.4% is shown in Table (1) page 19. Population growth, in this era of globalisation considering new technologies, economic and social development, and natural resource are at risk of being exploited. Consequently, the situation would lead to food scarcity, climate change and urbanisation as external drivers of water degradation if the governing institutions around the resources do not functions properly (Pereira, 2015). Due to pressure on the limited available land, there is an increasing pressure to convert land around the Lake into cropland. Demands from technological advancement are

compelling residence to put up modern structures, which end up loosening the soil (Amu-Mensah et al., 2014 & Mab National Secretariat, 2013).

Data and Sources

Data were mainly collected from the primary sources of information. Data for the study were collected from both primary and secondary sources. It is argued that using multiple methods of data collection will reduce the peculiar biases of each one (Blaikie, 2001). Hence, the interview schedules, in-depth interviews, focus group discussions and observation formed the basis of primary data collection. This source included institutions and structures that govern the use of Lake Bosomtwe as a resource; the perceptions of Bosomtwe stakeholders on current freshwater governance difficulties and the symbolism of some indigenous knowledge system. Other issues considered are practices in freshwater governance of Lake Bosomtwe and perceptions of stakeholders on using IK in water governance.

Various secondary sources such as journals; books; internet sources; government as well as local records and nexus databases were used for the secondary data collection. The review considered linkages of indigenous knowledge, governance, freshwater governance, community participation, and ownership and not discounting freshwater conservation was carried out.

Target Population

The target population is the larger group of respondents or participants in an intervention or research, whom the research's results apply (Creswell, 2016).

The target population, according to Burns and Grove (2005, p. 236), is "the entire combination of respondents that meet the designated set of criteria". Hitherto, Barone (1988) explains the target population as the group of persons, objects or institutions that define the issues of the study. Hence, the target population in this study constituted all the 17,783 persons in the 19 communities living within the buffer zone of the Lake. Besides, it also took into consideration all the Lake Bosomtwe stakeholders within the government sector affected and affect Lake Bosomtwe.

The study population included all institutions involved in freshwater governance policy formulation and communities in the immediate surrounding of the Lake. These consists of chiefs, sub-chiefs, elders, knowledgeable people in IK, priests, unit committee members, opinion leaders and some selected individuals from nineteen (19) communities who were 18 years and above with knowledge on indigenous freshwater governance.

According to Smith (2013) IK is transferred from generation to generation. Therefore, knowledge in IK is determined not only by age but also through transfer in time and space. Thus, the cross-section of the different generations' perceptions, opinions, and knowledge on the state of governance around Lake Bosomtwe and IK in freshwater governance were solicited based on Teddlie & Tashakkori, (2009) pragmatic view. Likewise, a cross-section of key informants available in the various government institutions involved in water policy formulation processes was interviewed for their knowledge of freshwater governance and IK.

Sampling Procedures and Sampling Size Determination

The multi-stage sampling technique was used in choosing respondents for an in-depth study. This was necessary because the study required a representative subset of the population from which generalisations were made about the population (Sarantakos, 2012 & 2005). This was especially so for the in-depth interviews where there were two or more stages in sample selection. According to Fowler, (1993), one familiar misconception people have is that the adequacy of sample size depends heavily on the fraction of the population included in that sample. Sampling is a requirement, especially when one is dealing with large populations. This situation helps to obtain a fair representation of people in the community since they cannot all be part of the study considering duration and expenses in conducting such a study.

From the government sector, leaders or representatives from the water sector/ institutions such as Water Resources Commission (WRC); Ministry of Water Resources and Sanitation (MWR&S), (water directorate); Council for Scientific and Industrial Research, Water Research Institute (CSIR WRI); Ghana Meteorological Agency (GMA) and the Bosomtwe and Bosome-Freho District Chief Executives (DCEs). Also, the Bosomtwe and Bosome-Freho Districts, District Assemblies Planning Officers (DAO) were all also purposively selected.

Finally, the identification and selection were based on their supervisory role and their knowledge in freshwater governance policy formulation processes and IK. The selection is in line with Giddens (1998), assertion that the interested persons are those within the immediate environment or context of the resources. Thus, those established groups with authority as the main drivers of the governing

body or institutions working within the Lake Bosomtwe's context were selected. The selection was also based on information power, thus the in-depth and detailed nature of the approach, which does not need a specific size, or method of selection used (Creswell & Poth, 2016; Haraway & Manifesto, 1991; & Patton, 2014). Two other knowledgeable leaders in IK were also identified and suggested for the study by WRC. In all, eight respondents were selected from the government institutions who are directly involved in freshwater governance policy processes on Lake Bosomtwe.

The selection of participant each from the identified group of organisations was executed using purposive and non-random sampling. This selection was because of their expertise and direct involvement in freshwater policy data collection and as leaders in the policy formulation (Governance) and IK. The second criteria for selection were also grounded in direct freshwater governance involvement for the past 15 years and above. Table (6) shows respondents selected from the freshwater resources sector and some key-informants in IK.

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Table 6: Respondents Selection from the Various Institutions

Institutions	Positions	Sex	Sample
Water Resources Commission	Executive	Male	1
Ministry of Water Resources and Sanitation (MWR&S), (water directorate)	The Director	Male	1
CSIR, Water Research Institute	Senior Environmental Hydrologist	Male	1
Ghana Meteorological Agency	Senior Meteorologist	Male	1
Bosomtwe District	District Chief Executive and Planning Officer	Female	2
Bosome-Freho District	District Chief Executive and Planning Officer	Male	2
Total			**8**
Knowledgeable persons in IK			
Church / Religious sector	Rev Priest & Brother	Male	3
University / Educational sector	Linguistic Lecturer	Male	1
Total			**4**
Grand Total Number			**12**

Sources: Amu-Mensah (2016)

Some community members identified a sample of key informants (chiefs, sub-chiefs, elders, experts, priests, assemblymen and women, unit committee members, opinion leaders from the nineteen (19) communities). These respondents were purposively selected for their knowledge in IK of freshwater governance. Two (2) priests, one from the Catholic Church and a charismatic church, all natives from the Lake Bosomtwe area were identified and suggested by some leaders and chiefs based on the purpose of the study through snowballing. The selection was purposive, based on their knowledge in IK on freshwater governance. Snowball

sampling technique was employed to allow each respondent interviewed, to suggest additional people with similar knowledge for the interview. Furthermore, two (2) chiefs and seventeen (17) respondents, including sub-chiefs, elders, and a queen mother were also selected. The next group were nineteen (19) participants made up of assemblymen and a woman as well as nine (9) opinion leaders was selected from an initial group of chiefs and opinion leaders to provide in-depth information on Lake Bosomtwe's governance and on IK.

Identification and selection of all participants were determined by availability and knowledge in indigenous freshwater governance within the ages of 18 years and above emphasising Creswell & Poth (2016); Haraway & Manifesto (1991) and Patton (2014) thoughts on knowledge power. Two (2) fifteen-year-olds were also purposively selected based on their in-depth knowledge and involvement with their parents and grandparents. The selection of the 15-year-olds confirms Lawas, (1997) that knowledge is from man's interactive process with the environment. The young men, according to some leaders in the area, have gained knowledge by telling the history of Lake Bosomtwe at Apewu, in one of the Bosomtwe communities, which enabled their inclusion.

Consequently, native respondents numbering fifty (50) were suggested by respondents and purposively selected from the 19 communities. These people exclude the eight (8) respondents from the government institutions and the two knowledgeable respondents. The selection was in line with the nature of IK and freshwater governance around the Lake. In the initial stages, all the 19 communities were selected, in the next step, all the chiefs, subs-chiefs, and opinion

leaders were identified for selection. Finally, respondents were selected based on their knowledge in IK as well as involvement in issues on the Lake's conservation.

Furthermore, the study also took into consideration the meanings given to symbols and practices within freshwater governance in general. This highlights, Giddens, (1998) view on the action and intentions of people as significant in giving meaning to human behaviour. Consequently, the one hundred and one (111) respondents selected was enough to provide the required IDI rich information that was needed in accordance with Patton (2014).

Focus Group Discussion (FGD)

Purposive sampling was used to select six (6) communities for the Focus Group Discussion (FGD). The purpose of using FGD for data collection was to explore the depth and shades of participants' opinions regarding the nature of participation, external constraints and opportunities by the communities in freshwater policy formulation. It was also to help interpret the respondent's views based on access, use, control and ownership concerning good governance practices by government institutions. The sixth community was selected with no stream flowing through it. The selection was purposively made to serve as a control for comparison in the interview responses and to safeguard against the risk of missing important data (DePaulo 2000). In the next level of sampling, participants were recruited with the help of sub-chiefs, elders and opinion leaders who suggested respondents, who also suggested additional people using the snowball technique. Each group had the same number of gender groupings (Male and female) and age categories (elderly, matured and young).

Respondents were made up of farmers, fishers, fishmongers, sub-chiefs, provision traders, hairdressers, bar attendants and tour guides. The participants characterised their education levels like primary, middle school, JHS, SHS, and tertiary levels of education. Others did not have any level of formal education. For every community, three persons from each gender group were identified for the group discussion.

Since FGD suffers from some common methodological shortcomings, the Situation Analysis Tool (SAT), was used to compensate for the individual limitations, and to exploits their respective benefits (Guba, 1981 & Brewer, Hunter 1989). The combination, helped to create a hybrid of FDG and SAT according to (Hunter, 2004). The Situation Analytical Tool (SAT), takes into consideration the Activity Profile (AP) and the Access and Control Profile (ACP) to identify and examine the institutional structures that govern the Lake. It also helps to reveal power relations between gender groups based on access rights, control rights and ownership rights for resources use (March, Smyth & Mukhopadhyay, 2010; Hunt, 2004). A total of 108 participants in the six focus groups participated, as seen in Table (7) with the available streams and names as follows:

Table 7: Number of Selected Communities and Streams

Community	Stream / Channel	District	Sample Size
Dompa	"Kussiesua"	Bosome-Freho District	18
Abono	"Abonoboɔ"	Bosomtwe District	18
Obo	"Obuensebie"	Bosomtwe District	18
Adwafo	Adwafo Bo, Abrantie	Bosomtwe District	18
Apewu	Abrewa	Bosome-Freho District	18
Banso	No Steam	Bosome-Freho District	18
Total			**108**

Sources: Amu-Mensah (2016)

The Banso community, as indicated in Table (7) has no steam flowing through the community, but it shares boundaries with Apewu on the western and southern sides of the Apewu community. The community was purposively selected since it also relies on the Abrewa stream for some source of water.

Secondly, stratified random sampling was used to select 18 participants for each group from each of the six communities, making a total number of 108 participants of six groups from six communities. Stratified random sampling provides or helps to divide the population into smaller subgroups. These groups are formed based on member's attributes like age or characteristics like education or income attainments. Participants within different age groups were also selected and categories based on gender and age groupings for each community separately. Table (8) provides an overview of the mode of selection.

Table 8: Age Category of Participants Selected for the FDG with Situational Analysis Tool (SAT)

Category of participants for each community	Age category	Number of persons in each category
Elderly Women (EW);	61 and above	3
Elderly Men (EM);	61 and above	3
Mature women (MW);	31-60	3
Mature men (MM);	31-60	3
Young women (YW);	18 – 30	3
Young Men (YM);	18 – 30	3
Total		**18**

Sources: Amu-Mensah (2016)

Age was used as a form of stratification, for a better understanding of the specific groups and their positions with regard to their contributions in freshwater governance. The age categorisation was arranged to ensure that the study has a representation of each of the gender groups in six communities affected by Lake Bosomtwe (Tynan & Drayton, 1988). Accidentals and convenience sampling (whoever is accessible) were used in identifying respondents for engagement in the SAT's Activity Profile (AP) and the Access and Control Profile (ACP).

Finally, another level of selection was organised, grounded in their participation in community activities be it formal or non-formal following Fern, (1982, p.12); Mendes de Almeida, (1980) thoughts on qualitative sampling selection for FGD. The study emphasises a combine gender framework, which adapts different components of separate gender frameworks adding to individual ideas (Coffey International Development [CID], 2014a & March, Smyth and Mukhopadhyay, 1999). In all, three (3) persons from each group were selected and interviewed together. The selection was made separately in each community (Tynan & Drayton, 1988).

Although a group of six or seven is the required number for a focus group, in this study, the situation analysis was used where six different focus group discussions were held in six different communities (Stewart, 2014). In the first group, there were eighteen participants instead of the FDG eight or 12 in each group following the example of Liamputtong and Ezzy (2005).

These groups were further categorised into groups of three participants based on their age and gender. The categorisation helped to distinguish the groups' impact on the resources. It also helped to explain respondents are affected by the

degradation within the environment. To conclude, participants numbering 108 from six groups of the six communities were selected to participate in the FDGs and SAT.

Questionnaire Survey

Tellis (1997) explains that the number of respondents in a quantitative study does not matter for a case study to be considered acceptable, provided the study has met its objective of describing the phenomenon being studied. Nevertheless, in order ensure the right selected sample, and sample size that was not too small or too large, it was logical to do an estimation based on Krejcie and Morgan (1970) sampling size determination method. As shown in Table (9) which was backed by Raosoft's (2004) sampling chart, see Appendix I for details.

Table 9: Population and Communities of Respondent around Lake Bosomtwe

2010 Population (Bosome-Freho District) by Sex				**Estimated Sample**	**Sample Size (M)**	**Sample Size (F)**
Communities	**Male (M)**	**Female (F)**				
Ankaase	430	524	846	12	5	7
Apewu	481	524	1,005	23	10	13
Duasi	420	529	949	20	8	12
Detieso	489	525	1014	24	11	13
Banso	541	564	1,105	25	12	13
Dompa	1,414	1,522	2,936	68	32	36
Esaase	1,588	1,639	3,227	74	35	39
Adeito	464	520	984	12	5	7
Total	**5,827**	**6,347**	**12,066**	**258**	**118**	**140**
2010 Population (Bosomtwe District) by Sex						
Abease	107	107	214	5	3	2
Amakom	356	360	716	15	6	9
Old Brodekwano	48	48	96	2	1	1
Agyamanmu	206	232	438	8	3	5
Abrodwom	116	136	252	6	3	3
Old Pipie No. 1	313	339	652	13	6	7
Adwafo	470	535	1,005	21	9	12

Table 9: Continued

Abonu	463	544	1,007	24	11	13
Obo	222	274	496	12	6	6
Nkwawi	197	251	448	10	4	6
Anyinatiase	199	194	393	8	4	4
Total	**2,697**	**3,020**	**5,717**	**124**	**56**	**68**
Total No. of all Communities	**Male**	**Female**		**Est. Sample**	**M**	**F**
Grand Total	**8,524**	**9,367**	**17,783**	**370**	**169**	**201**

Source: Ghana Statistical Services (GSS) (2016)

In determining the sample size, the Krejcie and Morgan (1970) formula for determining sample size is given as:

$s = X^2 NP (1 - P) \div d 2 (N - 1) + X^2 P (1 - P)$. As indicated by Krejcie and Morgan, as the population increases the sample size increases at a diminishing rate. Where:

s = required sample size.

X^2 = the table value of chi-square with a 1 degree of freedom at the desired confidence level (3.841).

N = the population size.

P = the population proportion (assumed to be 0.5 since this would provide the maximum sample size).

d = the degree of accuracy expressed as a proportion (.05),

A calculated s= 370 using the Microsoft Excel

The sample size remains relatively constant at slightly more than 370 respondents, aged 15 years and above, with a Confidence Level of 95% and a Margin of Error of 5%. Given this, a proportionate sample was calculated for the selected communities with the help of Microsoft Excel, to select samples from the various communities using the gender variation for selection.

Raosoft's (2004) method helped to distinguish the sample size required as representative of the opinions and perspectives of respondents in comparison to (Krejice and Morgan, 1970). This formula is applied when the target population is less than 10,000 and more than 20,000 (Cohen & Crabtree, 2008; Kvale, 1996).

Data Collection Procedure

Reconnaissance survey

An initial reconnaissance survey was conducted to define the relationship between the community location and the type of human activities that have effects on freshwater use dynamics. It was a protocol to offer schnapps and money to the chief (Hagmann & Kurwira, 1996). The survey was conducted in the latter part of July and the beginning of August. Two durbars were held in collaboration between CSIR Water Research Institute and UNESCO for which the study took advantage of to enter into the community although the study was separated from the activities of these institutions.

Each village was made aware of the proposed research, to create awareness, thereby ascertaining the consent of the communities as a whole. Two local elders were appointed to take us around the communities by boat and on foot. Group interviews with the farmers, fishers and some government authorities were made. Although the team tried to administer the survey questionnaires based on the initial calculated community sample, in Table (9), at a later stage in the questionnaire administration, the research team had to change its strategy.

Data Collection Instruments

In line with the mixed methods approach as the underlying philosophy guiding the study, interview guides, interview schedules for focus group discussion and observation checklist were developed for primary data collection. These data collection instruments were used because it is generally agreed that the most appropriate means of primary data collection when information should come directly from 'people' and 'actors' who are actively involved and are aware of the problems under investigation (Patton, 2003).

In-depth Interview Guides (IDIs)

Semi-structured questionnaires and well-structured interview schedule were administered mainly to the local leaders and other participants. This was based on their in-depth information on the nature of indigenous knowledge on freshwater governance and community participation and ownership. Whiles semi-structured and structured questionnaires, as well as interview schedule, were used to collect information from the formal institutions of government and formally educated informants. The questionnaire was read to the participants, and the answers were written as well as tape-recorded. This method allows the free flow of information and the concentration of the researcher on the response for further inquiry (Hague, 1993; Stewart & Shamdasani, 2014; Stewart, 2014). Figure 9 shows the researcher conducting an in-depth interview. Transcription was done immediately after the interviews to avoid memory lapses.

Figure 9: An in-depth Interview with a Fisher

Source: Amu-Mensah (2016)

Focus Group Discussion (FGD)

Using six communities, FDG was conducted in areas with an available stream, the presence of tourism activity and the availability of a chief or a sub-chief. The Situation Analysis Tool (SAT) framework synergy used allowed six focus groups to be conducted with 18 participants per each group. This grouping was in line with March, Smyth & Mukhopadhyay (2010) and Hunt (2004) who used a synergy of SAT and FDG. The synergy, helped to identify external constraints and opportunities considered in planning and policy developmental interventions in local communities with the gender analytical tool SAT. The tool also allowed three participants from each group to draw from or collectively

brainstorm together within the same age and gender groupings (Guba, 1981). This technique led to the collection of several ideas, opinions and issues on participation in policy formulation and the possible use of IK in the governance of Lake Bosomtwe. Data was collected for the FDG situation analysis in freshwater governance within the Lake Bosomtwe's immediate surrounding. This was done during one of the communities rest days (Tuesday) to ensure inclusion of all gender and age groups. The purpose of the study was read to the group and issues pertaining to the protection of the Lake were discussed. By means of the Freshwater Resources Use Profile (FWRUP) modified from Grindle (2002) model, (see Appendix F for details), participants graded their access (use), control and ownership with respect to good governance practices using structured and semi-structured questionnaire.

This enabled the researcher to recognise the trend for follow-up questions to substantiate the respondents' answer as put to each group (Bell, 2014). A conscious effort was made to probe issues that came up as questions were asked. Some significant answers were categorised into components to be graded properly based on the meaning. The questions were translated into the local languages (Akan) to avoid misinterpretation. Their concerns, views, and discussions, in general, were also recorded and handwritten as well for further coding based on information power (Patton, 2014).

Observation

Since observation is usually associated with qualitative and sometimes quantitative methods, similar occurrences and statements were quantified for the

quantitative study. The different observations helped to identify areas of agreement and disagreement in quantifying the observed practices, occurrences and the research design in addition to the questionnaire development process. All the 19 communities within the immediate vicinity of Lake Bosomtwe, whose names were provided by the GSS, (2014a) and (2014b), were observed for possible impacts of human activity on the Lake. An observation checklist was prepared through which a list of items to be observed was indicated and these were the natural environment, waste disposal, construction works and how people naturally interact with the water (shrines) and the nature of water in the channels entering the Lake from the different communities. A digital camera Canon DS 126271 was used to take pictures of some occurrences observed (Gill et al., 2008)

Observation of water conservation methods, routes, and indigenous practices was recorded on paper, and in some cases, photographs were taken (Pido, 2014). Enough information was generated to obtain the research objectives based on the mixed-method research design. There was direct observation as an observer-participant as well as a participant-observer because, although the people knew the study was collecting data, in some cases they did not know the study observations were being recorded (Gold, 1958).

Questionnaire

The questionnaire is a 'tool' used for collecting and recording information. It is a set of questions developed for obtaining statistically valuable and individual information using structured and semi-structured questionnaire (Datt, 2016). The key parameters in evaluating freshwater governance were determined by the

interviews of key informants and FGD. A large number of respondents' questionnaires make it easier for generalisation across the whole population in the study area (Creswell and Clark, 2007).

Three sets of structured and semi-structured questionnaires to distinguish between the different groups, the first set were administered to government officials in freshwater governance. The second set was administered to key informants (chiefs, experts in IK and freshwater governance). Finally using Krejcie and Morgan (1970) sampling method 370 respondents were selected using proportionate stratified sampling (see Table 10), this was backed by Raosoft's 2004 sampling chart (see Appendix I). This sampling selection was changed on the field to three hundred and fifty-four (354) respondents from nineteen communities, thus resorting to accidental and voluntary selection. Data collection started very early each morning at six (6) a.m. before the farmers left for their respective farms till six in the evening whiles having two intervals of rest for those who wanted to eat.

Data collection started from Apewu community on the extreme end of the untarred road, and we worked towards our place of abode, Abono. On the second side of the road, data collection was also started from Dompa, working towards Abono since there was no link between these two roads moving from village to village. On average, we covered two to three communities in a day, depending on the number of respondents in the village. The interviews were recorded with a Sony recorder, as well as handwritten.

Answers to the questionnaires were provided with some additional notes scribbled next to questions. In some instances, answers were also recorded during

the data entry. The results helped to confirm or disprove important issues from participants or observations that came up in the course of data collection.

Data Possessing and Analysis

Unstructured text, audios and image were collected, cleaned and transcribed precisely in Qualitative Data Analysis Software (QDAS) NVIVO version 10 for Windows a statistical, qualitative data analysis software. Node and codes were created to identify term-words. Besides, how the respondents used the words, in other words, the semiotics of the language in the qualitative data collection. Additionally, the codes helped to keep track of data, for description, why they were used and for comparative analysis (Denzin & Lincoln, 2008).

Word frequency query was used to group similar words under particular codes or terms that occurred frequently. Research objectives on institutions; institutional structures; policy formulation and implementation in freshwater governance were used as a guide. Codes were organised in response to the significant questions of the study for translation. The meaning of similar words in the Twi language was grouped for translation on the prior preference of study (Maxwell, 2013).

The quantitative data were processed using Statistical Product and Service Solutions (SPSS) version 21. Variables identified were coded in line with information collected for entry and processing in SPSS (Nie, Bent & Hull, 1975).

. Descriptive statistics, including means, frequencies, percentages, median, and crosstabs, were used to process quantitative data after the data has been cleaned. Quantitative data analysis also included the use of standard,

nonparametric statistics Creamer's V test, Relative Importance Index (RII) test and Pearson's Chi-square for dependency test. Cross tabulations were also used to determine associations between variables (Creswell, 2016).

Data Analysis

WordStat and cluster analysis tools in QDAS miner software facilitated the qualitative data analysis process. The total numbers of codes were reduced to 10 based on IK and freshwater governance, significant terms and issues. Bubble charts helped to see the interrelationships between coded sectors of the data, emerging patterns, similarities and differences based on the research questions to provide answers (Creswell, 2016). Pictures were also used to make a visual representation in support of data collected. Although a second person verified the codes, most of the answers were collaborated by respondents during the quantitative data collection.

The quantitative variables were exported into Microsoft Excel 2013, for further analysis and presentation, using a nonparametric test Creamer's V. It uses cross-tabulation to measure the association or relationship between two variables while displaying the relationship between them in a single table. Pearson's Chi-square for dependency test was also used to determine the strength, relationship and significance differences in between variables and the different responses were established. Although the use of chi-square has certain limitations, the creamer's V also a nonparametric tool was used to compensate for its shortcomings (Bert and Hull, 1970 & James, Laurent and Hill, 1971). The relative importance index (RII) test was also used to rank variables to determine their level of significance.

A Likert scale where 1= very low and 5 = very high was used to rate performances, based on importance and impacts. Descriptive statistics, frequencies and cross-tabulations results were presented using bar and pie charts as well as tables formats. Photographs were used to provide pictures of activities to present a vivid description of activities and their relationship to the research terms.

Finally, both qualitative and quantitative data obtained were analysed and compared with the research aims and objectives and the literature reviewed, as additional proof or confirmation of the significance of the data collected. This was done to reflect contents and evidence of links to data marked since it is critical in any qualitative study, where the validity of conclusions has to be argued without the support of p-values (Beazley & Jackson 2013).

The results were compared with the objectives and instruments, as discussed by (Creswell, 2016). The disadvantage here in using NVIVO is breaking down the data and organising data does not follow a specific procedure (Creswell & Miller, 2006b). Only certain versions of audios and videos are acceptable by NVIVO, which can also be a setback (Bazeley & Jackson, 2013).

Preparation for Pre-Testing of Instruments

To start the pre-testing exercise permission for fieldwork was granted by the Department of Geography and Regional Planning of the Social Science Department, University of Cape Coast. The chiefs and other responsible authorities finally granted permission where the study was undertaken.

Pre-testing of the instruments for the study took place in Abono, one of the major tourist study communities around the Lake. This was because the

community has been experiencing fishing and tourism activities on a large scale commercially. It is also the very first community you enter at Bosomtwe. The pre-testing helped to check people's understanding and ability to answer the questions. Questions that were not clear were highlighted while providing an estimated average time for the questionnaire to be completed. All corrections were made before the final version was administered.

Fieldwork Challenges

Getting key informants to participate in the study was very challenging. Several visits to conduct IDI with the key stakeholders were difficult. The researcher had to re-schedule the meeting repeatedly before finally getting through to respondents. This was the main reasons why the research took a longer time than it was intended to, even when it was pre-arranged. Residents who were farmers and fishers were equally difficult to come by, as they could not sacrifice their daily livelihood activity for the research. This was because it was difficult to obtain the required number of females and male in each selected community. This was because as the team moved from community to community, the arrival time for every community changed. Therefore, some community respondents left for their farms, which were out of the study area. So the selection was based on convenience sampling and on the number of people available within a community. This further extended the data collection period. But for those who could not be found, substitutes were identified through the sample sampling techniques. This was repeated until the sample was exhausted. Some residents showed open discontent and unwillingness to participate in the study because they perceived the

researcher was just collecting the data which would not benefit them (the residents) but for their own personal gains.

To address this challenge, the researcher explained the objectives and purpose of the research to the respondents. Interviewing chiefs initially was a problem because they seemed to have their own stories or information to provide although they were being asked specific questions most of them digressed from the specific question. The team, in the initial stages, found out that the study did not follow the traditional structured way of soliciting for information but followed the conventional or scientific way of not giving gifts before data collection (Bell 2014). Here the drink of the token of appreciation was supposed to be presented before one can proceed to ask questions and not after. The terrain was difficult to go through, especially during the rainy season where it is difficult for even four-wheel drives to go the communities without being stuck in the mud. Respondents numbering 354 were used for the survey instead of 370 as expected due to some of these challenges and cleaning out data that was not needed during the data entry (Fowler, 1993 & Tellis, 1997).

A total of 573 respondents were used for all the data collection instruments. See appendix I for the total number of respondents and tools used. The summary of the instrument used in data collection and analysis is provided in Table 10.

Table 10: Summary of Instruments Used in Collecting Data and Data Analysis on each Research Question

Research Question	Data Collection Instrument	Mode of Data Analysis
Examine the institutions and structures that govern the use of Lake Bosomtwe as a common resource;	In-depth Interview, and Questionnaire	Descriptive statistics (Frequencies and Percentages), Chi-Square based on ownership of the lake Photographs
Assess the perceptions of stakeholders on the difficulties encountered in current freshwater governance	In-depth Interview, Focus Group, observation, and Discussion Survey	Descriptive statistics (Frequencies and Percentages), Chi-Square based on the relevance of the lake the communities
Examine the relevance of indigenous knowledge system and practices in freshwater governance of Lake Bosomtwe and evaluate the general perceptions of relevant stakeholders on using IK in water governance	In-depth Interview, FDG, Survey	Transcription, Frequencies and Percentages)

Source: Amu-Mensah (2016)

Ethical Considerations

The origin of any data should be respected in addition to the dignity and privacy of the respondents (Bassey, 1995). Various ethical issues were taken into consideration in undertaking this study. The initial, ethical clearance was taken from the Institutional Review Board of the University of Cape Coast. Then the Department of Geography and Regional Planning of the Social Science Department, University of Cape Coast, granted permission for fieldwork. The chiefs and other responsible authorities finally granted permission where the study was undertaken. The purpose of the study was explained, ensuring that the study is voluntary and no harm shall be caused to the respondents.

Chapter Summary

The chapter reveals that the principle of understanding the symbolism of IK in freshwater governance to provide significant information and benefit for improved water governance was discussed. Other theoretical concepts on Giddens, (1998) structuration theory; the concept of governance; indigenous knowledge in general, indigenous freshwater governance was discussed concerning water governance. Additionally, an empirical study on the role of IK has been examined, identifying gaps in the studies. This chapter presents the findings of the study and tries to offer interpretations, evaluation, and validity on issues relating to indigenous freshwater governance and water conservation practices within the Lake's immediate basin Bosomtwe. Despite the field challenges, the validity of the data was not compromised since the mixed method helped to confirm the results.

CHAPTER FOUR

BACKGROUND CHARACTERISTICS OF RESPONDENTS

Introduction

The main objective of the study was to assess the usefulness and role of indigenous knowledge in freshwater governance, a case of Lake Bosomtwe basin, Ghana. Amongst the issues discussed, here are the situations or nature of institutions and institutional structures governing freshwater resources in general with particular reference to Lake Bosomtwe. The discussions also bordered around challenges encountered in accessing, using and the control of Lake Bosomtwe as well as how relevant IK governance is to the conservation of the Lake.

The chapter presents the responses to these questions and discussions in extension to literature and the conceptual framework. As indicated in the literature review and empirical studies, indigenous freshwater governance has been used in the past, and it still has the potential of supporting freshwater conservation.

The chapter also presents the background characteristics of respondents interviewed, giving a general overview of the nature of gender education, in relation to their age, since gender, age and education are major issues in resolving conservation issues. Chapter four also provides information on the characteristics and position of the respondents. It also provides data on the role of IK in its governance the Lake Bosomtwe.

General Profile of Respondents

Age and Gender of Respondents around Lake Bosomtwe

Two groups emerged from the face-to-face interviews. These are respondents from the formal institutions and informal sector as discussed in the methodology of the study. Age and sex form a critical aspect in freshwater governance and indigenous knowledge systems depending on the experience and involvement of respondents (Kholif & Elfarouk 2014; Giordano, Samad, & Namara, 2006; Hunt, 2004). In all, respondents targeted, numbered 9,367 females, forming the majority while the males were 8,524. The total number resident around the Lake, were females 54.9% and males 45.1% as indicated in the methodology. This finding confirms the 2000 Population and Housing Census. The data collected therefore could be said to be representative of the population.

The age and gender of respondents are discussed in Table (11). The results indicate that gender divisions vary substantially by age that the older male respondents aged 66 to 75 years were in the minority. Female respondents' age group 18-25 were in the majority, while the least was aged 76< age range. The oldest respondent was 101 years. Indications are that the older respondents who have skill and experience in IK freshwater conservation around the Lake and its environment were reducing in number.

Table 11: Respondents Age and Gender Relationships

	Age Range							
Gender	18-25	26-35	36-45	46-55	56-65	66-75	76-<	
Female	27	44	51	19	23	9	10	183
Male	31	33	31	35	24	7	10	171
Total %	16.0	22.0	23.0	15.0	13.0	5.0	6.0	100.0
Total	**58**	**77**	**82**	**54**	**47**	**16**	**20**	**354**

Source: Amu-Mensah (2016)

The implications are that these older generations who have unique skills, experience, insights, and operation on the maintenance of the Lake Bosomtwe, which reflect the communities' needs and preferences are reducing in number. Therefore, there would be fewer experienced people to provide information on the Lake's conservational practices. Kholif and Elfarouk (2014) confirm this assertion that, women have invaluable insights about the design, operation, and maintenance of water systems, which reflect their needs and preferences as the environments primary user. The writer emphasised that women provide a significant role in raising the efficiency and effectiveness of river resources.

As represented in Table (11), a relatively large proportion of the sampled population interviewed were aged 36-45, followed by 26-35 years forming 23% and 22% respectively. The data suggest that the respondents were old enough to have experienced issues relating to freshwater governance and IK about the Lake and its customs since traditional knowledge is believed to be transferred from generation to generation (Senanayake, 2006).

In addition, respondents within the old age range who are regarded as the custodians of cultural symbols and practices were in the minority group representing 5.0% and 6.0% of the age groups 66-75 and 76- and beyond respectively. Suggestions are that these custodians of the customs and norms of

the local community, according to Smith (2013) who has considerable interaction with the water resources for transferring their cultural practices are dwindling. Consequently, their water use, access, and control vary accordingly. Comments from an in-depth interview question support this assertion from the data. The question posed was, if respondents were familiar with customs and practices and they were still adhering to, these conservation practices of the Lake. A comment from an in-depth interview:

"Nypayinfono nyinaa erri wowo, aka yen mofra noti yen tomi endi Bosomtwe mmbra no so" [Female, provision trader, 38 years]

This means that most of the elderly are dying, living the young folks who have very little knowledge about the Bosomtwe catchment customs and practices so most of us do not adhere to the practices.

Background of Respondents in the Government and Formal Sector

Within the government sector Table (13), shows that the number of females within freshwater policy formulation framework was few compared to that of their male counterparts within the categories selected. As observed, there was no woman within the high-level position in the water sector of the government institutions. All the Government Officials (GOOF) such as director, chief executive

Table 12: Gender, Educational Levels and Positions

Respondents	Frequency	Female	Male	Level of education	Position
Water Resources Commission	1	0	1	MPhil	Executive Secretary GOOF 1
Water Research Institute	1	0	1	Ph.D	Snr. Environmental Hydrologist GOOF 2 /Chief Director for Water GOOF 3
Ghana	1	0	1	MPhil	Director GOOF 4 Synoptic Meteorology and Forecasting
University/ Traditional Authority	6	1	5	First-degree/ PhD, MPhil, MSLS	Priests P1 & P2 / Professor P3/ Queen Mother Kutunase P4/ Chiefs P4
Bosomtwe /Bosome-Freho Districts	4	2	2	First-degree/ MPhil	DCEs / Planning officers P5
Total	**14**	3	9		

Source: Amu-Mensah, (2016)

(P) Represents respondents in other government institutions

Secondly, there was no female identified as knowledgeable in IK for the interview and amongst the policy formulators as indicated in the table to bring in the human issues. This situation does not appear to give a true reflection of actors in the water policy processes which controlled society's access to freshwater.

Age Dependency and Educational Level of Respondents

The age and education of respondents may influence the behaviour of respondents towards control and use of freshwater resources. Formal education could aid in the understanding of changing natural resource tenure and good governance as well as unequal patterns of access to and control over natural resources which helps with the reversal of natural resource degradation and

thereby confirming the study by Xu, Ma, Tashi, Yongshou, Zhi, and Melick, (2005). This data indicates that the number of years spent around the resources also improves the experience and skill in solving real-life water resources issues.

Age and education data analysed, shows that majority of respondents with no formal education were within the age group of 66-75 were 63%, this was followed closely by 60% of respondents between the ages 76 and above. Those within the ages of 76- and above had a minimal level of education while the least age group with no formal education were within the age group of 18-25 being 3.0%. Respondents with JHS level of education, between ages 18-25 were in the majority, with 67%, this was followed by those within ages 26-35 who had 65%. Indications are that the JHS level of education seems to be the educational level which most of the respondents attained. Respondents in the majority with the highest tertiary level of education were between ages 46-55, with 11%.

It was evident from the data that respondents aged 76-< who are considered by Boamah, (2015); Miller, (2006a) and Smith, (2013) studies, as skilled, experienced, as well as the custodians of the local knowledge, were not empowered with tertiary education to be able to handle contemporary issues on western freshwater governance systems.

Therefore, it explains knowledge and education in freshwater conservation practice enhance its use to reduce degradation (Mahler, Smolen, Borisova, Boellstorff, Adams, and Sochacka, 2013). The implication is that with some elders with no formal education and others with a minimum level of MSLC education the older people's cognitive process would not be able to efficiently process the information within the western system of freshwater governance for their

participation, to ensure multiplicity, transparency, accountability, thus confirming Daily et al. (2003) and Kendie's (1997) studies. These authors assert that rules or byelaws are imposed to protect the honour of the government officials, who expect to accomplish their job by such imposition of western rules irrespective of the local situation for participation.

On the other hand, 25 % of the respondents had JHS and SHS level of education and were ages 18- 25 and 26-35. The total number of respondents with JHS education was 36% this was followed by 20% with Middle School Leaving Certificate (MSLC) and those with no formal education being 9%. The least number of respondents were those with the tertiary level of education, forming 5%. The age group with the least level of formal education were within ages 56-65, followed by age 66-< totalling 0.6 for all the respondents in the age categories indicated.

The results for the minimum number of respondents within the tertiary level of education could be explained by United Nations, (2017) assertion that lack of academic economic opportunities in the rural areas causes large, talented high school graduates to migrate to the areas of intellectual capital or economic opportunities. This assertion is confirmed by interviews, and observation that the only level of formal education in the communities was up to the JHS level and available jobs in the community were for bar attendant, farming, fishing, fish production (Smoking, frying), receptionist, food and laundry. The implication is that local knowledge transfer is truncated due to the western system of education. Therefore, it was not surprising that the younger generation directed most of the

questions on the values and norms for the conservation of the Lake to the older generation.

Using a non-parametric Chi-square to test for independence with, $X^2(1, n = 354)$ showed a Cramer's V test of 1.02 indicating that the age attained perfectly predicts the educational level of the respondents around Lake Bosomtwe, as suggested in McHugh, (2013) and Sharpe, (2015). This outcome affirms the argument that the capacity to understand and apply local knowledge in water conservation by the young age group would be out of the cognitive views of the resource environment since these young group of JHS and SHS are dependent on very little information from the western system of education. This data confirms Lawas (1997) that the Western system of education imposes a different system of training from the local experience. Thus, the behavioural response to the Lake and nearby environment would change based on different needs, desires, perception confirming, and the conceptual framework, adapted for the study.

The study noted that those in school spend eight hours of the day in educational institutions and therefore experience very little of the informal education that is supposed to be acquired from the older generation. The required skill and experience considering the number of respondents within the young and energetic age group with the western system of education are more than the number of older people who are skilled and experienced in the local system of water conservation.

It is also clear that the capacity of the older generation to apply the western system of water conservation would be difficult. This finding shows why the residents inability to understand the principles and structures of the western system

of water conservation. Furthermore, there is also the issue of the ability to transfer indigenous freshwater practices, which is practical and linked to spirituality to the younger generation. Since their thinking processes, is interconnected to logical and methodological principles as it is seen in the western systems of education. Consequently, their educational level the language of the freshwater policies, coupled with change in the systems of operation makes it difficult for such groups to learn and to develop their sense of curiosity in conserving natural resources, thus affirming Klionsky (1998) view that learning is more successful when it is practical with experience than by 'listening'. This opinion also illuminates Pahl-Wostl et al., (2013a) and Odame-Ababio's (2003) stance, which indicates that freshwater governance policies are enforced with little consideration to the environmental (educational) consequence.

Respondents Gender in Relation to Number of Years in School

Gender and education as indicated here refer to the different roles, rights and responsibilities to the number of years spent in school, which helps to explain the different gender groups' socialisation processes in and around the freshwater resources (Gutierrez, 2017 & Mahler et al., 2013). Research has shown that gender and the number of years one spends in school impacts significantly on the understanding and experience gained in water conservation patterns. Gender roles of power, access, and control towards water resources use, varies based on the number of years spent in experiencing water conservation patterns (Gutierrez, 2017).

Formal and informal education also influences how individuals respond to changes in water resources management based on the choices the different gender groups make in the use of freshwater resources, (Gilg & Barr, 2006 and Mahler et al., 2013) have espoused this view. From the bar chart, on gender and education in Figure 10 specifies that respondents with lower levels of education, thus form the category of no level of education, to the JHS level were female and those without SHS level of education were also females. The data shows that the relationship between gender and educational level.

Indications are that females with no education, were (25%) and males were (12%) of respondents with no education. Female with primary education formed (24%) with the male forming (9%) of the total population of primary education.

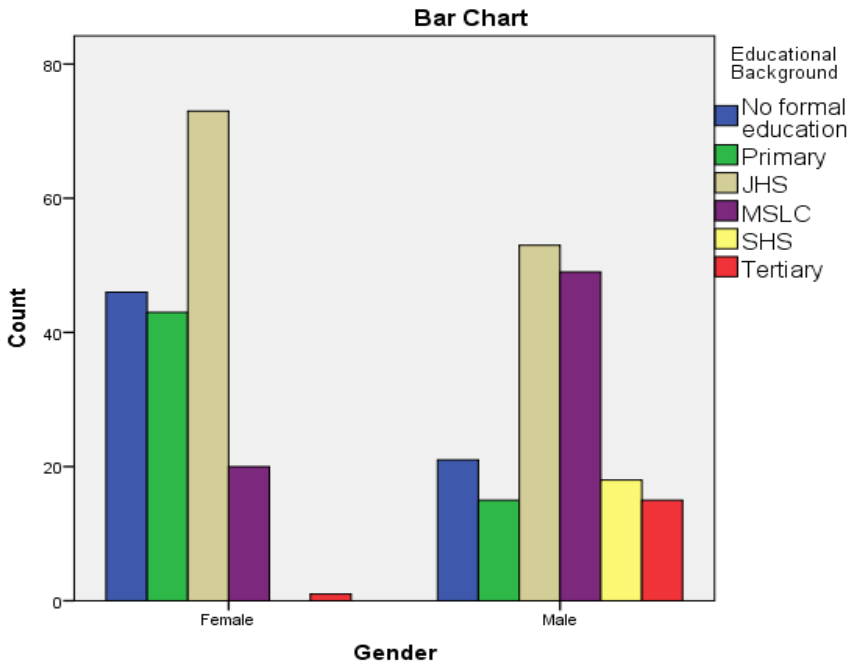

Figure 10: Relationship between Gender and Educational Background

Sources: Amu-Mensah, (2016)

From the graph female with JHS, level of education had the highest number of respondents dominating with 40% and males with (31%). With the MSLE level of education, the situation changed with females obtaining 11 % and the males (29%). At the SHS level, the female no representation but the males were represented with 11%. With the tertiary level of education, the females were represented with (0.5 %); however, the male-dominated with (9 %).

Males dominated the MSLC, SHS to the tertiary level of education. Figure 10 is an indication that there are fewer females in higher levels of education. The results explain the fact that the various gender responsibilities increase women's time for labour-intensive family tasks and therefore their inability to attain a higher level of formal education within the local communities (Kholif, & Elfarouk, 2014; Abreu et al., 2016).

The female respondents are disadvantage since their age group falls back on informal education as well as experiences around the lake and its environment. The explanation is because they spend a more significant part of their early formative years in informal institutions with dying cultures. Inadvertently, they also do not attain the level of education, which would enable them to understand and apply the western system of freshwater governance because their household labour task as asserted by Abreu et al. (2016) is time-intensive. Another explanation is the fact that in most local communities around water resources, the males are the preferred gender for higher education since most females end up being given into marriage early.

Primarily, this creates the avenue for the young ones to indulge in illicit sex, ending up in teenage pregnancy. Although the males have the opportunity to

continue, their education the female is not able to do likewise even after giving birth because she would have to find a menial job to take care of the child after birth thus leaving the females with a minimum level of education. Results confirm Asfaw, (2012) assertion that one's educational level affects the choices and intentions to conserve water. The rippling effect of these disparities in educational level is unleashed on to the resource's environment as an unskilled and inexperienced female group who do not have the ability or knowledge in current freshwater governance.

A Chi-square test for independence (gender and educational attainment) in Table (13) indicates that there is a significant statistically significant association between gender and educational attainment, X^2 (5, n = 354) = 61.1728, p = 0.000, Cramer's V = 0.4.

Table 13: Frequency Distribution of educational attainment by gender

	Female	Male	X^2 (p-value)
No formal education	68.66	31.34	61.1728 (0.000)
Primary	71.67	28.33	
JHS	57.94	42.06	
MSLC	34.88	65.12	
SHS	0	100	
Tertiary	6.25	93.75	

Cramer's V = 0.4157

Source: Amu-Mensah (2016)

Indications are that the independent variable gender helps in predicting the dependent variable, which is the level of education around the Lake Bosomtwe communities. The study shows an association between gender and education, and it shows that more male has a higher education than females. This result is similar to the viewpoint at the national level.

Respondents Ethnicity and Religion

Ethnicity is a significant indicator in the conservation of resources as explained by Assimeng, (1981) that, one's relationship leads to the belief of the governing body's jurisdiction whiles reflecting its devoutness to the environment. Findings revealed that the majority of the people, around Lake Bosomtwe, are Asante. Yet some of the females come from a different lineage, through marriage. Indications are that 99.8 % are all from the Ashanti region with 0.2% from other regions, namely the Northern and Volta regions who are there purposely for fishing or hunting. There were two Europeans families' resident in one of the surrounding communities. Most of the respondents have lived in the community throughout their lives, having given birth to their children in the same community.

Indications are that unwritten social rules or knowledge, that regulate human behaviour as an Akan could help to constraint or govern the use of the shared freshwater resources as indicated by Adu-Gyamfi, (2011) and Smith, (2013). Yet the conceptual framework and Lawas, (1997), explain that in knowledge acquisition, a person's cognitive view influences the person's behaviour and response towards the environment and the Lake.

The average family size ranged from (2) person per family to 20 per household, and males headed about 90% of the family. These households sometimes comprised of grandparents, parents, children and some extended family members like uncles, cousins etcetera or just a young husband and the wife. The situation gives the impression of interconnectedness within the communities to enable the old impact their experience and knowledge to the younger generation as expressed by Berkes, (1993) and Giliba et al. (2011). However, Lawas, (1997)

and Woodley, (2002) explained that with regards to space and time, the changing environment, new goals and factors such as historical influences and traditional knowledge are replaced (Giliba et al., 2011). Additionally, the situation could also explain the inabilities of the locals, especially the young ones, to adhere to customs and regulations on the Lake.

The major religious activity reported in the Bosomtwe District report is Christianity, 89% followed by Islam, Islam 4.5% traditional 0.4% and others being 5.8 % (GSS, 2014a & b). From the secondary data, indications are that Christianity has made inroads into the previously traditional community as reported by Appiah-Kubi II (undated).

> "*The Lake is not what it used to be in the past. The rules and regulations were working perfectly well. Due to education and change in religion, the children do what they want without fear of the gods"* [Native fisher, 71-year-old, FGD].

Lynn White re-echoes this view from the 71-year-old woman on Judeo-Christian traditions in Taylor et al. (2016) on the assertion to the word (Subdue) which causes its destructive behaviour on the environment based on inculcated human attitudes. Adu-Gyamfi, (2011) also emphasises a similar point that with the arrival of Christianity, Islam, and other foreign civilisation, many beliefs, taboo, customs, and traditions have been relegated to the background. The author explained that many Christians and westerners view these customs, as fetishes and useless, demonic and satanic, even though they played a crucial role in environmental protection.

Alternatively, Bergstrom, (2014) and Morrison, Duncan, & Parton, (2015) explains that the word “subdue” in the Christian bible here is misinterpreted by western exploiters. The author emphasised that Christian beliefs could be a strong motivation that provides humans, the ability to relate to other creatures of God in harmony.

CHAPTER FIVE

FRESHWATER GOVERNANCE

Introduction

This chapter investigated the relevance of government institutions and institutional structures or rules and resources guarding the Lake for the perception of the differences in the educational level from both districts. The results are consistent and do imply that majority of the respondents believe that the government's rules are ineffective in protecting the Lake. The analysis was on how relevant current state of governance in terms of data collection, formulation, implementation, and enforcement of water laws and practices based on the perception of the respondents.

Rules and Regulations Governing Lake Bosomtwe

In examining the social institutions and institutional structures, data revealed that apart from the traditional authority and the district assembly, the other institutions available were the religious bodies, family and the formal educational system. They have structured institutions to regulate the activities of the people. Respondents explained that it is a taboo to go fishing on Sundays. They emphasised that the day is a rest day, as well as the belief that, is the day for Kwasi Bosomtwe, the god for the Lake to be able to make an appearance without any disturbances. Other recurring patterns of behaviour indicated by the respondents show that no one is expected to wash in the Lake, be it cooking utensils, clothes, bathing with soap, washing of cars or fishing nets. The understanding was that the use of soap was hazardous to the living organisms in the water, but to the locals,

it was a taboo for the gods. Women in their menstrual period as well as those who have newly given birth, not more 40 days, are not supposed to bath in the Lake. The young mother is not expected even to go fetching water from the Lake.

Respondents explained that they were banned from cutting down trees or removing grass around the Lake and its streams, without the permission of the Odikro or Chief. Cutting of twigs was allowed for firewood since big trees are pruned constantly for human use, but not for sale or for making a profit. Respondents explained that fish that was not sold or leftover fish after sales should not be returned to the Lake since they are dead. Tourism, they clarified as posed a big challenge in the sense that, it generates much rubbish, which cannot be controlled, and these end up in the Lake.

> *The "meet-me-there" is our problem, everyone enters the Lake to bath with his or her clothes, no one can distinguish between someone who is in the menstrual cycle or not in the menstrual cycle, and these issues have corrupted our taboos,* [Young Native Female, 30 years old].

According to the locals interviewed, it is also a taboo to use engine boats, for fishing, except is the wooden-planks (Figure 8). In another instance, no one is expected to go near the Lake in the night. The use of light near the Lake is forbidden according to respondents. Another custom that kept coming up was the purification of the Lake. The purification of the Lake starts with a lot of preparations and the sacrifice of a cow. According to respondents in both the in-depth interview and the focus group discussion, the purification has not taken place for about 18 -20 years now. Form the respondents' perception, this failure is the

leading cause of the deterioration of the Lake. They explained that the procedure puts fear in the residents on that day to keep the water clean. Respondents explained that the new generation has not experienced this festivity and law enactment and therefore do not understand the reasoning behind the institutions pertaining to the Lake Bosomtwe. On this day, sacrifices are made to the Lake with dogs, fowls and a cow. A respondent said,

> *The Asantehene (Otumfuo) and Asamanhene go around the Lake with special water called 'Mpomponsuo", after which prayers are said, and drinks are poured to seek the permission of the god Kwasi Bosomtwe and other gods to continue fishing. The Asantehene, the chiefs, elders of the area, priest or priestess lead the community to atone for the sins for the people. These elders make atonement for the forgiveness of sins. A sacrifice is then made to appease the spirit of the Lake, with a dog, fowls and a cow in August at Abrewamu and Asuoneaso communities. Finally, at Taakofi in Abrodwom the cow is slaughtered. The Asamanhene is then empowered by the Asantehene, who enacts laws on the Lake. After this period of purification, the people are prevented from fishing for about a week.* [Odikro Male 65 years old]

Throughout this time, the Odikro explained:

> *"we share and depend on the meat from the cow that was sacrificed, which helps to increase our fish catch"* [Native Fisher 70-year-old male]

The stream "Abrewa Akua" is believed to be the mother of the Lake is treated with great care. Respondents explained that it is the major sources of inflow into the Lake because it does not dry up. This assertion was also observed to be valid throughout the study.

Benefits of adhering to rules

Questions on how important these institutions (taboos) or rules and institutional structure enhanced the livelihood of the people and communities showed that the rules and regulations helped to increase fish production, as it aided in the protection of the Lake. For example, the answers from respondents helped to emphasise the fact that these structured institutions (rule, taboo, sacred grooves, and other regulations) helped to prevent the people in the communities from totally clearing the vegetation or bushes around the Lake. The bushes are the breeding sites for some fishes which supports increased their fish catch for economic benefit. Another respondent stressed the point that the traditional rules supported the cleanliness of the Lake, which provided them with healthy big fish and not the small-sized fishes they are currently catching. Another responder said it also protected the Lake and its environment from overexploitation since they feared the repercussion from the gods for not abiding by traditional rules. He explained that these taboos kept them in-line with the regulations of the community, which confirms Smith (2013).

Government Rules

From the Government Officials (GOOFs) interviewed, majority of them explained that they are only trying to enforce the traditional rule, which used to be in practice and therefore had no special rules for some time. The only rules they have imposed currently were the ban on catching fingerlings or baby fishes because they were small and needed to grow. Secondly, locals were expected to farm 60 metres away from the Lake to prevent sedimentation.

> *To curtail erosion, some Non-Governmental Organisations (NGOs), specifically Friends of the Earth and Friends of Rivers and Waterbodies, are trying to help the communities to plant trees and coconut along the Lake* [Male GOOF].

A respondent from one of the government institutions explained that they did not have the resources (financial, human and infrastructural) to enforce the rules at all times since all their officers within the locality live several kilometres away from the communities surrounding the Lake. He explained that their representative pay occasional visits to the communities to ascertain if there are any unusual occurrences and they report.

Report from the FDG indicates that the government is doing very little in terms of systems coordination, financial and infrastructure support to improve the state of the Lake. According to the local respondents, no government officials visit the communities unless a visitor is coming to the area. Preferentially, such visitors are NGOs bring in supports or education on the conservation of the Lake.

> *Currently, residents treat the water anyhow without worrying about the results of their actions. Traditional knowledge has helped us to do what is right without anyone telling us what to do. Our rules were no restrictions but part of our everyday life and so you do not see them as limitations.* [Chief, Native Male, 70 years].

> *The ban on catching small fishes would not work because they limit us from our livelihood and source of food. Some of the fishes are relatively small despite their age. That is their nature or natural structure because we cannot get the big fish to catch. We depend on the small stature fishes for our economic support* [Native Fisher 42 years].

Respondents explained that they did not know of any government rules. Other respondents believed the NGOs who visit them try to enforce planting of trees and coconut trees. Respondents in an in-depth interview explained that facilities to prevent defecation along the streams were insufficient, not available, and some cannot be used because they generate extreme heats during the day. Others emphasised that in the year 2014, government officials from the Environmental Protection Agency (EPA) and other government institutions established some rule to protect the Lake. The respondents explained that although the community members provided some information based on questions asked by the government officials, they were not consulted on the final decisions taken and the mode of implementation as well as its impact on the communities.

> *We are not supposed to catch small fishes, they said we should not farm near the Lake, the government says we should farm 60 metres away from the Lake, and there is a ban on farming near the Lake, but it will not work. Apart from the traditional practice, there are no rules, yet these rules do not favour us, as residents* [Native Male, Fisher, 56 years old].

The Relevance of Current Freshwater Governance

Respondents perception of the relevance of current freshwater governance is presented in Figure 11 based on the local dwellers level of education. With this, a straightforward 'Yes' or 'No' question about freshwater governance was posed to the respondents. Residents with SHS level of education indicating, "Yes", government rules are working and those who indicated "No" it is not working had no differences in their response. Yet there is a difference in the answer "no" government rules and regulations are not helping to reduce the degradation of the Lake Bosomtwe. A majority (70%) of the respondent indicated a "No" answers were respondents with JHS level of education. MSLC level graduate with 71 percent followed this. The least respondents who were not sure were 7 percent with MSLC level of education.

A significant difference between the level of education and the perception of the respondent was ascertained. The analysis was on the relevance of governance, regulation and conservation of the Lake as indicated in the results. However, the relationship is weak since $X^2(5, n = 354) = 20.4920$, $p = 0.025$, Cramer's $V = 0.2$. From the results, there were no significance differences in

response of respondents based on their level of education. The respondents saw governments performance as week and ineffective.

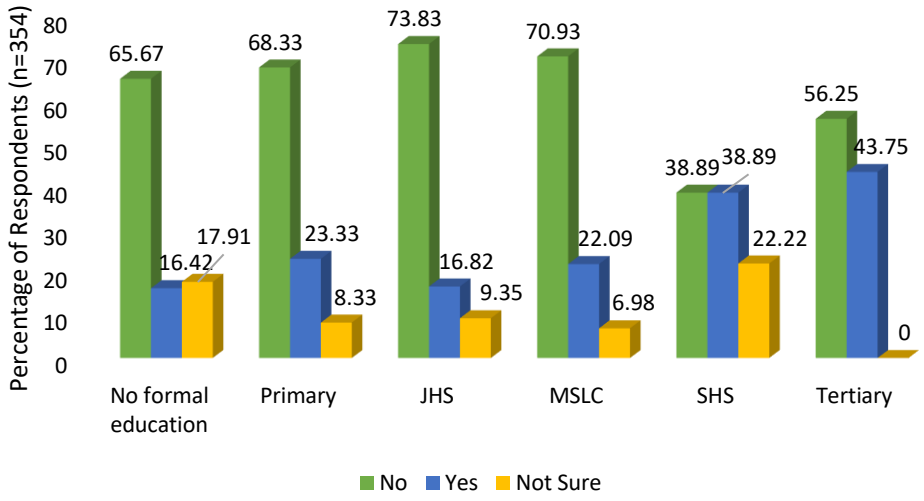

Figure 11: Respondents Perception Government Regulations around Lake Bosomtwe

Sources: Amu-Mensah (2016)

These scores on government performance in freshwater resources governance and regulation and implications on conservation is supported with evidence on Figures 12 and 13, concerning the activities around the Lake as indications of weak institutional governance. Indications form Figure 12 shows that no one prevents them from washing near the lake with detergent, which is harmful to the living organisms in the Lake.

Figure 12: Washing of dirty clothes by the shores of the Lake

Sources: Amu-Mensah (2016)

Logging is also another socio-economic activity in addition to the washing that leads to eutrophication of the Lake thus endorsing findings by Pebbles (2014), Chuvieco et al. (2018), Anderson (2017) and Smolen (2013)'s assertion that although phosphate are critical for plant growth, it can also cause algae to grow faster thereby leading to its deterioration.

Figure 13: Logging around Lake Bosomtwe Catchment Area

Source: Amu-Mensah (2016)

There is a tie or nexus between the aspirations of the local communities for better living conditions and the aim of protecting and conserving the Lake as a common property resource. The local communities did not seem to understand the importance and implications of the Western governing rules and so flout them in the process of making a living.

Perception of Policy Formulation and Implementations

Questions raised on the issue of stakeholders' perception of governance concerning the government's policy formulation, brought out several responses. One of the facilitators for policy formulation said:

> "*Sometimes, the key stakeholders within the local communities are not involved in policy formulation. It is better to involve them so that they would own it. Broad stakeholder's consultation is the best option"* [GOOF 3, 12/10/ 2016]

Another policy formulation facilitator explained that:

> "*The challenge we have is that the basin authority is supposed to work with the local authorities, but the relationships are not very strong, the reasons being that the assemblies have their challenges (financial and other logistics). There are expectations from the traditional authorities that are difficult for the District Assemblies to comply with, for example, the buying of schnapps and provision of money to initiate a collaboration'.* [GOOF 2, 4/9/2016].

For example, at the Weija Lake in the Central region of Ghana, the rate of encroachment on the dam has instigated WRC to liaise with National Security to encamp around certain perimeters of the Lake, as water police in order to ward off encroachers. The Pra, Densu basin authority and Black Volta Basin Authorities in Wa, are still being set up, to take over the enforcement of rules and regulations to protect the rivers. We did not have to go through any traditional protocols. Yet P5 a local stakeholder had this to say about the effectiveness of the public governing system:

> "*Even though the basin authority is supposed to work with the local authority they not stationed in the communities. The relationships are therefore not very strong, reasons being that the assemblies also have their challenges of logistics". There are not adequate finances to pay the chief any time they have an audience with the chief even if it is in our interest. The government pays people to work for them, and so there must be some agreement they can come to in finding a solution to freshwater conservation"* [P5, 2016].

Based on the preceding, respondents in an in-depth interview, a respondent pointed out that the Council for Scientific and Industrial Research (CSIR)'s Water Research Institute (WRI) is involved in quality and sediment data collection. The Hydrological Services Department (HSD) has the mandate to collect data on streamflow and Ghana Meteorological Agency, provides critical data for temperature and rainfall, which feed into a freshwater policy for management. With the current system of, governance of

the waterbody, which is a top-bottom approach. This position confirms the dependent nature of policy formulation and implementation.

Commenting on the issue of governance respondents complained that fishes in the Lake are dying whiles the Lake is drying up due to non-adherence to traditional rules and the nonexistence of government rules. In Detieso, a 62-year-old male participant explained:

> *"When the rules are sent to us, we only debate on it, and after they have explained we accept, but it is not adhered to because it is not everybody who accepts. Unfortunately, there is no one to enforce these rules. Yet within the Banso community, they respect the rules"* [Native 62-year-old male].

The findings thus confirm the Ibrahim (2017) report on the rule of Law in Governance. Concerning empirical evidence, the Akans of Ghana, for instance, submit that: "adidi daa yɛ sene adidi prɛko" which means: "it is not good to eat all that you have in one day". This proverb sums up the traditional Ghanaian' understanding of the concept of sustainable development, and this was during an in-depth Interview by Awuah-Nyamekye, (2009) with Nana Adu Gyamfi, the Akwamuhene of Berekum Traditional area.

Giddens (1984) mooted that, IK is based on mediated experience, where the prime mediator in the body and its umwelt meaning, the immediate environment. In this instance, oral cultures become the mediating vehicles in the physical presence. It is also the perceptual and communicative modalities of the body. Umwelt thus refers to a person's subjective world that acts through,

ecological relationships, involving signs, perceptions, and interpretations and the language semiotics.

Ownership and Control Regimes of Lake Bosomtwe

A cross-tabulation of the ownership of the Lake and control of the Lake shows that majority (51.7 %) of the respondents believed that Asantehene owned and controlled the Lake. Another significant portion of 23.4%, however, indicated that God controlled and owned the Lake. The results, however, shows a clear lack of relations between traditional local governance and government institutions; thus, it is not clear as to "who" controls "what" and "who" owns the Lake. It is also not distinct as to who ensure enforcement of rules and regulations since the government officials indicated it is their responsibility in an in-depth interview and the locals around the Lake indicated it was the traditional leaders.

This situation creates a dilemma for the communities living around the Lake on who is responsible for enforcement. Although the Lake belongs to the local authorities and the Asantehene, the control, policy formulation and rule enforcement is by the government. The results show that there is an association between Ownership and Control of Lake Bosomtwe as shown in Table (14) using the formula X^2 (25, n = 354) = 4.3252, p = 0.000.

On a similar challenge as to who is responsible for rules and regulations, an older man in an in-depth interview indicated that he was not sure whose rules they were supposed to enforce. He questioned if it was, their customary laws or the byelaws from government, which he indicated was created in the year 2016.

"*The law is good, but people do not abide by it. The community members do not respect authority because even the chief can be sent to the police station"*. [Sub-chief 67-year-old]

Table 14: Ownership and Control of Lake Bosomtwe in Percentage

Key Actors							**Total**	**X^2 (p-value)**
Who has the Right to make Rules on the Lake								
Who owns the Lake		Asante-hene	Government	God	Every-one	No Body		
Asante-hene	n	183	7	0	0	2	190	4.3252 **(0.000)**
	%	51.7	2.0	.0	.0	.6	53.7	
Gov't	n	8	4	1	0	1	14	
	%	2.3	1.1	.3	.0	.3	4.0	
God	n	83	5	15	6	3	112	
	%	23.4	1.4	4.2	1.7	.8	31.6	
All of us	n	17	1	1	1	3	23	
	%	4.8	.3	.3	.9	.8	6.5	
Nobody	n	12	0	0	0	1	15	
	%	3.4	.0	.0	.0	.3	4.3	
Total %	**n**	**303**	**15**	**17**	**7**	**10**	**354**	
	%	**85.6**	**4.2**	**4.8**	**2.0**	**3.4**	**100.0**	

Source: Amu-Mensah (2016)

It was also gathered from the interviews that respondents perceived that the Chiefs and 'Odikros' have much better ways of presenting stringent rules that attract strict adherence. Yet, the government rather presents bye-laws which are supposed to be enforced by the chiefs and the 'Odikros', whose power and control have waned down drastically over the years by the current democratic arrangement confirming Opoku et al. (1999). This situation confirms the argument by Daily et al. (2003) and Kendie, (1997) that rules or byelaws are imposed. Yet the different

opinions, interests, and views of communities, who are also stakeholders, but not considered in decisions made. This confirms the gap identified in the Structuration Theory (ST) that the structures are built on the government executives' understanding or perception of the phenomena. Table 15 or 16 shows respondents' views on participation in policy formulation.

Table 15 Community Involvement in policy formulation

	Frequency	Percent
Very much	1	0.3
sometimes	27	7.6
Not really	76	21.5
Not at all	248	70.1
Neutral	2	0.6
Total	354	100.0

Source: Amu-Mensah (2017)

The perspectives of owners of the resources or the direct actors may not be considered. Analysis of the data, presented in Table 15, confirms this assertion since about 92 percent of the respondents indicated that the communities were not involved in the policy formulation of the Lake.

Nature of Policy Formulation

In-depth interviews with Government Official [GOOF] as key, expects from Government Institutions revealed that water governance at Lake Bosomtwe is dependent on the local environment. Although freshwater problems are attributed to the governance of activities within the resources' environment, the

seasonality of rainfall also contributes to defining the quality and the quantity. Additionally, in the case of Lake Bosomtwe, its nature as a closed lake also contributes to its current state, considering the intensification of activities around the Lake. Policies introduced by the Ministry of Sanitation and Water Resources [MSWR] formally the Ministry of Environment, Science and Technology [MEST], WRC and their agencies or institutions at the district level to ensure implementation of rules and regulations, as supported by the statement below:

> *"The institutions provide the technical inputs or data before the policies are developed for the Ministry of Environment Science and Technology Innovation (MESTI) and agencies under the Ministry implements them"* [GOOF 1, 12 /10/ 2016].

The officer explained that there are three categories of institutions: first, the Water-Related Management Institutes and Agencies, the Regulatory Institutions and the Water User & Data Management Institutions. Under the Data Management Institutions are:

The Council for Scientific and Industrial Research, Water Research Institute (CSIR, WRI) responsible for quality and sediment data collection; Hydrological Services Department (HSD) collects streamflow data and the Ghana Meteorological Agency (GMA) which provides key data for temperature and rainfall which feed into water management policy. Water Resources Commission (WRC) then collects the data, processes the information for the Ministry, but they are not data gathering institutions. There were no institutions collecting information on the anthropogenic and cultural challenges on freshwater resources. This is a clear indication of a top-down, stewardship style of governance likened

to Giddens, (1998) structuration theory, instead of the current stakeholder approach or the integrated system of governance.

The situation around the Lake also depicts how current government institutions have shaped the behaviour of individual members and produced a chain of apathy in the system of governance around Lake Bosomtwe. This is because the respondents expect the Asantehene, to "own" and "control" the Lake with his own set of customary rules, well understood by the people in the community. However, they believe the government has usurped this power without instituting written laws for the people could adhere to.

> *"We are weeding everywhere (Yɛɛ dodɔ baabiara)" "Yɛ nim mmara no ho nimdeɛ"* [Trader woman 35years]

This statement means that residents do not have an understanding of the government rules - in this case, the rules, principles, values, policies, and laws which provide the bases for strengths and weaknesses of governance is not properly in place signifying a weak institutional system (Rim-Rukeh et al., 2013). Indications are that the locals do not have the opportunity to participate and contribute their knowledge to the formulation of policy. Governance in the case of the Lake is not participatory and therefore not transparent.

Gender and Policy Formulation

Results indicated differences in gender involvement in policy formulation, and indications are that males were more likely to be involved in such issues. In all, 75 percent of the respondents gave indications that it is mostly men who attend such government meetings. Nearly a fourth, numbering 24 % indicated that both

male and females were involved in policy issues. Meanwhile, 8 percent of respondents pointed out that it was females were involved since the leaders always sort for the view of women local issues. This result is evident from their response that males in the Akan tradition are the ones who become the Chiefs, sub-chiefs and Village Heads or "Odikro" and therefore they, deliberate on issues concerning the Lake and its environment with some inputs from the older women.

The respondents explained that females were more influential and therefore helped to enforce the law by training the children. Yet from the in-depth interviews, it was revealed that there were no restrictions by the government until recently. The respondents indicated that people were obedient and feared the elders and so they did whatever they were told,

> *"I believe that if the traditional rulers are properly resourced, they would be able to enforce the rules. She explained: the rules were part of our everyday lives and therefore there was no need for the strict enforcement of the rules at that time"* [Native, elderly woman 76-year-old], and another respondent said:
>
> *"The males make the laws, but it is the mostly the females who utilise these...most of the rules on the lake are for the females who are a major user of the resources"* [Native, Man: 47 years]

He indicated that the females are the ones who fetch water for use in homesteads and clean the pots or cooking utensils. When the question on fishing was posed, the response was that it was only recently that rules on the use of fishing nets were imposed on them. The respondents explained that the Lake is in the hands of the government through the district assembly. Current government

responsibility towards the Lake is in revenue collection and the management tourism in the area. However, the respondents clarified there was no person available in or around the communities, to enforce the rules. For instance, a young man had this to say:

> *"The locals-only collect the revenue and send the money to the district assembly"* [Native Male: 25 years].

The revenue collector confirmed this during an in-depth interview. The results confirm there is a nexus in the aspirations of the local communities and protection of the Lake.

Indigenous Knowledge and Policy Formulation

Based on the views of the local people, major decisions on the Lake used to be taken by the local people, which are then communicated to those in authority. Nonetheless, the inception of Christianity and Western education, most young people in authority (political appointees) do not respect the local authorities' thoughts and practices. This stance is taken because educated people believe such knowledge it is out of place in the current dispensation of freshwater governance. Yet, this was the comment:

> "*These practices are what have kept us from doing what would destroy the lake"* [75-year-old woman].

The fetish priest is consulted in some instances were issue or problem is beyond their ability to solve. In other instances, challenges are sent to the Assamanhene, who then reports to the Asantehene and his elders. These leaders deliberate on the issues and send feedback to them, through the Asamanhene to

the Chiefs and Odikros. The Chiefs and Odikros also disseminate information to the members of the community through the "gong gong" beater for a social gathering. This situation ensures information flow on what to do, and what they should not practice around the Lake to ensure its sustainability.

Respondents explained that they had formed committees to discuss different issues of concern to the community. An older woman reiterated this in one of the communities as:

> *"We put people to task like in communal labour for building toilets, borehole, and teachers' quarters"* [Native, 75-year-old woman].

Hardin's, (1968) theory of the tragedy of the commons, explains that human population doubles in growth with each cycle while food production is by the repeated addition of a uniform mathematical increase in common-pool resources till depletion. Alternatively, the

> *"When we encounter problems, we try to find solutions to it, amongst ourselves. Other residents look for alternative jobs outside the community to reduce the burden on the Lake, but it is not enough"* [Sub-chief, 70-year-old]; and

> *"Due to increase in population and the fact that there are no corresponding jobs for educated young ones, they leave the community"* [Sub-Chief, 68 years Old]

The issues of population increase and its linkage to improper use of the Lake is confirmed by the data taken from the Population and Housing Census [GSS] (2014a & 2014b) indicating a growth rate of 3.4% per year in the area.

The purification of the Lake, according to the respondents, follows this pattern. Information is sent around the communities before the yearly purification is organised. The chiefs meet, and every community is charged to pay for the purification of the Lake. Communities like Abaase and Abrodjom do not contribute towards the purchase of the animals because it is their responsibility to organise the cleansing. The other communities pay 100 Ghana cedis, to help pay for the cow, dog and fowls. This annual purification rite helps to remind the people and revitalises the bond they have with one another. The chiefs are enjoined to follow the instructions of the elders. This process and significance confirm Donaldson & Preston's (1995) network of relationships, which helps to improve benefits to the stakeholder. At Lake Bosomtwe however, the governance mechanisms are not in place, and there is a lack of ownership responsibility, authority and sensitisation on the Lake.

Communities' Perception of Freshwater Governance

The study applied Grindle's (2002) model of data collection, which emphasises the effectiveness of decision making on the principle of governance, with a little modification. The researcher thus used aspects of governance that are in line with policy formulation and knowledge inclusion, see Appendix F. Hence, with the help of the Situation Analytical Method of data collection similar to Krueger and Casey (2000), supported by observation and interviews, help to evaluate locals' perception on governance and government performance at Lake Bosomtwe. Efficiency in governance concerning the Lake is determined adherence to rules as well as the state.

These rules and principles provide the stage for assessing the strengths and weaknesses in governance (McMahan & Roa, 2016 & Rim-Rukeh et al., 2013). The researcher also examined governance; using access (use), control and ownership to good governance practices.

Assessment of Equity

In the assessment of issues relating to equity and inclusiveness, the older males and females explained that due to their inability to participate in policy formulation, there was no equity. Some older residents emphasised that due to their old age, it is difficult even to get some fish to eat. They shed light on the fact that fish used to be in abundance such that others always give the old females, who cannot go fishing.

> "*We can only catch the small fishes or buy from the men. Although I have not heard of any taboo, I have not seen any woman go fishing except the men. It considered as, a male occupation"* [Native elderly woman 90 years old]

Assessment on Participation

In the focus group discussion with the matured females and young females, this is what they had to say about their participation in policy formulation:

> "*We are only informed after they have prepared the law. Due to Christianity, everybody does what they want. Our norms and values are seen as idolatry, now the children are taught many things in school, and sometimes they have taught to us, instead of the adults training the young ones"* [FGD 2016].

The two female groups emphasised that there used to be very little collaboration in the year 2015. Henceforth until the recent durbar organised government and related institutions like the Water Research Institute, UNESCO, the district assembly and some NGO's which was meant to discuss issues related to the Lake came to ask us questions about the Bosomtwe Lake. A young man commented:

> *"After this, some by-laws were prepared and brought to us to help protect the Lake. We debated on the laws, and we accepted it, but it is not everybody who accepted the laws. People do not adhere to the laws because it is not everyone who was in favour of the laws; unfortunately, there is no one to help enforce the law"* [FGD, 2016].

> *"The Lake is currently not good for drinking, and it can only use for cooking plantain which enhances the taste of the cooked plantain, this is how useful the Lake is to us"* [Opinion Leader, male, 68 years old].

On the issue of participation and involvement in policy formulation, this is what one of the older women, had to say:

> *"We are not part of government policy formulation or implementation. Attitudes and action of government officials, who are organisers of beach activities, disrespects our laws"*. [Male 87-year-old Native].

We have visitors coming to swim during the "meet-me-there" respondents' explained, and this is a national socialisation program. The explained that outsiders

intrude on their privacy. Residents emphasises that outsiders who come to swim, in the Lake do not have any regard for their customs.

Assessment on Rule of Law

Results show that it has been twenty years since the Lake was purified from such acts of dishonour from outside users. Therefore, residents have become adamant to their own rules.

A young farmer said:

> *"People have cut down the trees and are now farming close to the Lake. This situation is destroying the Lake and nearby streams which are now exposed to the weather conditions. Small nets are used to catch all sizes of fish, so, the fishes are not growing to the right sizes"* [Young Native Male].

> *"No one listens or pays attention to us as residents, and I only play with my grandchildren when my daughter is busy with her shop"* [Native female Fishmonger, 68 years old].

Another person passively concerned about the Lake remarked follows:

> *"Some of us presently manage shops, and this does not give us time to concern ourselves with the Lake anymore. Sometimes we have to travel to Kumasi to buy things that the tourists prefer to buy during their visits* [Native elderly provision trader woman, 51 years].

Appraisal on Access and Use

In general, the older women indicated that they do not use the Lake as they used to when they were young. They added that currently, there is no privacy because of the many foreigners touring around the Lake. Additionally, they explained:

> *"The place is too open for me to participate in recreational activities. Some people have taken part in the Lake for their personal use, and we do not know who gave them permission to do that. No one provides information these days"*. [Native Fish trader, 69 years old].

One of the young males indicated that they have other businesses to attend to and everybody minds their businesses, and so people are least concerned about protecting the Lake especially when sacrifices for the gods have not been performed. He further explained that residents had used their quest for wealth to destroy their "agyapadeɛ" [inheritance], thus referring to the Lake. It was emphasised that in this era, money is everything and not our rules and regulations, since everything they had is lost to greed, except a few who still believe in the traditions.

The Lake is "Esusan nsuo", an old man lamented, meaning Lake is sustained by rain, as he tried to emphasise the vulnerable nature of Lake Bosomtwe towards overexploitation.

The cool weather around the trees provides breeding grounds for the fish but now the trees are no more, the sun shines directly on the Lake [FDG, 2016].

Under transparency and accountability, they explained that power and attitudinal implications were the problems, in addition to, the issue of anonymity in the community.

The respondents explained that what the District Chief Executive [DCE] says is final. It was emphasised that to make things worse, religion and the current educational system, do not help with the informal education of the young ones, because they believed the formally educated ones show some good-feeling of knowing better than the older generation who were not formally educated.

A further probe also showed that there was confusion about who was responsible for the conservation of the Lake because the respondents indicated that the DCE only issues instructions and everyone must comply with this instruction. Meanwhile, the respondents indicated that no one in the communities tries to enforce these rules similar to an earlier submission. One of the young men confirmed this by indicating that:

> *"The government came to meet us, so we expect that residents would form part of any discussion on Lake Bosomtwe and not make the decisions alone. They emphasied, this is our community, and we are the ones who know what is best for Lake Bosomtwe". Government officials came to ask us questions. They finally put those thoughts together and presented them to us as byelaws. It is evident that power to control has moved from the Chiefs and elders to the government, yet the government does not have the right structures on the ground to enforce the rules. In the past, we were making our laws, but now it is the government making the laws. Because of that, people are bold*

enough to arrest the Chiefs and take them to court, thereby reducing their self-esteem [FGD 2016].

These are some indications of measures put in place to ensure effective use of the basin's resources. An indication was that men who used to make the rules. This assertion was confirmed during an in-depth interview with some key informants:

"Men make the rules. There is a saying that "obaa enkɔ sa" (a woman does not go to war) and "Obaa tɔ tuo a etwere bema daamu" [Native male 95 years old].

This implies that, when a woman buys a gun, it is kept in the man's room. In this context, the comment shows that men are the ones who always take decisions on issues. Similarly, on equity and inclusiveness, they indicated that amongst themselves there is much sharing and sometimes you can even barter your fish with farm produce.

Results under the ownership of the Lake: Respondents explained that men make the laws; residents explained that it is women, who abuse the rules. They emphasised that the rules are made for the women who are always working around the Lake. Another indication was that government has taken over law making and enforcement. Meanwhile, the residents do not enforce laws by the government because they do not understand most of it. They also indicated that residents do not consider these policies as laws being backed by the Asantehene and the chiefs since it does not follow the concepts or tenets of tradition. Therefore, people tend to break the rules. Regarding law enforcement, a Youngman, stated as follows:

> *When laws are broken, no one has the financial strength to send the offender to the law enforcers who are far away. Moreover, even if we had financial support, there are no selfless or altruistic people to catch offenders. Moreover, these offenders might be our family members. Customarily you would even have to spend money paying for the court fines of the same person you helped to catch. Another issue is that our local rules or taboos are not written, they are coded in our everyday activities, but no one explains why we practised them and so it is easy for us to ignore them if we do not understand its benefits* [Native Youngman, 26 years old].

Finally, under effectiveness and efficiency, the respondents explained that about two years ago, the government came to discuss issues concerning the Lake. According to an 81-year-old man, the locals are supposed to leave a distance of 60 meters from the Lake. The older man indicated that the government instituted the law after the District Assembly, EPA, UNESCO and some organisations came to interview them. A middle-aged woman had this to say

> *"The only interaction happened when the government institutions give us the bye-laws on water conservation without our inputs. They only asked us to form a group called CREAMER from amongst ourselves to enforce the byelaws. CREAMER is made up of 1 woman and 15 men".* [Native trader 52-year-old Female]

She also emphasised that despite all the interventions by district assembly and some NGO has to sustain the Lake there is no change; people use to follow the rule, but the situation is different now. Another respondent had this to say:

"No one listens to the elders because the younger generation believes they are in a new dispensation and therefore better-off or well educated than us. The idea of using fear of the unknown to prevent wrongdoing is no more applicable. For example, we believed that becoming sick or dying after wrongdoing was attributed to disobeying the rule or taboos of the water spirits or gods, but this is no longer tenable.

People plant along the Lake because the soil there is fertile even though it is against the rules, no mishap occurs to us. We were told we would give birth to stubborn children or develop some kind of incurable illness if we disobey the rules. She explained that obedience to rules and regulations ensured peace" [Native 26 years old female]

Unfortunately, some of the locals do not associate the degradation of the Lake to the mishaps. Indications were that previously the fear of the gods kept them from disobeying the rules and adhering to the values around the Lake. The local people claim that out of disrespect, sometimes government authorities do not consulted before rules are made.

In conclusion, there is a lack of collaboration between the government and the local authority. Accordingly, there are challenges of equity and transparency in policy formulation processes and implementation around Lake Bosomtwe. There is very little or no participation of local communities along the Lake in these processes. As indicated by the respondents, there is no transparency in the formulation of policy and the revenue collected from the tourism proceeds. From

the result, it can be said that inefficiencies in policy formulation lead to weak governance policy and ineffective response to rules and regulation. Following the principles of good governance, suggested in the study, Rim-Rukeh et al. (2013) and Pahl-Wostl, et al. (2013a) submissions on good governance are confirmed. Rim-Rukeh and others, as well as the study results, indicate the lack of cooperation among the stakeholder leading to weaknesses in freshwater governance around at Lake and environment.

This affirmation helps to explain that it is the principles in the knowledge that provide some direction for better stakeholder orientation, to boost both local and government authorities to set up an agenda for result-oriented policy. This also confirms findings of McMahan and Roa (2016) that principles of governance or a good system also, assure opposing views and removes doubt in the minds of local participants. It can also provide stakeholder engagement whiles, making policy formulation a good practice, functional and more visible in support of man and the environment (OECD, 2015).

Socio-economic Impact of Respondents Activities on Lake Bosomtwe

The study showed socio-economic activities around the lake, impacts directly on the physical and chemical characteristic of the resources. Based on a blend of FGD, in-depth interview, observation using a digital camera and reviews, indications are that respondents were engaged in various economic activities such as fishing, tourism, farming, petty trading (provisions) and livestock production. Only a few of the respondents were into formal employment.

> "*Those of us, who work in the hotels, lodges and the district assemblies, are not many. We also have farms, and some of the residents, fish for family consumption early in the mornings.* [Native male, receptionist, 38 years].

Fishing, according to the respondents, is perennial and does not pay much due to the sizes of fish caught. The most income-generating activity is from farming (cocoa, plantain as the primary income generator, others are cassava, cocoyam, tomatoes, cabbage, and pepper)

> *"In the past onions use to be the major crop cultivated has given way to plantain cultivation"* [Native male, (Odikro) sub-chief, 84 years].

He explained that the plantain is a major income generator compared to the onions. When he was questioned about the impact of plantain production close to the streams and the Lake, he explained that the people are aware. He clarified that because there is not enough land for everyone in the community, there is very little they can do more so, plantain is a great income earner. The picture in Figure 14 shows how farming activities are conducted close to the Lake, which does not ensure an environmentally friendly attitude.

Figure 14: Observation of Lake Bosomtwe Channels or streams with plantains trees along the Channel

Source: Amu-Mensah (2016)

Rubbish from commercial activities is dumped along the streams. Woodcutting within the forest and charcoal burning for sale also deprived the forest of its vegetation. This contributes to sediment loads and the changing the geomorphology of the streams as seen in Figure 15, which shows sandy streambed confirming findings by Kusimi, et al. (2014). The observation of logging and other exploitative agricultural activities erode the soil, with the heavy rains.

> *"Some people often spray our crops and farms, with pesticides and herbicide, and we use fertilizer to improve on the yield" In clearing the land, we cut and burn the bushes or use weedicides before for cropping"* [Native male, Assemblyman, 58 years].

This assertion by the 58-year-old man is affirmed in Figure 15.

Figure 15: Bush burning on the slopes of Lake Bosomtwe's catchment area
Source: Amu-Mensah (2016)

In an attempt to make a living, the part of the catchment as seen in the picture, is burnt depriving the top soil of its protective cover to reduce erosion as indicated by Boamah & Koeberl (2007) and Abreu, et al. (2016). Some respondents explained that they travel to the top of the hills to farm whiles others farm very close to the Lake due to the richness of soil around it.

> *"We farm along the banks because the crops do well and you also do not need to carry water up the hill to water your crops*" [A 39-year-old, farmer FDG]

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Question on the taboo for farming along the Lake affirmed, most respondents' knowledge of the law but indications were that the enforcement was weak. Meanwhile, the installation of an Asaman chief has been stalled. Therefore, there is no one to assist the Asantehene, to perform the purification rites to enforce the laws. He also indicated that there was no available land for farming, and so they farm on the land around the Lake.

The findings in the study, confirm Adombire, et al. (2013); Guppy and Anderson, (2017) and Smolen, (2013)'s assertion that although nutrients like phosphate are critical for plant growth, it can also cause algae to grow faster and abundantly thereby reducing the quality and quantity of freshwater. It also emphasises the assertion by Chuvieco et al. (2018); Boamah & Koeberl, (2007) and Abreu et al. (2016) that human activities within the catchment area, causes adverse effects on the water resources leading to eutrophication.

CHAPTER SIX

INDIGENOUS KNOWLEDGE AND FRESHWATER GOVERNANCE: THE EVIDENCE

Introduction

This chapter discusses the relevance of indigenous knowledge in the use of water resources in Lake Bosomtwe. In so doing, the chapter analyses the data on the symbolic meaning of some indigenous knowledge systems and practices among the local communities in and around Lake Bosomtwe.

The Relevance of Indigenous Knowledge in Governing Lake Bosomtwe

The Relevance of Indigenous Knowledge in Governing Lake Bosomtwe

IK's relevance in freshwater governance is established in the symbolism and root word, which helps to indicate how, when and why, the practice started. On this issue, it came out that the local people in the communities understand the usefulness of IK in protecting the Lake. Further proof of their understanding of the usefulness of IK's and relevance on the Lake's conservation is seen in Table 16, which gives information on how traditional knowledge can be applied to the conservation of the Lake.

The result from Table 16 indicates that 90 percent of the respondents believed that traditional knowledge was either very important or essential. Only a few of the respondents representing 10.2% indicated that traditional knowledge was not important. Some respondents also indicated that in this era of science, it would be challenging to apply IK or get residents to comply with such rules since sometimes they also do not know why some customs are practised. Their

understanding was that the knowledge is related to spiritual issues, which would be difficult for most Christians to comply.

Table 16: Relevance of Indigenous Knowledge in Protecting the Lake

Response	Frequency	Percent
Very important	241	68.1
Important	75	21.2
Not Important	23	6.5
Not at all important	13	3.7
Neutral	2	0.6
Total	354	100

Source: Amu-Mensah (2016)

Respondents from the communities indicated that IK was not being used, since, some practices perceived as fetish practices. From the results based on a cross-tabulation, the gender differences in response to IK's use in the conservation the Lake. The results indicated that 80 % of the female respondents indicated that "No" IK was not being used while 70% of the males also said "No" it was not being used. Respondents, representing 13% females and 23 % of males indicating "somehow" followed. Other residents 5% of the female and 4% present of the respondents gave a "Yes" response to whether IK was being used. Only 2 % of females and 3 % of males said they were not sure if IK was still being practised.

Similarly, indications were that there were no significant differences between the responses of males and females on the current state of the practices as shown by the pr. value of 0.126 in Table 17

Table 17: Chi-Square Tests of Gender-Use of Practice Responses

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	7.200[a]	4	.126
Likelihood Ratio	7.253	4	.123
Linear-by-Linear Association	6.816	1	.009
Number of Valid Cases	354		

Source: Amu-Mensah (2016)

The findings in Table 16 and 17 confirm the assertion by Awuah-Nyamekye (2013) and Smith (2013) that colonialism has eroded indigenous practices of the past using religious connotations. Respondents indicated that IK is no more being used since some of the practices are seen as idol worship and unchristian. Woodley (2002) also explains that a change in social life is an indicator of change in knowledge and practices. This finding, likewise confirms Smith, (2013) argument that without understanding IK, it is difficult to recognise and understand the interrelationship among the improvised symbols. The author supports the assertion that symbols become unfriendly, insufficient, and less productive and out of context for effective resource governance. Additionally, this finding also supports Giddens (1998) point out that these externalities or improvised knowledge create restraints within the structure if it does not come from the context of the resources.

The Symbolism of IK in Freshwater Governance

Understanding the symbolism of the word or practice reveals the usefulness or importance of IK to freshwater resources governance, as indicated in Table (17).

Awuah-Nyamekye (2013) emphasises this assertion by indicating that understanding the significance of IK ensured judicious use of natural resources. A conversation Awuah-Nyamekye had with some chiefs, showed that the natural resources were conserved to achieve growth in life and for the next generation using symbols in their everyday activity to train the younger generation. Therefore, the meaning of symbols and the semantics of the language, contribute to the clarity of interpretation given to the word as presented in Table (18)

Table 18: IK Implication, Symbolism and Usefulness to Freshwater Conservation

	IK and practices	Local meaning/name	Implication, Symbolism or Usefulness to Freshwater Conservation
1	god /Bosom	"Ɛsom bo" / Precious	Its actual meaning is something precious or of great value
2	Yearly purification of the Lake using animals (Cow)	"Esubo"	After the purification the meat is shared as a source of protein for the period they stay away from the Lake
3	Sacred days (Sundays) or Close season	"ahomegye da" or Afoofi da"	These are the days of rest for the fishers to be involved in family discussions, repair, and maintenance of fishing gear and training of young ones. In addition, it is a time for the water to restore itself.
4	The taboo on the use of soap on the Lake		The taboo prevents the propagation of scale formation in the water as well as bacteria and algae bloom. It is also a check on salt and soapy water intrusion.

Table 18: Continued

5	The taboo on bathing during Menstruation on the Lake	"Bra enkɔ Bosomtwe mu"	These activities provide a source of contamination for the person or others. This activity, contributes to bacteria and algae propagation in the Lake. This depends on the number of persons in similar situations.
6	Taboo after childbirth	Obaatan foforo nnkɔ Bosomtwe mu	This taboo serves as a form of protection for the mother and child. *The taboo helps to prevent contamination of others. It also contributes to the propagation of bacteria and algae growth, and it depends on the number of persons in similar situations.
7	Use of light on the Lake	Kanea nnkɔ Bosomtwe mu	* Spawning, hatching and growth rate of some fish spices, are affected by the sudden changes in light; from light to dark and intensity affects.
8	Washing of dirty things or Black pot	tumm Adeɛ tuutum nnkɔ Bosomtwe mu	This taboo is similar to the contamination of the water and propagation of bacteria and algae.
9	Shorting or whistling whilst on the Lake	Yɛ nbo hwerɛma wɔ Bosomtwe so	*indications are that the resonance or sound masks the biologically relevance of sounds. Which causes behavioural changes in fishes, such as moving towards or away from a sound source or leaving a feeding or breeding site, thus, increasing fish stress that affects the spawning pattern.

Table 18: Continued

10	Use of Padua (wooden plank) on the Lake	Padua	The type of tree used in constructing the "Padua" is ecologically friendly to the water in that the sap is not poisonous to the animals and plant (P1).
11	No palm wine is taken close to the lake	Nsa nnkɔ Bosomtwe ho	Drunkards can easily fall and drown in the Lake.
12	Clearing all the grass around the Lake	Yɛ ndɔ Bosomtwe ho	Where the grass is supposed to grow has been encroached upon and so water that is supposed to be flited by the grass goes directly into the Lake with the sediments
13	Terracing		Nature of the soil is loose so the terracing helps prevents erosion

Source: Amu-Mensah (2016)

The in-depth interview indicates that the essence of freshwater sources to the African and for that matter the Ghanaian or the Akan is its sacredness as a god. The respondent explained that the water has spirits, agents and fruits that are the creatures in the water body (fishes, crocodiles, frogs, foliage and other living organisms). These living things help to enrich the lake whiles serving as the protectors of the spirit world. He commented that:

> *"Rivers or lakes are regarded as sacred because their existence is difficult to comprehend or explain by the human mind. Given this, anything that has a mystery surrounding its existence is regarded as something of great value (god). Water is regarded as a spirit. It also*

signifies purity and therefore, one must show dignity and respect for the place". [P2, 27/1/2016]

Other respondents regard it as the "Sustainer" of human life, for all kinds of creatures and it is regarded as the nourisher of the land, to keep it fertile for crop or plant production and reproduction towards the substance and benefit of man.

Indigenous Support for Protection of Freshwater Bodies

The participants explained that knowing how to protect freshwater resources has been handed over from generation to generation, through historical experiences of man and his interaction with the freshwater. This is in an effort to protect what God has given to man for survival. So in Akan, there is a saying that "Nsu ye enkwa" thus water is life. Humans should be discerning to understand that water is part of what God has given us for our survival, and therefore, it should be protected.

Generally, people do not go to the riverside at night because there is the belief that you would meet the god at night who would put a curse on you and your family. P2 commented that:

"It is believed that the day you see the god you would be deformed, become dumb, or some calamity would befall on you. Sometimes it is said that you, a family member or both can die'.

He explained that all these stories and mysteries helped to protect the waterbodies and to prevent them from overexploitation. An older woman confirmed this assertion in an in-depth interview.

"I remember how my father shouted and beat me up for sending the lantern close to the lake, and he gave me a strong warning never to do that again" [Native female, 86 years old].

Ultimately, these practices protect the human who might meet a dangerous animal at night or otherwise prevent and deprive an animal of coming to drink at night because of human presence.

Results from the in-depth interview also indicated that indigenous people could tell or predict rainfall based on the position of the clouds. According to GOOF (3), the cry of the common toad signals the arrival of rain within 24 hours. The indication is that the weather has changed, with either threatening rain, or raining. GOOF (3) explained that some animals respond to the sharp increases in humidity and some climate parameters and at a certain level, then they cry out. He emphasised that:

"When you see a donkey running from the bush to the house within 24 hours, it would rain" [GOOF 3, 2016].

Local people can observe a particular colony of birds, and if they start migrating, then during the next month the rains would start and emphasised that: "These traditions are working, yet we thought these were too archaic" [GOOF (3), 2016]. He explained that these animal or insects respond to the environmental factors, climatic factors and they express these things, and so our people observed these animals all over the years to make their predictions. This information, confirms Awuah-Nyamekye (2013) & Smith's (2013) thoughts on the local

generation of information that it is not just based on local knowledge but also on practical observations just like what the scientist does.

Sacrifices and Purification as a Form of Freshwater Conservation

Sacrifices and purifications, according to P2 and P4, are regarded as seeking God's will to gain favour just like in prayer and not like a sacrifice. When the god is offended, there is the need to pacify or gain the goodwill of the god, because whatever punishment it decides to inflict on you can affect you, your home and village, for that matter your town or your community. A respondent explains why the need and means to purify the gods, especially when the products of the spirit that is the fishes and other creatures, are dying indiscriminately without reason. People begin to find reasons for the causes of deaths, and it is believed that somebody has caused a product of the resources, its existence. It is believed that these measures ensure that the people are conscious of the dangers in order not to incur the wrath of the gods. This belief causes them to abide by the rules to ensure the conservation of the Lake.

Water, its existence and spirituality are more in-depth than we see or can comprehended. Philosophically, the Bible also focuses on the power and value of water, which is difficult to understand. An example is the flood and Noah's Ark in Genesis chapters six, seven and eight as well as crossing of the Red Sea in Exodus 14: 16 -26. These readings show how water destroyed man for his disobedience to God.

Additionally, the respondent explained that the reasons why someone is supposedly regarded as unclean to go near freshwater, was explained in the following quote:

"*Is not because the woman by nature is unclean*" [P1, 2016]

In the Bible Leviticus Chapters 12 and 15:19, also talks about the uncleanliness of a woman when she is discharging blood. Uncleanliness physiologically has something to do with that which is stagnated in a person. Therefore needs to take out, that unclean thing, which is unwanted. The period blood consists of the endometrial lining and the blood. This information, is confirms reports by Water Factsheet, 2010; de Roda Husman & Schets, 2010 and World Health Organization [WHO], (2006). The blood is also known to contain the infectious agents in the case of having an infection. It, therefore, presumes that swimming while having periods would cause health issues to everyone using the water. Therefore, it is best to avoid water, especially where its quality cannot be assured, while one is in the menstrual periods due to sanitation and health risks. This condition is because there are undoubtedly some bacteria, viruses, protozoa and other microorganisms present in the water that would infect a swimmer (Water & World Health Organization (WHO) (2006). Viruses can cause blood-borne severe diseases, which are transmitted by direct contact with infected blood or other body fluids. Implying that infected blood in a swimmer can cause another person to be infected.

This supports the symbolism of taboo on menstruation, as emphasised by P1:

> *"To the Akan, the menstrual blood is equated with filth, and it is believed that one does not bring "such", as has been regarded as not useful or unclean to a sacred place (freshwater)". In light of this, he explained: "if the freshwater body is a sacred source of life and the woman is in this state of expelling something unclean, it is common sense for the people to ensure that you do not get closer to contaminate the water resources, with the blood"* [P1, 2016]

The indication is that if one washes the self in the Lake something unclean would be introduced, into the Lake and so it can, therefore, be argued that for the sake of a sacred thing, women can only approach it when they are sacred, and that is in her 'clean' moments: He expatiates further that:

> *"Even man avoids sleeping with women in that state, so how much more the freshwater body that is regarded as a precious"* [P1, 2016].

It is in this same regard or category that a woman who has just given birth for the first three months does not go near the Lake. In essence, the health implications for the baby and the mother at that moment is critical, in that they could die through contamination or drowning if she is weak and therefore, would need to stay away from entering the Lake Bosomtwe to fetch water. Likewise, is the washing of black cooking pots, cars, clothes and other materials, is also considered to be a form of introducing something that man regards as unclean and not fit or good "Aborniedia/ Atantadie" into the sacred waterbody. The name

Kwesi Bosomtwe as the Lake is popularly called was found on a Sunday. In addition, Sunday is about purity and cleanliness, the day for washing their household utensils and need to get resources into perfection. The name Kwesi signifies cleanliness washing off the dirt and reconciling with one another.

This situation necessitates the process of purification, a form of reconciliation before one can use to the Lake after many years of the occurrence of anthropogenic activities. In this sense, the Lake is left for a week or two, to renew itself. This period also coincides with the spawning period of the fishes. According to P7, the implication for killing the cow, during the period of purification, is to provide meat. This alternative source of protein, other than the fish, is shared among the residents. Distribution of the meat is carried out to enable a rest period for the Lake, while the residents depend on the meat. The dog meat forms part of the celebration activities because, according to an oral report, the hunter's dog was the first to taste the fish in the Lake to ensure its wholesomeness. This also serves as a reminder of how the Lake was traditionally found.

The Significance of Taboos on Freshwater Protection

From the literature review it was evident that taboos can support to reduce the facilitation of organism's population growth especially microbes, (a disease-causing germ) in the water -body which can be a danger to man's existence directly or indirectly, depending on how it is propagated or introduced. Increased nutrient loading can stimulate toxic algal growth, which is a threat to tourism or recreational potential (EPA, 2000).

Although there are many severities and frequencies of illnesses associated with recreational freshwater, the study did not focus on health issues, but on possible health implication associated with the Lake, like skin diseases and stomach complication as indicated in Water and World Health Organisation [WHO], (2006) on freshwater recreation. In addition, it concentrated on IK practices that could help to reduce contamination of humans and destroy the fish breeding sites so that they can hatch and grow to its actual size ready for consumption towards the human's general wellbeing. This explanation shows that the reasoning behind the indigenous statements words and practices. The older generation was not just putting fear in people; they were trying to conserve the resources. There were socio-economic, health implications as well as impacts on the freshwater resources as the residents are experiencing currently. It is therefore essential to identify the gap of IK usefulness, meaning and implication of IK in freshwater resources conservation, for a better introduction into freshwater policy. IK is thus useful, confirming the fact that the colonial masters did not allow the African to experience change using their practices or way of life to develop.

Application of Indigenous Knowledge for Freshwater Protection

Results showed that the inability to understand the symbolism of the indigenous knowledge, the sudden introduction of a new kind of education and religion through colonialism spurred on the breakdown of IK. Furthermore, the removal of authority from the action spot to national offices reduced the power or ability and respect of the Chiefs to sanction offenders.

"Water bodies were not dying because they were sacred; you cannot harvest the straw used to manufacture basket. When I was a child, nobody could farm close to the water source. The chiefs and opinion leader would not even allow you to do that" [P4, 2016].

Current dispensation shows that areas around the freshwater resources are a source of the economic venture for planting and a dumping ground for waste disposal. Even the municipal assemblies can go and dump human waste in the water bodies. The respondent interviewed, explained that because of the local customs, morality and belief system in the local system, few people in time past disobeyed the rules. A respondent said:

"It is the majority of the people who flaunt the rules because the traditional council or the chief's current sources of power is no more effective. I believe people disobey rules because we have lost our morality. Our belief systems guiding our conscience are not being used. Our actions are only guided by monetary gains, as to whether what they are doing would end up good, bad, right or wrong all we need is financial success in the short term" [P3, 2016].

He further pointed out that:

"Indigenous people were not dumping in the waterbodies because they regarded the waterbodies as gods. Residents were therefore not allowed to dispose of waste not even by waterbodies

"In the past, he explained, they had dump sites with perpetual fires in them. Fires that continue to burn called (sumina so) in Akan

because of the heat in it decomposes or burns over time, like the process of charcoal burning. Even as it burns the inside was hot, therefore as you dump there, the fire inside reduces the waste to ashes maintaining the size of the waste over years so that rubbish did not pile up. As it burns and smothers, the process collapses the rubbish onto itself because of the new weight added" [GOOF (2) 2016].

The respondent was not sure if this system of waste disposal would work in current situations, considering the much bigger population and the rate at which rubbish keeps coming in. Again, GOOF 2 emphasised that, because of technological advancement, there are different kinds of waste, which previously was made-up of organic material, paper foodstuffs wood and other materials. The major headache the participant said is with the plastics, rubbers, tins, and metals. These do not decompose even with the fire.

Another respondent also pointed out that currently, most Ghanaians know their rights and P3 indicated that:

"Some people pay bribes, sweet talk or get the public figure to plead on their behalf. People circumvent the laws in so many ways and therefore they are no more afraid of the consequences of the law" [P 3, 2016].

The study confirms Blumer's theory (1969), that knowledge and action are dependent on the symbols developed through interactions. This assertion emphasises that the implications of a crisis would depend on the action that it advances. In this case, the state of freshwater bodies has a bearing or is connected

to human interactions and conduct. This situation is usually based on the interpretation of knowledge based on the symbolic interactionist theory where human interaction with the resource produces human systems such the taboos, totems etcetera to manage the resources (Bressers et al., 2013).

Changes in IK Due to Adapted Change around Lake Bosomtwe

Respondents also answered questions on the extent of adapted changes on the Lake, the summary, as shown in Table 19, based on the responses, generated on livestock rearing. Respondents generally agreed that they have gone through one kind of adapted change on the Lake. Using the relative importance index RII = 69.8%.

Table 19: Extent of Adapted Changes around Bosomtwe

Factor	Mean	SD	RII	Rank
Domestic Use	4.0	0.21	81.0	4
Crop Production	3.9	0.23	78.6	2
Livestock Rearing	3.5	0.21	69.8	1
Social Activities	4.1	0.24	82.0	3

Source: Amu-Mensah (2016)

The responses, however, indicate that there were social activities, domestic usage and crop production being adapted around the Lake and its basin. Results indicated a RIIs of 82.0%, 81.0%, and 78.6% respectively. The indication of changes in human activities in the face of deterioration is explained by Lovelock (1979) based on Gaia's theory of the earth as a self-regulating complex super-organism. This system is linked to the human, as part of a whole, indicating that, humans do not exist in isolation. Consequently, whatever changes effected around the resources, has a repercussion on the people dependent on the resources, again

colonialism also induce a change in the way of life of the resident in the form of the governance structure.

Additionally, people's need and wants have changed in favour of the western style of living. This style comes with its complications of excess waste and destruction of the immediate surroundings of freshwater bodies for recreational purposes. Additionally, knowledge generation within the Lake's ecosystem is not suitable for prevailing structures around the Lake.

Perceptions of Stakeholders on Using IK in Freshwater Governance

The results presented in the pie chart Figure 16 concerns the importance of using IK around the Lake. In terms of importance, 68% of respondents indicated that it was very important to use or incorporate IK in freshwater governance without any modifications. Other respondents, 21 % said it was important, but it was necessary for some clarifications to enable its proper usage. Additionally, seven percent of the respondents indicated that it was not important in this current dispensation of the scientific era. The least respondents of four percent believed that IK was not at all important and that, it should be discarded. The results confirm Nakashima, et al. (2000) that IK is useful for natural resources conservation. Warren et al. (1995) also express the similar views contrary to the assertions made by Banuri et al. (1993) that the immediate livelihood need of local people is more of subsistence and not for large-scale issues.

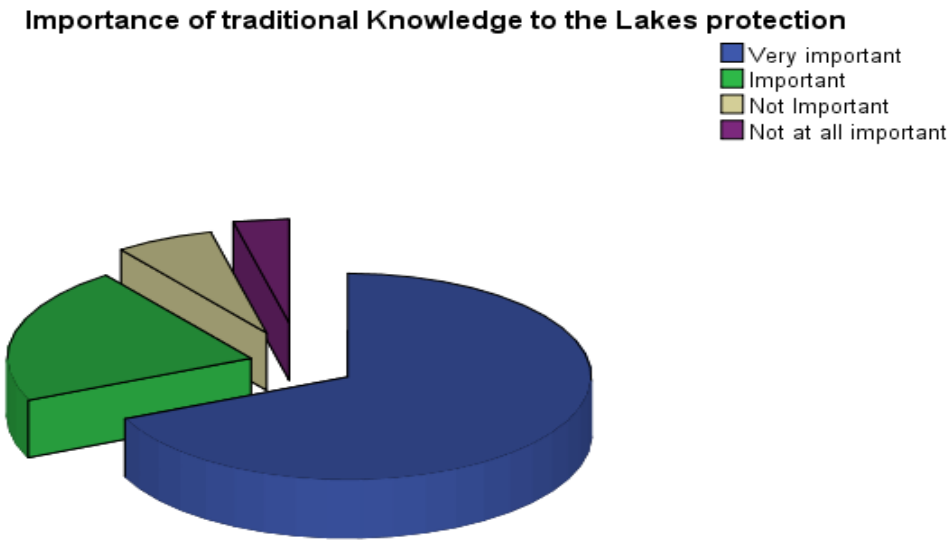

Figure 16: Importance of IK in Lake Bosmotwe's Conservation
Source: Amu-Mensah (2016)

In furtherance to these contrary assertions Agrawal (1999) also expresses the view that IK is unorganised and not analytic enough for conservation of a resource, yet the study indicates an importance of IK towards conservation or a resource. Although IK would need some clarification and explanations in relation to its usefulness to governance and development in general after so many years of IK being inactive for integration into freshwater policy.

CHAPTER SEVEN

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The chapter presents a summary of key findings, conclusions, and recommendations of the work done. The summary brings to bear the study objective, the methodology employed and the major findings. The conclusions are based on the results whiles the recommendations were generated from the results and conclusions. The chapter ends with the limitations of the study and areas for further studies.

Summary

The study sought to examine the institutions and structures that govern the use of Lake Bosomtwe as a resource; assess the perceptions of stakeholders on current freshwater governance difficulties, examine the symbolism of some indigenous knowledge system and practices in freshwater governance of Lake Bosomtwe and evaluate the general perceptions of stakeholders on using IK in water governance. The nature of this study required a mixed-method data collection to sample participants and respondents' perception, attitude, and knowledge of freshwater governance, indigenous freshwater conservation and symbolism of indigenous knowledge systems and practices. Therefore, to have a rich understanding of freshwater governance at Lake Bosomtwe and indigenous freshwater governance, a case study was used.

Key Findings

1. To become familiar with the perceptions of stakeholders on current freshwater governance and difficulties, an in-depth interview and a survey was conducted. Indications were that the respondents believe the Otumfou the Asantehene is the owner of the Lake and therefore controlled it. A significant additional response was that God controlled the nature of the Lake. Meanwhile, on the issue of policy formulation, the findings show no clear-cut participatory approach to policy formulation. This institution was built more on welfare, approach to freshwater governance. Yet the logistics to support effective freshwater governance was not available;
2. Concerning participatory and contribution of local knowledge in policy, indications are that such conditions are missing, except in meeting attendance to listen to what the government has to say. This is an indication of less transparency in policy formulation. Although there is a dual system operating around Lake Bosomtwe, it is evident that the lack of coordination between traditional local governance and government institutions. This system makes it unclear as to "whose" rules to enforce, creating a dilemma of who is to enforce the rules, the situation is such that residents do not even "understand" the rules and its implications to the human life and the freshwater resource;
3. Gaps identified in the formal freshwater governance structures indicate that until recently, no local knowledge, let alone its gender sensitivity had been included in freshwater governance policy, this confirms Coffey

International Development (2014); Manzungu (2004) and Lenton & Muller (2012) on unequal power relations. Secondly, there is no female participation as well as religious, moral and health contributions in freshwater policy formulation. In this regard, it does appear that governance of Lake Bosomtwe is not a true reflection of actors in the processes which control, society's access to water as the criteria for water governance (Franks & Cleaver, 2007; Hunt, 2004);

4. Coordination and cooperation between responsible freshwater institutions are presently not encouraging since they scarcely meet to discuss issues bothering on water conservation together. The water Basin Boards are also run like government institutions where the locals only meet to listen to what the government has proposed for them Berkes et al. 2000a; Hermans, 2005). Therefore, the governance system at Lake Bosomtwe lacks interaction between the different stakeholders in decision making, as Lawas (1997) explains in the conceptual framework. This condition creates a gap in their ability to interact towards a possible solution to problems of freshwater conservation. The government only considers the economic and materialistic aspects involving the Lake's ability able to generate revenue from tourism activity and not the human development aspect. From the review, the gaps of when who, why and how to participate in the policy formulation process, hinders practical contributions to the freshwater policy at the local level;

5. Given adherence to rules, indications are that there is insufficient logistics for the District Assemblies, to go round each community, ensuring compliance. Decision making pertaining to the Lake is currently the responsibility of the government institutions mentioned in the study. Yet the belief of the locals is that Asantehene and his elders need to collaborate and ensure that the rules are coming from his end and they are appropriate for Lake Bosomtwe.
6. The findings indicate that the hierarchical process of enforcing the rule, by Government officials overrides the traditional system in place without due regards for the owners of the land. The difficulty here is that a subject, who is a DCE cannot give instructions to a Chief and the right way is to discuss and not to instruct. Indications are there is a procedure that one can use for better collaboration towards the development of freshwater resources. This circumstance emphasises Blumer (1969), the theory of knowledge and action as being dependent on the symbols developed through interactions which in most cases is difficult to comprehend if it is not part of your practice;
7. The results further indicated that 90 percent of the respondents believed that traditional knowledge was either important or very important for freshwater conservation. Freshwater bodies are regarded as gods or precious to maintain its value. Residents living close to freshwater bodies are dumping waste into waterbodies because the spirituality that sustained the taboos is lost. The rules are no longer regarded as useful, and so they

are not being used to help conserve the freshwater. The study also confirms a breakdown of the indigenous control, and hierarchical structures, for compliance to rules and receiving instructions leading to the degradation of freshwater resources;

8. The findings confirmed the study findings of Awuah-Nyamekye, (2013) and Smith (2013) that colonialism had eroded indigenous practices of the past using religious connotations. It was also evident that over the time reasons or symbolism from human actions are lost because the people are socialised into copying and practising without finding out the reasons and therefore, the meanings or symbolism to actions.
9. It was evident that most of the indigenous knowledge and practices portray how the Lake is to be protected. The cognitive views of local people have been handed over to the younger generation to generation. This condition has been accomplished through historical experiences of the locals and their interaction with the Lake and its environment. That confirmed the symbolic interactionist theory by Bressers et al, (2013) that there is a meaning behind every word or sentence which is based on one's interaction with the environment
10. Government policies are, in most cases, not favourable to the local communities. Also, the removal of authority from the action spot to the public sector reduced the power or ability and respect of the Chiefs to sanction offenders.

11. The study also revealed that overpopulation in a particular area contributes to the depletion of available resources. Therefore, the movement of people from a concentrated area to other improved places or areas would help the natural resources to be rejuvenated as it was happening in the past.

Conclusions

In conclusion, there is the risk of missing important contributions to freshwater policy formulation if local or social issues are not incorporated into the governance policy of freshwater.

There is limited interaction and integration of knowledge from stakeholders, and the different gender groups have undoubtedly created a deficit in the policy and its implementation. This interaction is in terms of skills, experiences, insights and local operations of Lake Bosomtwe for freshwater conservation. The nature of freshwater governance is through a top-down approach with very little or no participation from the local community. Because of the extent of adaptation in socio-economic activities and lack of leadership and control in enforcing rules and regulations, local practices, as well as government rules, are not helping in the conservation of the Lake. IK in freshwater governance is acceptable to almost all the local communities yet its understanding, and implications to freshwater conservation are getting lost.

Recommendations

Ministry of Sanitation and Water Resources should make sure that all relevant information which captures the thought processes of the

resources environment, as well as views of the different groups and stakeholders should be collected by, WRC and CSIR-WRI and GMA, for integration into freshwater policy towards resources governance. This situation takes into consideration the social constructs, spirituality, intuitions, motivation, livelihood and health issues of the local communities.

It is crucial to understand IK in the context of its environment to be able to unearth its usefulness to freshwater policy formulation, for conservation and the environment as a whole. For this reason, it is suggested that IK on freshwater conservation should form part of water policy formulation. Example of IK here may include issues on, closed period or close season, farming along waterbodies and the taboo on women in their menstruation, who bath in the freshwater. Both the community leaders and government departments in charge of water resources are to reduce the impact of the closed season on the local communities. It is suggested that an alternative livelihood support is provided during this period. The chiefs and the local communities could modify the purification rites of Lake Bosomtwe in conjunction with WRC, local government to suit current situation for the conservation of the Lake and the benefit of all stakeholders and the Lake's environment.

Additionally, the religious bodies, in the catchment area, should spiritually help sustain rules or taboos around Lake Bosomtwe. Local representatives should be used to ensure adherence to rules and regulations.

Chiefs and Sub-chiefs should ensure terracing around the Lake before cropping and after construction works as a priority, to reduce erosion after construction.

WRC, the District Chief Executive, District Assembly and the community members should ensure that policy on terracing should form part of freshwater conservation practices in the Lake's environment the responsibility of the. Similarly, the vegetation around the freshwater bodies could be slashed down by the community members to ensure a continuation of the process of reducing sedimentation of the Lake.

WRC should ensure that freshwater policies formulation takes into consideration the concerns of all gender groups and stakeholders in the socio-economic, religion, health and education.

WRC and the Ministry in charge of Environment and Sanitation should be enforced the buffer zone policy. The concerns of the residents' should be consideration in policy formulation. Eco-friendly habitat reserve should be created for man to live in harmony with nature.

The Ministry of Education should realign the current educational system by incorporating some of the essential issues in IK into the study of the environment and water-related issues. It is recommended that indigenous systems and practices should be studied in details to understand its merits and demerit in freshwater conservation.

Participation in governance should include local cognitive views of the freshwater resources environment.

Government, district assemblies and WRC should make sure that the rules are enforced from the local context of the people to ensure participation from the communities

It is recommended that future studies should be executed in other freshwater resources areas to identify and understand the operational terms, governing structures as well as the usefulness of IK for integration into freshwater policy.

Contributions to Knowledge

In contributing to knowledge, the study methodology produced a hybrid of Focus Group Discussion and the Situation Analytical tools concerning good governance practices. This hybrid helped to incorporate the view of all the gender (male and female), and age grouping (young, matured and old) identified. The principles of good governance practices were used to resources use profile, control and ownership since each group is affected and affects the resources differently. It also helped the groups to come out with various challenges.

The study also helped to confirm Giddens (1998), Berkus et al. (2000a) and Smith (2013) thoughts that the use of a different system (Western) which is different from the local experience and practices could alter the local person's behaviour and responds to a resource and its nearby environment.

The study data also confirmed McHugh (2013) and Sharpe (2015) assertion that age attained helps to predict the educational level of respondents in a particular community as it is in the case of Lake Bosomtwe community.

The study models developed help to differentiate between the cognitive view, which represents indigenous knowledge and factual view or western knowledge of freshwater governance. The construct tries to show the interrelationship of IK between the physical, biological, social and spiritual environment of the people, which gives sound advice for effective governance. It can be recognised that IK is constructed for everybody in the community to use it because it is part of their being. IK is such that it is perpetuated through culture, and therefore it is the reality, as experienced by the participant.

As a socially construct, the study uses social meanings, which is the symbolism or the semiotic within the local knowledge, spiritualism as well as environmentally sound advice or rules for the protection of the freshwater resources. Therefore, IK governance of the freshwater is socially sustained and supported by spiritualism. Henceforth, the positive knowledge relationship developed the model in Figure 4 provides a lead to the protection or the conservation of the freshwater body.

The cognitive process influences the local participant's interactive process in the environment and spiritualism associated with the resources. The cognitive process provides the cognitive view, which is sustained socially and spiritually. This condition presents an embedded and meaningful, easy to understand symbols (positive or actual knowledge) for the protection of the Lake or environment.

Although the participant's emotions, motivations, needs, desires, and objectives influence the interaction process around the Lake. Positive relationship response generated, supports and sustains the interaction process, to reduce

overexploitation or degradation of the resources. Here Sanders (2014) points out the structural, institutional capacity from the grassroots helps the individual to make a rational choice, used in the Common Property Resources theory and Daniel's (2008) submission on pragmatism. Daniel explained that the nature of knowledge would either support or not support the reduction of resources degradation based on the context. Accordingly, IK, is based on the cognitive processes of knowledge generated closely in connection to man and the resources. These processes culminate into environmental language, concepts, meaning, and belief of the local practical needs as well as the environment. Based on these findings, the study proposes a model (see Figure 17) for future suggestion on improving freshwater governance.

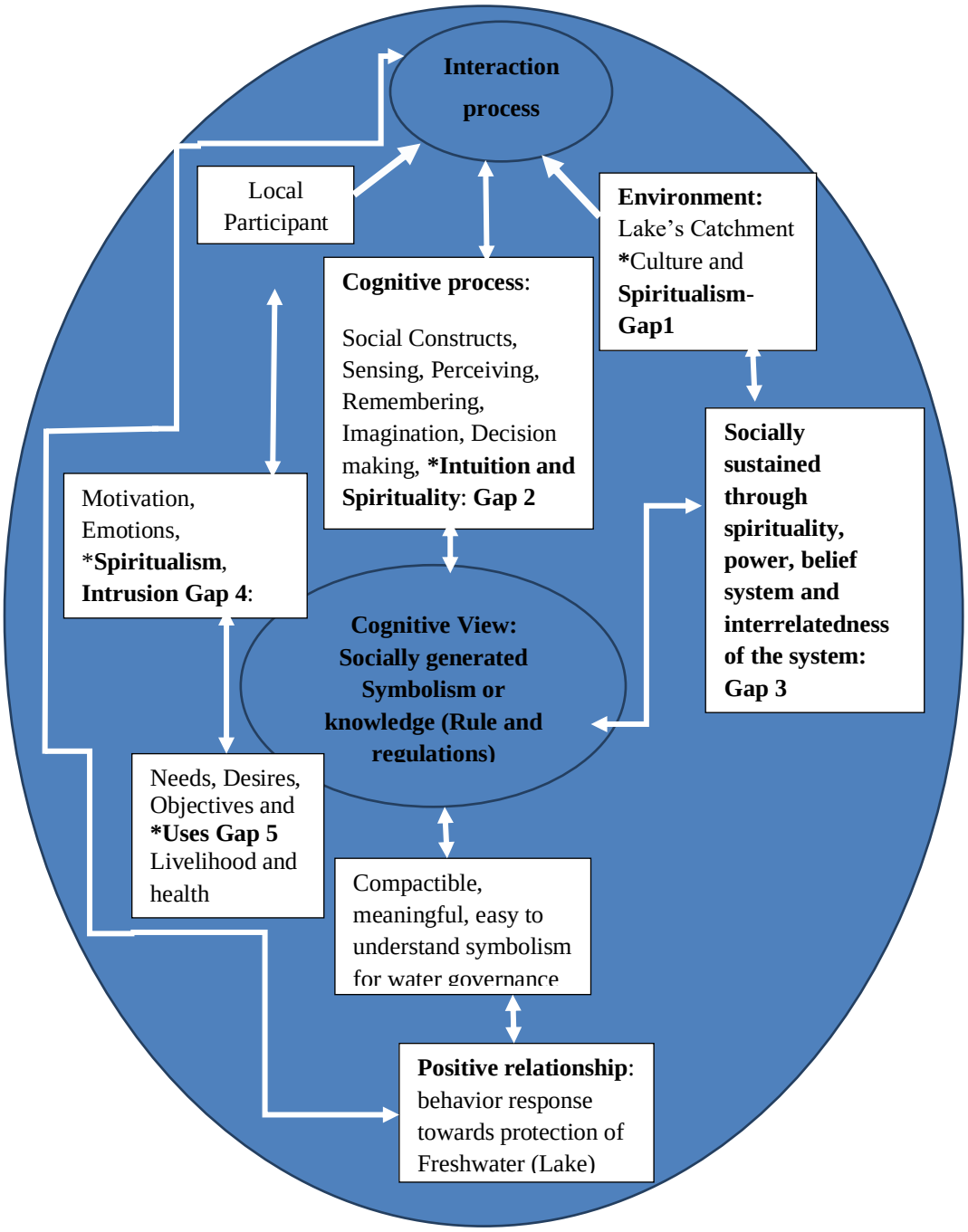

Figure 17: IK model for positive freshwater governance
Source: Modified from Lawas (1997)

The model illustrates that scientific or western paradigm of freshwater resources governance is an externally imposed system of governance. Its knowledge generation is only meaningful and understandable to the generator of the symbols.

Thus, the cognitive views are disconnected from the physical and social environment, as well as from the participant or user, affecting the cognitive view leading to negative response as shown in the broken lines.

In the case of negative knowledge relationship, as presented in Figure 5, the cognitive process of perception, learning and reasoning aspects are truncated. The broken lines represent this from the interaction process to the cognitive process and the resources environment. Because the cognitive process is disrupted or replaced with an improvise knowledge, interaction with the environmental and spiritual symbols become disrupted. The improvised symbols are difficult to comprehend for a productive relationship.

This situation leads to negative behavioural response since the environmental or spiritual symbols do not support the emotions, motivations, needs and desires. The participant's impact on the resources, therefore, leads to its degradation. This position, confirms Smith, (2013) statement that the difficulty in the use of a different system is in the recognition, understanding, and interpretation of the improvised symbols. As a result, such symbols become unfriendly, insufficient, and less productive and out of context for practical resources governance. This point also endorses Giddens (1998) structuration theory that these externalities or improvised knowledge creates restraints within the structure

or environment. Consequently, understanding the local community structures or system of governance would improve negotiations and collaborations in freshwater governance.

The framework, therefore, provides a useful investigative way for understanding the reason peoples continued interaction and exchange or otherwise with the resources, provides an understanding or knowledge within the local governance system. Thus, providing an informed decision generated from the cognitive processes of the local communities or owners of the resources based on their interaction with the resource's ecosystem.

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APPENDIX A

CRAMER'S V Table for Interpreting the Value of the Level of Association

LEVEL OF ASSOCIATION	Verbal Description	COMMENTS
0.00	No Relationship	Knowing the independent variable does not help in predicting the dependent variable.
.00 to .15	Very Weak	Not generally acceptable
.15 to .20	**Weak**	**Minimally acceptable**
.20 to .25	**Moderate**	**Acceptable**
.25 to .30	**Moderately Strong**	**Desirable**
.30 to .35	**Strong**	**Very Desirable**
.35 to .40	**Very Strong**	**Extremely Desirable**
.40 to .50	**Worrisomely Strong**	**Either an extremely good relationship or the two variables are measuring the same concept**
.50 to .99	Redundant	The two variables are probably measuring the same concept.
1.00	Perfect Relationship.	If we know the independent variable, we can perfectly predict the dependent variable.

APPENDIX B

World Freshwater Forums, Summits and forums/ Water Declarations

Forum/ Reforms to Improve Freshwater	Main issues of Concern	Approach
Stockholm Conference on the Human Environment in 1972 **Source**: (Rogers & Hall 2003)	The creation of a growing recognition that technology and infrastructure wrongly applied can do more harm to human and the human environment.	Stewardship approach
Rio Declaration on Environment and Development-1992 **Source:** (UNEP, 2012 & UNCSD 2012)	Ensure progress and positive outcomes in integrated approaches to water management	Integrated approaches
UN Watercourses Convention First Water Forum held in Marrakech in 1997	World Water Council to develop a World Water Vision for the year 2025 and framework for action	Vision and a Framework for Action
2nd World Water Forum in The Hague in 2000 **Source:** (Cleaver and Franks 2005)	One of the first international freshwater meetings that explicitly addressed governance as a main issue of water crisis	IWRM / Value based
UN 2000 Millennium Assembly **Sources:** (GWP, 2015) & (GWP 2000)	Emphasised protection of freshwater bodies and to stop the unmanageable exploitation of water resources, through equitable strategies at the regional, national and local levels, which promote access to water	Conservationist and stewardship principles
Bonn International Conference on Freshwater 2001 **Source**: Kabat and van Schaik, (2003) & NRC-COHS, (2011)	One of the important issues was freshwater governance on Global Water and Sanitation Program as well as inclusive, and	Integrated approach

	collaborative international partnership programs	
Johannesburg World Summit Sustainable Development (WSSD) in 2002 **Source:** GWP, (2003) & NGLS, (2002)	Sustainable Development on water efficiency plans by 2005. IWRM; It expects societies to take normative decisions which are appropriate for the group	Integrated approach
International Conference on Water and the Environment at Dublin, Dublin Water Principles in 1992 **Source:** Muller, (2010) 3rd Ghana Water Forum, Accra, Ghana, 2011	It puts freshwater resources firmly under State's function. It is advisory and maintains a system of property rights, through the principle of participatory management, asserts and the relevance of decentralisation at the lowest appropriate level.	Property rights, through the principle of participatory management
The World Bank sub-Saharan water policy paper resources strategies 1996 Sources: Sharma, Damhaug, Gilgan-Hunt, Grey, Okaru, & Rothberg (1996).	It considers water as a scarce economic good while emphasising social equity and environmental sustainability based on good governance. Related issues involved developing strengths from local ownership and commitment, that is considering environmental stewardship	Integrated, participatory and multisector approach
The 3rd WWF in Kyoto, Japan in 2003 **Sources**: Cleaver & Franks (2005)	The focus was on water governance as the key process, the latter drawing effortlessly from the former. Broader and less technocratic approach consistent with current trends in development	Integrated; Indigenous Peoples' Kyoto Water Declaration
4th World Water Forum, held in Mexico City	Generated the Tlatokan Atlahuak Declaration	Human Rights

Source:	(2006) reaffirmed the Kyoto declaration Stressed that, "for all Indigenous peoples of the world, water is the source of material, cultural and spiritual life" (p. 1)	
Ratified, United Nations Declaration on the Rights of Indigenous Peoples (United Nations General Assembly **Source:** Gilbert, (2007)	• It considers the rights of native people towards resources protection and maintenance of one's unique culture and tradition. It is also a call for the maintenance and strengthening of cultural identities, emphasising the right to pursue development within local needs and aspirations. It also prohibits discrimination against indigenous peoples and promotes their full and effective participation in all matters that concern them.	Human rights (Indigenous) approach
Rio+ 20 Earth Summit -2012 **Sources**: Rogers & Hall (2003) and Dellapenna, Gupta, Li, and Schmidt. (2013)	Countries to adopt integrated sustainable development in freshwater governance	Integrated
United Nations Environment Programme **Source**: UNEP (2012)	Reforms to improve the enabling environment for water resources management based on the application of integrated approaches as stated in Agenda 21 and affirmed in the Johannesburg Plan of Implementation	Integrated approach
Bonn Conference on Water in the Anthropocene 2013	It discusses issues that helped to benchmark the current state-of-the-art in global water science and fundamental material for the Bonn Declaration on	It is a dual perspective of human water and natural system security more of an

Source: Vörösmarty, Pahl-Wostl and Bhaduri (2013)	Global Water Security. Its principal aspect is the unique role of humans in shaping the character of water systems. It also deals with solutions through the co-production of knowledge from the water sciences to policy formulation and to the applications.	integrated approach
The 2015 UN-Water Zaragoza conference **Sources**: United Nations UN, (2015)	The conference is concern with strengthening equitable, participatory and accountable water for all countries. Its goal addresses developmental issues in societies besides promoting human dignity and ensuring long term sustainable developments	Integrated and human rights bases approach
Stockholm World Water forum 2016 **Source**: Stapleton, (2016)	To achieve the interrelationship between the water, energy and food SDGs, known as the Water Energy Food (WEF) Nexus and its ripple effect in the eco system	Working out interlinkages: Integrated approach

Population Trend in Ghana and around Lake Bosomtwe

Area	1960	1970	1984	2000	2010	Growth rate %
Ghana	6,726,815	8,559,313	12,296,081	18,912,079	24,658,823	3.4
Ashanti	1,109,133	1,481,098	2,090,100	3,612,950	4,780,380	3.2
Bosomtwe/ Atwima & Kwanwoma Districts	-No data	100	148	253	-*	3.2
Bosomtwe & Bosome-Freho Districts	-*	-*	-*	-*	154,307	3.4

-* Different administrative regimes and changes in the number of districts

Source: Ghana Statistical Services (2014 a &b)

APPENDIX C

QUESTIONNAIRE

UNIVERSITY OF CAPE COAST

COLLEGE OF HUMANITIES AND LEGAL STUDIES

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

COMMUNITY FOCUS GROUP DISCUSSION

Indigenous Knowledge and Water Resources Governance

Introduction

There is a global assertion that, there is a relationship between the nature of governance and the deterioration of the Lake Bosomtwe. The understanding of indigenous knowledge IK in freshwater governance systems is likely to lead to a reduction in the degradation of Lake Bosomtwe. Therefore, study seeks to situate this idea in the right context of Lake Bosomtwe, which is going through degradation, and why current governance systems are to helping as well as how IK systems can be strengthened to help improve on the local content in governance.

Female / Male group Number

Section A: Identification data

1) Date of interview:

2) Name of district:

3) Name of community:

4) Location/place of interview:

5) Language used for the interview:

6) Name of interviewer:

7) Time of start of interview:

8) Time interview ended

Section B: demographic data

10) Name Community/ District (……)

11) Age range

12) Ethnic background of respondent

13) Highest educational level attained

{1, No formal education 2, Primary, 3 MSLC 4, JHS 5, SHS 6, Tertiary}

14) Occupation (main source of income)

15) Alternative source of income

16) Position in community

*Number of years (name) has stayed in the community……..

Section C: Nature of Governance (interaction, processes in rules, regulations and implementation) and institutional frameworks for freshwater governance

17)
From your point of view, has there been (or are there) policies or rules on water conservation in Bosomtwe or district? Obj. 1, 2 &3

1) Yes/

2) No

3) Do not Know

If yes answer the following questions

- Can you please name them?

• If yes, how have/has it helped to resolve the deterioration of the lake?

• Are there any concerns about Lake Bosomtwe's quality?

• What about the concerns on the water quantity?

• What were/are the main issues bothering it use and conservation?

• Are you and your people satisfied with the outcome?

• What would be a satisfactory outcome from your point of view?

• What would be a satisfactory outcome from your point of view?

18) Studies show that indigenous knowledge has helped to protect / governed water resources in the past, from your experience what is your perception and that of your organization about indigenous water governance, most especially on Lake Bosomtwe? Obj.4 &5

• Is it possible to improve current water governance based on some traditional knowledge (norms, values and practices) used, in past to ensure sustainability of the water resource?

Please explain

• What potential risks or benefits can you foresee in the use of indigenous knowledge and practices, in policies governing water resources?

• Are you part of the institutions that formulate and execute innovative water policies?

• Which communities form part of policy formulation on water governance

• Which communities /groups form part of water policy implementation

• Does your institution (Chiefs/ elders) receive external aid for policy formulation and implementation?

• Are these policies yielding any results?

• What is the state of the discussion between your communities and the other organizations with respect to formulation and expected changes?

19) Based on your knowledge, how are do institutions responsible for policy formulation on water governance, collect information and prepared policy with respect freshwater resources (Bosomtwe)? Obj. 1 & 2

- What are the main steps taken by those organizations?

- How are these policies implemented or how are these rules disseminated and enforced?

- What are the communication channels between these institutions and your community?

- What measures have you put in place to ensure sustainability of policies on the lake?

- To what extend do these processes contribute to positive results or the lack of results in Bosomtwe's water resource management?

- How long have these policies been in place?

- Before these policies where put in place what where the practices?

You will be given an individual paper to rate the performance of governance in Bosomtwe (control)

20) How would you rate your participation in water governance? Obj. 2

1. Very High,

2. High,

3. Low,

4. Neutral

5. Very Low:

-Please explain why that choice

21) What type of Water governance system (rule making and implementation) do you find in around freshwater resources (Lake Bosomtwe) Ob. 2?

1. Bottom-Up

2. Top-down

3. Customary Law

4. Religious law

Please can you explain your answer?

5) How can indigenous knowledge and practices be turned into cooperation potential by the key Stakeholders? Obj. 4&5

- Are there cooperative approaches possible, which can help decrease deterioration on the lake?

- What are the possible solutions to water governance in Bosomtwe?

- Do you know of any practice that you do locally, to sustain the Lake?

Please explain the practice?

6) What is the potential for applying all or parts of the indigenous practices to other communities? Obj. 5

Mark an X on the following scale.

(The scale runs from? I, no problem? To, V, impossible?):

I It would be no problem at all to transfer the practice to another group/culture/land-use system, etc. [ ]

II. It would be rather easy to transfer the practice, although some adaptations might be necessary. [ ]

III. It would be possible to transfer the practice, but there certainly would be conditions and prerequisites to consider. [ ]

IV. It would be rather difficult to transfer the practice. It would require many adaptations and even then, it would be difficult. [ ]

V. It would be impossible to transfer the practice. It is too specific and only possible at this particular place and level. . [ ]

If you have marked I, II, III or IV, please answer the next question.

7) Are there specific conditions or obstacles, which make it impossible to replicate or transfer the practice elsewhere? Obj. 3 & 4

(e.g., a specific climate or specific cultural beliefs or social relations, which are important for the success of this practice)

8) Has the TK practice been replicated elsewhere?

- Where?
- By whom?

9) Are there any other aspects regarding replication, which need to be mentioned here? (e.g., agreements, regulations, Gender, Provisions regarding Intellectual Property Rights, etc.)

9) Is there anything you want to add which have not been mentioned yet? If yes, can kindly share with me.

Thanks for your time

APPENDIX F

UNIVERSITY OF CAPE COAST
COLLEGE OF HUMANITIES AND LEGAL STUDIES
FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING
IN-DEPTH INTERVIEW WITH NON-GOVERNMENTAL AND PRIVATE ORGANISATIONS

Indigenous Knowledge and Water Resources Governance

Introduction

There is a global assertion that, there is a relationship between the nature of governance and the deterioration of the Lake Bosomtwe. The understanding of indigenous knowledge IK in freshwater governance systems is likely to lead to a reduction in the degradation of Lake Bosomtwe. Therefore, study seeks to situate this idea in the right context of Lake Bosomtwe, which is going through degradation, and why current governance systems are to helping as well as how IK systems can be strengthened to help improve on the local content in governance.

Section A: Identification data

1) Date of interview:

2) Name of district:

3) Name of community:

4) Location/place of interview:

5) Language used for the interview:

6) Name of interviewer:

7) Time of start of interview:

8) Time interview ended

Section B: demographic data

9) Gender:

{1, Female 2, Male}

10) Name (first name preferred/pseudonym)

11) Highest educational level attained

{1, No formal education 2, Primary, 3 MSLC 4, JHS 5, SHS 6, Tertiary}

12) Position in organisation: ……..

*** means probe**

The underlying principles of indigenous, norms, rules and practices in water resources governance Ob., 1, 3, 4 & 5-

1. Please can you explain in your own word what water governance is?

2. What is your perception about the governance of the county's freshwater bodies?

3. *What is the essence of freshwater resources to the African, and for that matter the Ghanaian or the Akan.

4. In your view what do you know about the governance of Lake Bosomtwe?

5. *How does the indigenous person/local support and protect the water bodies for future use.

6. *What is the importance of the practices around water bodies?

7. *What is the significance of these norms and practices in protecting the water bodies?

8. What are the benefits of the indigenous norms and practises to the communities in view of population growth?

9. Does IK have any significance in current water policy?

10. How can indigenous Knowledge structures contribute to the implementation of water Lake Bosomtwe?

11. Studies show that indigenous knowledge has helped to protect / governed water resources in the past, from experience what is your perception Obj. 3&4

• What about that of your organization on indigenous water governance, most especially on Lake Bosomtwe?

• Is it possible to improve current water governance based on some traditional knowledge (norms, values and practices) used, in past to ensure sustainability of the water resource.

Please explain

• What potential risks or benefits can you foresee in the use of indigenous knowledge and practices, in policies governing water resources? Ob. 5

13) *What is the potential for applying all or parts of the indigenous practices to other communities?*

Mark an X on the following scale.

(The scale runs from? I, no problem? To, V, impossible?):

I. It would be no problem at all to transfer the practice to another group/culture/land-use system, etc. [ ]

II. It would be rather easy to transfer the practice, although some adaptations might be necessary. [ ]

III. It would be possible to transfer the practice, but there certainly would be conditions and prerequisites to consider. [ ]

IV. It would be rather difficult to transfer the practice. It would require a lot of adaptations and even then it would be difficult [ ]

V. It would be impossible to transfer the practice. It is too specific and only possible at this particular place and level [ ]

14. Please are you a chief, elder, opinion leader with Knowledge about Lake Bosomtwe (Norms and practices in the past). Please answer question under **14-16**. **Obj. 3**

Questions; (For ages 50 and above) - Please when you were young (15 and above) where you able to weed around the water? **Obj. 3**

2) Can you describe the state of the lake at that time?

3) Please describe practices around the Lake the dos and do nots

4) Which people protected the Lake?

15. Please explain how these were done

1) How can indigenous knowledge and practices be turned into cooperation potential by the key Stakeholders?

- Are there cooperative approaches possible, which can help decrease deterioration on the lake?

- What are there possible solutions to water governance in Bosomtwe?

16) Do you know of any practice that you do locally, to sustain the Lake?

Can you please explain the practice?

Thank you

APPENDIX G

UNIVERSITY OF CAPE COAST

COLLEGE OF HUMANITIES AND LEGAL STUDIES

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING

IN-DEPTH INTERVIEW WITH GOVERNMENT ORGANISATIONS AND INSTITUTIONS

Indigenous Knowledge and Water Resources Governance

Introduction

There is a global assertion that, there is a relationship between the nature of governance and the deterioration of the Lake Bosomtwe. The understanding of indigenous knowledge IK in freshwater governance systems is likely to lead to a reduction in the degradation of Lake Bosomtwe. Therefore, study seeks to situate this idea in the right context of Lake Bosomtwe, which is going through degradation, and why current governance systems are to helping as well as how IK systems can be strengthened to help improve on the local content in governance.

Section A: Identification data

Date of interview:

Name of district:

Name of community:

Location/place of interview:

Language used for the interview:

Name of interviewer:

Time of start of interview:

Time interview ended

Section B: demographic data

Gender:

{1, Female 2, Male}

Name (first name preferred/pseudonym)

Highest educational level attained

{1, No formal education 2, Primary, 3 MSLC 4, JHS 5, SHS 6, Tertiary}

Position in organisation: ……..

Section C: Nature of Governance (interaction, processes in rules, regulations and implementation) and institutional frameworks for freshwater governance Obj. 1 & 2

1. From your point of view, has there been (or are there) policies or rules on water conservation in Bosomtwe or district? Probe with these points
- If yes, how have/has it helped to resolve the deterioration of the lake?
- Are there any concerns with regards to Lake Bosomtwe's quality and quantity?
- What were/are the main issues bothering its use and conservation?
- Are you and your organization satisfied with the outcome?
- What would be a satisfactory outcome from your point of view?
2. Studies show that indigenous knowledge has helped to protect / governed water resources in the past, from experience what is your perception Obj. 3 & 4

   Can you confirm this statement; Do you think your organization would approve the use of indigenous water governance, most especially on Lake Bosomtwe?

3. Is it possible to improve current water governance based on some traditional knowledge (norms, values and practices) used, in past to ensure sustainability of the water resource? Please explain **Obj. 4**
4. What potential risks can you foresee in the use of indigenous knowledge and practices, in policies governing water resources? Obj. 4 & 5
- What about the benefits?
- Are you part of the institutions that formulate and execute innovative water policies?
- Which organisations form part of policy formulation on water governance?
- Which organisations form part of water policy implementation?
- Does your organisation receive external aid for policy formulation and implementation?
- Are these policies yielding any results, please explain?

5. Please what is the state of the discussion between your organization and the communities with respect to formulation and expected changes? **Obj. 1**

6. Based on your knowledge, how do institutions responsible for policy formulation on water governance, collect information and prepared policy with respect freshwater resources (Bosomtwe)? Obj. 1 & 2
- What are the main steps taken by these organizations?
- How are these policies implemented or rules disseminated and enforced
- What are the communication channels between these institutions and the communities?
- What measures have you put in place to ensure sustainability of policies on the lake
- To what extend do these processes contribute to positive results or the lack of results in Ghana's water resource management?
- How long have these policies been in place?
7. Before these policies where put in place what where the practices?

8. How would you rank your participation in water governance?

1. Very High,
2. High,
3. Neutral
4. Low,
5. Very Low:

-explain why that choice

9. What type of Water governance system (rule making and implementation) do you find in and around freshwater resources (Lake Bosomtwe) **Obj. 2**

1. Bottom-Up

2. Top-down

3. Customary Law

4. Religious law

5. Both

Please can you explain your answer?

10. How can indigenous knowledge and practices be used to the benefit of potential by the key Stakeholders? Ob. 3 & 4

- Are there cooperative approaches possible, which can help decrease deterioration on the lake?

- What are the possible solutions to water governance in Bosomtwe?

Do you know of any practice that you do locally, to sustain the Lake?

Please explain the practice?

11. What is the potential for applying all or parts of the indigenous practices to other communities, Lake or Rivers? Obj. 4 & 5

    Mark an X on the following scale.

    (The scale runs from? I, no problem? To, V, impossible?):

    I. It would be no problem at all to transfer the practice to another group/culture/land-use system, etc. [ ]

    II. It would be rather easy to transfer the practice, although some adaptations might be necessary. [ ]

    III. It would be possible to transfer the practice, but there certainly would be conditions and prerequisites to consider. [ ]

    IV. It would be rather difficult to transfer the practice. It would require many adaptations and even then, it would be difficult. [ ]

    V. It would be impossible to transfer the practice. It is too specific and only possible at this particular place and level. [ ]

    If you have marked I, II, III or IV, please answer the next question.

12. Are there specific conditions or obstacles, which make it impossible to replicate or transfer the practice elsewhere? Obj. 4

    (e.g., a specific climate or specific cultural beliefs or social relations, which are important for the success of this practice)

13. Has the TK practice been replicated elsewhere?

    Where?

    By whom?

14. Are there any other aspects regarding replication which need to be mentioned here? (e.g., agreements, Regulations, Gender,
15. Are there any provisions regarding Intellectual Property Rights, etc.)
16. Is there anything you want to add which have not been mentioned yet? If yes, kindly share with me.

    Thanks for your time

APPENDIX H
UNIVERSITY OF CAPE COAST
COLLEGE OF HUMANITIES AND LEGAL STUDIES
FACULTY OF SOCIAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND REGIONAL PLANNING
INTERVIEW QUESTIONNAIRE ADMINISTRATION COMMUNITIES
Indigenous Knowledge and Water Resources Governance

Introduction

There is a global assertion that, there is a relationship between the nature of governance and the deterioration of the Lake Bosomtwe. The understanding of indigenous knowledge IK in freshwater governance systems is likely to lead to a reduction in the degradation of Lake Bosomtwe. Therefore, study seeks to situate this idea in the right context of Lake Bosomtwe, which is going through degradation, and why current governance systems are to helping as well as how IK systems can be strengthened to help improve on the local content in governance.

Section A: Identification data

1) Date of interview:
2) Name of district:
3) Name of community:
4) Location/place of interview:
5) Language used for the interview:
6) Name of interviewer:
7) Time of start of interview:
8) Time interview ended

Section B: demographic data

9) Gender:
   {1, Female 2, Male}
10) Name (first name preferred/pseudonym)
11) Highest educational level attained
    {1, No formal education 2, Primary, 3 MSLC 4, JHS 5, SHS 6, Tertiary}
12) Occupation (main source of income)
13) Religious affiliation
14) Alternative source of income
15) Position in community
    *****Number of years (name) has stayed in the community……..

Section C: Nature of Governance (interaction, processes in rules, regulations and implementation) and institutional frameworks for freshwater governance

(Who are the main initiators, actors, stakeholders and users?) 1&2

1. From your point of view, has there been (or are there) policies, rules or certain practices on water conservation in Bosomtwe or district?
   - If yes, how have/has it helped to resolve the deterioration of the lake?
   - Are there any concerns with regards to Lake Bosomtwe's quality and quantity?
   - What were/are the main issues bothering it use and conservation?
   - Are you and your people satisfied with the outcome?
   - What would be a satisfactory outcome from your point of view?
2. Are these government practices helping to reduce problems on the Lake?

1. Yes
2. No
3. Not sure

3. Has there been changes in Lake Bosomtwe
- What about the size of fish

16) What is the quantity of fish caught? Frequency, duration (timing), and

4. Intensity of rainfall ever since you stayed in this community?
5. What changes?
6. Since when?
7. Has there been changes in Bosomtwe on values, norms and practice: duration
- What changes?
- Since when?

8. Do you have old practices that were used to protect the lake from getting polluted or misused?
- Explain their implication to good water use

9. Has this (if any/so) affected the availability of fish, water for all use, and your livelihood?
   Since when has this/these (if any) been the case?

10. Can you please rate the benefits in terms of applying IK in Freshwater Governance,

Rating	Political-control by community	Social benefit	Economic benefit	Environmental Benefits
Very beneficial				
Beneficial				
Neutral				
Not beneficial				
Not at all beneficial				

11. What is the potential for applying all or parts of the indigenous practices to other communities, Lake or Rivers?

    Is there any potential to applying traditional practices to other lakes or rivers Obj. 4?

    Mark an X on the following scale.

    (The scale runs from? I, no problem? To, V, impossible?):

    I. [ ] It would be no problem at all to transfer the practice to another group/culture/land-use system, etc.

    II. [ ] It would be rather easy to transfer the practice, although some adaptations might be necessary.

    III. [ ] It would be possible to transfer the practice, but there certainly would be conditions and prerequisites to consider.

    IV. [ ] It would be rather difficult to transfer the practice. It would require many adaptations and even then, it would be difficult.

V. [ ] It would be impossible to transfer the practice. It is too specific and only possible at this particular place and level.

If you have marked I, II, III or IV, please answer the next question.

Are there specific conditions or obstacles which make it impossible to replicate or transfer the practice elsewhere?

Section D: Perception of current water governance (processes and implementation) 1&2

17) Are the communities (elders chiefs involved in policy processes and implementation?
(Please explain their contributions)

12. Whom does the Lake belong?
1. Asantihene
2. Government
3. God
4. All of us
5. Nobody

13. Who controls activities around the Lake...?
1. Asantehene
2. Government
3. God
4. Everybody
5. Nobody
6. N/A

14. Who is involved in making these rules and regulations?
1. Government representative
2. Traditional Authorities
3. NGO
4. Other
5. N/A

15. Who take the final decision on rules and practices on the Lake

16. What institutions / organisation do you have in the community helping to sustain the Lake
1. Government,
2. non-governmental

3. Traditional,
4. religious,
5. Other…….

17. What kind of laws do you have protecting the lake? Multiple options are okay

a. Customary
b. Common pool
c. Religious
d. Political

- Are there restrictions by traditional Authorities or NGOs on use of resources?

18. Which groups or institutions are there to ensure the lake is maintained (How do they do it)

1. Traditional authorities
2. NGOs
3. District assembly
4. Philanthropist from abroad
5. Other

19. How does the current state of the lake affect you and/or your family/community?

- Domestic use;
- Crop production;
- Livestock rearing;

20. Does the current state of the lake affect everyone equally in this community?

- Are there some (group of) people it affects more than others (women or children)?
- Who and why?

21. Are there any restrictions by government agencies on use of the lake (public agencies
- (Probe for nature of restrictions)

22. Are there rule and regulations on the use of the lake and land for (farming, animal rearing etc.?)
23. How are the rule made and implemented

- Who made the rules?
- How are the rules implemented?

24. Respondents' perception of how rules on the lake were made and enforced
What is your role or participation of the local community in making and implementing rules governing the Lake?

- How would you rank your participation in governance?

  1. Very High,
  2. High,
  3. Neutral
  4. Low,
  5. Very Low:

  Please explain why that choice

25. What type of Water governance system (rule making and implementation) do you find in around freshwater resources (Lake Bosomtwe)

1) Bottom-Up
2) Top-down
3) Customary
4) Common pool
5) Do not know

Section D: Indigenous knowledge and practices for water governance resources in the past, experiences, and perceptions about indigenous water governance, most especially on Lake Bosomtwe - 3 & 4

26. Do you know of any indigenous knowledge that has helped to protect the lake and its resources in the past

- What is the community setting of the practice?
  -District / Town
  -Period
- When did the practice start? (dd/mm/year, or the season if it is a seasonable practice)

- Is it still in practiced? Any evidence of how the practice has helped or is it has died off? (When did it happen and why? date/year)
- When did the practice start? (dd/mm/year, or the season if it is a seasonable practice)

27. How has knowledge on Customs, rules, folklore, songs, shrines, special trees, forest reserves helped to protect the Lake
28. Is it possible to improve current water governance based on traditional knowledge (norms, values and practices) used, in past water governance to ensure sustainability of the water resources?

    Please explain
29. What potential risks or benefits can you foresee in the use of indigenous knowledge and practices, in policies governing water resources?
    (Which aspects of sustainability does the practice involve? How and/or why?)

a. Political- control by community
b. Social benefit (social, cultural, tourism etc.?)
c. Economic benefit (economic activity) aspects
d. Environmental Benefits
e. [ ] other aspects, that is

30. Please describe the practice and how it could be modified

31. To what extent have you adapted to changes on? What have you been doing to adapt to the crisis on lake Bosomtwe for these uses:

    Extent of adapted to changes on Bosomtwe (Domestic use)
    Extent of adapted to changes on Bosomtwe (Crop production)
    Extent of adapted to changes on Bosomtwe (Livestock rearing)
    Extent of adapted to changes on Bosomtwe (Social activities)

Rating Adaptation	Domestic use	Crop production	Livestock rearing	Social activities
Very much Adapted				
Adapted				
Neutral				
Not Adapted				
Not Adapted at all				

32. What are the underlying principle of this Indigenous knowledge or practice to the:
    1. Lake,
    2. Your health and
    3. Livelihood?
    4. Your community
33. Who gives permission for the use the lake?
34. What institutions do you have in the community (Government, non-governmental cultural, religious, etc.?
35. What assistance have they offered you in your domestic and economic activities?

Section F: Gender and human rights related conflicts of rules, practices and systems

Has there been or are there formal or informal institutions, rules or practices for water governance that conflicts with the rights of the people to water or land?

Is there any history of how water governance practices have affected any group of people in the past or present? Obj. 4&5

- Risk of rules and practices
- Benefits of rules and practices

Please describe

- the current opportunities of the practice
- and future opportunities of the practice
- the ways in which these opportunities affect or could affect the operation of women & children 0bj 1, 2 & 3
- the ways in which it affects men

36. How are the household power relations in terms of - Decision making?
- Division of labour,
- Resource allocation,
- Access to resources.
- Probe for the power relations between spouses, in-laws and fish trader, and children.

37. In what ways has culture shaped the life of the respondent and affected their means of Livelihood?
- What cultural constraints has she /he faced in her domestic and economic lives, in her/his bid to make a livelihood?

38. Who is involved between men and Women in decision making ( )

1.	Men	2.
	Women	3.
	Both	

39. Who is involved between men and Women in rule enforcement ( )

1.	Men	2.
	Women	3.

Both

40. Which of the community development associations are you a member of? (Water group Savings, Susu, Cooperative, Self-help, etc.)

Type of Organisation

Name of Organisation

Activities/Function

41. What leadership position do you hold in your community? (Multiple Responses Allowed)

Community Leader,

Traditional Leader,

Women Leader,
Religious Leader,
Professional Leader
Youth Leader
Leadership Positions Held

Position held by Spouse

42. Are you Willing to Participate in environment and Water resources decision making / Management
    1. Yes 2. No 3. Not sure

- Explain how can you contribute with your participation
- Is there anything you want to add which we have not mentioned yet? If yes, kindly share with me.

Thank you for your time

APPENDIX D

UNIVERSITY OF CAPE COAST

FACULTY OF SOCIAL SCIENCES

DEPARTMENT OF GEOGRAPHY & REGIONAL PLANNING

Our Ref: GRP/I.4
Your Ref:

UNIVERSITY POST OFFICE
CAPE COAST, GHANA
WEST AFRICA

10th December, 2014.

Dear Sir/Madam,

LETTER OF INTRODUCTION

TO WHOM IT MAY CONCERN

The bearer of this letter, **Miss Marian Amu-Mensah** (SS/DGR/13/005), is an M. Phil. Student at the Department of Geography and Regional Planning, University of Cape Coast.

She is conducting research into: ***Indigenous Knowledge in Water Resource Governance in Ghana: A case study of Lake Bosomtwe-Freho District of Ghana.***

We shall be very grateful if your Organisation could offer her all the necessary assistance she would need for the research.

Thank you.

Yours faithfully,

Dr. Benjamin K. Nyarko.
Head

Telephone: *(Head)* 03321-30681, *(General Office)* 03321-30680
Fax: 03321-34072 E-mail: geography@ucc.edu.gh

APPENDIX E

UNIVERSITY OF CAPE COAST

INSTITUTIONAL REVIEW BOARD SECRETARIAT

TEL: 03321-33172/3 / 0207355653/ 0244207814

C/O Directorate of Research, Innovation and Consultancy

E-MAIL: irb@ucc.edu.gh

OUR REF: UCC/IRB/A/27

YOUR REF:

23RD AUGUST, 2016

Mrs. Mariam Amu-Mensah
Geography and Regional Planning
University of Cape Coast

Dear Mrs. Amu-Mensah,

ETHICAL CLEARANCE –ID NO: (UCCIRB/ CHLS/2016/10)

The University of Cape Coast Institutional Review Board (UCCIRB) has granted **Provisional Approval** for implementation of your research protocol titled: **"Indigenous knowledge in water resources governance: Case of Lake Bosomtwe in the Ashanti Region of Ghana."**

This approval requires that you submit periodic review of the protocol to the Board and a final full review to the UCCIRB on completion of the research. The UCCIRB may observe or cause to be observed procedures and records of the research during and after implementation.

Please note that any modification of the project must be submitted to the UCCIRB for review and approval before its implementation.

You are also required to report all serious adverse events related to this study to the UCCIRB within seven days verbally and fourteen days in writing.

Always quote the protocol identification number in all future correspondence with us in relation to this protocol.

Yours faithfully,

ADMINISTRATOR
INSTITUTIONAL REVIEW BOARD
UNIVERSITY OF CAPE COAST
Date: 23-08-16

Samuel Asiedu Owusu
ADMINISTRATOR

APPENDIX F

1. Woodley (2002): Table for System Components in the three subsystems of the Ecosystem

Subsystem	System Component
Context	Population, Biophysical & Historical
Practice	Land tenure, Gardening practices Hunting & Fishing Practices Technology, Economic Activities & Education
Belief	Indigenous Spirituality Ritual and Traditions Values Christianity

1. **Freshwater Resources Use Profile**

Variables under access to water resources	Variables under control	Variables under ownership
Right to abstract: (Ease of abstraction/ distance to sources)	Power/ freedom to direct /determine or regulate	Right to transfer: Freedom as Local elites to appropriate, Right/ Responsibility to sell and benefit
Right to use (Availability, knowledge, experience, wealth)	Power/ freedom to check/put in structures discipline	Ability to Participation, Consensus oriented,
Right to obtain (quality/cost/ time)	Power/ freedom to determine/ use /norms/ wealth	Equity and inclusiveness
	Power/ freedom to participate /decide on standards / rules	Effectiveness and efficiency
	Power/ freedom to prevent, violation	Transparency and Accountability

Sources: Modified from Grindle, (2002)

Perceptions of Government Performance 2000/2001

Governance Principles	Rating of performance "five years ago"	Rating of current performance	Percentage Change
Participation	2.82	3.12	10.06
Fairness	2.71	2.86	5.5
Decency	2.82	3.10	9.9
Accountability	2.52	2.70	7.1
Transparency	2.66	2.87	7.8
Efficiency	2.77	2.93	5.7

Source: (Court and Hyden, 2001:22 in Grindle 2002:42)

APPENDIX G

United Nations Educational, Scientific and Cultural Organization

UNESCO Office in Accra

Ms. Melody Boateng
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THE REPRESENTATIVE OF UNESCO TO GHANA

Mrs. Marian Amu-Mensah
Research Scientist
CSIR Water Research Institute
P. O. Box M 32
Accra
Ghana

7 April 2017

Ref.: GHA/0020/17/SC

Dear Mrs. Amu-Mensah,

INVITATION TO ATTEND A STAKEHOLDER KNOWLEDGE GATHERING WORKSHOP

On behalf of UNESCO, I take great pleasure in inviting you to a workshop being organized within the context of UNESCO's International Hydrological Programme on the theme *Ecohydrology for Sustainability.* The workshop will be held in Prampram at the City Escape Hotel from 20 to 21 April 2017.

We would be honoured to have you as one of the speakers/presenters during this workshop. In view of this, we would be grateful if you could give a presentation on the topic, ***The Interrelationship of Anthropogenic activities and Ecohydrology***.

Please find attached the workshop concept note and a draft agenda.

Kindly note that the arrival and departure dates of participants is the evening of 19 and morning of 22 April respectively. UNESCO will cover your travel, accommodation and meals during this workshop.

Thanking you very much for your kind consideration, I remain,

Yours sincerely,

Tirso Dos Santos

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APPENDIX H

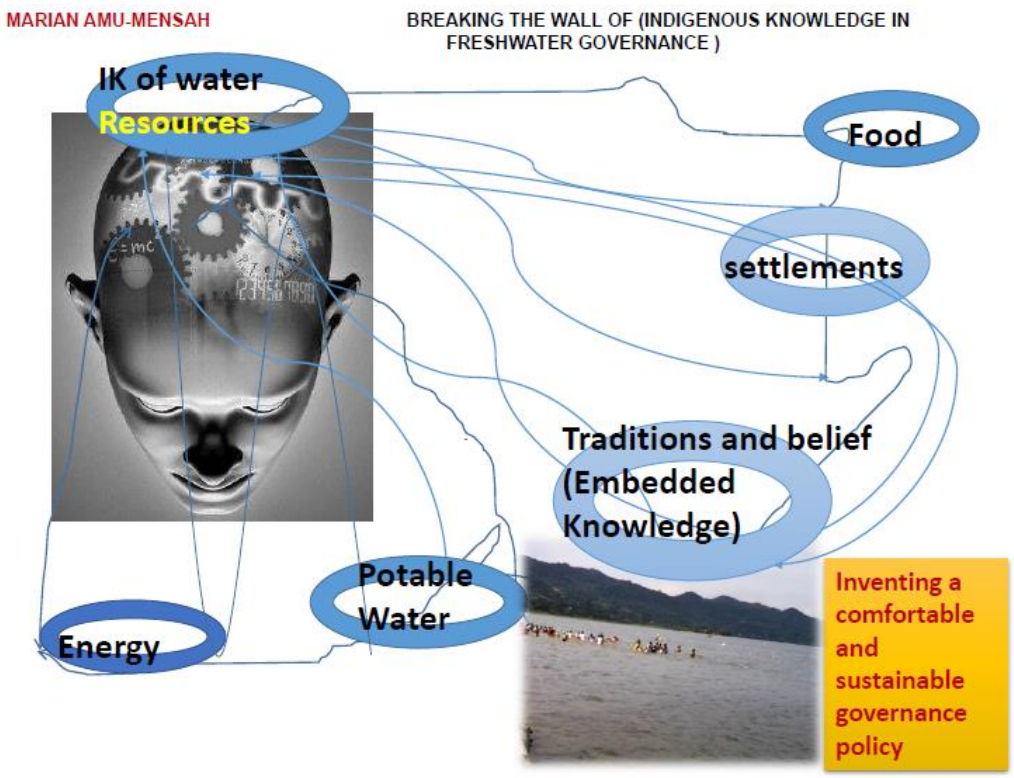
BREAKING THE WALL OF INDIGENOUSE KNOWLEDGE IN FRESHWATER GOVERNANCE

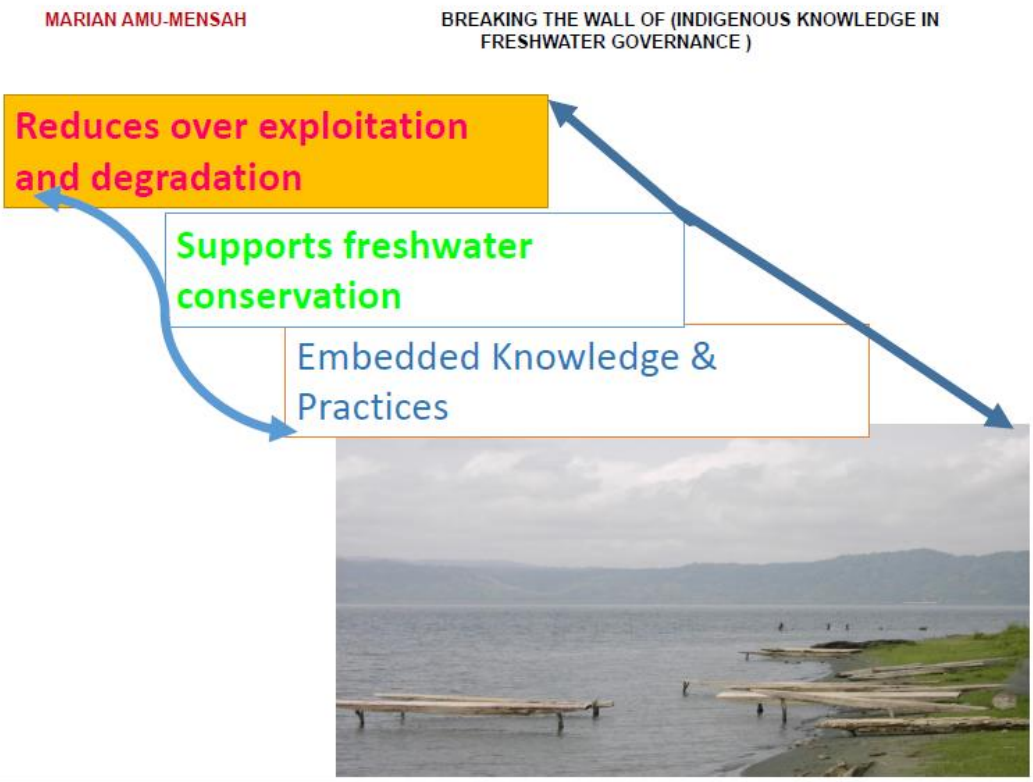
MARIAN AMU-MENSAH

GHANANIAN

UNIVERSITY OF CAPE COAST / CSIR WATER RESEARCH INSTITUTE

FALLING WALLS LAB GHANA





Demystifying Indigenous Knowledge for Freshwater Governance Policy

Marian Amu-Mensah[1], Antwi Barima[1], Collins Adjei-Mensah[2], Leonard Amu-Mensah[2], Stephen Kendie[1]

Abstract

Freshwater policy has a diverse range of impacts on freshwater resources' physical and socio-economic systems. True and up to date information on areas affected by freshwater policy is critical to better understanding the drivers of resource degradation activities, as well as their relevance to biological, chemical water quality and sedimentation, in aid of freshwater conservation management. Planning policy data was traditionally executed from the government institution's office, using secondary data. With the use of knowledge from the context of the environment or ecosystem, indigenous knowledge (IK) becomes a more practical alternative for integration into other existing freshwater policies as they provide a timely local, regional and global source of information. The study reviews the most recent approaches to water governance and evaluates current approaches in policies both at the global and regional level in IK. Using the mixed method approach this paper explores the moral and practical bases of IK from the local and formal institutional context through examination, observations, and understanding of IK implications to freshwater conservation. Respondents numbering 111 were used for the in-depth interview, 108 for the Focus Group Discussion in groups of six and 354 for the Questionnaire administration. The study identified challenges encountered by stakeholders, in policy formulated and implementation. The paper describes the historical trends of using IK and the scientific system in freshwater conservation. Finally, the results identified possible future opportunities to further reduce degradation of water resources using IK as part of freshwater policy and developed a model for water policy formulation.

Keywords: Degradation, Indigenous, Conservation, Ecosystem

From: Ann Goubert
Sent: Tuesday, January 7, 2020 1:15 PM
To: maamu.mensah@csir-water.com
Subject: Setac Dublin Abstract Acceptance

Dear Marian Amu-Mensah,

We are contacting you as presenting author of following abstract, submitted for the SETAC Europe annual meeting in Dublin, Ireland (3-7 May 2020):

- Control id: 55808
- Abstract title: Demystifying Indigenous Knowledge for Freshwater Governance Policy
- Presentation preference: Platform

The Programme Committee has evaluated your abstract on scientific content, language and overall conference fitness. We are pleased to announce that your paper has passed this evaluation and is ACCEPTED to be presented at the conference; congratulations! However, note that abstracts are currently being evaluated by the session chairs so the designation of session and presentation type (platform, poster, poster corner discussion) as well as the date of your presentation can ONLY be communicated last week of January. We hope this early notification, pending the decision on session and presentation type, can speed up your conference registration as well as your visa application process, for those needed. If so, note that your invitation letter can be requested here: https://dublin.setac.org/general-info/travel/

Please note that **ALL presenters should register by the early bird registration deadline of 4 March 2020**. Online registration will open 27 January and can be done via https://dublin.setac.org/registration/register/ Kindly note that presentations from authors not having registered by 4 March 2020 will be cancelled and excluded from the programme and abstract book!

If you have any questions, please visit our meeting website (https://dublin.setac.org). For information on your abstract and the scientific programme, please contact Roel Evens (roel.evens@setac.org). For questions related to your registration, please contact Veerle Vandeveire (veerle.vandeveire@setac.org). For invitation letters and SETAC membership, please contact Ann Goubert (ann.goubert@setac.org).

We look forward to seeing you in Dublin!

SETAC Europe office

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ISDS Article ID: IJDS17113001

Freshwater governance; Case of Lake Bosomtwe in the Ashanti Region of Ghana

Marian Adwowa Amu-Mensah [1], Barima Antwi [2], Frederick Kodwo Amu-Mensah [1*]

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[2] *University of Cape Coast, Cape Coast, Ghana*

Abstract

The study, investigates the nature of governance system around Lake Bosomtwe and its impact on the conservation of the freshwater resources. It also seeks to understand the structural process and contribution of local knowledge in freshwater conservation, which is a gap identified in freshwater governance. Data was based on residents' impact and institutions involved in collation, formulation and implementation of freshwater policy. Based on the findings there is a unanimous indication that, locals are not part of freshwater governance at Lake Bosomtwe and this finding has nothing to do with their educational background. This renders the system of governance as a top-bottom approach. Indications are that this system does not support the conservation of the Lake considering the apathy in adhering to rules and regulation by the locals. The locals believe that their contributions and participation would help strengthen capacities of knowledge and practices in freshwater governance to reduce degradation.

Keywords: Freshwater Governance; Degradation; Local Knowledge; Conservation; Stakeholder's Perception; Water Policy

Cite this article as: Amu-Mensah, M.A., Antwi, B. and Amu-Mensah, F.K. (2018), "Freshwater governance; Case of Lake Bosomtwe in the Ashanti Region of Ghana", *International Journal of Development and Sustainability*, Vol. 7 No. 1, pp. 281-295.

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Knowledge Relationships in Freshwater Governance

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Abstract

Freshwater governance policy formulation and implementation are usually undertaken with little consideration to the thought process of the owners of the resources and resource environment. Even though considerable efforts have been made to the social change theory by incorporating stakeholder's views, the individual-level or local-level insights as well as constructs and environmental connections (cognitive view) in freshwater challenges are usually left out. Using the case study research design, with emphasis on the descriptive design helped to access local knowledge in freshwater governance. The mixed method approach, helped to put together information based on behavioural concerns, the spirituality of the people, and the resource environmental issues required for the analysis and discussion of the data, while drawing meaningful conclusion from data. The results provide a framework, which will help to address interventions that simultaneously address both development and behavioural determinants of freshwater degradation, toward social change conservation policy in reducing crisis in freshwater governance.

Keywords

Cognitive View, Freshwater Governance, Indigenous Knowledge, Conservation

1. Introduction

Information acquired by an individual based on the person's perception and

APPENDIX I

Total number of sampled respondents Used

WRC	1
MWR&S	1
CSIR WRI	1
GMA	1
DCE	2
DAO	2
Native priest	2
IK knowledgeable	2
Chiefs	2
Sub-chiefs queen mothers	17
Local Assembly	19
Opinion Leaders	9
Fifteen year old	2
Native Respondents	50
Total IDI	111
FGD	108
Survey	354
Total	**573**

Raosoft's (2004) Sample Size Determination Table

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	170	118	400	196	1300	297	7000	375
50	44	180	123	420	201	1400	306	8000	373
55	48	190	127	440	205	1500	306	9000	268
60	52	200	132	460	210	1600	310	10000	373
65	56	210	136	480	214	1700	313	15000	375
70	59	220	140	500	217	1800	317	20000	377
75	63	230	144	550	226	1900	320	30000	379
80	66	240	148	600	234	2000	322	40000	380
85	70	250	152	**650**	**242**	2200	327	50000	381
90	73	260	155	700	248	2400	331	75000	382
95	76	270	159	750	254	2600	335	10000	384

*N is the population size
*S is sample size

Alpha level (α) = 5%,
R=50% response rate

Source: Adopted from Raosoft (2004)