UNIVERSITY OF CAPE COAST

INDIGENOUS KNOWLEDGE IN WATER RESOURCE MANAGEMENT IN THE UPPER TANO RIVER BASIN, GHANA

BY

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own originalresearch and that no part of it has been presented for another degree in this University or elsewhere.

Candidate's Signature:……. Date:…….

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Supervisors' Declaration

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

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ABSTRACT

This study assessed indigenous knowledge in water resource management in the upper Tano River basin of Ghana. Despite the effort of formal water resource management institutions, human activities along the Tano river continued to put the Tano basin in danger hence the need to find other vital means to help in managing the basin.Respondents for the study were chiefs, elders, some selected community members in five riparian communities along the Tano River and the Tano basin secretariat officer among other stakeholders who were involved in the management of the river. Purposive and snow ball sampling techniques were used. Data from the study was analysed manually by transcribing recorded data; organising it into themes where discussions were done under each theme and supporting discussions with pictures, where relevant. The results of the study revealed that, River Tano takes its source from the Tano sacred grove in Tanoboase near Techiman. It was also found out that, deities were mounted along the river in the upper basin and this was manned by sub chiefs and their court of servers to ensure that the use of the river wasregulated. Indigenous knowledge included holding the river as sacred god hence prohibiting people from fishing in it. It was further established that, indigenous institutions faced several challenges such as non-existing bye-laws or legislative instrument to support the enforcement of indigenous knowledge. It is thus recommended that, bye-laws are enacted by the Water Resource Commission basin secretariat together with MMDAs and other formal institutions to assist with the enforcement of indigenous knowledge since it can help significantly in the management of the water resource.

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DEDICATION

To my family

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LIST OF ABBREVIATIONS

CBD	Convention on Biodiversity
CBOs	Community Based Organisations
CBWL	Community Based Water Laws
DA	District Assembly
EPA	Environmental Protection Agency
FGD	Focus Group Discussion
GWP	Global Water Partnership
IWRM	Integrated Water Resource Management
MMDA	Metropolitan, Municipal and District Assemblies
NGOs	Non-Governmental Organisations
PACN	Pan Africa Chemistry Network
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organisation
WRC	Water Resource Commission

CHAPTER ONE

INTRODUCTION

Background to the Study

The management of water resources has gained attention over the years in the world's development discourses. Water is indispensable to the existence of humankind and all living things. It is used for a variety of purposes. For instance, it is used for industrial, domestic and irrigationpurposes from which society derives a range of values (FAO, 2009). In its innumerable occurrences, management and uses, wateris a crucial element of human development anda crosscutting issue in contemporary development priorities driving international efforts for achieving sustainable development goals.

In furtherance of this, it is captured in the Sustainable Development Goal (SDG) six (6) which is to ensure availability and sustainable management of water and sanitation for all. Sustainable development according to the World Commission on Environment and Development (WECD) (1987) is seen as development which seeks to meet the needs and aspirations of the present without compromising the ability of future generations to meet theirs. Protecting water resources and improving water services are essential for increasing hygiene and sanitation service levels that affect productive lives of people.In addition, efficient and reliable sanitation and water supply system is fundamental in reducing morbidity and mortality;and preventing vector and water borne diseases (United Nations Educational, Scientific and Cultural Organization, 2009).

The appreciation of the value of water for the sustenance of life began decades ago. As guardians of natural resources and due to generations of experimentation, indigenous peoples over the years developed an expansive body of knowledge for sustainable use and management of natural resources such as rivers and streams. The continuity of this knowledge and sustainable use of these resources were enforced through rules, and beliefs systems which formedfragments of their customary laws (Gadgil, 2005). Indigenous peoples possessed systematic knowledge of managing plants, animals and natural phenomena of the ecosystems and their ambiances. However, when colonisation and the introduction of technology as well as population growthemerged and their lands and territories were taken over, the process of plundering the resources and deprivations began (Henrik, 1996).

The introduction of statutory laws marginalised these customary laws that regulated the application of their knowledge to the management of natural resources within their territories (Opoku-Ankomah, Amposah& Some, 2006). The situation continued to aggravate over the decades with the coming of the era of economic development, which was aggressively pursued by private companies. In line with this, numerous initiatives at conferences have over the years led to the advancement of policy issues on water.Examples of such initiatives include the Lake Success Conference on Conservation and Utilization of Resources in 1949; Mar Del Plata Conference of 1977; United Nations Conference on the Human Environment in 1972; International Conference on Water and Environment held in Dublin in 1992 at which the Dublin Principles were developed; the United

Nations Conference on Environment and Development in Rio de Janeiro in 1992; and the Second World Water Forum and Ministerial Conference held in The Hague in 2000.

Examples of recentconferences include the International Conference on Freshwater in Bonn in 2001; the World Summit on Sustainable Development in Johannesburg in 2002; as well as the Third, Fourth, Fifth and Sixth World Water Forums held in 2003, 2006, 2009 and 2012 , 2015 in Kyoto, Mexico, Istanbul, Marseille and Daegu-Gyeongbuk respectively. These conferences, summits, and forums resulted in the development of an Integrated Water Resources Management (IWRM) plan and other principles for water resources management. These models and principles have been adopted by the international community and had been argued to be vitaltools that could help manage water resources globally.

Numerous water resources can be found in Africa. Examples include Lake Victoria, Niger River and the Volta River.Fresh water availability is crucial to the development of Africa. Yet, according to the World Health Organization (WHO) (2014), more than 40 percent of all people without access to safe drinking water lived in Africa, with some 300,000 people deprived of clean water sources due to ineffective management of the water resources. Freitas (2013) stated that,the growing pressure on water resources in Africa, could lead to domestic unrest, exacerbate existing inter-state tensions and even constitute a source of armed conflict.

Prüss-Üstün, Bos, Gore, and Bartram (2008) argued that, if water sources including river basins are not managed properly, it could lead towater pollution. Unsafe and polluted water consumption in Africaaccording to Prüss-Üstün et. al could leadto the widespread sufferings from, typhoid, dysentery and many other diseases. Apart from this effect on health, Prüss-Üstün et al., (2008) noted that, the loss of productivity that results from water-related illnesses hold back the progress of the continent. The World Health Organization (WHO), (2008) averred that, the population in many African countries was growing rapidly each year, averaging 2.5% across sub-Saharan Africa, but inadequate safe water and poor sanitation reduced economic growth to twice that rate.

It is to this effect that the World Wide Fund for Nature (2014) argued that, achieving sustainable development as well as effective water management in Africa required representative participation by all who stand to gain or suffer, and consideration of water timing, quality and biodiversity. Mondello (2006) also called for the implementation of the Integrated Water Resource Management (IWRM) and other sound policies to ensure sustainability and efficiency of water use in the future. This was to be achieved by following these subsequent steps including: the establishment of multilateral river basin management authorities for more than 50 percent of eighty 80 trans-boundary Rivers and lakes in Africa; establishing national plans for the management and wise use of wetlands;and conserving 50 million hectares of freshwater wetlands to sustain the livelihoods of local peoples.

In line with this, a number of countries in Africa underwentreforms in the water sector. Examples include the establishment of the Okavango basin management board to manage trans-boundary water problems in Botswana, Namibia and Angola; and the Nyando basin management board in Kenya. Nonetheless, it is argued by Biswas (2008) that, the emergence of formal policies including the IWRM plan and other principles had not eliminated completely, problems associated with the management of water resources in Africa.

Ghana is also blessed with numerous water resources including rivers such as Volta River, Densu, Pra, Tano, and Ankobra Rivers. In accordance with the new paradigm for water resource management internationally, Ghana adopted formal water policies which informed new policies and enactments such as Water Resources Commission (WRC) Act 522 of 1996 for river basin plans followed by National Water Policy of June 2007 where all stakeholders were expected to be brought on board as far as management of river basins in Ghana was concerned. The introduction of the IWRMat decentralized levels in selected river basins according to WRC (2012) wasessential as a result of factors such as encroachment on water shed zones by farming activities along river bank; water shortages in an otherwise perennial river system caused by an accelerating increase in irrigation demand; and establishment of numerous smaller dams and dug-outs in the upstream parts of the river system among several other factors(WRC, 2012).

Furthermore, the IWRM was seen to be essential in managing freshwater resources in Ghana. Several IWRMframeworks have been elaborated for various

basins in Ghana. For instance, IWRM for the Densu River Basin was finalised in 2007 followed by White Volta, Ankobra,Pra and the Tano Basin IWRM plans. However, similar to Biswas (2008) argument, the introduction of these formal policies in water management in Ghana has not solved water management problems in totality (Millar, 2005). It was believed that, if formal institutions were put in charge of managing water resources by adopting these principles, then, solution could be met. Yet, pollution and loss of biodiversity continue to increase even under the management of these formal institutions (Bonye, 2008).

Indigenous peoples continue to emphasise and practice their distinctive way of life and worldviews on a narrow margin. For instance, Opoku-Ankomah et al. (2006) noted that, rural communities in the Volta basin in Ghana employed flexible institutional arrangements, including the use of taboos and other cultural practices to protect natural resources.Indigenous knowledgeis gaining grounds as a tool that can be used by the global community to respond to the present and future challenges in food and health security (Reed, 1997). In the same vein, there is also an increasing realisation of the invaluable role that indigenous knowledge and customary laws could play in securing the health of the planet (Boelens, Chiba, & Nakashima, 2006). For instance, the relevance of indigenous knowledge is echoed in the agenda of development and conservation including the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP);and the Convention on Biodiversity (CBD).

Henrik(1996) attributed contemporary poor management of natural resources to intrusive state policies which were alleged to have interfered too

much on the local scene and undermined traditional institutions from playing their part in regulating resource use. According toHenrik (1996), states have pursued their resource policy objectives through policies which concentrated the right to managing natural resources in the hands of the state and their resource management agencies relegating indigenous institutions to the background. Agyenim (2011) also noted that, the trivial representation of traditional authorities in for instance, the WRC board points to the diminishing control and roles of the traditional authorities in water management shift from traditional leaders to state institutions.

However, indigenous knowledge embedded in traditional institutions is argued by Millar (2004) to be a vital means that can help manage and solve water resource management challenges. The assurance problem in collective action theory argues that, when users of common goods are allowed to come into consensus as to the rules for management, it serves as incentive for proper and sustainable management. Indigenous institutions possess knowledge, norms and practices that have positive capabilities in river water resource management which have to be considered along with the negative aspects of traditions and prejudices.

Statement of the Problem

The Tano Basin is a principal basin which is part of the south-western river system of Ghana. It flows through the BrongAhafo, Ashanti and Western Regions and has a number of socio-ecological functions such as being one of the most reliable sources of water for domestic, industrial and agricultural purposes in

the BrongAhafo Region and other regions that it flows through. A report by the Environmental Protection Agency (EPA) in 2011 on water resources in the BrongAhafo Region stated that water quality was good but activities such as bad farming practices could affect water resources if not managed properly. Due to competing demands for water, the IWRM plan was adopted in 2012 with the intention to facilitate broad stakeholder input in order to build compromise and equitable access.

However, the Water Resource Commission's report in 2014 on the Tano basin attested to the fact that,human activities of people along the Tano river wereputting the Tano Basin in danger, which could have rippling effects on the lives of many who depend on it for their livelihood. According to Water Resource Commission's report in 2014, legal and illegal mining of gold and other minerals, as well as clay and sand mining are major problems affecting the Tano Basin. Farming and the cutting down of trees within the buffer zone, as well as building of structures by people were also identified as activities affecting the basin. Inadequate water to meet the demand for domestic, commercial, agricultural and industrial purposes was indicated as some consequence that could occur if measures are not put in place to curtail such practices. Nevertheless, the Endogenous Development approach by Haverkort, Van't Hooft, and Hiemstra (2003) arguedthat,the use of local resources, including local human resources or leadership and institutions could serve as vibrant tools for addressing development problems. Hence, this study sought to assess how indigenous

knowledge is being used in the management of water resources in the upper Tano river basin.

Objectives of the Study

The main objective of the study was to assess the role of indigenous knowledge in the management of water resourcesin the upper Tano Basin.

Specifically, this study sought to

1. Describe the forms of indigenous knowledge used in management of water resources;
2. Examine the indigenous practices, norms and beliefs that existed in the management of water resources in the communities;
3. Examine the interface between formal water policies and indigenous knowledge in water resource management in the basin;
4. Describe the challenges faced by indigenous institutions in using indigenous knowledge to manage water resources in the communities; and
5. Make appropriate recommendations on the need to incorporate indigenous knowledge in basin management policies

Research Questions

These research questions guided the study.

1. What indigenous knowledge exists regarding the management of water resources in the upper Tano basin?
2. How are the indigenous practices, norms and beliefs that exist being used in the management of water resources in the communities?

3. How does the interaction between indigenous institutions and formal water management policiesplay out in the upper Tano basin?
4. What are the challenges faced by indigenous institutions in using indigenous knowledge to manage water resources in the communities?

Justification

Poor water resources management has given rise to a number of problems in relationto health, socio-economic development and environmental management, which need to be solved (Dungumaro&Madulu, 2003). To effectivelyavoid these problems and address future water management needs, there is the need to understand howindigenous knowledge could be used as a source of input (Cain, Batchelor, &Waughray, 1999). Ignoring indigenous knowledge and values could be detrimental to water resource management but building on it is crucial for easyimplementation of water development programmes and plans.

Scope of the Study

The study looked at the essence of including indigenous values and knowledge into water and related resources management policies and laws. It was restricted to riparian communities along the upper Tano River in the BrongAhafo Region of Ghana. It wasmore of a qualitative research that sought to describe the community's norms and practices as well as how these practices impacted on water resources management in the upper Tano basin. Theoretically, the study is based on the endogenous development approach and the theory of collective action as explained by Runge (1984) and Ostrom (1990)

Organisation of the Study

The study has been divided into five main chapters. Chapter one puts the study into perspective through the background of the study, statement of the problem, the objectives of the study, research questions, justification of the study and the organisation of the study. Chapter two presents the review the related literatureincluding definitions and concepts of water resources, indigenous values and knowledge in water resource management, and theories on water resource management such as assurance problem in collective action. Chapter three comprises methodology for the study whiles chapter four presentsresults and discussion of data collected. Finally, chapter five consists of the summary, key findings, conclusions and recommendations of the study.

CHAPTER TWO

REVIEW OF THE RELATED LITERATURE

Introduction

This chapter presents a review of related literature on indigenous knowledge in water resource management. This includes theoretical perspectives; discussions of concepts on water resources and its management; Integrated Water Resource Management (IWRM); the implementation of IWRM in Africa; critics of IWRM; water resource management in Ghana; indigenous knowledge in water resource management as well as the extent to which indigenous knowledge are recognized in management of water resources in Ghana. This chapter also presents counter arguments on the relevance of indigenous institutions in water resource management; an empirical review and provides a conceptual framework that will guide the study.

Theoretical Perspective

Endogenous approach to community development as explained by Haverkort, Van'tHooft, and Hiemstra (2003) and the theory of collective action as explained by Runge (1984) as well as that of Ostrom (1990) are the theoretical underpinnings to this study. Each of them is explained below by linking it to its relevance for this study.

Endogenous DevelopmentApproach

Endogenous development is a theoretical standpoint that stressesvital community involvement, possession and use of local resources, including local

human resources and institutions for addressing development problems (Haverkort, Van'tHooft, &Hiemstra, 2003). This theory basically suggests development compelledpredominantly from within communities. Proponents advocate that,development is driven mainly on locally available resources, knowledge, culture and leadership, whileallowing for the introduction and adoption of appropriateexternal knowledge and practices for development purposes (Haverkort et al., 2003).

Millar (2004) wasalso of the view that, endogenous development patterns hinge on, but not exclusivelyto locally available resources such as water, land, vegetation, local knowledge, culture, leadership and local mechanisms of carrying out trials and learning. Millar (2005) continued to state that, indigenous knowledge serves as important tools in endogenous developmentand this form of development is more analogous to African systems of agricultural productivity than other paradigms of development.

Henrik (1996) noted that, indigenous knowledge is rooted in the community and is exceptional to a given culture or society.Moreover,Harverkort et. al., (2003) underscored the fact that, since endogenous developmentis fundamentally development from within communities themselves, indigenous knowledge is essential to the process of sustainable community development. Indigenous knowledge isvigorous and resorts to solving societal challenges through local experimentation, and innovation under varied and assorted conditions. Thesefruitful adaptations according toAluma(2004)are conservedand

handed on from one generation to another through oral and or experimental means.

There has been amplified acknowledgment that indigenous knowledge is a tactical resource and driver of advancement for sustainable development (Ramphele, 2004). Severalpurviews of indigenous knowledge systems exist that are relevant for endogenous development. An example is the indigenous system of governance which is the root of values and norms that guide behaviour of people. Since endogenous developmenttheoretical perspective highlights self-initiated development based on local knowledge, institutions and resources (Harverkort et al, 2003); indigenous institution's role in the development process is implicitly underscored. This study therefore, argues from an endogenous development perspective as theoretical guidance for empirical analysis and proposes that knowledge and values that are embedded in indigenous institutions can be an essential resource in water governance or management in communities. This is because,these values are of crucial importance if sustainable management of water is to be met.

Theory of Collective Action

Marshall (1998) defined collective action as 'the action taken by a group (either directly or on its behalf through an organisation) in pursuit of members' perceived shared interests'. Meinzen-Dick, Di Gregorio, and McCarthy (2004) observed that specific and diverse definitions have in common the following features: the involvement of a group of people, shared interests, common and voluntary actions to pursue those shared interests. Pretty (2003) underscored the

fact that we live in a world of interdependent individuals, each of whom holds expectations about the behaviour of others. Literature written over the decades has centred on how individuals coalesce to manage diverse kinds of common property resources (CPRs) (Bromley, Feeny, Mckean, Peter, Runge, & Thompson, 1992; OECD, 2013; Ostrom, 1990).

With regards to public goods,usually associated with common property resource regimes, excluding anyone from individual use or consumption within the group is difficult (Agrawal, 2001). In this regard, when there are no exclusive use rights imposed from outside, interdependent consumption decisions are necessary because if no such decisions are made it creates incentives to free ride at the group's expense (Bromley et al, 1992). Factors such as pollution and overpopulation habituallyseem to back the free rider hypothesis. That is, for instance, if a mining firm can benefit by polluting while passing the cost of clean air or water to society as a whole, then what is the guarantee that clean air or water will be achieved in the area (Uetake, 2012).

Several theoretical approaches have been developed that tries to explain the problems associated with the use of public goods of which water resources can be cited as an example (Ostrom, 2007). The theoretical underpinning that informs this study (i.e. the assurance problem in collective action by Runge, 1984) traces its roots from the game theory of the single period prisoner's dilemmain which the dominant strategy is always to free ride is used for analysis. Based on this, several perspectives on collective action have been

developed over the years including Hardin's (1968) "tragedy of the commons" and Olson's logic of collective action (1965) which argued that, users of common property cannot be left to decide how to use them and that their use has to be controlled to avoid over exploitation.

The assurance problem proposed by Runge(1984) is grounded on the assumption that individual decisions are conditioned on the expected decisions of others, rather than being separable from them. This raises the question of how these expectations are coordinated over time. Uetake (2012) explains that, the prisoner's dilemma as applied to public goods is a formal expression of the apparent illogic of collective action, conveying a set of preferences in which free riding will always dominate. However, Runge (1984) argues that, the incentive to advance political and economic institutions lies in the coordination of expectations. Institutions which successfully perform such harmonisation provides theguarantee in the face of uncertainty regarding the expected actions of others.

Institutions can be explained as, the entities withbehavioural rules that coordinate patterns of political and economic relationships. These take account of the general social rules which Lewis (1969) and Hardin (1971) conceptuallydesignatedas "conventions," as well as more tangible rules in organisations and decision-making units, such as firms and political groups (Meinzen-Dick, Di Gregorio, & McCarthy, 2004).Structuring individual expectations so that group actions can be coordinated results in rules which provide information that helps in predicting the behaviour of others (Pretty,

2003). It is argued by Runge (1984) that, the declaration that others will contribute to public goods, can significantly influence many individuals to contribute as well. Moreover, whenever coordination can raise the welfare of a group,thenthe incentive to initiate institutional agreements fostering such prediction arises.

Runge, (1984) agreed with Hardin(1968) and Olson (1965) that their models provide important insights into why social institutions break down, yet he argued that, Hardin(1968) and Olson (1965) gave no explanation of how or why institutions begin and are maintained. Instead, they asserted that within any group, no internal incentives exist to initiate or maintain institutional agreements. It is with the objective of preventing the Hardin's tragedy of the commons that governments in Africa, and other parts of the world, have, until recently, assumed the direct control and management of natural resources, such as water bodies, forest, and wildlife. For instance, in the "Tragedy of the commons",Hardin (1968) noted that, the private benefits of grazing an extra head of cattle on a shared range surpassed the private cost because the costs of retaining range quality (the public good) could be shifted to the group as a whole.In this case,it was seen by Hardin (1968) that, irrespective of the anticipated actions of others,each person's spuris to free ride which isthe calamity of overgrazing.

Similarly, Olson (1965) was of the view that "rational, self-interested individuals will not act to achieve the common or group interests". These arguments proposed by Hardin and Olson led to the inference that, without

outside enforcement public goods will never be supplied. However, Runge (1984) is of the view that, there are incentives thatcultivate and maintain institutions branded by rules which make voluntary contributions to public goods a utility-maximizing strategy.The assurance problem infers that, people have a preference to act collectively in public goods circumstances.

This argument put forth by Runge (1984) was also in line with Davies, Blackstock, Brown, and Shannon (2004), who were also of the view that, in actuality, we notice substantial voluntary contributions to public goods without outside enforcement. Experimental investigations which were used to support the assurance problem also questioned the validity of the free rider hypothesis and the impossibility of voluntary provision of public goods (Pretty, 2003). These investigations proposed that, although some weak free riding may arise, individuals often contribute resources to public goods voluntarily. The assurance problem has implications similar to results which involved repeated plays of the prisoner's dilemma (Axelrod & Hamilton, 1981).

Olson (1965) was of the view that unless the number of individuals in a group is quite small, or unless there is coercion or some other special device to make individuals act in their common interest, rational, self-interested individuals will not act to achieve their common or group interests. Yet it is argued by Runge (1984) that, where people are stirred to contribute and if this behaviour is also expected of others, institutions which convince them that these expectations are justified can promote voluntary provision of public goods.

This does not imply that voluntary contributions can supply all necessary public goods. However, significant incentives exist, internal to any group, to contribute voluntarily, which implies that public goods can in some cases be provided without coercion or selective side-payments from outside the group. A note of positivity is thus introduced into the enquiry of collective action and focuses attention on the role of institutional agreements in nurturing this type of behaviour (Davies, Blackstock, Brown, & Shannon, 2004).

Similar to Runge's point of view, Ostrom(1999) also argued that, theories for how self-organised groups can persist for protracted periods of time when they develop governance arrangements reliable with a set of design principles, has been suggested and is reinforced by auxiliary empirical research (Asquith, 1999; Bardhan, 1999; Lam, 1998). Although collective action is often associated with activities carried out by formal organisations, according to Ostrom (2007), more attention should be paid to informal collective action, where local networks or local groups of people organise and coordinate local action in order to achieve specific short-term purposes. Ostrom (1999) proposed a set of contextual variables which could be beneficial or disadvantageous to endogenous collective action.

These variables include:the type of production and allocation functions; the predictability of resource flows; the relative scarcity of the good; the size of the group involved; the heterogeneity of the group; the dependence of the group on the good; common understanding of the group; the size of the total collective

benefit; the marginal contribution by one person to the collective good; the size of the temptation to free ride; the loss to co-operators when others do not cooperate; having a choice of playing or not; the presence of leadership; past experience and level of social capital; the autonomy to make binding rules; and a wide diversity of rules that are used to change the structure of the situation.

On the subject of the dynamics affecting the prospect of groups overpowering social dilemmas,several intellectuals have offered theoretical syntheses of empirical findings (Baland and Platteau, 1996; Marwell and Oliver, 1993). In particular, the impact of the size of a group and internal heterogeneity are frequently considered important contextual variables, but the trend of their impact and how they manoeuvre is strongly challenged (Molinas, 1998; Leach, Mearns, & Scoones, 1999;Olson, 1965). Ostrom (1999) arguedthat, it is essential to assume the existence of multiple types of players, rational egoists, as well as players who use social norms in models of non-market behaviour.

Ostrom (1990) concludes that multiple types of players could endure, and even flourish, in social predicament situations by embracing social norms that intensely depend on their capacity to identify one another. Ostrom (1999) explained that,seven design principles appear to characterise most of the robust user-organized systems. An eighth principle characterises the larger, more complex cases. Ostrom (1999) defined a design principle as a conception used consciously or unconsciously by those constituting and reconstituting a continuing association of individuals about a general organising principle. These eight design principles are discussed in the following paragraphs.

The first principle deals with clearly defining boundaries regarding the use of the commons. Ostrom, (1999) was of the view that, without delineating the boundaries of a CPR and closing it to 'outsiders', indigenous users face the possibility that any remuneration they create by their efforts will be reaped by others who do not add to these efforts. Hence, those who invest in a public good may not receive as high a return as they expected. At the most awful, the actions of others could destroy the resource itself (Ostrom, 2007). That is, for any user to have a minimal interest in coordinating patterns of appropriation and provision, some set of users has to be able to exclude others from access and use rights.

The second principle, according to Ostrom(1999),deals with congruence between appropriation and provision rules and local conditions. This suggests that, uniform rules established for an entire nation or large region of a nation can rarely take into account the specific attributes of a resource that are used in designing rules-in use at a particular location. For instance, Swaney (1990) argued that, no single set of rules defined for all irrigation systems in a region would satisfy the particular problem in managing each of these broadly similar, but distinctly different systems.In furtherance of this, Ostrom (1999) deduces that, for effective governance of the commons, rules should meet local conditions

Collective-choice arrangement is the third principle.It implies that users of common properties take energetic part in rules binding the resource. CPR institutions that use this principle are able to tailor better rules to suit local situations from the individuals who directly interact with one another. Similarly, the rules can also be modified over time so as to better fit them to the specific

characteristic of their setting (Agrawal, 2001). The fourth and fifth principles have got to do with monitoring and sanction. Ostrom (1999) argued that, monitoring of the common should be done by the users themselves or better still someone who will be constantly accountable to them.

In this case,Ostrom (1999) argued from the perspective that, when CPR users design their own operational rules (Design Principle 3) to beenforced by individuals who are also local users or accountable to them (Design Principle 4) using graduated sanctions (Design Principle 5) that define who has rights to withdraw from the CPR (Design Principle 1) and that effectively restrict appropriation activities given local conditions (Design Principle2) then sustainable management of resources could be achieved.The commitment and monitoring problem are solved in an interrelated manner (Ostrom, 2007).

Individuals, who think that, a set of rules will be effective in producing higher joint benefits and that monitoring (including their own) will protect them against being a sucker, will be willing to make a dependentself-commitment. For the seventh principles, Ostrom (1999) proposed that, providing accessible, low-cost means for resolving dispute concerning common property use could help in its management. Finally, building obligation for governing the common resource in nested tiers from the lowest level up to the entire interconnected systemswas argued to be effective ways in which the commons can be governed.

In this wise, it can be deduced from Runge (1984) and Ostrom (1990) points of view that, if indigenous institutions, in which knowledge and values that guide social behaviour of people are allowed or resourced to manage water

resources in their various communities, then sustainability and efficiency is rest assured. It is argued that, since the communities along the upper Tano river basin are homogenous based on the traditional governance structure, then Runge and Ostrom's assertion can be applied. Runge (1984) and Ostrom (1990) illustration through field work and theory is converging to show that where traditional institutions are given the opportunity and the resources to develop their own management systems and tenure regimes, they are wellable to do so.

Contrary to the 'Tragedy of the Commons' argument (premised on the main stream view that local people are responsible for causing natural resource degradation), Runge (1984) formulated an 'Assurance Problem' theory as a means of understanding how rural communities evolve their own management systems. Ostrom (1990) argues that traditional leaders and their indigenous knowledge systems remain the symbol of an intimate alliance with their territories. The physical closeness to their "community" allows for the application of a set of rules, norms and practices that will rarely be out of touch with the ecological reality and the management and conservation requirements of the resources in their territory (Baland, & Platteau 1996). Thus, there may be numerous incentives internal to indigenous institutions which can compel members to contribute voluntarily to collective management of water resources.

Historical Overview of Water Resource Management

To Biswas (2004), water is an important factor for progress and development and represents the basis for the development of authentic

civilizations through the ages. Fresh water is a renewable resource, yet the world's supply of fresh water is steadily decreasing (WHO, 2014). This is because, water resources are increasingly under pressure with demands that are growing in volume and with different uses and activities affecting their quality and quantity as well as the timeliness of their availability (WHO, 2014). Water resources provide multiple goods and services that are essential to human development, such as water for food production, drinking-water and sanitation, conservation of natural ecosystems, recreation and hydropower (FAO, 2009).

These goods and services are interrelated and partially overlapping, e.g. water reservoirs may be used for power generation, irrigation, drinking-water supply, fisheries and recreation among others depending on their location, design and operation. Water is critical to the well-being, livelihoods and socio-economic development of humankind. In African countries such as Angola, Botswana, the Democratic Republic of Congo, Ghana as well as Lesotho, water is of great importance to all sectors of the economy, more especially agriculture (which uses over 80% of the developed water resources) which supports most of the 200 million people in the region (FAO, 2009).

Pollution and unsustainable use of freshwater comes with serious consequence on livelihoods and its effect is felt in both industrialised and developing countries although developing countries suffer most (WHO, 2008). For instance in the developing world, diseases associated with poor water and sanitation still have considerable public health significance. Unsafe water, inadequate sanitation, and insufficient hygiene account for an estimated 9.1

percent of the global burden of disease and 6.3 percent of all deaths, according to the World Health Organization (WHO), (2014). This burden is disproportionately borne by children in developing countries, with water-related factors causing more than 20 percent of deaths of people under age 14. In Africa, although the continent is blessed with massive water resources, infections or diseases associated with inadequate water supply and sanitation have been recorded (Bartram, Lewis, Lenton& Wright, 2005). With impacts on agriculture, education, energy, health, gender equity, and livelihood, water management can therefore be said to underlie most basic development challenges.

Water management has gone through different phases over the years. Prior to colonisation, the indigenous rulers used their knowledge systems and occupied a unique position in the management of water resources. They were accepted by their subjects as the religious, political, judicial and the spiritual embodiment of their communities and therefore took responsibility in the management of community resources (Opoku-Ankomah et al., 2006). Fairheadand Leach (1994) also argued that, colonisation in Africa and other developing countries was a key foundation of departure in their mode of natural resource management. In addition, decades of colonisation in Africa, for instance, alienated its people from their traditional ways of management and utilisation of natural resources.

Colonial rule and the emergence of technology in most parts of the world empowered the modern governance structures and took away the resource from the natives (Appiah-Opoku&Hyma, 1999). In the pre-colonial era inGhana for

instance, waterresources were regarded as common property which was not subjected to an individual claim or ownership under the customary laws which were being used at that time. Although, it was a common property, the belief of the people was that the earth and the water bodies have spirits of their own and that these resources were to be used conscientiously.

During colonisation and after independence, states assumed ownership and control of resources yet the rate of unsustainable use of these natural resources got worse. For instance, availability of freshwater began to decrease at a faster rate and as such, water no longer represented a cheap resource, which could be profligately used, abused or squandered without noticeable consequences on humans and for generations to come (Fairhead& Leach, 1994). In addition, water security was affirmed by the Second World Water Forum in The Hague, Netherlands in the year 2000 as the principal concern for sustainable development in the twenty-first century. This led to worldwide shift in conservation and natural resources management from the costly state centred approach to those that include local people to play a more active role (Shackleton, Campbell, Wollenburg& Edmunds, 2002). Efforts at the global level were aimed at formulating implementable solutions to environmental problems and increasing levels of poverty (Chikozho, 2002).

To Shackleton et al. (2002),these reforms in water management were aimed at increasing resource user involvement in natural resources management decisions and benefits by restructuring power relations between central state and communities. That is, through the transfer of management authorities to local

level organisations, though reality seldom reflects this rhetoric. Uncountable initiatives at conferences have over the years led to the advancement of policy issues on water including the International Conference on Water and Environment held in Dublin in 1992 at which the Dublin Principles were developed; the United Nations Conference on Environment and Development at Rio de Janeiro in 1992; International Conference on Freshwater in Bonn in 2001; the World Summit on Sustainable Development in Johannesburg in 2002; as well as the Third, Fourth, Fifth and Sixth World Water Forums held in 2003, 2006, 2009 and 2012 , 2015 respectively in Kyoto, Mexico, Istanbul, Marseille and Daegu-Gyeongbuk respectively.

After several deliberations at conferences, the integrated water resource management concept emerged as a pillar upon which water resources should be managed. The advent of the notion is one of the results from the search for a new water management paradigm. Confronted with increasing water scarcity, pollution, climate change, including fractioned and isolated sectorial water management practices, the water community contributed useful principles and frameworks which provide efficient and sustainable ways of managing water resources.

Global Water Partnership (GWP) explains IWRM as "a process which promotes the coordinated development of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (GWP, 2000). In this process, the coming together of all concerned stakeholders is

universally recognised as a key component in obtaining a balanced and sustainable use of water. To Grigg (1999) IWRM emphasize social interdependence for planning that balances all the relevant understandings of stakeholders. This definition points to the need to maximise economic and social welfare while ensuring equity and sustainability of vital ecosystems.

Cardwell, Cole, Cartwright and Martin (2006) defined IWRM as a coordinated, goal-directed process for controlling the development and use of river, lake, ocean, wetlands and other water assets. The IWRM process is described as an iterative cycle, building on previous conceptions of policy development and strategic planning by adding commitment building and stakeholder dialogue to the steps outlined in earlier publications, e.g. World Bank, (2003). These conceptions of water resources management as a process are appealing because they offer a logical sequence of steps to follow in the development of policies and strategies.

Several principles have been derived for comprehensive water management but the Dublin principles echoes the key principles that are widely accepted. These principles were placed in a societal framework together with the goals of economic efficiency, social equity and the sustainability of ecosystems. The four Dublin Principles were agreed upon at the International Conference on Water and the Environment in Dublin in January 1992. Later these principles helped to inspire Chapter 18 of Agenda 21, which was agreed at government level. For decision-makers and practitioners alike, these principles

have provided a simple, reasonable and very worthwhile guidance for water resources management and development over the last 17 years.

The four key IWRM principles adopted by the Dublin Conference on Water and Environment are: "Water is a finite, vulnerable and essential resource which should be managed in an integrated manner; Water development and management should be based on a participatory approach, involving users, planners and policymakers at all levels; Women play a central part in the provision, management and safeguarding of water; and Water has an economic value in all its competing uses and should be recognised as an economic good" (GWP, 2000: 13-14).

Dublin principle one pronounces a holistic demand that, water resources are to be managed in an integrated manner. This principle calls for a comprehensive approach in managing water resources (Jeffrey & Gearey, 2006). It is argued that, integration is required of both natural and human systems within and between themselves (Bandaragoda, 2005). It also aims at managing activities to meet both socio economic and environmental objectives (Placht, 2007). In the human system, integration is required between demand and supply, across various water use sectors and among stakeholders (Bandaragoda, 2005; GWP, 2000). Within the natural system, integration is required between land and water resources; freshwater and coastal zones; surface water and ground water, upstream and downstream; "green water" and "blue water"; and water quantity and quality (Bandaragoda, 2005). This approach therefore calls for public involvement or stakeholder participation.

The fourth principle, knowing the economic value of water, necessitates the use of the market for rational allocation of water as a scarce resource among competing uses. This calls for the usage of charges and prices to guarantee sustainability and proficient expenditure of water resources and cost reclamation (Lamoree& Van Steenbergen, 2006). However, other schools of thought suggest that water should be free for the people who cannot afford to pay (Rahaman&Varis, 2005). These arguments are based on the basic right of all human beings to have access to affordable clean water and sanitation (Snellen&Schrevel, 2004; Mar del Plata conference in 1977, Agenda 21 of the United Nations Conference on Environment and Development at Rio de Janeiro, 1992 among others). In response to these concerns, in July 2010, the UN General Assembly adopted a declaration on the human right to water and sanitation (Agyenim& Gupta, 2010).

The second of these principles states that water development and management should be based on a participatory approach, involving users, planners, and policymakers at all levels while the third principle states that women play a central part in the provision, management and safeguarding of water (GWP, 2000). That is, the second and third principles highlight the fact that all stakeholders must be involved in water development and management. Nevertheless, Manzungu (2004) noted that, these two principles do not consider the fact that stakeholders of particular resources do not wield the same influence. By developing along the second and third principles, it was hoped that this would

enable stakeholders to come to a common stand, in so doing leading to an improvement in water governance

However, there is still a large gap in understanding the modalities and contrivances which will be necessary for indigenous knowledge and values to secure the central role in the sustainable management and use of water resources. This has often created conflict of role between traditional institutions and state structures set up to manage community owned resources resulting in reduced community mobilization spirit for the promotion of community owned natural resource management systems. Henrik (1996) argued that, the central government itself has often failed to successfully manage natural resources and those legislations have often tended to override customary rules which were once used to control the use of water resources.

Integrated Water Resources Management and its implementation in Africa

To ensure sustainability and efficiency of water use in the future, many including Mondello (2006) have called for the implementation of IWRM. IWRM seeks to reconcile basic human needs, ensure access and equity with economic development not overlooking the integrity of the ecosystem (Van der Zaag, 2005). The early 2000s saw a number of countries in Africa incorporated the IWRM concept into formal government structures. The concept of IWRM has been accompanied by promotion of the river basin as the logical geographical unit for its practical realization.

IWRM provides a solid framework for thinking systematically about a future in which water use is ecologically sustainable, socially equitable and

economically efficient (Snellen&Schrevel, 2004). Implementation of IWRM depends largely on how it is defined and what variables and institutions are to be integrated (Dungumaro&Madulu, 2002). The IWRM concept has brought about many reforms in Africa, especially the creation of new institutions and proper inter-sector coordination but had offered little explanation regarding how the institutions can effectively engage with stakeholders at different levels (Fatch, Manzungu, & Mabiza, 2010).

During this period, a number of African countries such as Ghana, Burkina Faso Malawi, Mozambique, Namibia, South Africa, Tanzania and Zimbabwe, embarked on water reform processes (Manzungu, 2004). The Ghana Water Resource Commission Act (1996), the South African Water Act (1998) and Mali's 2007 Water Code, among others, take an integrated approach. In furtherance of this, Burkina Faso completed an IWRM Plan in 2003 whiles Kenya, Malawi, Mali, Senegal and Zambia completed their plans in 2008.

Although IWRM emphasises the need for improved governance of water resources through the participation of various stakeholders by adopting the other principle in water management (GWP, 2000; ICWE, 1992), the conceptualization and implementation of local participation at the basin and trans-boundary level remains unclear (Fatch et al., 2010). In Ghana, IWRM is based on the basin scale-approach where basin boards manage theirrespective basins with WRC in charge of coordinating it at the national level through basin secretariat and representatives.

Criticismsof IWRM

Every change is met with challenges and with challenges are opportunities.Different institutions and researchers have questioned the practicability of the concept and the definition as too complex to understand and difficult to implement (Biswas, 2004; Agyenim& Gupta, 2011). Van der Zaag(2005) is of the view that achieving IWRM requires that there are transparency and all-inclusiveness in decision making processes. Van der Zaag (2005) cites institutional dimension, decision process and upstream-downstream linkages as some of the key challenges that hinder its smooth implementation.

Similarly, Biswas (2004) is of the view that the concept of IWRM means so many things to many different people. As a result, it is difficult to understand the actual meaning in operational terms.Biswas (2004) as cited in Agyenim& Gupta(2011) explained that, in the real world, integrated water resource management becomes very challenging since water has linkages to all development sectors including social issues hence, bringing all of it under one umbrella is practically impossible. For institutional challenges, Van der Zaag (2005) prescribes that, new water organizations should primarily serve as consultative bodies ensuring consistency in development throughout the basin rather than merely having executive functions.

Thepoise with which IWRMplan was promoted has started to fade away especially in Sub-Saharan Africa. Some critics believe that IWRM may work in the formalised water economies in the industrialised countries and not the informal

water economies of developing countries. For instance, Svendsen (2005) argued that, transferring the best practices under the IWRM plan regarding river basin management institutions to developing countries is likely to result in transferring 'north' to 'south' models of management as 'blueprint'; and imposing institutional models to vastly different socio-ecological contexts. Hooper (2006) was also of the view that,IWRM plans had failed in developing countries because too many issues were introduced at the same time leading to too many implementing tools being developedat a time which added to the intricacies.

Margerum (1995) also associated the failure of IWRM to institutional structures which did not integrate easily with the model. Water management under IWRM is argued by Sokile and Van Koppen (2004) as bias towards the formal state-based institutions hence overshadowing the local informal ones. In light of this, there is a renewed and growing call for a new vision of a more refined role for states, and other players in water resource management in informal sectors in developing countries, that allows community- based arrangements to play their full roles (Shah & Van Koppen, 2006).

Water Resource Management in Ghana

Ghana can boast of numerous water resources.They include the Volta river system basin, consisting of the Oti, Daka, Pru, Sene and Afram rivers as well as the White, Red and Black Volta rivers, which covers seventy percent of the country area with the southwestern river system watershed comprising the Bia, Tano, Ankobra and Pra rivers while the coastal river system watershed, encompass the Ochi-Nawuka, Ochi Amissah, Ayensu, Densu and Tordzie rivers,

cover the remaining eight percent of the country (Ministry of Water Resources, Works and Housing, 2007). Furthermore, groundwater is available in mesozoic and cenozoic sedimentary rocks and in sedimentary formations underlying the Volta basin. The Volta Lake, with a surface of 8,500 km^2, is one of the world's largest artificial lakes. In all, the total actual renewable water resources are estimated to be 53.2 billion m^3per year (Ministry of Water Resources, Works and Housing, 2007).

According to the Water Research Institute (2010), the river basins are utilized for hydropower generation, irrigation, domestic and industrial water supplies among others. However, a combination of factors such as population growth, climate change and watershed degradation have led to water stress and water scarcity in some communities. Most livelihoods of Ghanaians depend on these water resources.A number of international laws, protocols, agreements and declarations continue to placeobligations with regards to the management of water resources and the environmental resources on the government together with other key stakeholders (Ministry of Water Resources, Works and Housing, 2007).

The aim was to create a unified legal framework for government to allocate water rights with limits of environmental sustainability so as to treat water resources in an integrated fashion (UNDP, 2012). Several institutions have been set up by the government to help manage these resources. These include the Ministry of Water Resources, Works and Housing (MWRWH) which is the parent

ministry having the overall responsibility for the water supply sector. Examples of institutions involved in water management are discussed below.

First is the Water Resources Commission (WRC), which is the leading institution, involved in water resources management in the country. The Water Resources Commission (WRC) was established by an Act of Parliament (Act 522 of 1996) with the mandate to regulate and manage Ghana's Water Resources and co-ordinate government policies in relation to them. The Act stipulates that "ownership and control of all water resources are vested in the President on behalf of the people, and clearly defines the WRC as the overall body responsible for water resources management in Ghana". The Commission provides a forum for the integration and alliance of different interests and is composed of the major stakeholders involved in the water sector.

Secondly, the Water Directorate guides and coordinates water programmes in the country. The Environmental Protection Agency (EPA) is also another institution set up in 1993 which protects and monitors water sources from pollution and other encroachment under the Environmental Assessment Regulations (L.I 1652) of 1999 and the water user regulations (L.I 1692) of 2001. In furtherance of this, the Ghana Water Company Limited (GWCL), exercises management functions over water sources that it abstracts for treatment and subsequent distribution to consumers; the Community Water and Sanitation Agency (CWSA), is responsible for water supply to rural communities, including small towns. The Public Utilities Regulatory Commission (PURC) is the

institution responsible for reviewing and establishing tariffs and monitoring the quality of drinking water.

Water reforms in Ghana led to the adoption of IWRM plans by the WRC with the aim to "propose comprehensive plans for utilisation, conservation, development and improvement of water resources" with due consideration to stipulations in the National Water Policy and the Water Sector Strategic Development Plan (WSSDP). The Water Resources Commission (WRC) introduced the basic principles of Integrated Water Resources Management (IWRM) at decentralized level in designated river basins due to factors such as detrimental land and water quality degradation due to mining activities; encroachment on water shed zones by farming activities along the river shores; water shortages in an otherwise perennial river system caused, among other factors, by an accelerating increase in irrigation demand.

The first IWRM Plan elaborated was for the Densu River Basin which was finalised towards the middle of 2007 followed by White Volta River Basin IWRM Plan in 2008. The Ankobra Basin IWRM plan and the Pra Basin IWRM plans are subsequent ones. In 2012, intrusion into the Tano basin due to factors such as illegal loggingalong river banks and mining activities led to the adoption of the Tano basin IWRM plan to help manage the basin in a sustainable manner. It was expected that, it aids in the sustainable implementation of effective measures to improve land use practices and management of liquid and solid wastes from the mining activities as well as from the towns and communities within the basin.

Yet, it is unclear how indigenous values and knowledge systems have been incorporated in these water policies and enactment. This is because the plan only pointed out that, chiefs and queen mothers were invited as stakeholders and representatives of their people.Jackson and Altman (2009) correspondingly note that, for water planning to be successful, natural resource management practitioners need to better understand indigenous water values, interests, connections and relationships at the appropriate scale.

Indigenous Values and Knowledge

Roling and Seegers(1991) stated that,knowledge systems include sets of actors, networks or organisations which are expected to work together to support theunderstanding processes that improve the correspondence between knowledge and environment. Indigenous people have developed knowledge system over time which guides conduct in the society. Several authors have defined the term in varied ways. Dietz (1987) noted that, indigenous knowledge is stored and shared through songs, proverbs and stories. To Boelens, Chiba, & Nakashima, (2006), knowledge, skills and techniques that belong naturally to particular people and have evolved through their efforts can be termed as indigenous knowledge. Indigenous knowledge is an original form of knowledge which cultures have evolved out of the sheer need to survive.

Chowdhury (1996) also defined indigenous knowledge as the complex traditional beliefs and practices generated by indigenous people in relation to natural resource management, agriculture and human and animal health care. Indigenous knowledge has been established over decades in the cure of human–

environment interactions. Indigenous knowledge stockpiled in people's memory has also been commonly applied to remedy situations where technology is deficient. Values which include rules, beliefs and practices make up indigenous knowledge. In effect, it can be said that indigenous knowledge is local knowledge - knowledge that is unique to a given culture and society. Values in this study will be explained as the principles and beliefs that influence the behaviour and way of life of a particular group or community. Indigenous societies, in general, hold spiritual values about water that are not found in mainstream western culture and contemporary policies. These values may include taboos, norms and certain practices which vary from society to society.

Indigenous values and knowledge are essential components used by indigenous institutions in controlling behaviour in society. Olson (1965) refers to institutions as the collectively agreed upon social arrangements that oversee the interactions among members of a given group of people. Institutions spells out the rules of the game in a society or more formally, the humans devised constraints that shape human interaction (North, 1990). In this case, North, (1990) explains that,institutions reflect power relations in a community, which shape the ways in which differentiated actors access, use and derive well-being from environmental resources and services. They play a critical role in sustainable management of natural resources through defining property rights. For example, institutions ascertain who can graze cattle on a particular pasture and who cannot, and also define one's share (World Bank, 1993). Institutions promote stability of expectations ex ante, and consistency in actions, ex post, from

different actors (Agrawal& Gibson, 1999). Hence, it is increasingly believed that "getting institutions right" is as important as and inextricable from "getting incentives right", if sustainable resource development is to be achieved (Barett, 2004).

Components of Indigenous Institutions

The constituents of indigenous institutions may vary in different parts of the world. The traditional institutions in which values and knowledge are embedded in played a key role in ensuring that those who broke the rules were punished. These collective actions in natural resource management were expressed through religious beliefs, moral sanctions and a range of sacred and cultural practices (Bonye, 2008). The resilience of these beliefs and practices stood the test of time in natural resource management. The majority of the people (in the rural areas) in Ghanaare organised around various indigenous institutions for carrying out the activities that are important for their development and wellbeing in spite of the modern national political organisational system (Opoku-Ankomah et al, 2006). In actual fact, civil society in rural Ghana is embedded within these indigenous institutions and they are crucial to the organization of people at both rural and urban levels for their socio-economic development (Millar, 2004).

Indigenous institutions possess authority and is explained here as the leadership structures including (chiefs, clan heads, sectional heads, household heads, opinion leaders and women leaders) within the community who are by custom ascribed or elected (traditional forms) and provide the necessary

leadership which ensures that the norms, practices, and values of the community are respected (Mohammed-Katerere, 2004). Indigenous institutions often embody historical and lineage alliance with their territory that empowers them with important rights and obligations (Williamson, 1999). Their primary functions are to ensure peace and harmony in the rural communities within their territory.

In furtherance of this, their functions encompasses regulating access to land, holding land in trust on behalf of the people as well as mediating disputes over land, thefts of crops, and misconduct. Furthermore, sacrifices as well as mobilising people to participate in community activitiesare spearheaded by indigenous institutions. Chiefs, for instance, assumed key leadership roles in the traditional authority structure in the management of natural resources in their communities (Mohammed-Katerere, 2004). Taboos and totems are key tools used in beliefs and practices by indigenous institutions to control access to and use of natural resources. Taboo can be explained as acts that are seen as forbidden in societies.

Indigenous Knowledge in the Management of Water and other Natural Resource

The contribution of indigenous cultures and institutions are often overlooked as natural resource management issues in developing countries are increasingly imitating western prototypes (Fairhead& Leach, 1994). It has become increasingly clear that more viable and sustainable alternatives for natural resource management have to be sought if the drastic loss of

biological and cultural diversity is to be restrained and regeneration is allowed to occur (Yahaya, 2012). Several success stories have been reported internationally, where indigenous knowledge and values have been sought in connection with scientific knowledge. For instance, the collaborative research between the Rovina Lagoon indigenous groups of the Solomon Islands and marine scientists conducted in response to the local sea-tenure system resulted in the formulation of techniques for protecting endangered species of fish (Aswani& Hamilton, 2004).

Baird and Dearden (2003) likewise reported the successful planning and management of tropical nearing extinction areas in Cambodia using the local Brao people's resource tenure arrangements.An investigation into the causes of fish poisoning by scientists and the indigenous elders of the MalanbarraYidinji clan of Australia, for example, led to development of ways to protect culturally important fish species (Gratani, Butler, Royee, Valentine, Burrows, Canendo& Anderson, 2011). Similarly, collaborative work on sustainable harvesting of a culturally important pigeon helped to conserve the endangered bird using New Zealand Māori management strategies (Lyver, Jones, & Doherty, 2009).

Local institutions in the management of sacred groves such as"jatipanchayats" and "gaonmokhi" in India is reported by Aggarwal (2008) to show some promise through their successful natural resource management. Remarkably, these institutions have been able to conserve and manage natural resources much better than the usually externally imposed, technocratic, and resource intensive management systems (Henrik, 1996). Consequently, it can be inferred that these local systems managed resource efficient and effective manner

although most of these institutions operate informally at a limited scale (Aggarwal, 2008).

Likewise, in the Borana zone of Ethiopia, the local governance system called 'gada' is headed by the 'aba gada' , who carry out rituals and resolves social conflicts as well as governing natural resource management systems. 'Aada sera', include a set of laws for native people which guides all aspects of their life including dressing, food, social relations and the use of natural resources (Watson, 2003). In the case of the indigenous irrigation system instituted in Marakwet, Kenya, water rights are organised on the basis of institutions of village heads called 'kor' and clans termed 'kapkei'. It is arranged on the basis of gender and other complex social arrangements. One of the most important reasons why these indigenous institutions work is their social embeddedness. This makes people stick to the rules as trespassing them means trespassing the entire social system.

In Ghana, Awedoba (2002) reports that, certain animals and natural objects are considered as relatives, or ancestors hence killing some kinds of animals, believed to be totems is a taboo. Some animal species could not also be hunted during certain seasons (breeding season), avoiding the risk of depleting the resources (Bonye, 2008). Hunting of animals was restricted to males or older animals. This system is close to the culling practice of sustainable harvesting of wildlife resources among the people of Central Southern Africa. Adhering to taboos and totems ensured the continued population growth of their wildlife resources, while at the same time benefiting from the protein which is usually

lacking in environments where livestock keeping is difficult because of tsetse flies (Warren, 1992).

Consequently, sacred sites survived over several years and acted as reservoirs for biodiversity (Gorjestani, 2004). Nukunya (2003) also averred that, it was a taboo to catch some species of fish (Mudfish) believed to be totems among the Bosumburu clan of the Akans. Communities observed fishing seasons usually through a set of traditional ceremonies. Such a ceremony would usually open the fishing season. These practices ensured sustainable resource exploitation in the past and enhanced fairer dissemination of income. Other instances can be cited of fish from the river Bafo in the Ashanti Region which is not eaten by the inhabitants of the village (Appiah- Opoku, 1999). It can be stated that taboos were central in restricting people to traditionally protected areas. Only specialized people such as the fetish priest and other spirit mediums were allowed to these areas.

Water bodies were regarded as sacred and therefore it was a taboo to catch and eat fish from these water bodies. In certain Akan communities, it is a taboo to go to the river side on Tuesdays. It can thus be deduced from the discussion that, the management and use of natural resources in these areas very much depended on unwritten regulations (Millar, 2004). Hence, the chief and elders played a vital role in ensuring that those who broke the rules were punished either by paying a fine, banishment or attracting spiritual punishment from the gods. These regulatory mechanisms accounted for the survival of these protected areas over time and sustainable management of natural resources (Nukunya (2003).

Since indigenous knowledge (IK) and indigenous institutions are being recognised as essential in sustaining development initiatives, certain initiatives have begun to promote the inclusion of indigenous knowledge in water resource management. The Indigenous Peoples' Kyoto Water Declaration in 2003 prepared by native participants at the 3rd World Water Forum in Japan,for instance, supported the inclusionof indigenous interests in water and water protection issues. The declaration specifically affirms Aboriginal people's relationship to Mother Earth and responsibilities to future generations. Furthermore, section fifteen (15) of the declaration outlines the role of IK in water management and the fortes it can bring to addressing global water issues (Boelens, Chiba, & Nakashima, 2006). The declaration argued that, traditional practices are dynamically regulated systems and are based on natural and spiritual laws, ensuring sustainable use through traditional resource conservation.

Long-tenured and place-based traditional knowledge of the environment is extremely valuable, and has been proven to be valid and effective (Jackson & Altman, 2009). This therefore suggests that, traditional knowledge developed over the millennia should not be compromised by the over-reliance on relatively recent and narrowly defined western reductionist scientific methods and criterions. A series of internationally developed documents has also supported indigenous peoples' call for increased recognition of the importance of indigenous knowledge in resolving environmental crises, including those involving water (Boelens et al., 2006).

For instance, United Nations Convention on Biological Diversity and the United Nations' principles and guidelines for the protection of the heritage of indigenous people recognises the vital role indigenous knowledge can play in helping to protect environmental resources. The Indigenous Peoples' Kyoto Water Declaration in 2003 supported the implementation of strong measures to allow the full and equal participation of indigenous peoples to share their experiences, knowledge and concerns. In the same vein, Kgosietsile and Jeremy (2008) supported the declaration and asserted that, the indiscriminate and narrow application of modern scientific tools and technologies have contributed to the loss and degradation of water.

Empirical Review of Indigenous Values and Knowledge in the Management of Water and other Natural Resource

Jackson and Barber (2013) sought to assess indigenous water values and interests in Australiawhile highlighting current progress and on-going challenges for social justice in water planning usingRoper river catchment area in the northern territory as cases. The research was carried out under apact between the commonwealth Scientific Industrial Research organisation (CSIRO) and the Northern Land Council (NLC), which denote the traditional owners of the Roper River area. The research was conducted in 2010 and 2011 using methods such asarchival and literature searches, semi-structured interviews and participant observation at meetings and field excursions. Respondents were sampled using snowball sampling. The criteria used to select respondents included seniority, knowledge of the country, place and duration of residence.

In all, a sample size of 33 was used for the study. It was found out that, continuous occupation of the area by the local people has generated a distinct and strong attachment to land and waterscapes as well as considerable knowledge of its local features. These include rich set of stories;water serving as a unifier and identifier creating relationships and connection and historical associations which have generated protocols regarding human conduct and a concern with the maintenance of water for the country over the years.Jackson and Barber (2013) concluded that, although water plans were increasingly effective at acknowledging indigenous water values and interests, there is the need to resource indigenous capacity to undertake on-going land and water management.

Similarly, an assessment of indigenous knowledge in water and watershed management using 'Marakwet' conservation strategies and techniques in Kenya was done by Cheserek(2005). Broadly,the mixed methods research design together with exploratory research design was employed by the researcher. In furtherance of this, four divisions that traverse the three topographic zones of the Kerio Valley were purposively sampled for the study; then two divisions were randomly selected for study. These were Tunyo and Tot divisions. Simple random sampling was then used to identify household respondents for interviews. Samples size of 220 was usedwhich included males and females aged between 25-70 years. The respondents were interviewed while undertaking their daily activities using open-ended schedules. Structured questionnaires were administered to 35 key informants that included government workers, community leaders, churches and NGO workers.

Non-participant observation was then used to observe minute water management techniques. The data was analysed using descriptive statistics and cross tabulation, and reported using tables and percentages.Cheserek(2005) found out that the Marakwets were endowed with indigenous knowledge that played a big role in the management of water and watersheds. It was recommended that indigenous knowledge systems should be integrated in watershed management plans in arid and semi-arid lands and in the Kerio Valley in particular.

Correspondingly, Kgosietsile and Jeremy (2008) also conducted a study in the Southern Kalahari of Botswanawhere they explored the integration of indigenous technical knowledge and modern scientific knowledge for biodiversity conservation and human livelihoods. The study tested the assumption that, local people still employed indigenous ways in managing veld products and wildlife. The study employed both quantitative and qualitative research designs in data collectionconsisting of participatory methods such as the administration of questionnaires, key informant interviews and focus group discussions. It was concluded that a combination of indigenous and modern knowledge can be used to improve management of both veld products and wildlife in the region and that the best way to achieve this would be through the adoption of a Management Oriented Monitoring System (MOMS) which can be supervised by the state.

For Ayron and Astier (2011), the objective wasto examine Traditional Resource Management (TRM) among the Sonjo in rural Northern Tanzania, with particular reference to catchment forest protection and water quality. Using both

qualitative and quantitative methods to examine water use, and perceptions of water quality, it was reported that significant differences exist among river basins within seasons and between seasons. Their finding indicated that Sonjo, which is well known for their traditional forest conservation practices and irrigation management, may also benefit from TRM through improved water quality. Ayron and Astier (2011)asserted that, the scrutiny of traditional methods of water conservation provided understanding into how communities in resource-stressed regions thrive despite seasonal droughts and flooding. Thus these, findings concurred with findings from the studies done by Kgosietsile and Jeremy (2008) and Cheserek(2005) that indigenous knowledge can be used to sustainably manage natural resources.

In Ghana, some studies report the success of indigenous institutions in the managementof water resources. For instance, to assess water user associations and indigenous institutions in the management of community-based irrigation schemes in north eastern Ghana;Derbile (2010) made analysis based on primary data from two communities (Gumbrugu and Kasena) in the upper East Region as well as secondary data from a baseline studies conducted in the upper East and upper West regions on the Socio- economic dimensions of small-reservoir management and food security. In this study, both the quantitative and qualitative research designs were employed.

The simple random sampling technique was used to sample two communities from six purposively sampled communities who had community based irrigation schemes. In-depth interview guides, and focus group discussion

guides were used as instruments for data collection.Derbile (2010) found out that the management of community-based irrigation schemes strongly draw on the supportive roles of indigenous institutions for discharging their management responsibilities more effectively. That is, management institutions such as the Water Users Associations (WUAs) draw on the strengths and resourcefulness of indigenous institutions, particularly traditional authorities through their direct participation in operational and management functions such as land allocation, water resource management and mobilization of labour for project maintenance activities. This,Derbile (2010) reports produces sustainable and efficient management of the irrigations systems in the communities.

Zakaria (2012) also assessed the role of traditional institutions in the management of natural resources in the West Gonja traditional area in Northern Ghana. Both the qualitative and quantitative research designs were employed for this study. Instruments used included focus group discussion guide, observation checklist, interview schedules and questionnaires. Yet, Zakaria (2012) did not specify the kind of analytical tool used for data analysis of both the qualitative and quantitative data collected. The major findings were that,traditional practices and beliefs as well as norms have over the years played an important role in the management of natural resources and are still important though some of the practices have undergone modifications and are held in high esteem when it comes to the management of natural resources in recent times.

There are some challenges with regards to the management of natural resources by traditional institutions in the study area which include political

interference, difficulty in applying sanctions to close relatives, disrespect for indigenous beliefs and lack of logistical support and funds. It was also found out that agencies such as the District Assembly, Forestry Commission and the Environmental Protection Agency play countless roles in the management of natural resources. However, insignificantalliance exists between formal institutions and traditional institutions.

As a result, traditional authorities do not have ample information in terms of policy formulation and implementation Traditional institutions are less involved on the management systems of natural resource policy issues though they have over the years managed natural resources in their own. Lastly, it wasdiscovered byZakaria (2012)that women only occupied positions like magazias, but do not occupy positions like chiefs, elders, "kasawule-wurah" (land priest) and clan heads in thetraditional area hence limiting the level of women's participation in natural resource decision making process.

From the findings, Zakaria (2012) asserted that the traditional area should consider the use of endogenous development approach to policy building which would involve appraising and using indigenous natural resource management systems as aninitial point to an interactive policy building amongst traditional and formal institutions. In addition, District Assemblies' and Non-governmental organizations should consider expanding and including women in the management of natural resources in that particular traditional area. This, he argued could be done through designing collective strategies to support the activities of women in the traditional area. Zakaria (2012)

recommended that policy makers needed to mainstream theroles oftraditional institutions into natural resource policy issues which was suggested could be done through advocacy, dialogue, lobbying, networking and mobilizing as well as building consensus with traditional institutions.

Studies conducted by Bonye (2008) sought to explore how synergies can be harnessed with emphasis on the role of traditional institutions in natural resource management in the northern region of Ghana using communities in the Talensi-Nabdam District of Ghana as cases. To achieve this, mixed method research design was used.Purposive sampling technique was used to select traditional institutions (Chiefs, Tindanas, Clan heads, Magazias, Family heads, Soothsayers, Diviners, Medicinemen, women and Rainmakers) and groups in natural resource management who were interviewed for their take on the topic under discussion.

The study also employedParticipatory Rural Apparaisal (PRA)tools wherethe researcher haddiscussions withgroups (men and women) and individuals in critical arenas. Information was also collected from government agencies such as EPA, MOFA, NADMO and DA as well as NGOs operating in the district pertaining to their relationship with the traditional institutions in natural resource management. Bonye (2008) used a total sample size of 115. Interview schedules, questionnaires, observation checklists and in-depth interview guides were the instruments used in collecting the data.

Bonye (2008) reports that, indigenous beliefs and practices which stood the test of time in natural resources management were fading way. This was

because these beliefs and practices were found to be unpopular with children and the youth. Bonye (2008) then suggested that, building communities' confidence in their own indigenous knowledge in NRM through capacity strengthening will enable them understand and cooperate with local governance structures, and institutions concerning the use of these common goods.

Community based water resource management with emphasis on collective actions to manage water resource to improve livelihoods using the Volta Basin as a case was also undertaken by Anowie (2012). To accomplish this, data was collected by employing key informants interviews, focus group discussion and observations in selected rural communities along the Black Volta in the Upper West region of Ghana. Anowie (2012) found out that rural communities use their long standing social and cultural practices to manage and develop water resources. It was also found out that, the only means of livelihoods was to exploit the natural resources, yet, respondents concurred that they were aware of the negative consequences that their actions had on water resources and the environment as a whole.

However, Anowie (2012) reports that, communities were not enthused to put in place and enforce the right processes for sustainable management unless a joint action that sought to protect and preserve natural resources which did not overlook the need for them to survive on the resource was implemented. That is, respondents were willing to own and sustain any waterproject or development programme which integrates their ideas and their contributions and presence. Finally, Anowie (2012) concludes that althoughindigenous knowledge systems

which include tools such as taboos, prohibitions and common belief in communities along the basin were being used in water management; it was minimal and as such suggested that they are integrated in formal policies to ensure sustainability and efficient use of the water resources.

It can thus be deduced that, indigenous knowledge systems are vital tools that can help in water management in Ghana. Although most rural areas in Ghana use indigenous knowledge and value in the management of river and other water related resources, it is unclear the extent to which these values are incorporated into basin management and water policies of the country (Bonye, 2008). From the studies discussed, it can be argued that, in order to have sustainable water resources management, there is the need to integrate informal and formal knowledge systems as they prevent resource depletion through traditional and modern laws. This is because, peoples' livelihoods revolves around these resources. Promoting both strategies would enhance the sustainability of these resources.

Counter Argument on Relevance of Indigenous Institutions in Water Resource Management

Indigenous institutions have been criticised on account of being invented and manipulated; gender biased;for concentration and abuse of power and their role in changing socio-economic environment (Aggarwal, 2008). Power in such cases is vested in one family and it is hereditary. Hence, there is little chance given to other members of the community to share responsible positions. Yet, other scholars argue that, such hierarchy can be a resource to

ensure compliance of rules in such communities if regulated properly (Van Koppen, Giordano & Butterworth,2007).

Van Koppen et al., (2007) argued that the state can come in to assist in eroding such inequalities through policies, enactments and awareness creation to ensure that the strengths in community based institutions such as being robust in their resource use, adaptive and dynamism as well as nested structures for conflict resolutions through rules that match notions of fairness is not lost.Strengths such as inclusive and holistic; cost efficient and their flexibility are identified of indigenous institutions. On the basis of inclusive and holistic strengths, it is argued that indigenous institutions, however, espouse local knowledge, culture, and work on the basis of social networks and associations. They are inclusive and reflect poor people's true development needs unlike the conventional development models which are top-down and where benefits hardly reach intended people.

Also, these models promote development in a sectoral way. Van Koppen et al. (2007), are of the view that indigenous institutions provide alternative approaches to development, which are holistic. A case in point is the Maori tribe of New Zealand, which has a holistic perspective on well-being. Here, natives believe that employment, economic development, learning, food production, health, natural environment, wisdom of ancestors, culture and vibrant social institutions are all interdependent and interrelated. Furthermore, sectoral demarcations between social, cultural and economic areas are not

recognised (Loomis, 1999). This is true for many indigenous communities and institutions the world over.

Secondly, social embeddedness and being adaptive to local settings make indigenous institutions cost efficient for natural resource management (Van Koppen et al., 2007). That is, resources can be monitored and decisions can be taken quickly and accordingly, changes can be made in a less costly manner as compared to externally imposed institutional structures. Hence, available resources can be put to their most efficient and sustainable use with location-specific knowledge, which is best generated and interpreted locally (North, 1990). Similarly, conflicts related to resource use can be swiftly addressed at the local level, whereas bureaucratic systems are generally oblivious of the local situations and take a longer time to address these issues. Therefore, indigenous institutions can have an upshot on the economy that creates an imperative link between collective action and development (Nabli& Nugent, 1989).

Problems with Attempts to Integrate Indigenous Knowledge in Water Resource Management Policies

Some scholars believe that there are basic differences between an indigenous way of knowing and the western paradigm which do not mesh. Thus, indigenous scholars have defined several other spiritual and cultural elements of indigenous worldview that are primarily different from the western worldview. For instance, the work of Bielawski (1992) pointed to the underlying divergence between scientific and Inuit knowledge bases. In this case, the Inuit do not

separate people from nature, while arctic scientists do. For La Duke (1994), recurrent thinking and reciprocal relations and responsibilities to the earth and creation could be seen as common system of belief in an indigenous worldview. This may suggests that, indigenous knowledge which comes from this worldview cannot be easily integrated with dominant western ways of managing resources. Indigenous knowledge is also rejected by some scholars on the basis that it cannot be validated.

Nevertheless, there has been a great deal of effort to compare and contrast indigenous knowledge with scientific knowledge in the hopes of finding common ground on which to better integrate indigenous knowledge into natural resource management (Mailhot, 1993; Berkes, 1993;&Hipwell, 1998). These studies have tended to focus on how the three main characteristics of science, notably reductionism, objectivism and positivism differ from indigenous knowledge. Furthermore, these studies have shown why indigenous knowledge holders are often sceptical of western science and management institutions. Yet, it is suggested that, rather than seeking ways to integrate this 'data', other researchers are pointing to the need to understand indigenous knowledge as part of an entirely different worldview with its associated values, institutions and management systems (Huntington, 2000; Johnson 1992).

Conceptual Framework

Base on the above review, the conceptual framework as shown in figure one (1) will guide this study. This framework is informed by the endogenous theory of community development (where community leadership and knowledge

is considered an asset to community development) and various concepts reviewed. It is being suggested that, indigenous institutions are made up of actors including chiefs, elders, family heads, and all community members as a whole who may interact in a hierarchical manner. These actors possess indigenous knowledge which may include community's norms and practices. In furtherance of this, it is proposed that, these norms and practices can be incorporated into formal laws and policies being used to manage water resources in the basin which is expected to lead to sustainable water resource management.

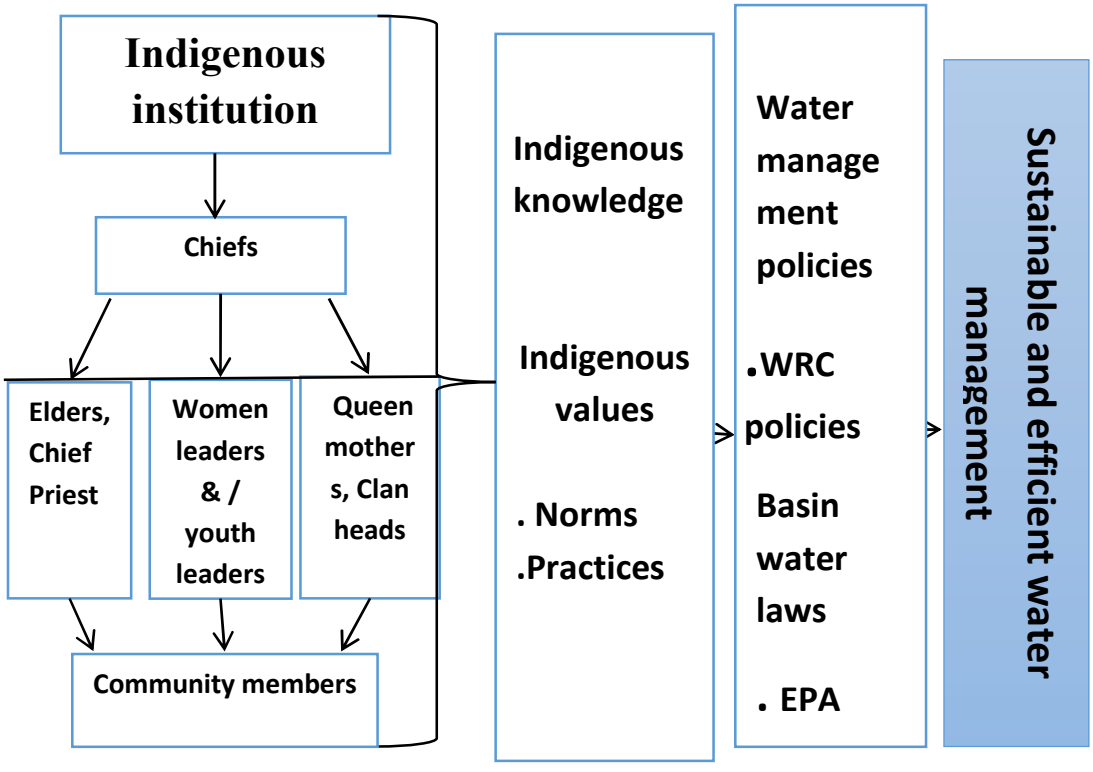

Figure 1: Conceptual Framework

Source: (Pretty, 2003)

Chapter Summary

In summary, it could be noted that, water is one of the essential resources that underpins development and key to livelihoods of humankind. It has also been reviewed that, water management and sustainability have been given due attention by the international community over the years through several conferences which has led to the promulgation of policies, principles and frameworks such as the Dublin principles that seek to guide water management all over the world. River basin plans based on the integrated water resource management framework (IWRM) have also been developed out of several conferences over the years including Mar del Plata conference of 1977 to ensure sustainable management of river basins.

Several arguments have supported indigenous knowledge and values in the management of water resources yet the extent to which they are integrated in international, national or local water management policies is not clear. When used as a common good, water also faces the problem of free riding in its management; yet, Runge (1984) and Ostrom (1999) argued that, incentives based on social norms can be developed within groups such as indigenous institutions which can help in the management of the resource. Community leadership and locally available knowledge is argued by endogenous development approach to be vital in ensuring community development

CHAPTER THREE

METHODOLOGY

Introduction

This chapter describes the methods that were used in gathering data for the study and how data was analysed. Specifically, the chapter covers the data sources, target group, research gathering instrument, sampling procedure, and data analysis procedures. The main objective of the study was to obtain information on indigenous knowledge in water resource management in the upper Tano River basin of Ghana.

Study Area

The Tano Basin is a fragment of the south-western river basin system of Ghana. It can be found between Latitudes 5^0 N and 7^0 40' N, and Longitudes 2^0 00' W and 3^0 15' W. The Tano basin traverses three administrative regions: the BrongAhafo, Ashanti, and Western Regions, comprising twenty one administrative districts. With a total catchment areaof about15,000 km^2, seven (7) percent is found in La Côte d'Ivoire and ninety three percent in Ghana. The main Tano River takes its spring from the highlands at Tuobodom near Techiman in the Brong Ahafo Region at an altitude of 518 meters above sea level, and flows for 400 km to discharge into the Aby Lagoon in La Côte d'Ivoire. The major tributaries comprise Abu, Amama, Boin, Disue, Gaw, Kwasa, Sumre, Suraw and Totua streams.

The basin can be divided into three sections; namely upper, middle and lower sections. This study focused on the upper river basin. The upper Tano river basin flows through five districts in the BrongAhafo region of Ghana. These include Techiman Municipal, Tano North, Tano South, Sunyani West and Sunyani Municipality. The study did not select respondents based on administrative regions but rather based on the traditional governancestructures along the basin. This is because, the traditional institution were homogenous across the upper Tano basin.The upper part of the basin is purposively selected because it is in the frontier zone between the savannah and forest ecological zones. In the same vein,arable lands occupy the highest percentage of the total landmass in the upper Tano basin area.

The Tano River Basin constitutes a major source of domestic water supply from surface and ground water. It is therefore argued that, communities in this transition zone can help the researcher answer the objectives for this study. According to the Water Resources Commission (2012),the climate of the upper basin falls partly under the wet semi-equatorial and partly under south-western equatorial climatic zones of Ghana. It is thus characterised by double rainfall maxima (May-July and October-November).

Mean annual rainfall of the upper basin according to the WRC (2012) is generally between 1200mm and 1300mm.The basin is warm and moist with relative humidity between 75%-85% throughout the year. The topography of the upper Tano Basin is characterised by relatively flat land although few peaks can be found in the mid to northern sections of the basin. The highest elevations

in the basin are located in the northern sections and the fringes of the eastern parts where elevations of up to 500 metres above sea level are common(WRC, 2012). The upper basin falls in the moist-semi-deciduous agro-ecological zones (AEZ) of Ghana and is also endowed with forest reserves such as the Apaape, Bosomkese, Yaya and Amama Forest reserves.

Timber logging is another important industry within the forest belt.Harvesting of timber is carried out in concessions granted to timber companies by the Forestry Commission although some illegal loggings also go on. Communities along the upper basin are leading producers of oil palm, cocoa, coffee and food crops such as plantain(WRC, 2012). For instance, communities along the basin in Techiman Municipality produce several food crops making the municipality home to the famous Techiman market and the largest food crop market in Ghana.

Apart from the formal governance system comprising assembly members, unit committee members, members of parliament just to mention a few which cut across all areas of Ghana, the riparian communities along the upper Tano basin are also governed by chiefs and elders. Other social structures include asafo companies, queen mothers, household heads, and youth leaders (WRC, 2010). These structures exert authority and influence over activities of members of the various communities. Figure two (2) presents a map of the Tano basin depicting the upper Tano basin.

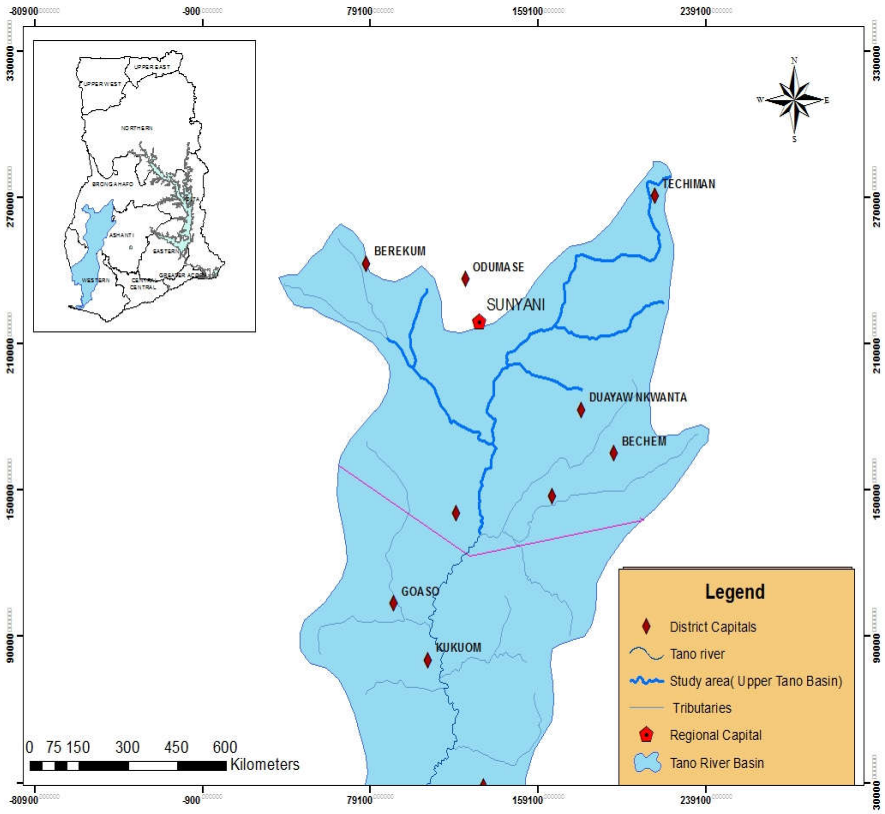

Figure 2: The Tano River Basin Showing the Upper Sub-Basin.

Source: Department of Geography and Regional Planning, U.C.C (2015)

Research Design

Creswell (2008) noted that, research design includes the plans and the procedures for research that elaborate the decisions from broad assumptions to detailed methods of data collection and analysis. The research design refers to the overall strategy that determines the blueprint for data collection, measurement and analysis. Broadly, the study employed the qualitative research approach. A qualitative research design according to Denzin and Lincoln (2000) highlights the qualities of entities, processes and meanings that are not experimentally

scrutinized or measured in terms of quantity, amount, intensity or frequency. That is, quality refers to an object or a thing's essence and its environment. This includes the what, how, when and where of it. Berg (2007) is also of the view that, qualitative research designs deal with the meanings, concepts, definitions, characteristics, metaphors, symbols and description of things.

Qualitative research design seeks to answer questions that stress on how social experiences are created and give meaning (Creswell, 2009). It also helps gather information from the respondents in their natural settings. It is believed that the information obtained by employing this approach would reflect the subjective opinions of the respondents about the phenomenon under study. Specifically, the study used a descriptive study design which aims at collecting data in order to describe the social system, relations and social event of the study area (Sarantakos, 2005). A descriptive study design helps in providing information about the naturally occurring phenomena such as behaviour, attitudes or other characteristics of a particular group.

Target Population

Schwandt (2007) defined population as a set of persons or objects that possess at least one common characteristic. These elements of the population are potential cases. The research was based on adults (18 year and above) in selected communities along the upper Tano River who could provide the needed data for the study. Chiefs, queen mothers and opinion leaders in various communities also formed part of the population for the study. In addition, officials in charge of

natural resource management in the district assemblies as well as WRC basin secretariat officer were also part of the target population.

Sampling Procedure

Bhattacherjee (2012) defines sampling as the statistical process of choosing a subset (called a "sample") of a population of interest for purposes of making observations and statistical inferences about that population. Since the study was aimed at assessing indigenous knowledge in water management in the context of the upper Tano basin, non-probability sampling techniques were employed. The purposive sampling procedures wasused. Schwandt (2007) noted that, purposive sampling involves strategies in which the researcher exercises his or her judgment about who will provide the best perspective on the phenomenon of interest, and then intentionally invites those specific perspectives into the study.

The upper Tano basin consists of five districts. These are, Techiman Municipal, Tano North, Tano South, Sunyani West and Sunyani Municipality.Five communities were purposively sampled from each district for this study since all the communities along the river in the upper basin are homogenous based on the traditional institutions. Thus, selection of communities was based on traditional governance structures and not the administrative district.Purposive sampling was used to select respondents in various communities who had ardent knowledge on the topic under study. Key informants included chiefs, queen mothers and other stakeholders who provided relevant data as far as indigenous knowledge in water resources management was concerned.

Table 1 throws more light on the number of communities visited and respondents interviewed.

Table 1-*Respondents for the Study*

Communities visited	**Respondents**
Techiman	One Sub chief, four elders, queen mother, FGD for the youth and the planning officer of the Municipal assembly
Aworowa	FGD for women and the youth
Krobo	FGD for Women and the youth
Tanoso	Chief, three elders, queen mother, one youth leader/former assembly man
Tanom	Chief, chief priest, FGD for women and the
Chiraa	youth
	Nifahene, FGD for women and the youth
Sunyani	Planning officer: Sunyani Municipal assembly; officer: Environmental protection Agency; Officer: Tano Basin secretariat office of the Water Resource Commission
Odomase	Planning officer: Sunyani West district

Source: Fieldwork, Awuku (2016)

Data Sources

The study used both primary and secondary data sources. Primary data was obtained from the study area, ie; from key informant such as youth leaders, traditional leaders among others from five communities in the upper Tano basin. Since the study was a qualitative study and communities were homogenous based on the traditional governance structure, five communities could provide relevant data for analysis. Secondary data was obtained from District Assemblies archives, the Tano basin secretariat office and the regional offices of the Environmental Protection Agency and the Forestry Commission in the Brong Ahafo Region.

Data Collection Methods and Research Instruments

Data collection methods include the procedures and the processes involved ingathering data. This is done with the aid of research instruments. Research instruments are the tools that are used to collect the data. In this study, interviewing, observation and focus group discussion were the main data collection methods. Bryman (2006) explained that interviewingencompass a communication between an interviewer and a participant (or interviewee). As a result, "qualitative interviewing requires intense listening and a systematic effort to really hear and understand what people tell you" (Bryman, 2006). For FGD, Yin (2011) argued that it involves gathering individuals who beforehand have had some common experience or presumably share some common views. Furthermore observation may involve collecting data with the eyes and perceived with the others senses. Interview guide, observation checklist and FGD guide werethe instrumentsused to collect relevant data for the study. In conducting the

interviews and discussions, permissions were sought from research participants so that recordings couldbe done as well as pictures taken where necessary. In organising FGD for respondents, the youth leaders assisted in organising youth between the ages of 18-35 who were indigenes of the communities. Each FDG consisted of 8-12 people. Field assistance helped to ensure that discussions went on well. In the case of the women, the queen mothers who took part in the study assisted in gathering women who were indigenes of the community.

Data Analysis

Data analysis according to Cohen, Manion, and Morrison (2007) involves organising, accounting for, and explaining the data collected. In a nutshell, data analysis comprises making sense of data in terms of participants' definitions of the situation, noting patterns, themes, categories and regularities. The narrative discussion approach was used for analysis. The data collected from the field were first cross-checked and edited to ensure that there were no mistakes in the responses and the information given were relevant. That is, first and foremost, field notes amassed from the fieldwork and other data collection were compiled and sorted.

Compiling here therefore means putting them in some order. Secondly, compiled data were broken down into smaller fragments or pieces which were accompanied with assigning new labels to the fragments or pieces. Discussions were done under each theme which was supported with pictures, where relevant.

Ethical Considerations

Ethics refers tonorms of conduct that distinguish between acceptable and unacceptable behaviour. According to Schwandt (2007), it is unethical to collect information without the knowledge of participants in social science research.Research ethics include the values and systems put in place to ensure the veracity of a research. Research ethics are in place in order to guard subjects or research participants from any physical, psychological and social harm and to ensure that their rights are not violated. In the course of this study, access to the community was sought from chiefs and elders.

Since it is considered unethical for a researcher to pressure or compel a respondent to participate in a study, the participants were given the free will to participate or take part in the study. Furthermore, theconfidence of the community members was gained before they took part in the study. That is, issues were explained to them to avoid the fear or the idea that the information gathered was going to be used against them. In furtherance of this, ethics in research such as prior informed consent and gaining access to and acceptance in the research setting were observed.

Field Challenges

During the data collection process, some challenges were encountered. These includedthe absence of some of the targeted respondents, unwillingness of some of the respondents to partake in the study and the busy working schedules of some of the respondents. That is, some of the respondents were not present upon arrival. Upon inquest, some indicated the date and time they would be available.

Due to this, subsequent visits were made at extra cost to interview such respondents. The native language spoken was also a slight barrier to the data collection process but it was dealt with by the help of field assistants who explained the views of respondents in Asante Twi and English for easy understanding and analysis

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Introduction

The chapter presents analysis of data on indigenous knowledge in water resource management in the upper Tano River basin including indigenous practices, norms and beliefs that existed in the management of the water. Furthermore, the chapter discusses the interface between formal water policies/laws and informal laws as well as challenges facing indigenous institutions in managing water resources.

Objective One: Indigenous Knowledge that Exists in the Management of Water Resource

The Tano River is the longest river in the Brong Ahafo Region of Ghana. It was established from the interviews conducted that the river served several purposes. These included being used for domestic purposes such as bathing, washing and cooking; for irrigation; and for industrial purposes. The chiefs interviewed elucidated that, the river, under the management of the traditional council was treated as a common good. This was because it was seen as a resource that has been given to all and sundry by 'Odomakoma' (the creator) and

the gods. This supports the statement made by Sarpong (2008), who established that, in the pre-colonial times, water in various forms such as rivers and streams were regarded as common property in Ghana hence it was not exposed to individual claim of ownership.

Due to this, no one was restricted from getting access to the river resource. Yet, the chiefs and elders interviewed explained that, taboos were put in place in various communities in order to help control the actions of people towards the use of the river and for responsible usage of the resources in and around it such as trees and aquatic animals in the river. The river was managed based on indigenous beliefs and practices that were enforced by indigenous institutions. The structure of indigenous institutions responsible for the management of the upper Tano River basin is discussed as follows.

The communities selected to be part of this study fell under the Techiman, Sunyani, Bechem and Chiraa traditional areas. The study sought to describe existing indigenous governance systems in the upper Tano basin. The dominant spoken language in the area is the Bono language which is a form of the Twi language spoken by the Akans in Ghana although slight variation exists in the way bono is spoken. The chiefs spoken to during the study explained that, 'Oman' in Akan means state which comprises communities categorised according to sizes. These include hamlets, villages, towns and cities which are headed traditionally by a paramountchief called 'Omanhene' in Akan. Each community has its own overlord which in Akan/Twi is termed 'Odikuro' or basically 'Ohene'.

In the Techiman traditional council, the hierarchy consisted of the 'Omanhene' and his sub chiefs. Similar cases were found in Chiraa and Tanoso (i.e Bechem traditional council). The selection of a ruler and enstoolment according to elders in Tanom, was through hereditary process. This includes the selection of usually males from royal matrilineal families in the communities who were accepted and respected by all citizens. This was done by a group of 'kingmakers' in a very competitive process from among a potentially large number of candidates.

The selected person could be removed or 'destooled' if the kingmakers believed he had breached his oaths of office, although this was usually not an easy process, and frequently incited violence in certain cases. The king, once in office, is assisted by a court of servers and a council to advise him, to make and construe laws, to impose taxes, and to wage wars as done in the past.That is, chiefs in the indigenous institutional setting were seen to be the political leaders of the indigenous communities who wielded authority over community members and also over migrants who settled on their lands or in their territories.

The traditional councils exercised authority and governed the people through adjudication of cases and invocation of traditional taboos including the governance of natural resources. This implies that, the chiefs and elders served as law makers and attorneys who sat to resolve conflicts between people in their communities and even held the power to decide the kind of migrants who were allowed in the community as well as their access to resources available. In furtherance of this, it can be stated that,the tools employed by the indigenous

institution in governing its peoplewere in the form of norms and practices such as the delineation of boundary or extent to which community members could farm along river banks; decrees that commanded people to attend communal labour; restriction as to the days to go to farms; how to fish or take care of the river and forest resources available and how to transport fruits or farm produce from the farm to the house.

According to the Akwamuhene of Techiman and Chief of Tanoso include in most cases 'obaahema' (queen mothers), 'Okyeame' (linguist), 'Ankobeahene', 'Adontehene', 'Kyidomhene', 'Nifahene', 'Benkumhene', chief priest (okomfo), 'Nkosuohene', 'ahenkwa', clan heads among others. According to the Chief of Tanom:

> *"...It is not traditionally right fora chief to talk to someone directly in public gatherings; hence the linguist serves as an intermediary between the chief and a visitor or the public by passing on messages between the parties. Furthermore, the 'okyeame' (linguist)is also responsible for the pouring of libations..." (Chief of Tanom)*

The elders interviewed in Tanoso described the role of the chief priest, Nifahene and Benkumhene and other positions in the kings court. For instance, it was explained that the chief priest 'okomfo' was seen as the spiritual head of the land and the link between the people and the ancestors or the gods. In most cases, the chief priest dictated or conveyed the messages from the gods of the land to the king's courts so that they became taboos. That is, for instance, the taboo of not

fishing from the Tano River according to an elderly woman in Chiraa was believed to have come from the priestess of the river god at the source of the river centuries ago. In support of this, the chief priest was seen as one of the key custodians of natural resources found in communities and the traditional area as a whole.

Likewise, the Nifahene and Benkumhene were sub-chiefs or elders who held the right and left position of the army in the past when the communities were going to war.The 'Adontehene' was the leader of the military flank that went in front of the army while the 'Kyidomhene' was the head of the military flank that went last during wars. In recent times the 'Adontehene' sits in the first palanquin that comes before the chief whiles 'Kyidomhene' sits in the last palanquin during festivals. The 'Ankobeahene'in the hierarchy of the governance system of the indigenous institution refer to the elder or sub-chief in the court of the king that serves as the caretaker of the palace. This person does not go anywhere.

In the past, during wars or whenthe king travelled with the other elders, this elder/sub-chief i.e 'Ankobeahene' was the one who was left behind to steer the affairs of the community until the king returns. Similarly, the 'Guantuahene' was the elder or sub-chief who was responsible for providing protection, shelter or for mercy. That is, he served as the source of refuge for community members in times of crisis. Mention can also be made of the 'Tufohene' (senior advisor or councillor); 'Manwerehene' (interior head) and 'Akyampimhene' (the distributor of foodstuffs or anything to be shared among community members).

Present at the king's court are the heads of various clans in the traditional area or community who stood as representative for clan members. These clan heads are known as 'abusuapayinfo)'. Examples of such clans according to one elder in Techiman include 'Biretuo', 'Aduana', 'Asona', and 'Agona'. Today, these sub-chiefs are 'odikuro'(chiefs) of smaller communities, towns or villages.Thesesub-chiefsalso have their own courts of servers in their various communities. 'Nkosuohene', according to an elder in Tanoso, was responsible for the development of the community or traditional area. He explained that:

> *"…as times went by we saw that, the development of our communities cannot be achieved solely by our own people. Therefore we deemed it prudent to include someone from either a different traditional area or sometimes someone from outside the country to be part of the king's cabinet to help in bringing out new ideas for our community's progress and also assist in developmental project. The person occupying this position might not belong to the royal family…That is, 'Nkosuohene' is given to someone who is contributing immensely to the development of our area hence could be a native of the traditional area or a foreigner…" (Elder in Tanoso)*

It can be inferred that, the explanationgiven by the elder supports the theory of endogenous community development where Haverkort et al., (2003) stated that, development can be achieved in an area based on locally existing resources, information, culture and leadership, while appropriate external

knowledge and practices for development purposes can also be allowed.For the queen or queen mother 'obaahemaa', this position according to the queen mother of Tanom,was reserved for a female who ruled alongside the chief. The 'obaahemaa' wasseen as the head of all the women and sometimes presided over the court that settled disputes among women. The queen mother wasusually a maternal relation to the king.Thus, the queen wasthe maternal aunt, a sister or niece to the ruler or king. Due to this, shewields the power to select a suitor for the throne as and when the kingpassed away or had been destooled.In relation to natural resource governance, the queen mother also played a key role in ensuring that people, especially, women and children obeyed the rules regarding the usage of the resources.

It can be deduced from this finding that, the number of women in the court of the king was less as compared to men in the structure of indigenous institutions. Similar finding were also found out by Zakaria (2012) in the West Gonja traditional area in Northern Ghana where women only occupied positions like magazias, but were restricted from occupying positions like chiefs, elders, "kasawule-wurah" (land priest) and clan heads in the traditional area,thereforerestricting the level of women's participation in natural resource decision making processes.

The 'mmrantehene' which means leader of the youth in the community is also one actor in the hierarchy of indigenous institutions. This person was seen to be the mouth piece of the youth and also an organiser during communal labour. An account was given in Tanoso in the Tano north district that showed the

essence of the 'mmrantehene' in the king's court of servers. A male respondent in Tanoso described the role of the 'mmrantehene' in their community that:

> "*…Some years ago, it came to our notice that the river we hold sacred was now under threat from a private investor who claimed to have the permit to mine sand from the river. Since it was a taboo, our leader, 'mmrantehene', with the permission of our chief and elders, organised us to demonstrate against the private investor who was winning sand in the water in an indiscriminate manner and polluting it. To us, he is one key person who helps organise us to defend our customs and traditions…" (A man in Tanoso)*

It can be deduced from the quote that, the youth leader wielded legitimacy in these communities. That is, the youth saw him as an authority that needed to be respected. In furtherance of this, it can also be concluded that a hierarchical governance system existed in thesecommunities. This assertion is drawn from the point where the youth leader sought permission from the chief and elders before initiating any command. That is, although he possessed some authority over the youth, it is seen that, he also took command from higher authority, i.e the chief.

It can also be stated that,taboos were key tools in preventing pollution, conserving water, protection of river catchment areas and ensuring environmental and ecological sustainability. This is because; the flora and fauna of other habitat of the river bed were saved from destruction although the people demonstrated in their quest to protect their customs and practice. This depicts that, the 'mmrantehene' was also a vibrant asset in the indigenous governance systems to

ensure development and progress as well as environmental sustainability.It can therefore be stated that, the structure of this indigenous institution was in a hierarchical form. It was through this medium that the people are governed including the resources available in the area. This also supports endogenous approach to community development where available community leadership can assist in bringing about development. Figure three throws more light on the structure of the indigenous institution found in the upper Tano basin.

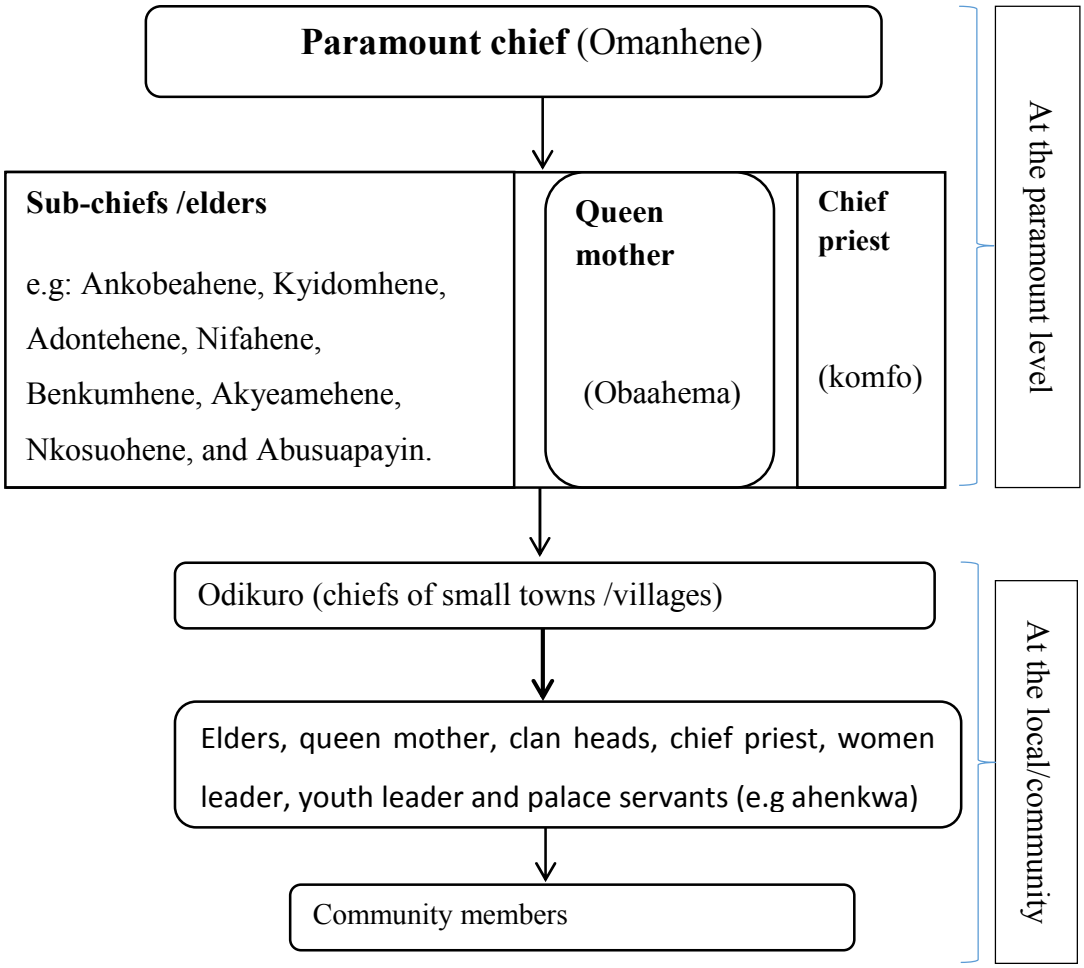

Figure 3: Structure of Indigenous Institution in the Upper Tano River Basin

Source: Fieldwork, 2016

These findings are in line with that of Nukunya (2003) who stated that this type of indigenous governance system or Akan kingship can be found throughout southern Ghana. Mohammed-Katerere (2004) also established that indigenous institutions possess authority and is explained here as the leadership structures including (chiefs, clan heads, sectional heads, household heads, opinion leaders and women leaders) within the community who are by custom ascribed or elected (traditional forms) and provide the necessary leadership which ensures that the norms, practices, and values of the community are respected.

The continuing influence of chiefs and the indigenous system was linked by the respondents especially by the Akwamuhene of the Techiman traditional area as resting upon factors including the following. First, their role in cultural leadership made them relevant in recent times. It was explained by chiefs, elders and the women interviewed that, chiefs and other traditional leaders symbolised deep cultural values and practices. That is, they were an embodiment of the culture of ancestors, fertility of the land, taboos, festivals etc. For instance, one woman in Chiraa recounted that:

> *"…When it comes to describing and giving account of the origin and cultural values of our people, it is only the chiefs, our clan heads 'abusuapayin'and old indigenous actors of our land that can tell it as it is…" (Woman in Chiraa)*

It is thus established from this explanation that, indeed the indigenous institutions possessed the indigenous knowledge of the area. That is, knowledge about the past customs, values and practices could only be gained from the chief,

queen mother or people who had stayed in the community for a very long time and/or were indigenes of the area.This supports Millar (2004) contention that, it is the indigenous institutions including sectional chiefs, elders and queen mothers that possess indigenous knowledge including norms and taboos in the management of the river and other natural resources as suggested in the conceptual framework for this study. The findings from the study thus confirm this and highlight the rich knowledge and authority that these actors had when it comes to management of natural resources in their territories.

Another factor is the control over stool lands by the chiefs and clan heads in various communities. It was also clarified from the FGD for women in Krobo that lands were owned through forms of customary tenure. For instance a woman in Krobo explained that:

> "*…in our community, if someone wants to buyland or wants a piece of plot to farm on, then he or she has to see the elders as it is still ordered or managed by our chiefs, and family heads although some lands are under the control of government...I must also state that, even with that of the lands allocated to the government, the assembly usually seeks permission from our chief and elders before commencing any project on those lands…" (woman in Krobo)*

The FGD for the youth threw more light on the essence of the indigenous institutions in present times and gave details that, chiefs and the indigenous institutions also acted as the identity of their various communities. Similarly, it

was stated that, the regalia and other customs worn by the chiefs during events such as festivals and funerals depict the rich cultural heritage of the people. This role as stated by Arhin (2002) has led to the frequent involvement of chiefs in party politics, either as brokers for the mobilisation of support, or as powerful actors in their own right. In relation to water resource management, the power that chiefs and other indigenous actor's wield gives them the authority to enforce rules and norms in their various communities. The youth in Aworowa explained that,the progress of the community, and the maintenance of its peace and unity in recent times wasstill seen as one of the prime duties of the chief and the indigenous institution as a whole. This finding supports that of Williamson (1999) who argued that the primary functions of the indigenous institutions comprised ensuring peace and harmony in the communities within their territory.

It wasalso established from the FGD for women in Aworowa that, the institutions were held in respect while at the same time it was perceived to be the embodiment of the ancestors and a link between them and the living community usually through the 'okomfo'. The youth interviewed noted that, indigenous institutions provided a renewed sense of belonging as well as being a dominantinstrument of social interconnection. The findings concurs with Millar (2004) statement that rural Ghana is embedded within indigenous institutions and they are crucial to the organisation of people at the rural level for their socio-economic development. It can therefore be said that, the findings support the theory of endogenous community development where Harverkort etal., (2003) argued that since endogenous development is fundamentally development from

within the communities themselves, indigenous knowledge is essential to the process of sustainable community development.

Objective Two: Indigenous Practices, Norms and Beliefs that Exist in the Management of Water Resources in the Communities

Chiefs, elders and queen mothers interviewed revealed that, the sacred River Tano takes its roots in the Tano Sacred groves (believed to be the traditional home of the Bono people who were said to have migrated from a cave called Amowi centuries ago) in Tanoboase near Tuobodom in the Brong Ahafo Region of Ghana where it flows through big sandstones rock formations. One woman in Tanom who hails from Tanoboase stated that:

> *"...I was told by my grandmother that the river Tano takes it source from a rock in which little drops of water drips into a feature like a calabash or pot which our local people termed as 'Odomankoma Ahina' meaning pot of the almighty God.This drops never stops whether during the dry season or wet season..." (A woman in Tanom)*

It couldbe inferred from this explanation that, the chiefs and people perceived that, there must be a greater force residing in the sacred grove that was responsible for continuous supply of the water. That is, the drops which never stopped whether during the dry or wet season. To all the elders interviewed in Tanoso, Tanom and Chiraa,the river and its resources were held sacred as a result of this continual supply. To the people, it is only a caring, loving and merciful supernatural god whocan be responsible for this continuous supply of water that is

not limited to a particular season.One man interviewed in Chiraa supported this explanation and averred that, due to the extent to which the source of the river was held sacred, they had set a buffer zone around the grove that remained a virgin land till date. That is, people were prohibited from farming or conducting any hunting activities in and around the sacred grove. This supports findings by Opoku Ankoma et al., (2006) who stated that indigenous culture and traditional methods of protecting the environment, catchments and protection of aquatic animals found in the river bedas well as water conservation rests upon the peoplesadmiration for their ancestors and their belief that supernatural beings exists or that, there are powers in water bodies and the earth. Plates 1 and 2 presentsections of the rocks found in the Tano Sacred groove where the river takes its source.

Plate 1: Section of the Tano Sacred Grove

Source: Tano Basin Secretariat archives

Due to the essential role that the river plays in the life of people along it, several laws and taboos exists to assist in its management. These taboos are believed to have been given to their ancestors by the 'Taakora' river god who is believed to reside at the source of the river. These laws have been laid down over centuries and passed down from one generation to the other orally in a bid to protect the river and the resources around it. Based on the reverence the communities along the river had for it, it has guided their activities and has served as identity for the people especially those who trace their root to the grooves or who believe that their ancestors originated from the groves in Tanoboase. One elder in Chiraa acknowledged that 'Asoboten' Tano reflects who theywere as Bono people. That is,they could not talk of River Tano without associating it to the way of life of the Bono people. Similarly, the Akwamuhene of Techiman traditional council stated that:

"...The knowledge that guides the management of the Tano River is regarded as a religion, or culturally, our way of life...We regard Tano as a mother who gives life to our people..."(Akwamuhene of Techiman)

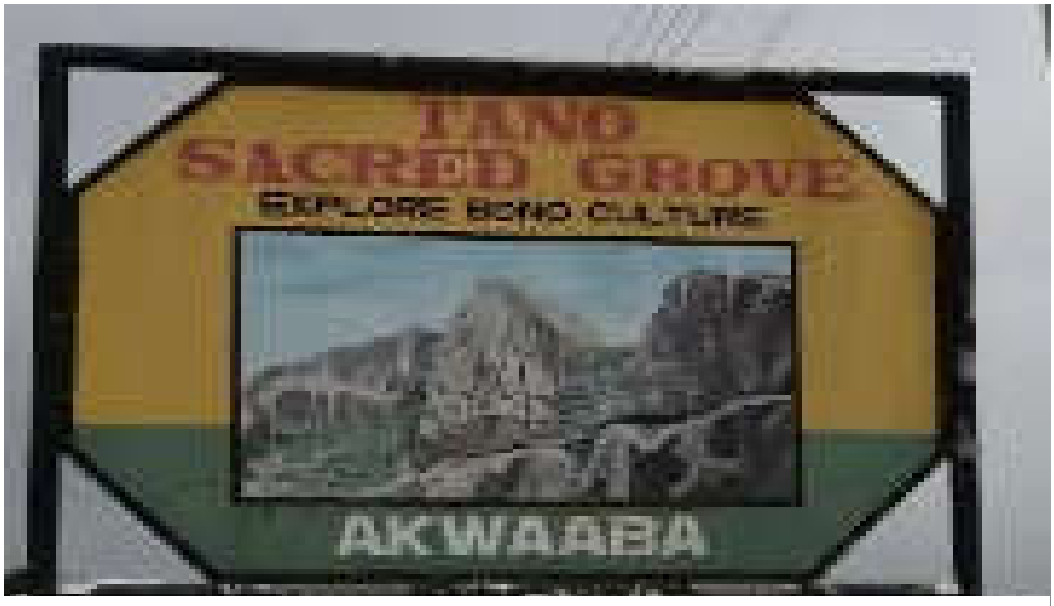

Plate2: Sign Post to the Tano Sacred Grove

Source: Tano Basin Secretariat archive

The river also served as providence and a reliable source of life to the people around. It is because of its reliability supported by the forest belt around it that enabled the people to produce foodstuff in large quantities. One can talk of the famous Techiman market where foodstuffs such as maize and yams are usually in abundance. The chief of Tanoso also supported this argument by stating that:

> *"…The Tano River is regarded as a God and is popularly called 'Asobonten Tano' within which the 'Taakora' god resides.To us Asobonten Tano is the giver of life and a protector of lives in the community…" (Chief of Tanoso)*

It was revealed in the FGD for women in Aworowa and Krobo that it was the presence of the Tano River and other rivers such as the Subin River that drew them to settle at their present communities. Since humankind practically depend on water for survival, past leaders of the traditional areas selected and entrusted the management of the resources to chiefs and elders of the various communities. These indigenous institutions were tasked to be custodians for the management of the water resources. For instance, the Akwamuhene of the Techiman traditional council stressed that, to effectively manage the water resources, the council divided the River into sections with different deities planted along the river. These were designated to the various sub-chiefs and their elders who were responsible for pouring libation and managing the deities along the river with

specific taboos and laws such as demarcation of limit or extent to which community members could farm along the river bank; not going to farms on Tuesdays and other special days such as 'wukudae'; not fishing in the river and loosing palm fruits before transporting from the farm to the house.

In furtherance of this, the Akwamuhene elucidated that, the Tuobodom king and his court of servers were responsible for managing the deity 'Twinpuro' and 'Taakora'god who is believed to be one of the highest Akan gods at the source of the river. The god at the source of the river is visited only on special occasions such as during festivals where special rituals were performed in a form of worship and sacrifices are offered in the form of food, money and slaughtering of sheep or fowls. Thiswas done by the chief priest or priestess and the entourage made up of chiefs, including the paramount chief of the traditional council, other sub-chiefs and some selected members of the traditional area.

Similarly, the Tuobodom chief and elders or sub-chiefs were tasked with enforcing taboos and laws regarding the management of the sacred Tano River and the sacred grove at Tanoboase. These taboos include limits as to where to cut trees in the sacred groove and alongthe river and not fishing in the river.The chief priest interviewed in Tanom gave details to the effect that the Tano shrine at the source of the river resided in a brass pot and was preserved at the Tanoboase town and the priest was responsible for conveying it to the grove annually for rituals.

Chiefsand elders of Tanoso, a community near Techiman were also responsible for the 'Atiakosa' deity and the management of the river. Similarly, the chiefs and elders of the Twaffo) town in the Techiman traditional area was

also responsible for 'Attakofi' deity. Taboos regarding the management of the river were similar in relation to the deities mounted along the river. That is, these deities were seen to be smaller river gods under the Taakora river god at the source of the river hence similar taboos were observed for the management of the river.

In Tanoso, Chiraa and Tanom, similar findings also existed regarding the management of the river. Each community had its own deity and belief system that directed community members as to how to manage water resources in the community. Elders interviewed affirmed that, these deities were mounted along the river with the aim of controlling the misuse of the river and other resources such as the forest belt around it. Tools used in governing these gods and the river management include taboo and beliefs systems. For example,the case where all aquatic animals in the river were regarded as sacred children of the river god hence are not supposed to be fished out or eaten is one key taboo that cut across the basin.

Non- adherence to this law by community members was a punishable offence. The culprithad to appear before the chiefs and elders and deliberation on the issue, the person might either paya fine or suffer banishment from the community as done in the past.Variouschiefs and elders in charge of the deities along the river saw to it that the rules were obeyed.This system according to the chief of Tanom had been used for centuries and existed till now although, its effect had decreaseddue to the emergence of formal laws that govern natural resource use. These findings are in line with Ostrom (1999) affirmation that self-

organised groups can persist for protracted periods of time when they develop governance measuresconsistent with a set of design principles that have been developed locally.

Thus, the finding supports Ostrom's point of view in the theory of collective action where it was explicated that multiple types of players could endure, and even flourish, in predicament by embracing norms that intensely depend on their capacity to identify one another. On the other hand, the existence and the persistence of indigenous knowledge in the basin have in relation to protecting water resources and the sacred grove goes to counter the assertion by Hardin (1968) and Olson (1965) that when common goods are left to users, they will not be able to manage it.

Similar findings were found by Aggarwal (2008) who also established that in Borana zone of Ethiopia, the local governance system called 'gada' is headed by the 'aba gada' , who carry out rituals, resolves social conflicts and governs natural resource management systems. Furthermore, the finding is in line with Cheserek (2005) who alsofound out that the Marakwets in Kenya are endowed with indigenous knowledge that played a big role in the management of water and watersheds

Several taboos and community based water rules existed for the management of the Tano River. Taboos were explained by the chiefs and elders interviewed as the forbidden actions regarding the usage of the Tano River and the resources in and around it. A number of taboos existed in the past and still continued to be used for the management of the river in the upper basin with more

similarities existing between the laws and normssome minimal differences were also identified. These taboos and belief practices are explained in the following paragraphs.

The first taboo identified in the course of study by the chiefs and elders interviewed is that, it was against the laws of the traditional council that fishes, crocodiles and any other aquatic animals in the river was fished out and eaten or used for any other purpose. The Tanoso chief argued that, in the past, the river was seen as a god or a mother hence all the aquatic creatures in the river including mud fishes and crocodiles were regarded as the sons and daughters of the river god hence it was prohibited to fish them out. That is, humans were supposed to rather show respect and appreciation to the descendants of the god responsible for their good fortune and prosperity in life.Due to the observance of this taboo, the river had in abundance, a lot of fishes as depicted in plate three (3) and four (4). Anelder in Tanomstated that:

> *"As a giver of life, it is highly forbidden for any of the community members and foreigners alike, to fish these animals and eat them. Rather, we advise people to feed these fishes and crocodiles since we believe that spiritually, they protect us. For instance, we believe that, asuboten Tano is responsible for bumper harvest in our communities …."(Elder in Tanom)*

Plate3: Fishes in the Tano River

Source: Fieldwork, 2016

Some examples of food that visitors and indigenes were advised to give to the aquatic animals include bread, kenkey and raw maize. By feeding them, it was believed to bring one good fortune and luck as these aquatic animals came out to eat what was given them, the elders in Tanoso re-echoed.It was revealed by the chiefs and elders in Tanoso that, those who worshipped the river god together with the priestess in Tanoso for instance offered or sacrificed fowls, eggs or sheep to the river gods and their children.

It was also revealed from the FGD for women in Chiraa that, indigenous communities continued to adhere to these taboos even till date, especially in communities such as Tanoso and Tanom due to the respect and reverence they have for their ancestors and authorities. The Tanom chief also confirmed this statement by statingthat, the leaders of the community ensured that indigenes and migrants to the community observed this rule by not fishing or eating the children

of the river god. In the Techiman traditional areas, the sub chief explained that, this taboo continued to exist although its enforcement was minimal in the urban areas such as Techiman. He narrated a recent account in Techiman that:

> "*…fishes in abundance could be spotted in the river near the Techiman market centre hence I together with the 'omanhene' and the other chiefs agreed to designate the place as a tourist centre since most of the community members and indigenous folks adhered to the taboo of not fishing the animals out. To help protect the site, we enacted a taboo in the town stressing that no one should use agro-chemicals along the river site. Unfortunately, a foreign trader brought a container with chemicals from a mining site to the market place and in a bid to wash it after using it, killed about 400 mudfishes and other aquatic animals in the Tano River. This was a sad day for the whole traditional area. We cried and organised a funeral for the dead animals since the sons and daughters of 'asuboten Tano' had been killed... So I am saying that, in the small communities, it is easier to enforce this taboo rather than the larger towns…"(Akwamuhene of Techiman)*

Inferences can be made from the explanation given by the Akwamuhene that, indeed the people held the river and its resources as sacred entities. This was evident in the funeral being organised by the people and their leaders for the fishes that had been killed. The funeral organised for the animals according to the chief, also served as a ritual and a way of pacifying the river god so that the

people do not incur its wrath and other goddesses mounted along it from upstream to downstream. This account also depicts that, indeed,vibrant belief systems existed in the upper basin, when it comes to the management of the Tano River. The sub-chief of Techiman continued by linking this taboo to the fact that, the elders of the various traditions saw that if they allowed people to fish from the river, they might overdo it which could affect the sustainability of the resource. The Tano Basin secretariat officer also associated this practice to the fact that, as aquatic animals like crocodiles reside in river bed, they create holes in the river bed hence serving as storage tanks for the river. In this way, the river was prevented from drying up totally.

In the past, according to the chief of Tanoso and Tanom, any person who flouted this rule (fishing these aquatic animals believed to be the children of the river god) was called to face the chief and his court of elders. After interrogation, this person was either fined some amount of money equivalent to the value of a sheep or more. In some cases, the person was made to slaughter a sheep or fowl in order to pacify the deities and the river god. In furtherance of this, the elders in Tanom stated that, even if someone fished from the river and was not caught by the chiefs and elders of the community, it was believed that, curses befell the person and their entire household.

This wasbelieved to be evident in sudden deaths of loved ones of those who had broken the law or maimed children being born into such households. In this case, these children might never walk (i.e. cripple); never develop teeth or might develop abnormal hair. In effect, the respondent echoed that, they behaved

like the fishes found in the river hence they were termed as ‘nsuo ba’ (child ofthe river). In the past, when a woman gave birth to such children, they were sent to the chief who organised all the communitymembers at a gathering where the child was sent to the shrine of the deities. There, rituals were done by the chief priest after whichthe child was left in the river. These rituals included the slaughtering of a sheep and/or fowls to appease the river god. It was the belief of the people that, since the baby was the fish (child of the river god) that was taken by that relative; it had to be returned to where it belongs. The belief in the past was that, the river god came to take the baby away in the night.

In the Techiman traditional area, such a place was called ‘agentuam’. It was also stated by a woman in Tanom that such maimed children could still be found in communities along the river who had flouted the taboo in recent times such as ‘Dadiesoaba’ in the Brong Ahafo Region. However, all the chiefs, queen mothers and elders who were interviewed stated that, the practice of leaving maimed children in the river was considered outmoded and infringement on the human rights of such children and a threat to human existence, therefore it had been stopped. This finding supports what Awedoba (2002) explained that, in most indigenous communities in Ghana, certain animals and natural objects were considered as relatives, or ancestors hence killing them was a taboo punishable by death. Subsequently, Gorjestani (2004) asserted that, rivers and sacred sites have survived over several years and acted as reservoirs for biodiversity due to the observance of such taboos.

Secondly, according to elders interviewed in Tanom and Tanoso, some days were set aside as days where community members were prohibited from visiting their farms or the river. Dissimilarities however existed in the particular days set aside as sacred days.In this case, Tuesdays was set aside for the people of Techimam; Krobo; Aworowa; Chiraa and Tanom whiles in the case of Tanoso under the Bechem traditional council, it was Mondays. It was revealed from the FGD for the youth in Krobo and Aworowa that, the youth did not have enough knowledge as to why these days were set aside.

Nevertheless,the chiefs interviewed noted that, these days were set aside because; it was believed that the river god used this day to relax and also to meet with his/her children in relation to the protection of the people. The Akwamuhene of Techiman connected this practice to the fact that, the ancestors saw the need to leave the river to rejuvenate after being used by the community members for a period of time. This day was also expected to be used by all members of the community to relax and prepare for the days ahead. It could be deduced from this finding that, taboos in the upper basin not only took into consideration the path to sustaining the environment but also contributing to the regulation of the wellbeing and health of the people.

It emerged from all the FGDs for women conducted in Krobo, Chiraa and Aworowa that, in the past, it was prohibited to carry bunches of palm fruit across the river or through the town on any day. People were directed to cut the fruit into pieces before transporting it home. Although, it was difficult to get a reason for this, most elders explained that these were customs and practices that they came

to meet. To them, the past chiefs and elders had good reasons for all the existing taboos. That is, all these were geared towards sustainably managing natural resources surrounding these communities which in the end had led to the conservation of biodiversity including flora and fauna.

For the chief of Tanoso, this practice might be associated with conservation of the palm fruit. Since the ancestors encountered difficulty in getting the seedling of the palm fruits for planting; it was speculated that, by loosening the fruit in the farm, there was a sure way that some of the fruits could fall into the bushes around hence ensuring growth and sustainability of the fruit. This findings can be linked to that of Opoku-Ankomah et al (2006) who argued thatin Ghanaian rural communities, in for instance the Volta basin,they had employed flexible institutional arrangements including the use of taboos and other cultural practices to protect natural resource including water resources over the years.

It was similarlyfound out that, washing of clothes, utensils and bathing along or in the river was highly forbidden in the upper Tano basin. One was advised to fetch the water and send it home to use instead. Onewoman in Aworowa gave details to this and stated that:

> *"Due to the use of firewood in cooking in our homes, the water can be polluted with the blackness that the cooking pot sustains during the cooking process, hence we are advised to fetch the water and bring it home before washing the utensils…To me this makes sense as it helps save the water from being polluted since it is the*

same river we use in cooking while serving as a sourceof drinking to some of our folks…" (A *woman in Aworowa)*

The chief of Tanoso clarified that this taboo existed in order to prevent the pollution of the river. That is, washing of clothes along the water would pollute the river with soda or the chemicals found in the soap used. The youth in Aworowa stated that, washing of cars along the river was also forbidden in the area. This is because, the oil in the cars together with the soap used could pollute the river and kill the children of Tano (.i.e. the aquatic animals in the river). It was also found out that, people were not expected to bath in the river. This taboo was especially applied to women in their menstruation period. This was seen as adding 'dirt' to the sacred River.There was the belief that this brought spiritual pollution to the river god and other goddesses along the river. Plate five (5) depicts the extent to which community members observe the taboo of not washing along the river.From observation during the data gathering process, it was observed that, people, especially, in Tanoso did not wash or bath in or along the river at all.

Plate4: A Community Member Fetching Water from River Tanoin Tanoso
Source: Fieldwork, 2016

Furthermore, carrying corpses across the Tano River was seen to be forbidden in the past. This was also because the river was seen as a sacred entity and a god that needed to be respected. Thus, corpses were seen as 'filthy' things that should not be brought near the river at any cost. However, this practice has dwindled in recent times.It was also established by the queen mothers interviewed that to prevent the river from drying up, a taboo or law was also enacted by the traditional council stressing that people should not cut trees along the river.

Plate 5: Section of Tano River with Trees along it in Tanoso

Source: Fieldwork, 2016

The elders interviewed noted that, the cutting down of trees along the river exposed the nakedness of the river god. In furtherance of this, the elders professed that if people were allowed to cut the trees around, the river god might get angry with the chiefs and people of the area and as a result might leave the river and

never stay in it again. If this happened, the protection of the river wasgone which thereforethis might result in the drying up of the river. This was also seen to bring hardship unto the people who depended on the river for survival. Plate six (6) depicts the Tano River being surrounded by trees which serves as shade to prevent the drying up of the river body.It was also discovered in the Techiman traditional area that, this taboo of not cutting down trees along river bodies was still being adhered to in recent times. For instance, the sub chief narrated that:

> "… *A portion of land along the river in the Techiman town was sold by one of the sub chiefs to a private investor to develop into housing and other estate complex. This made us so angry that during one meeting with the 'omanhene' (paramount chief), the rest of the sub chiefs united with chanting a song in a bid to demonstrate against the action. The song goes like this:'wa ton asase a ton Tano a!wa ton asase a ton Tano a!,Ye be nom nsuo ben! Ye be nom nsuo ben! ...By this we conveyed our grievances to the paramount chief by explaining that, lands were being sold to the extent that those within which Tano lived were also being sold. This shook our paramount chief to immediately call for replanting of trees along the area and the return of ownership of the land to the traditional council..."(Akwamuhene of Techiman)*

Similarly,forest areas along the river were designated by traditional leaders in the upper Tan basinas sacred forests which were termed as 'nana nnom mpo'; where community members and migrants alike were prevented from

entering to engage in any activity such as logging or hunting. The elders interviewed in Techiman noted that this sacred forest was believed to be the abode of the ancestors and other gods who were believed to reside in trees and certain rocks. However, one elder explained the reason behind this practice. That is, the sacred forest was set aside as a buffer zone where animals, trees and medicinal plant could be protected from threat of extinction and from unsustainable usage by people. In this case, all kinds of fishes in the river, bird species and animals were secured to have enough food and water at their disposal as well as to reproduce and multiply.

Accordingto an officer at the Brong Ahafo regional office of the forestry commission;this practice had led to the growth of various tree species. Some species of trees that can be found in the forest reserves along the upper river basin include 'ofram' (Terminalia superba); 'wawa' (Triplochiton scleroxylon); mahogany (Khya ivorensis);'kokrodua' (Periscopsis elata) and 'Akan-Brong' (Argomuellera macrophylla). The sacred forest was also known to house some important medicinal plants. Moreover, the officer interviewed at the forestry commission stated that, fauna is in abundance in the forest reserve along the river.

Plate 6: Section of Forest Reserve along the Tano River

Source: Forestry Commission's achieves (Brong Ahafo Regional office)

Plates seven (7) and eight (8) depict sections of the forest and plant species along the river and some tree species found there. Examples of plant and animal species comprisebamboos, baboons, bongo, and waterbuck as well as multiplicity of bird species. In this wise, it can be argued that the indigenous knowledge in the management of the river also discouraged deforestation through the use of taboos. Rim-Rukeh, Irerhievwie and Agbozu, (2013) also noted that, African traditional religion and belief systems were vested in the abode of the gods and goddesses located in rocks, streams, and trees found in forest and along rivers or anywhere within the community and respected by the people it governed. However, in recent times, deforestation due to human activities has decreased the extent to which the tree species and theirassociatedanimal species were in

abundance. For instance, an elder in Tanom attested to the fact that, the intensity with which bamboos were found along the river has decreased greatly.

Plate 7: Section of Bamboo along the Tano River in Tanom

Source: Fieldwork, 2016.

Therefore, it can be argued that indigenous institutions served a great deal in tackling the problem of deforestation along water bodies in the basin. Protection of trees and other biodiversity along the river is also being observed in the other communities selected, although all respondents affirmed that they were not without challenges in its enforcement. In some part of the basin, such as Tanom, goat rearing was a taboo. This wasbecause; it was believed that, goats were unclean animals hence the river god did not permit that the animal camenear

the river. Other practices included the prohibition of disposing waste into the river. The chief of Tanoso explained that:

> *"...It was an insult to the leadership of the community and to the river god (giver of life) that one throws refuse or waste generated in the course of an activity into the river… To us, it showed that, that individual has no respect for authority and our ancestors…" (Chief of Tanoso)*

It is therefore inferred from this finding that traditional methods of preventing water pollution also frowned upon the throwing of garbage into water bodies. All the discussed taboos had been used in managing the Tano River over decades and were held in high esteem by chiefs and stakeholders of the indigenous institutions in the basin despite challenges such as urbanisation that hindered their enforcement. To community members, the Tano River will remain a sacred river and the source of life that described the rich cultural heritage of their ancestors. Traditional rulers who participated in this research stated that, in the past, accounts on how the river had been managed was rendered to the people during festivals such as the 'Apo' festival and 'Akwasidae' festive days. The chiefs and elders interviewed recounted that, in the past however, there were fewer challenges in the enforcement of the taboos as compared to recent times. A summary of taboos and their meanings is presented in table 2.

Table 2-*Taboos and their Meanings*

Taboos	Meanings	Sanctions	Enforced by
1. Not cutting trees along the river: the cutting down of trees along the river exposed the nakedness of the river god.	Prevent the river from being exposed to direct sunlight;Conserving flora and fauna	Payment of fines; banishment from community	Traditional leadership of community
2. Not fishing in the river: all the aquatic creatures including mud fishes and crocodiles were regarded as children of the river god	aquatic animals create holes in the river bed hence serving as storage tanks for the river: the river is prevented from drying up totally	Paying of fines, offering sacrifice to pacify gods, Belief of spiritual curses befalling on culprit and family	Chiefs, queen mothers, leadership of community
3. Sacred days: community members were prohibited from visiting their farms or the river.	Rejuvenation of the river after being used period of time	Payment of fines,	Traditional leadership of community

Table 2 Continued

4.	Prohibited from carry a bunch of palm fruit across the river or through the town on any day	Ensuring that seedlings of palm fruits are sustained since getting a seedling for planting was difficult in coming by.	Payment of fines	Traditional leadership of community
5.	Prohibiting washing of clothes, utensils and bathing along in or the river	Avoid polluting the river with chemicals in the soap	Payment of fines	Traditional leadership of community
6.	Prohibition of disposing waste into the river	Avoid pollution	Payment fines	Community leaders

Source: Fieldwork, Awuku (2016)

Objective Three: Interface between Formal Water Policies and Indigenous Knowledge in Water Resource Management in the Basin

Several formal institutions and laws exist in a bid to ensure sustainable utilisation and effective management of watersheds and in rivers the Brong Ahafo region and in Ghana as a whole. Under the 1992 Constitution of the Republic of Ghana, provisions are made under Article 269 (1), Water Resources Commission Act 522 of 1996 and the Local Government Act 462 of 1993 to give the WRC and

district assemblies mandate to manage natural resources. In the upper Tano basin, these institutions include the Tano basin secretariat of the Water Resource Commission; offices in charge of natural resources management of various district and municipal assemblies; the Environmental Protection Agency; Forestry Commission; Non-Governmental Agencies as well as concerned institutions and individuals in the riparian communities along the river.

At the peak of the formal bodies in charge of managing the river is the Tano basin secretariat of the Water Resource Commission that regulates all activities that affects the river. For instance, the secretariat has the mandate to give permit to companies that engage in mining in and around the river as well as companies engaged in the extraction of water for irrigation and purified drinking water.

Examples of some of the companies that had been given permit by the Tano basin secretariat office to abstract water in the upper basin,according to the officer, included the following: Newmont Ghana Gold Ltd; Chirano Gold Mines Ltd; Ghana Nuts Company Limited; Yab natural mineral water and Amoro Puse-Bosi.Additionally, the basin officer noted that, the Tano basin Secretariatoffers a forum for integration and collaboration of different interestsconcerning the management of the river as well as to monitor and evaluate programmes for the operation and maintenance of the resource.

The metropolitan, municipal and district assemblies (MMDAs) are also the arms of government at the decentralised level that are tasked to regulate the use of the river in partnership with the Tano basin Secretariat office.Examples of

some MMDAs in the upper Tano basin includeSunyani municipal, Sunyani West District, Techiman municipal and Tano North district. Similarly, the Environmental Protection Agency under Act 490 (1994) according to the officer interviewed at the regional office in Sunyani,was responsible for protecting the environmental resources with broad public participation, efficient implementation of appropriate programmes and technical services.

The agency is tasked with ensuring consistent enforcement of environmental laws and regulations in the upper Tano basin and the Brong Ahafo region as a whole. For instance, the officer noted that, in relation to the management of the river, the Agency engaged in programmesuch as the Strategic Environmental Assessment (SEA) along the river. After the assessment, it was found out that some harmful weeds were invading the Tano River hence measures were put in place to curb or manage the invasive aquatic weeds on the river.

The forestry Commission is in charge of managing the forest and wildlife reserves along the river. This includes protecting the buffer zones such as the Yaya forest reserve from threats of unsustainable use. Moreover, several Non-governmental organisations (NGO) exist to manage the river in the upper basin. For example, the National Forestry Forum is an NGO in the Brong Ahafo Region that engages in programme and advocacies with regards to the protection of rivers and forest reserves in the region. This involve the supply of tree species to farmers and communities along the river and offering educational programme to the public on the essence of protecting and conserving water bodies and the trees along it. Apart from these institutions discussed, other institutions such as Ghana

Water Company, Lands Commission and other concerned individuals were all involved in the management of the river at the upper basin. All these institutions play their part in ensuring that the resources in and along the river are well protected. Figure four (4) portrays the structure of feormal institutions in the upper Tano basin.

The findings from the study indicated that, the management of the river was done in conjunction with members of the WRC office of the Tano basin secretariat; planning officers of the District Assemblies; EPA; public organisations; traditional authorities; NGOs & CBOs and concerned individuals from the riparian communities. This indicates that, in recent times, indigenous knowledge vested in traditional rulers has become one of the options in the management of the river as compared to pre-colonial era where it was the only method used in managing natural resources. It can be argued that,some sought of legal pluralismexist regarding the management of the resource. Legal pluralism is explained by Barzilai (2003) as the presence of numerous legal systems within an area pertaining to the management of a resource. For instance, where several formal institutions exist alongside traditional system of managing a particular resource or governing a group of people, then it can be said that legal pluralism exist.

Through a consultative forum, the secretariat involvesboth formal (planning officers of the District Assemblies; EPA; public organisations)and informal (traditional rulers and concerned individuals) stakeholders to help identify several water resources management issues. In 2012, according to the

basin secretariat officer, such a forum was held. Factors including deforestation, farming activities along the bank of the river, and mining were identified during the forum as leading to water quality deterioration and degradingthe ecosystem in and along the river. To this effect, it became necessary to develop an equivalent of an Integrated Water Resource Management (IWRM) plan within the basinto manage the water resource. To the Tano basin officer:

> *"...the river basin required basin-wide planning approach involving stakeholder participation, awareness raising, capacity building and training, and environmental engineering..."(Tano basin secretariat officer)*

It was believed that, this approach could lead to the sustainable implementation of operative measures to improve land use practices and management of liquid and solid wastes from the mining activities as well as from the towns and communities within the basin. It was indicated that, in the course of designing the IWRM in the basin, workshops and training sections were organised for various stakeholders at both the identification and objective setting stage where stakeholders involved were placed on several committees including land use management committee, waste management committee, education committeeandthe programmes& budget committee.

The basin still faces challenges, althoughthe plan is still being enforced to help manage the water resource. These include encroachment on watershed zones with activities such as farming activities; dumping agro chemical bottles and other waste particles into the river especially in urban centres hence affecting the

quality of water resources. The major source of pollution that had become a major concern was at the lower basin where illegal mining popularly known as 'galamsey' was being undertaken as well as massive sand and clay winning inand along the riparian communities.

Awareness creation about the water management policiesby the basin secretariat and other formal institutions like the EPA was through the following means. These are Radio/TV Programmes; Community Durbars in collaboration with NGOs/CBO; Target group negotiations/discussions (e.g. School Health; Educational Programme - SHEP); Regional Co-coordinating Councils and Local Government Assemblies Awareness creation/Educational Programme; and School Visitations/ Symposia.All formal institutions visited including the district assemblies, forestry commission as well as the EPA stated that, they were involved in the management of the Tano River. Some challenges faced by these formal institutions include financial challenges and coordinating problems between other sectors that delay the passing of laws to assist in enforcement.

However,the findings from FGD conducted during the study suggest that, publicity of the existence and activities of the Tano basin secretariat and other formal institutions such as the EPA was limited among communities visited. For instance, most of the youth and women interviewed had not heard about the Tano basin secretariat and its functions in relation to the river before. It emerged from FGD for the youth that, they were rather familiar with the indigenous knowledge that existed in their communities and with the fact that, MMDAs were one way or

the other in charge of the river management. According to one male respondent in Aworowa:

> *"...I have no idea that a separate secretariat exists to manage Asuboten Tano apart from our chiefs and the assembly...I have not heard of their advert on radio or television before..."(male respondent in Aworowa)*

In furtherance of this, an officer at the Sunyani West District Assembly noted that, there was limited publicity of the secretariat's activities which hindered the manner in which they liaised with them. Furthermore, majority of the youth interviewed also stated that, they were not adequately informed on laws and enactment from the Tano basin secretariat and that they were moreconversant with the taboos than the formal water policies and laws. Some even stated that, they had not heard of the IWRM plan before. Findings from the study further indicate that, no formal laws exist to support the enforcement of indigenous knowledge in the upper Tano basin. The Basin officer explained that,before, during and after the process of designing the IWRM plan, no legislative instrument or bye-laws were established to support the use of indigenous knowledge to manage the river in communities.

These practises and belief systems werenot documented and available in the archivesof any ofthe formal institutions (MMDAs, EPA, and Forestry Commission) visited.However, it was indicated that, during the process of designing the IWRM plan, traditional rulers were encouraged to continue to enforce these beliefs systems. This is because; stakeholders saw the positive

aspect or the ecological significance that indigenous knowledge had in helping to manage natural resources in the basin. That is, indigenous knowledge was seen to be a key instrument in helping to protect water bodies from pollution, and preventing degradation of the ecosystem. To the officer interviewed at EPA, the taboo of not cuttingtrees along river bodies made so much sense and should be supported by either bye-laws at the district assembly or the development of a legislative instrument in the parliament of Ghana if possible.

The development planning officers interviewed at the district assemblies specifiedthat, no enactment or bye-laws existed to support the use of indigenous knowledge in managing water resources in terms of finances; educational awareness or helping to punish culprits who flouted traditional taboos. All the formal institutions (Tano basin secretariat, MMDAs, EPA, and Forestry Commission) visitedasserted that, indigenous knowledge was a vital tool that could help in the management of the Tano River. When these indigenous institutions are given assistance, they could help manage the resources and help close the gap at where formal institutions might not reach.

All traditional rulers (informal institutions) who were interviewed also stated that, they were involved in programmeand activities initiated by the basin board and the district assemblies. For instance, the Akwamuhene of Techiman noted that, the traditional rulers in his traditional area were involved in the designing and identification stages during the designing of the IWRM plan.However, no assistance was given to aid them in the enforcement of the community based water laws or taboos. The only support or law according to the

chiefs interviewed was embedded in the customary laws that gave chiefs authority to rule in Ghana. It can therefore be stated that, although indigenous knowledge is a vital input in the management of the Tano River basin, no bye laws supportsthis cause toward conserving biodiversity in the indigenous way.

The bridge between the formal and informal institutions and agencies is seen in the consultative process where representatives of the informal institutionswere invited to be part of committees during programme organised by the formal institutions.But, no bye laws existed to support informal institutions in the river management. Since both sides are faced with varied challenges, a collaborative effort between the two is suggested. It is argued that, the involvement of traditional institutions in basin activities is a good course that needs to be continued. Since indigenous institutions have been able to govern these resources for long periods of time, concerns are being raised about the possibility of enacting laws that support educational awareness programmes to educate people on the ecological significance of these taboos in managing the Tano River.

Objective Four: Challenges Faced by Indigenous Institutions in Using Indigenous Knowledge to Manage Water Resources in the Communities

From the findings of this study, it is being argued that indigenous institutions are an embodiment of indigenous knowledge in the management of the Tano River. Nevertheless, these institutions face several challenges in enforcing the practices and the belief systems to ensure sustainable management

of the resource in recent times. Some of the challenges that were listed by chiefs, queen mothers and the elders interviewed are elaborated as follows.

The first factor that posed a great challenge in using indigenous knowledge to manage the resource was the emergence of foreign religion. The elders interviewed stressed that, the conversion of most community members to these foreign religions including Christianity and Islamic religions had made many people to regard customs and taboos as things of the devil hence they did not need to respect the traditions. For instance, one woman in Krobo lamented that:

> *"…The enforcement of taboos in our community has dwindled significantly because some of our elders have switched to new religion such as Christianity… due to this, even if people break the laws, the punishment is not that effective as compared to the past…"(Woman in Krobo)*

The findings from the FGD conducted for the youth and women in Aworowa and Krobo also affirmed this finding. The extent to which people paid attention to the taboos had decreased because they saw it as outmoded practices. It can thus be said that, the introduction of both Christianity and Islamic region has contributed to the ineffective manner in which indigenous knowledge is being used in the basin. It was therefore argued by the youth in Aworowa that, if formal institutions could help explain the ecological significance of the taboos to people who judge it as outmoded fetish practices, then the watersheds may be saved from further encroachment.

The second challenge facing indigenous institutions in enforcing the use of indigenous knowledge is urbanisation. The growth of villages into towns and from towns to cities has resulted in the migration of different people with different traditional backgrounds into the riparian communities along the river basin. This, according to the chiefs interviewed, has made it difficult to enforce the laws and taboos associated with the usage of the water resource that existed in the communities. In furtherance of this, increase in the number of people was usually associated with different economic activities that required the use of the river, which were very difficult to monitor.

The chiefs and elders interviewed listed activities such as sand winning, housing, carpentry deposit of saw dust, agrochemical deposit from spraying of farms and logging among others as key economic activities in communities that were being undertaken by both migrants and community members. The end products of such activities one way or the other affected the management of the river. The findings from the study suggest that, urbanisation which had affected the size of communities (i.e towns to cities) was creating a challenge in enforcing the community based rules. This supports Ostrom (1990) statement that, the size of a group and internal heterogeneity might pose a challenge to traditional institutions or users who are into the management of common resource. Another account was given by an elder in Tanom that:

> *"...In the past, we could go near the river and sometimes play with the fishes in it without any fear. But today, due to sand mining and the non-observance of certain taboos together with interference by*

formal laws, some sought of fear exist that if our grandchildren are allowed near the river, they might get drowned... During my days as a kid, I never heard that anyone got drowned in our sacred 'asuboten Tano', but these days, some cases had been recorded… In my own opinion, if we observe the taboos carefully, these entire calamities will be avoided…" (Elder in Tanom)

a **Plate8: Sand Winning along the Tano River**

a Source: Fieldwork, 2016

species of crocodiles in the river in the past, however, due to intensive sand winning and disposal of rubbish into the river, one could hardly see these animals in the river in recent times. This finding could be linked to the decreasing water quality noted by the secretariat officer. This is because sand or clay winning in the river bed could lead to removal of channel substrate that can affect habitat in the river and the biodiversity in general.

Furthermore, the chiefs and elders interviewed stated that, since no bye-laws existed to support the enforcements of the community based laws and taboos from the district assemblies, WRC or other related agencies, it is very difficult to punish culprit who flouted the rules. The elders interviewed stated that some culprits are left to go punished due to their political influence or association with certain government officials. Some also gave the excurses that, the river now belongs to the government therefore anyone could use the resources without restriction by the chiefs. This served as platform for some youth in the community to also flout the rules since they did not see the reason why they should be punished while others go unpunished.

The sub-chief that was interviewed in Techiman cited this as one of the key challenges hindering the enforcement process of indigenous knowledge regarding the management of the Tano River. This supports the findings of Henrik (1996) in Burkina Faso where it was noted that, contemporary poor management of natural resources was attributed to intrusive state policies which were alleged to have interfered too much with the local scene and undermined traditional institutions from playing their part in regulating resource use. In this case, it can be said that, intrusion by government official in the sanctioning of culprits who flouted rules in the basin remains a challenge that needs to be addressed. Water management under IWRM is also argued by Sokile and Van Koppen (2004) as biased towards the formal state-based institutions hence overshadowing the local informal ones.

Cases where individuals were granted permission to engage in logging activities at places regarded to be under the control of the government served as a basis for boycotting the rules and taboos in the community. This is because members of the community, who for instance, were not permitted to cut trees even on their own farms where the river passes, regarded this action to be discrimination against them. One woman in Krobo recounts her ordeal:

> *"...I have several 'odum' trees along the watershed in my farm but due to the respect I have for my ancestors and our customs and traditions, I do not temper with them. But recently, I have noticed some logging in other places that is making me to reconsider my decision. This is because, I need money to support myself and my family and these trees can fetch me some income..." (Woman in Krobo)*

The finding supports the assurance problem in collective action proposed by Runge (1984) where argument was made that, individual decisions are conditioned on the expected decisions of others, rather than being separable from them. Thus, if a group agrees to abide by the laid down taboos and are treated on equal basis; it served as incentive for all and sundry to respect it. However, where variances existed in the punishment given to culprits, then people begin to find the rules as unfair hence might not comply with it at all. In furtherance of this, the finding is in line with what Ostrom (1999) noted that, the size of the temptation to free ride and the loss to co-operators when others do not cooperate can affect the extent and willingness to which common property users

obey rules regarding the management of resources. It can thus be said that, the challenges facing the indigenous institution as well as community members stem from diverse areas and needs to be supported by various stakeholders since the ecological worth of the indigenous knowledge cannot be underestimated.

From the discussion on the various taboos that were used to manage the river, it could be deduced that, some weaknesses existed in the laws. For instance, there were inconsistencies in the days that were held sacred. Different traditional councils had varied days where people were prohibited from visiting the river or their farms. Furthermore, as the towns grew into bigger towns, the number of people also increased. Mining and farming on large scale that required irrigation facilities started to emerge which made it difficult for traditional rulers to control the extent to which the river was being used. To the chiefs interviewed, colonisation coupled with these weaknesses in the traditional ways of managing natural resources resulted in the introduction of formal institutions into the management of the river bodies and other natural resources in the basin. Yet, traditional methods of managing natural resources using indigenous knowledge as tools continues to exist and forms one of the options in managing the river in recent times.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter concludes the research journey by outlining a summary of the objectives, main findings, the conclusion drawn and the recommendations. It also identifies areas for further studies.

Summary

This study was undertaken to assess the role of indigenous knowledge in the management of water resources in the upper Tano River basin of Ghana. The study specifically sought to:

1. Describe indigenous knowledge in management of water resources
2. Examine the indigenous practices, norms and beliefs that exist in the management of water resources in the communities
3. Examine the interface between formal water policies and indigenous knowledge in water resource management in the basin
4. Describe the challenges faced by indigenous institutions in using indigenous knowledge to manage water resources in the communities

The study employed the qualitative research approach. The non-probability sampling method with purposive sampling techniques was used to collect data. Targeted population included members of the riparian communities in the upper Tano basincomprising chiefs, elders, women groups and old people who had knowledge with regards to indigenous knowledge in the management of

the Tano River. Headsin charge of formal institutions that are involved in the management of the Tano River in the upper basin such as the Tano basin secretariat officer were also sampled using purposive sampling technique.

Secondary data sources were sought from Tano basin secretariat archives and achieves of MMDAs that were visited.Data from the field was analysed manually based on the narrative discussion approach by dividing it into themes andaccompanying discussions with tables and graphics where relevant.

Key Findings from the Study

Based on the research questions, the main findings of the study are summarised below:

- It was found out that, a hierarchical traditional governance system exists in the upper Tano river basin where a paramount chief had divisional or sub chiefs together with the queen mother and a court of servers who exercised authority within their jurisdictions through adjudication of cases and invocation of traditional taboos
- It emerged from the study that, water was treated as a common good/property in the traditional/indigenous institutional settings where indigenous knowledgewas used in managing natural resources;
- The importance of the river to the survival of community members cannot be under stated. The river served several purposes including domestic purposes, irrigation purposes and industrial use.

- Deities are placed along the river starting from the source (where 'Twimpuro' and 'Taakora' the highest Akan god are believed to reside) to the downstream of the river.
- Sub chiefs and their court of elders and servers were tasked to manage the river along the basin by enforcing the use of taboos and other agreed community based laws.
- Taboos used in managing the river include: prohibiting the fishing or use of aquatic animals in the river as food; not washing, bathing or washing of utensils or cars along the river; not crossing the river with corpses; not cutting trees along the river; not carrying a bunch of palm fruit across the river and not going to the river on Tuesdays and in some communities Mondays.
- It emerged from the study that, the indigenous institution faces challenges in enforcing indigenous knowledge in the management of the river. These included the emergence of foreign religions; urbanisation together with rise in economic activities such as housing, carpentry deposit of saw dust; inadequate bye-laws to help in enforcement; and intrusion by government officials in the sanctioning process.
- It emerged from the study that, certain weakness in the enforcement of indigenous knowledgesuch as inconsistency in the days that were held sacred and urbanisation made it necessary for formal institutions to come in to help manage the river. Findings from the study indicated that, this has rendered indigenous knowledge becoming one of the several ways in

which the river is managed in recent times as compared to the past where it was the only option.

- Apart from the indigenous institutions that manage the river, it was also found out that, formal institutions including Water Resource Commission basin secretariat; Municipal and District assemblies, Environmental Protection Agency; Forestry Commission and Ghana Water Company Limited among others existed and collaborated in managing the basin.
- Publicity of formal water policies was minimal as some respondents claimedthat, they have no idea what IWRM plan meant and the laws regarding it.
- No bye-laws or support mechanism existed in the formal water institutions that supported indigenous institutions in using indigenous knowledge to manage river resources in the basin

Conclusions

Based on the findings obtained, it can be concluded that:

Indigenous knowledge in the management of water resources can be found in the upper Tano River basin in the form of taboos and practices. These taboos are not written down laws but rather verbal taboos that had been passed down to the people by their ancestors centuries ago. It could also be concluded that,the Tano River is a valuable and useful asset to riparian communities and traditional rulers who hold it as sacred god and the giver of life.It could also be established that, indigenous institutions in the upper Tano basin possess indigenous knowledge and are the custodians whospear head its enforcement.

Secondly, it could be established that, some indigenous practices, norms and beliefs that existed in the management of the river in the upper Tano basin included the following: not going to the river on Tuesdays and in some communities Mondays; not washing, bathing or washing of utensils or cars along the river; not crossing the river with corpses; not carrying a bunch of palm fruit across the river and prohibiting the fishing or use of aquatic animals in the river as food. All these practices are still respected by community members as sacred customs and traditions and are also regarded as cultural heritage.

It can also be sealed that, indigenous institutions face challenges including urbanisation, interference with enforcement processes by political authorities and the emergence of foreign religions that have affected the manner in which community members respected and complied with community based laws. Lastly, it has been established from the study that, both informal and formal institutions are involved in the management of the river in recent times. Some formal institutions listed include the Tano basin secretariat office under the Water Resource Commission of Ghana, MMDAs and the EPA. It is concluded that, all formal institutions performed their functions with the support of laws and provisions in the constitution of Ghana. For instance, the EPA was being backed by Act 490 of 1994. However, it could be concluded that, no form of bye-laws exist at the district assembly and other institutions to assist with the enforcement of indigenous knowledge in the upper basin. In addition, it can be concluded that, indigenous institutions are involved in the management of the river through consultative process with other stakeholders.

Recommendations

Based on the findings from the study, it is recommended that:

- Bye-laws or support structures are established by the Water Resource Commission's basin secretariat for the Tano River together with MMDAs and other formal institution so as to assist with the enforcement of indigenous knowledge since it can help greatly in the management of the river resource
- The secretariat of traditional councils seeks support (in the form of bye-law enactment) during committee meetings with the Tano basin secretariatand MMDAs so as to assist them in the enforcement process.
- Education or awareness programs of formal water laws and the impacts of polluting water bodies or degrading thevegetation along the river need to are intensified by the basin secretariat, MMDAs, EPA, Forestry Commission and other non- governmental organisations. It is suggested that, unsustainable usage of the river could decrease.
- Education on the ecological worth or significance of taboos should be added to the awareness programs organised by the formal institutions.This is expected to encourage people to respect and comply with taboos not only for their traditional or fetish background but it's worth to biodiversity conservation. A discussion of taboos in relation to recent bodies such as 'friends of the earth and river bodies' will tune people's mind to the relevance of regarding water its related resources as vital friend in

sustaining human livelihood. It is suggested that, such education will inform people who have converted to foreign religions that, taboos are indeed relevant for biodiversity conservation.

- The government through the Water Resources Commission provide the necessary support for the formal institutions in charge of the management of the Tano River so as to aid them intensify educational programmes regarding water protection
- Formal institutions including District Assemblies desist from interfering in the enforcement and sanctioning process at community levels.

Suggestions for Further Research

- A study should be conducted in other river basin such as the Pra River to map indigenous knowledge being used and how it is captured in formal water policies.

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APPENDIX A

Interview guide for chiefs/elders/ clan heads/old people in community

Purpose: This interview guide seeks to solicit information on indigenous knowledge in water resource management in the upper Tano River basin. The information you provide is purely for academic purpose. I therefore assure you of total confidentiality.

1. Date of interview …….
2. Status of respondent ……
3. Can you elaborate more on
    a. traditional governance system:
    b. hierarchy;
    c. the different positions and responsibilities
4. How does this community depend on the river?
5. What are some of the benefits the community derives from using the resource?
6. What were the mechanisms put in place for the management of the Tano River in the past?
7. How were culprits punished for violating the laid down rules/taboos/CBWL?
8. In those days how did you render accounts to the community and when? (At village meetings, durbars, any other occasion).
9. What were the challenges that hindered smooth management of the river at that time

10. Please comment on how the water resource is being managed today
11. Who is in charge of the management of the resource in the community and at district level?
12. Are you consulted on development and water issues by NGOs, DAs, WRC Tano Basin secretariat or any government agency regarding development affecting the river resource?
13. How are traditional authorities involved in decision-making processes at the community level and district level
14. Would you say that incorporation of past management practices could help in water management today
15. Are the past norms and practices being used in WRM today
16. What are some of the factors hindering the use of indigenous knowledge in managing the water resource today in the community
    a. Size of group
    b. Globalization (internal heterogeneity)
17. What specific practice would you say is relevant today /outmoded?
    a. Potentials and threats
18. Would you say that the submission of ownership and management of water to government has become interference to traditional ways of managing the resource?
19. Suggestions on the way forward. …….

APPENDIX B

Focus Group Discussion guide

Purpose: This interview guide seeks to solicit information on indigenous knowledge in water resource management in the upper Tano River basin. The information you provide is purely for academic purpose. I therefore assure you of total confidentiality.

1. Date of discussion …….
2. Type of group ……
3. Please comment on the major uses of water in this community.
4. How was water bodies managed in the past?
5. Who set the rules? Sanctions: what happened to defaulters?
6. Major sources of pollution of water bodies and effect on livelihood and the resource
7. Have you heard of WRC before
8. How are water resources being managed today?
9. Modern and indigenous (bye-laws, beliefs, norms, taboos) ways rules and regulations governing water bodies and use of water resources.
10. How were you involved in the activities organised by WRC/Tano Basin office, NGOs, DAs, Unit committees and traditional leaders?
11. What were your motivation and expectations?
12. Contributions made -

    Tangible and intangible; individual or collective.
13. Rules and regulations - What are the rules?

14. Do you know that cutting trees along watershed zones are not permitted?
15. How well do you know government policies regarding the access and management of the Tano River?
16. Way forward for sustainable water management in the basin……..

APPENDIX C

Interview guide for Tano basin secretariat officer

Purpose: This interview guide seeks to solicit for information on indigenous knowledge in water resource management in the upper Tano River basin. The information you provide is purely for academic purpose. I therefore assure you of total confidentiality.

1. Please elaborate on the mandate of WRC and functions.
2. Can you explain the relationship between the WRC and other water related MDAs?
3. How does the WRC implement its decisions?
4. Has there been an implementation of IWRM framework for this basin
5. Was the framework designed within the basin or it was transposed from national level?
6. What issues informed the adoption of the framework?
    a. Pollution
    b. Encroachment on watershed zone
7. Which stakeholders were involved in the formulation process and what roles did they play?
8. What are some of the agencies you collaborate with in the management of the basin?
9. In the course of the IWRM planning, did the secretariat organize workshops for stakeholders (communities in particular) in the Tano Basin with regard to water resources management?

a. Identification and design, objective.

10. What were the groupings of stakeholders involved?
    a. (Community members, local group leaders, chiefs, elders, the youth, women, men, (school) children, CBOs, water users).
11. Was there any enactment or laws that allowed the use of indigenous knowledge in communities to be brought on board in the management process?
12. How is indigenous knowledge incorporated?
    a. Decision-making and/or implementation,
    b. The approach (instrumental or empowerment).
13. What are some of the awareness creation methods used to help educate community members in the basin on water management policies?
14. Please comment on their effect?
15. State of water resources in the Tano Basin
    a. Quality and quantity; demand and supply.
16. What is the future of river resources in the basin?
17. Challenges facing sustainability of the Tano Basin water resources:
    a. sources of water pollution and effect;
    b. Conflicts in protecting forest reserve, watershed zones, etc.
18. Would you say that when indigenous institutions are empowered in the communities, they can help the WRC in the management of the basin?
19. Recommendations on the way forward……

APPENDIX D

Interview guide for district assembly/EPA/Forestry commission

Purpose: This interview guide seeks to solicit information on indigenous knowledge in water resource management in the upper Tano River basin. The information you provide is purely for academic purpose. I therefore assure you of total confidentiality.

1. Date of interview …….
2. Status of respondent ……
3. What are the mandate and core activities of the assembly/organisation in relation to water management in the upper Tano Basin?
4. Please list institutions that you coordinate with in the management of water resources in the district.
5. What relationship exists between the assembly/organisation and the WRC Basin secretariat?
6. How were you involved in water policy formulation and IWRM planning in the upper Tano Basin
7. At what stage; how (consultative meeting, workshop, any other form).
8. Which categories of stakeholders were involved?
9. Challenges facing sustainability of the Tano Basin water resources:
    a. Sources of pollution and effects; conflicts in forest reserve protection.
    b. The water supply situation in the basin: reliability; challenges with water supply.

10. Challenges facing your outfit in participating in water management activities
11. Please elaborate on how you coordinate with indigenous institutions in water management
12. Is there any documentation on indigenous knowledge in water management?
13. Are there any bye-laws that support the use of indigenous knowledge in water management?
14. Has there been any effort by the assembly to empower indigenous institutions in water resource management?
    a. Financial support b. education c. providing support to help sanction culprit
15. Do you think indigenous knowledge could bring relevant input in managing water resources in this district?
16. Explain
17. Suggestions on the way forward……

APPENDIX E

OBSERVATION CHECKLIST

1. Abundance of fishes in the river as a result of observance of taboos [ ]
2. Disposal of solid/ liquid waste into the river [ ]
3. Abundance of Trees along the river banks [ ]
4. Community members fetching water or washing (utensils, cars etc.) along river [ ]
5. Sand winning along river [ ]
6. Building project along river banks [ ]