

**LOCAL PEOPLE'S WILLINGNESS TO CONTRIBUTE TOWARDS WATER  
QUALITY IMPROVEMENT IN OFFIN RIVER IN ATWIMA MPONUA DISTRICT,**

**GHANA.**

**KNUST**

**BY**

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## DECLARATION

I hereby declare that this submission is my own work towards the MPhil in Natural Resources and Environmental Governance and that, to the best of my knowledge, it contains no material previously published by another person or material which has been accepted for the award of any other degree of the University, except where duly acknowledged.

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## DEDICATION

This thesis is dedicated to Augustina Amankwaa, my mother and a friend, who instilled in me the drive and determination to pursue my goals, and Rhoda Arhinwaa-Antwi, my wife, who is a constant source of inspiration to my life. To little Maame Serwaa Agyemang Praises, I love you.

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## ABSTRACT

This study investigated local people's willingness to allocate their household financial resources to help improve the degraded water quality of the Offin River. It also determined the factors that influence their willingness to pay towards the program. Closed ended questionnaire was developed and administered to households in three selected communities within the catchment area of the river to determine both WTP of residents and factors that affect their WTP. Results indicate that majority of respondents have visited the river and believe that improving water quality in the river is an important concern. Respondents were willing to make an average monthly contribution of GH¢ 45.51, per household, to support the improvement program of the Offin River. A multiple regression analysis conducted found factors such as future use of the river, household income, household size and years of residency of respondents, to be important drivers of WTP for the improvement of water quality of the Offin River. Other factors such as distance to the river, level of respondents' education, occupation and gender, have no influence on respondents WTP. An independentsample t-test conducted to test the influence of the socio-economic factors on the mean total willingness-to-pay (MTWTP) amount, found age to be the only variable with significant difference between the active and the non-active age groups (active age;  $M=6.97$ ,  $SD=5.663$ , non-active age;  $M=8.88$ ,  $SD=5.905$ ;  $t(147) = -1.987$ ,  $p=0.049$ ). Based on the results of this study, illegal mining in and around the river need to be curbed and efforts made to dredge the river and also re-plant the trees and vegetation that once provided shade to the river. It is also recommended that decision-makers and environmental managers of the river endeavour to implement educational programs and enforce existing laws by involving the local people and where necessary, make new laws, to help improve the quality of water in the river.

Keywords: Offin River, illegal mining, willingness to pay, environmental management, water quality improvement, vegetation restoration.

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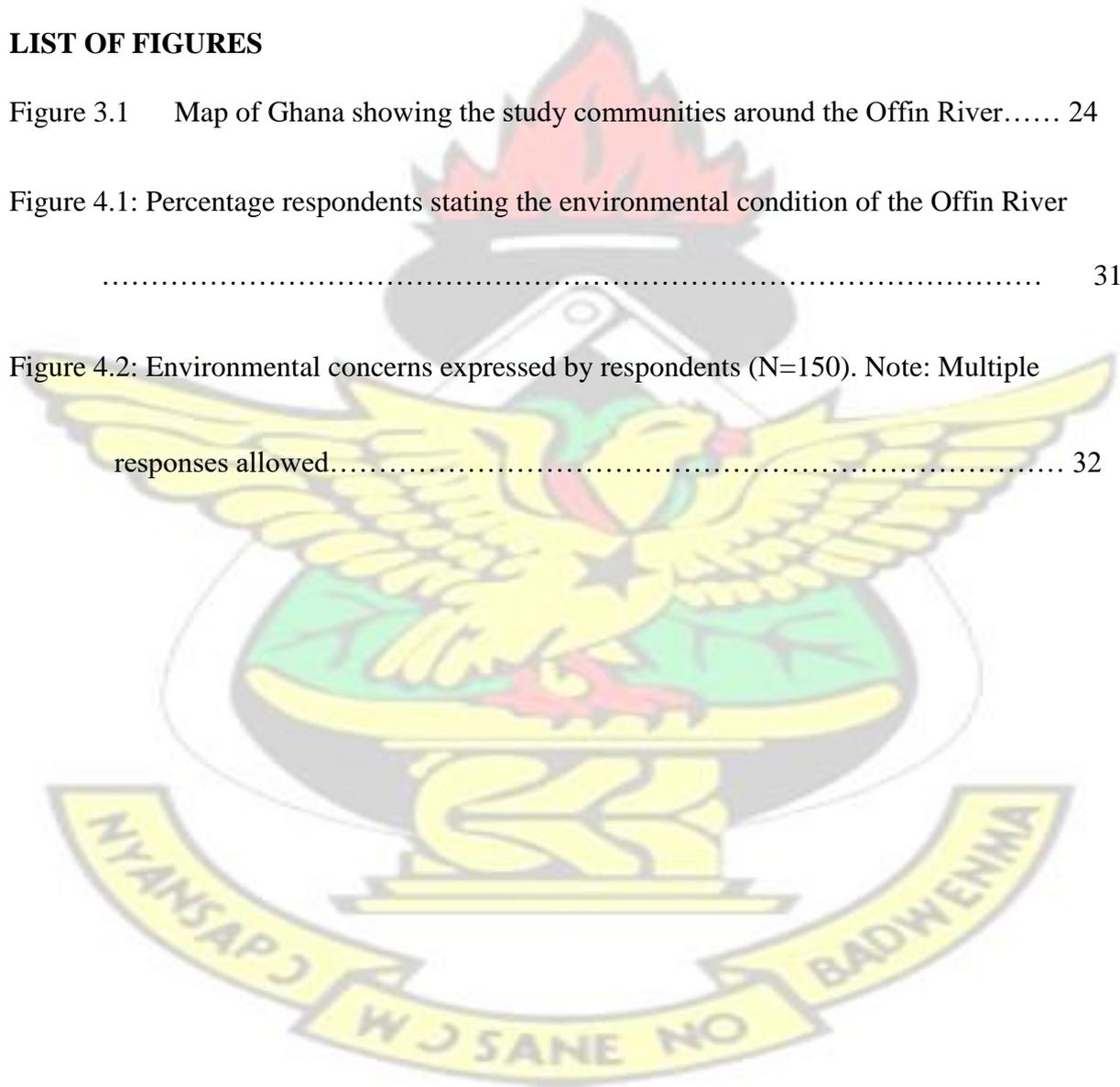
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## LIST OF ABBREVIATIONS

CVM.....	Contingent Valuation Method
ECV.....	Extended Contingent Valuation
HPM.....	Hedonic Price Method
TCM.....	Travel Cost Method
TEV.....	Total Economic Value
TWTC.....	Total Willingness To Contribute
WTA.....	Willingness-To-Accept
WTC.....	Willingness-To-Contribute
WTC <sub>M</sub> .....	Willingness To Contribute Money
WTC <sub>T</sub> .....	Willingness To Contribute Time
WTP.....	Willingness-To-Pay

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## CHAPTER ONE

### INTRODUCTION

#### 1.1 Background

Environmental and natural resources such as forest parks, wetlands, rivers, lakes and beaches produce flows of goods and services such as fish, clean water, recreation, clean air, aesthetics and flood protection, (Strange *et al.*, 1999). The goods and services produced are generally categorised as public goods. They exhibit specific characteristics of non-rivalry and non-excludability in consumption. These characteristics make it very difficult or impossible for the market system to operate normally. The supply or provision of such goods and services may be facilitated through public policy where the government, through its various institutional arms, plans and manages environmental and natural resources for the benefit of all consumers. Goods and services provided outside the market system do not have market value, although, some may carry shadow prices where similar goods are supplied through the market.

Rivers play very important multi-dimensional function on human wellbeing. They provide many goods and services to humans, such as: recreation and fish habitat, as well as agricultural and industrial users, supplying of water for rural and urban inhabitants. Perhaps the most important issues in river resources management is their economic valuation because of the potential importance they may have in influencing public opinion and policy decisions (Loomis *et al.*, 2000).

River Offin in Ghana, some years ago, served as a source of livelihood for the fringe communities along its course. Fishing was done for subsistence and sometimes for commercial purpose, providing alternative livelihood for the people who are predominantly peasant farmers. The plain along the river provided fertile soil for cultivation of rice and also for dry season vegetable cultivation. It served as the main source of drinking water and for other household uses such as cooking, washing, cleaning and bathing. The local people also engaged

in mining operations using local implements such as shovel, pan and pick axe. The washing of the laterite containing the gold was not done in the river and no chemicals were used in refining the gold, thus there was no pollution to the river.

The Offin River offers a good example of a public good and the tragedy of the commons. The river, which is a common-pool asset, is over exploited and has been allowed to degenerate over time with no distinctly defined and assigned property rights and no resource management plan to protect and conserve the river. Uncontrolled mining in the river bed and around the river course, release of cyanide and mercury into the river and removal of vegetation around the river have resulted in the pollution, siltation and decrease in water volume of the river (Golow and Mingle, 2003).

Local people's collective memory and perceptions are that the Offin River was once a vibrant river within its catchment areas. For some years now, the general thought is that the river's ecosystem has degraded. The river's original abundance of fish and wildlife is now remembered mostly through stories (Thomas Nyarko, Aniamoa, *pers. comm.*, 2014). This study, therefore, focuses on the Offin River; a case where environmental goods and services provided by the river are not taken into consideration before giving the catchment areas of the river as concession to mining companies.

## **1.2 Problem Statement**

Rivers provide many services to humans. Like many rivers throughout the world, the Offin River has in the past, provided livelihood support to inhabitants living in its basin. The water from the river was the main source of drinking water for the fringe communities and was also used in almost every household chore; cooking, washing, cleaning and bathing.

Fishing in the river provided livelihood support to the inhabitants as the fish from the river served as sources of food and income. The floodplains of the river served as a fertile ground

for the peasant farmers during the dry periods of the year. Paddy rice cultivation was a common phenomenon along the plains which boosted rice production in the area. Also the river provided other ecosystem services to the fringing communities as well as the environment in general until the advent of mining activities in the basin.

The Offin River has, for some time now, been altered by diversions, adjacent land use, mining and pollution to the extent that the river ecosystem, including its aquatic organisms is endangered (Tschakert and Singha, 2007). The activities of both registered and unregistered mining companies along the river have resulted in pollution of the river to such an extent that the river water cannot be used for any household activity contributing to the drastic reduction in the livelihood of the inhabitants around the river.

The mining activities along the banks of the river have destroyed the buffer zone which provided shade, exposing the river to direct sun rays and causing massive evaporation and fragmentation of the river during dry seasons. This has led to the dwindling in volume of water in the river. The embankment along the river is also removed through the activities of miners. As a result the river overflows its banks destroying property with the least rains.

There are no proper resource management plans in place to manage the river, resulting in total neglect of the resource. The traditional authorities no longer have the power to enforce local customary laws that once preserved and ensured the sustainable use of the river due to the current system of governance in the country.

There is the fear that if nothing is done to reverse the deteriorating condition of the river, it will soon deteriorate, both biologically and hydrologically (Adger *et al.*, 2001). Therefore, a restoration or rehabilitation program is urgently needed to prevent continual deterioration of the water status and restore the health of the river to a „good“ ecological status.

Improving damaged ecosystems such as that of the Offin River, is a way of conserving aquatic species, ecosystem functions and biodiversity. However, the ecological improvement

of large ecosystems is a major task and it can only be successful with local people's support and participation. The aim of this research is to investigate local people's willingness to allocate part of their household financial resources (money) and/or time to help improve the degraded river ecosystem. The study also investigates how respondents' household socioeconomic characteristics affect their contribution towards river ecosystem improvement program.

### **1.3 Study Objectives**

The objective of this study is to assess local peoples' willingness to contribute money and/or time towards improving the quality of flow of the Offin River and to develop conservation strategies for the improvement of the river.

Specifically, the study seeks to:

1. Determine local peoples' willingness to contribute money and/or time to improve the water quality of the Offin River.
2. Identify the factors that influence people's WTP towards improving water quality of the Offin River.
3. Determine conservation strategies needed to maximize the goods and services produced by the river.

### **1.4 Research Questions**

The study is guided by the following questions;

1. What specific ecosystem services provided by the Offin River are the key drivers of households' willingness to pay for its water quality improvement?
2. How much are households fringing the river willing to contribute (financial and/or time) to improve the river and is their willingness to contribute dependent on any factors?

3. What conservation strategies are people fringing the river willing to adopt to help maximize the goods and services produced by the river?

### **1.5 Hypotheses**

The following hypotheses are tested in the study.

1. Local peoples' willingness-to-pay towards the improvement of river water quality is strongly related to the value and demand they place on the river.
2. Local peoples' willingness to pay is directly related to their socio-economic conditions.

### **1.6 Justification**

The Offin River was selected for this study due to the fact that many communities along its course depend on it. It supplied its inhabitants with water for household use, fish and its floodplains used for cultivating crops. The pollution of the river through mining and other activities has dire consequences on the use of the river as an amenity and also as habitat for aquatic organisms that thrive in its basin.

The economic valuation of the river will offer the information needed on the value of the river, quality and application in alternative uses, facilitating decision making and providing estimation about the economic value of any development projects. The study will provide the total economic value estimate (both use and non-use value) of the river and consequently provide the basis for policy recommendation on the way forward that will represent the economically and socially preferred options for managing the river ecosystem. Findings from this study will inform policy and decision makers on how best the river could be put to use in order to enhance economic growth and alleviate poverty among inhabitants and also ensure ecological sustainability of the river.

## **1.7 Limitations of the study**

The study uses the Contingent Valuation Method that estimates the total economic value and not the individual values of ecosystem goods and services provided by the river. Choice experiments could be employed in a future research to estimate individual values for ecosystem services or goods provided by the river.

Also, the survey was administered at various times throughout the day during the entire period of the survey administration. This varied time of administration may have contributed to an under or over sampling of some occupational sectors that have employment times parallel to the survey administration times.

Furthermore, there was not enough financial resource to enable full participation of large numbers of respondents and facilitation of the research activities. There were difficulties expanding the sample population to include other communities which were willing to take part in the study due to financial constraint to travel to these communities. However, the findings from this study are sufficiently accurate and reliable to make informed generalization about the local people's willingness-to-pay to improve the quality of water in the Offin River.

## **1.8 Organization of Thesis**

The study is composed of six chapters. Chapter One introduces the study background, statement of the problem, specific objectives, research questions and hypotheses, significance and the limitations of the study. Chapter two deals with the theoretical and empirical framework of the study. It describes the contingent valuation technique, its strength and weaknesses, water governance systems in Ghana and previous empirical studies on water quality improvement.

Chapter three describes the methodology and design of survey procedures used to estimate respondents' willingness-to-pay towards river quality improvement. The results of the study are presented in chapter four while chapter five is devoted to the discussion of the results of the

study. Chapter six provides the summary of the major findings from the research and makes conclusions and recommendations.

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## 2.1 Theoretical Framework

### 2.1.1 Non-Market Valuation Technique

Non-market valuation is a process of estimating monetary value for goods and services that have limited market or no market (Bateman *et al.*, 2002). It largely makes use of analytical tools from welfare economics, econometrics and microeconomics (Haab and McConnell, 2003). The need to value environmental goods and services is as a result of the desire to integrate the natural environment in cost-benefit analysis of public policy (Boyer and Polasky, 2004).

A number of techniques used in valuing non-market goods and services in monetary terms have been developed (Mitchell and Carson, 1989; Freeman, 1993; Pearce *et al.*, 1994; Winpenny, 1995; Bateman and Willis, 1999; Bateman *et al.*, 2002). Generally accepted classification of valuation methods differentiates between revealed preference (RP) methods and stated preference (SP) methods (Asafu-Adjaye, 2000 and Shechter, 2000). Revealed preference methods involve inferring an implicit value for a non-market good from observable prices of market goods and services, which are related in some way – as complements to or substitutes for the environmental good or service of interest (Alam, 2003).

The commonly used revealed preference methods are hedonic pricing and travel cost methods.

On the other hand, stated preference (SP) methods aim at revealing the demand for an environmental good or service through consumer's surveys where, through properly constructed survey instrument (questionnaires), individuals are requested to state their preferences for the environmental good or service. Examples of SP methods used in valuing environmental goods and services include contingent valuation, choice experiment, contingent ranking methods and conjoint analysis. The choice of a particular economic valuation technique depends on the data, resources to be valued and the resources availability as well as the context (the specific problem being studied).

### 2.1.2 Contingent Valuation Method

Contingent Valuation Method (CVM) is a survey-based method used to estimate the economic value of non-market goods. It sets up a hypothetical market in which respondents are requested to express monetary bids for various goods based on the information provided to them. The fundamental assumption is that people are able to translate a wide range of environmental criteria into a single monetary amount representing the total value to them of a particular resource, and the more they value it the more they will be willing to pay for it. As a result of this, contingent valuation is able to measure both use and non-use values of an environmental resource theoretically (White and Lovett, 1999). Imber *et al.*, (1993), also state that the use of CVM depends on the assumption that responses to hypothetical markets reflect the choices and the values that would be revealed if there existed an actual market.

CVM over the years, has provided the opportunity to estimate both use and non-use values. This means that all the components together or in other words, combination of components of the total economic value (TEV) can be determined through the use of CVM (Carson *et al.*, 1992; Diamond and Hausman, 1993; Hoevenagel, 1994; Bateman and Langford, 1997; Berrens *et al.*, 2000; Russell *et al.*, 2001; Tyrväinen, 2001). Carson *et al.*, (1992), state that in many instances, valuation as a package is more desirable than piece-wise valuation (component-wise of TEV) since such piece-wise valuation neglects the possibility that the value of one service is dependent upon the value of another. As the purpose is to estimate non-market benefits, the CVM is the technique of choice and is used for this study as a package for non-market components of TEV.

In a contingent valuation (CV) survey, respondents are asked to specify either their willingness-to-pay (WTP) to secure/improve a benefit, or their willingness-to-accept (WTA) compensation to forgo a benefit or tolerate environmental degradation, continuous deterioration or lack of environmental improvement. To obtain a conservative benefit estimate and to

maximize the legitimacy of the valuation problem to the respondent, a WTP question is applied in estimating the non-market values/benefits of an environmental program. For this reason, the household's WTP, rather than WTA, for environmental quality improvement estimated from the contingent valuation survey is the choice of measure of welfare in this study.

Even though CVM is valued because of its exceptional capacity to estimate non-use values and TEV, there are lot of literature criticising the method both related to the practical implementation (e.g. survey design) and other problems associated with the method itself. One of the criticisms directed at CV is the fact that it is based on a hypothetical or nonexistent market (Cummings and Harrison, 1994). The argument of the critics is that answers obtained through hypothetical situations are subject to a range of biases which make them invalid as valuation of the resources in question (Diamond and Hausman, 1994; Cummings *et al.*, 1995).

Theoretical and empirical studies have advanced to an extent that it is not only possible to uncover the biases associated with CVM, but also possible to carry out corrective measures to surmount these biases (Mitchell and Carson, 1989; Hanemann, 1994; Smith, 1994). Angelsen *et al.*, (1994) recommended that CVM should not be rejected based on its potential biases, but rather, one should be conscious of the difficulties involved, and try to avoid these pitfalls through all the stages of design, implementation and analysis. In this study, careful survey design was employed to eliminate many of the limitations and biases associated with CVM.

### **2.1.3 Willingness-to-Contribute: Another Way of Valuing Non-Market Goods and Services**

The underlying theoretical assumption of CVM is that people have clearly defined and stable preferences for non-market goods and services which can be elicited through cautiously designed and administered survey (USACE, 1996). Money is used as the unit of account in CV survey, for eliciting people's preference. Georgiou *et al.*, (1997) maintain that the use of money as the measuring rod permits the comparison for various policy decisionmaking purposes. Also, for the purpose of comparison, it is a conventional practice to use dollar value along with the

local currency of the study area. Dollar value is preferred as dollar expressions of benefits are meaningful in that they can be interpreted unambiguously and consistently by different users of a benefits assessment (Cox, 1986). The question is whether money should always be the benchmark/standard for valuing non-market goods. How can the economic valuation of these resources encapsulate the situation where substantial parts of the economic activities of the people are not monetized?

A conventional contingent valuation survey asks respondents about their direct monetary contribution. The different variants of CV can be distinguished on the basis of exactly how they elicit the willingness to pay. Asking respondent, a question may take many forms, such as: open-ended questions (Angelsen *et al.*, 1994), dichotomous choice question (Johnson *et al.*, 1990), bidding game (Bateman *et al.*, 1995) and checklist method (Angelsen *et al.*, 1994; Rowe *et al.*, 1996). Regardless of the question format, CVM requires respondents answering hypothetical questions to provide a monetary valuation of a situation. However, the traditional approach of formulating valuation questions usually, does not consider the local context in developing countries where a lot of their economic activities are not monetized, and also many of the economic transactions are conducted in non-monetary ways. In some parts of Ghana, especially in the study area, labour as an economic activity is partly measured in monetary units. In many instances and situations, donations/contributions towards certain activities in the communities (e.g. establishment of school, religious institutions, funeral donations, church harvest and school levy) are done in the form of cocoa beans, grain (maize and millet), beans or other forms (sheep, chicken).

CV surveys are based on the assumption that every respondent has the potential to pay towards protecting environmental resources. However, the well-to-do in the society have discretionary real income to possibly allocate to environmental resource improvements as well as other things they may value. In the developing countries, there is acute income disparity

among residents than in the developed countries. Even though the questions posed to respondents imply equal sharing of contribution among all respondents, it is reasonable to assume that residents would give some weight to what they perceive to be their actual contribution as well as their income when answering valuation questions.

A statistically significant relationship between respondents' income and their willingness-to-pay is found in many CVM studies (Carson and Mitchell, 1993; Arimah, 1996; Lauria *et al.*, 1999). Should this therefore be the basis to say that affluent people care more for their environment than less affluent residents? Methods that depend on the traditional willingness-to-pay approach probably ignore the potential contributions and concerns of respondents with low or little incomes. Individual incomes for many respondents in the study area are inadequate to meet basic needs. Most of the adult population are not doing any work while some are involved in unpaid work. It therefore does not make any sense to express willingness-to-pay for such respondents from only their „insufficient disposable“ income.

In this study, the conventional CV technique is widened by adding another unit of measurement, time, in addition to the conventional money unit of measurement in order to include the aspect of respondents' preference in the context of developing countries. In this format, questions are posed asking respondents to contribute in the form of money and/or time. In the context of developing market economies, this non-monetary contribution, that is, willingness to contribute time ( $WTC_T$ ) is very important. It has particular significance in the context of high rate of unemployment, and respondents' unfamiliarity with the preference elicitation process in a hypothetical market and low disposable household income.

In addition to the conventional willingness to pay (WTP) questions in an extended contingent valuation (ECV) survey, questions in the form of respondents' willingness to contribute time ( $WTC_T$ ) should be asked. These two types of questions,  $WTC_M$  and  $WTC_T$ , together represent the respondents' total willingness to contribute (TWTC) to a proposed

environmental program. Therefore, Total willingness to contribute (TWTC) = willingness to contribute money ( $WTC_M$ ) + willingness to contribute time ( $WTC_T$ ) Or,  $TWTC = WTC_M + WTC_T$

Traditionally, the concept “willingness-to-pay” is used to imply respondents’ preference of direct payment for an environmental good or service improvement. In this study, this concept is referred to as “willingness to contribute money or  $WTC_M$ ”. Measuring the willingness to contribute time (i.e.  $WTC_T$ ) and hence, the total willingness to contribute (i.e. TWTC) is not just another way of answering the valuation question, rather it is another approach to valuing the environmental goods that may be better than the conventional method. A similar concept was used by Alam (2013), to determine the total willingness to pay to clean up the Buringanga River in Bangladesh, where respondents were willing to contribute money or time, but not both, to help clean up the river.

#### **2.1.4. Methodological Procedure of CVM**

In a typical CV survey, respondents are presented with detailed information about a hypothetical scenario that would help reduce or increase the quality or quantity of natural or environmental resource. There should be a clear definition of that environmental entity, the goods or services it provides, and the change in quality or quantity of these goods or services using diagrams, pictures, literary descriptions and maps. This will provide adequate information about the „product“ the respondent is being asked to evaluate.

Haab and McConnell (2003) state that the good or service needs to be significantly limited geographically and temporally and well defined in terms of characteristics that can convincingly enter a respondent’s preference function. An appropriate mode of payment (payment vehicle) for the elicitation of WTP/WTA values must also be described, detailing and

specifying timeframe and nature of payment and linking such payment to the provision of the benefit; that is, „no payment, no benefit“.

The hypothetical scenario of a CV survey creates a market situation in which the respondent's behaviour is observed. The hypothetical scenario must be credible and respondents should believe that such a program is plausible (Beasley *et al.*, 1986); or else respondents will not be serious towards the survey. In this study pictures are used to represent both the current and the future after the improvement program.

Question on respondents' willingness to pay/accept (WTP/WTA) is then presented within the survey setting, asking respondents to state their maximum/minimum WTP/WTA for the given change in the quality or quantity of the environmental resource. The procedure then continues by challenging respondents with additional questions to confirm their previous response to the WTP/WTA questions. The CV survey then proceeds to extract the socioeconomic, behavioural and attitudinal indicators such as income, sex, education, preferred recreational activities and the general views of respondents towards the environment, which may have influence on their preferences and help to explain WTP (Lienhoop and MacMillan, 2007).

### **2.1.5 Administration of the Survey**

The major methods used in administering CVM survey instrument are personal interview (in-person), telephone and mail (Dillman, 1978). Deciding on which method to use depends on how the valuation question is framed and the associated cost to each method. Bradburn (1983) argues that contrary to the general belief favouring face-to-face interviews, there is no clearly superior method that yields better results for all types of questions. Although mail survey method is cheaper to use and also permits the use of visual aids, it may encourage bias

associated with sample selection because people who respond to mail surveys tend to have special interest in the resource than non-respondents (Mitchell and Carson, 1989).

In-person or face-to-face interview has the potential to include people with reading difficulties unlike mail survey. It also provides a lot of control over the sequence and manner in which survey materials such as maps and photographs are presented. The in-person method provides further information by way of explanations by the interviewer but may come at a high cost and is a potential source of interviewer bias. In this study, in-person interview was used as most of the respondents in the study areas are unable to read and write. There are no mailing systems and communication system is now being developed.

### **2.2.1 Water Resources and their Role in National Development in Ghana**

Ghana's water resources consist of surface waters like rivers, ponds, streams as well as ground water sources. The major surface water resources are the three main river systems that drain the country, viz.; Coastal, South-western and Volta systems (National Water Policy, 2007). The Densu, Todzei/Aka, Ochi-Nakwa, Ochi-Amisah, Ayensu comprise the Coastal Systems. The South-Western river system is made up of the Pra, Ankobra and Bia rivers. The Volta system is made up of the White, Black and Red Volta Rivers as well as the Oti River (Ghana National Water Policy, 2007). The Offin River which is the focus of this study is a major tributary of the South-Western river system. It enters the Pra River in the southern part of the country.

The water resources in Ghana play vital role in agriculture, forestry, fisheries and livestock production and urban and industrial use in the country. Water resources and their use are essential for increasing hygiene and sanitation service levels that may affect productive lives of the citizenry, enhance enrolment and retention of girls in school, enhance women's dignity and ability to lead, reduce morbidity and mortality, reduce pre and post-natal risks and prevent

vector and water borne diseases. Health, nutrition and food production are dependent on availability of water resources in adequate quantities and good quality. Rivers in the country are significant source of drinking water and for other household chores such as bathing, washing and cooking especially in areas with no portable water.

### **2.2.2 Water Resources Management in Ghana**

The management of Ghana's water resources, including rivers, streams and underground water sources, is one of pluralism, a mix between customary and statutory laws.

#### **Customary water resources management**

Before independence, traditional norms and customs served the basis for protecting water resources from human intrusion and pollution. Water bodies were considered the preserve of gods and ancestral homes and thus were kept sacred. It was forbidden to draw water or go fishing in certain rivers on certain days. It was also an act against the gods to farm or mine along river banks as such places were considered resting abode of the river gods and their children. These practices extended beyond the boundaries of protecting watercourses/bodies to the conservation of biodiversity and other species (Hens, 2006). Shrines were usually sited near watercourses/bodies. This instilled in the local folks the spirit of alertness when farming, mining or undertaking any activity around these areas. The citizens feared they would displease the gods should they do anything that degrades the natural environment.

As a result of colonisation and the advent of the modern state, the potency of customary norms as tools for the enforcement of norms on water usage has significantly diminished. Christian beliefs, for example, have supplanted customary beliefs as propounded by fetish priests and priestesses; hence sanctions that were feared would be visited on would-be violators have paled into insignificance (Hauck and Youkhana, 2008).

## **Statutory laws for water resources management**

Colonial rule and the introduction of Christian beliefs into traditional settings rendered traditional practices and customs less potent but did not fade off completely (Water Resources Commission, 2015). Chiefs dominating influence on water and land management issues were overpowered by the Governors. Legal efforts to managing water resources actually started in 1903 following the enactment of the Rivers Ordinance (CAP 226) to regulate the use of certain rivers regarding dredging and diversion of water for various uses (Rivers Act, 1903). Under this enactment, it is stipulated that, diversion, pumping or any act that causes water to flow out of the natural course of a river for the purposes of farming and industrial uses without a licence from the minister is illegal (Rivers Act, 1903). There was however no regulations to back this enactment and thus it was overtaken by time following which other legislations were made (Odame-Ababio, 2002). These follow-up enactments were targeted at mandating agencies and departments to perform some distinct functions.

Following independence in 1957, water resources management was given considerable focus and attention considering the paucity of enactments relating to water resources that were enacted. While some had some customary norms informing their enforcement and implementation mechanisms, others frowned at the existing traditional practices that managed the respective water sectors (Ghana National Water Policy, 2007).

Until in 1996, when legislatures perhaps taking inspiration from the fact that the 1992 constitution of Ghana made provisions for the establishment of commissions to oversee, regulate and co-ordinate policies relating to the utilisation and management of some natural resources such as minerals commission and the fisheries commission (The Water Resources Commission Act, Act 522), established the Water Resources Commission (WRC), water resources were fragmentally managed. The WRC since its establishment is tasked to perform the following functions:

- Regulation and management of the utilisation of water resources as well as co-ordination of policies relating to them.

- Propose measures for the improvement of water resources.

- Issuance of water rights.

- Water resources“ data and information dissemination.

- Monitoring and evaluation of programs for the maintenance of water resources.

- Advising pollution control agencies on the matters concerning the management and prevention of water resources pollution (The Water Resources Commission Act, Act 522).

Currently, the WRC is the commission that oversee water resources utilisation in Ghana and coordinates the activities of other agencies and departments within it ambits.

Although, the above laws are supposed to regulate and protect the environment and water resources as a whole, non-enforceability of these laws and policies is a bane of Ghana“s water resources. Enforcement of existing laws suffers from weak institutional capabilities, lack of knowledge about the law at the operational level and inadequate resource allocations for the agencies mandated to do so. The existing policies, rules and regulations can also be said to be inadequate and some very obsolete to deal with the current emerging problems associated with rivers.

The mining laws that prohibit mining in river bodies in Ghana are not or weakly enforced. As a result, mining companies are at liberty to mine in water bodies and also remove river embankment causing the river to flood with little increase in water volume. There are severe environmental problems associated with water quality and quantity in the Offin River as a result of the activities of mining companies and farmers through the release of mining and agricultural effluents into the river. There are no effective regulations that take into account the ability of the Offin River to dilute and disperse effluents disposed into it. Presently there are no strict rules and regulations to limit the discharge of pollutants into the river.

### **2.2.3 Threats to the Offin River**

The hydrological survival of the Offin River is threatened by a number of factors. These factors can be natural, as a result of climate change and human related activities. The natural factors include river bank erosion and gradual siltation of riverbed and floodplain which is as a result of the flow of various streams draining into the river at various points. These streams supply the river with high volumes of water as well as sediments which cause gradual siltation of the river.

Irregular rainfall pattern is the only observed climate induced threat to the Offin River. There has been erratic rainfall pattern leading to reduction in both duration and quantity of rain fall (Ghana Meteorological Service, 2012). This has reduced the volume of water in the Offin River drastically. In 2014, there was massive flooding within the catchment areas of the river which was as a result of heavy rainfall.

The human induced problems are the major factors threatening the hydrological survival of the river. They include; mining in the river course, disposal of mining effluent into the river, diversion of the river course, farming and mining along the river banks and spilling of lube and oil from mining operations into the river. These are the major problems causing the degradation of the river. The human induced threats or problems are more or less avoidable and possibly could be kept under control.

#### **2.3.1 Empirical Review of Water Related CVM Studies**

Contingent Valuation Method is regarded as one of the most commonly used methods to estimate an economic value for environmental goods (Bishop and Romano, 1998; Mitchell and Carson, 1989). Valuation of ecosystem services using contingent valuation method has received much attention after Costanza *et al.*, (1997) used it to estimate the world's ecosystem services value. A number of studies have applied CVM to investigate a range of water quality issues,

focusing on residents' WTP for improving water quality and quantity in developed as well as in developing countries.

Lant and Roberts (1990) estimated the benefits of improved river water quality in three drainage basins located in Iowa and Illinois in the USA. The study revealed that the value of removing current riparian cropland from production to achieve improvements in river quality exceeds the value of those lands. Mohammed (2009) estimated the benefits of Pine River water quality improvement in Thailand using the CVM to be in the range of US\$1.25-3 million per year

Gonzalez and Loomis (1997) used contingent valuation surveys of Puerto Rican households to estimate residents' willingness to pay for preserving in-stream flows in the Mameyes and Fajardo Rivers. Results indicated that the annual base amount that the people were willing to pay was \$11.33 million for the Mameyes and \$13.09 million for the Fajardo.

Alam (2013) used CVM to measure respondents' willingness to contribute, both in the form of money and time, to restore an impaired river ecosystem in Dhaka City, Bangladesh. The results from the logistic regression analysis lend support to the hypothesis that a significant relationship exists between residents' willingness to participate in restoring the river and their socio-economic and perception characteristics.

A CV study by Abramson *et al.*, (2010) discovered that Israelis and Palestinians were willing to pay similar amount of money for stream improvement efforts in two transboundary watersheds in the region despite the enormous socio-economic differences between the two societies. Phuong and Chennat (2003) used the CV method to estimate the value loss of water resources due to pesticide contamination in the Mekong Delta of Vietnam. Results revealed that the economic losses were about US\$251 million.

### 2.3.2 CVM Research in Ghana

A number of studies have been conducted using CV method to determine residents' willingness-to-pay for a particular resource in Ghana. It has been used in areas such as health, air quality improvement, provision of potable water, sanitation and organic food.

Whittington *et al.*, (1993) estimated household demand for sanitation improvement services in Kumasi, Ghana. The findings showed that the demand for water and sanitation is high. Moreover, cultural and social factors had little effect on the people's willingness-to-pay. Twerefou *et al.*, (2015) used CVM to investigate households' willingness-to-pay (WTP) for the provision of potable water and the factors that affect their willingness-to-pay in the Accra-Tema metropolis in Ghana. The results indicate that residents are willing to pay more for the provision of potable water in the metropolis.

Asenso-Boadi and Vondolia, (2013) surveyed residents within three communities in Ghana to estimate their WTP in an attempt to assess a policy of better water supply for urban dwellers. The results indicate that more than 80% of the respondents favour some form of private sector engagement in water quality improvement. The mean household monthly water bill was found to be GH¢10.82. Baidoo *et al.*, (2013) estimated farmers' willingness to pay for improved access to water for irrigation in the Upper East Region of Ghana. It was found out that about 80% of the farmers expressed willingness to pay for an improvement in their system of irrigation.

CVM has been widely used and continues to be a useful tool in estimating the economic value of non-market goods in developed as well as developing countries. It has the capacity to estimate use and non-use values and thus, is a useful tool for estimating the value of river water quality improvement. In Ghana, to the researcher's knowledge, there is no study exploring the willingness of people to pay towards river water quality improvement.

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## **CHAPTER THREE**

### **METHODOLOGY**

#### **3.1 Study Area**

The study was conducted in three communities in the Atwima Mponua District of Ashanti in Ghana. It lies within longitude 20 00°W and 20 32°W and latitude 60 32°N and 60 75°N and covers a land area of 1883.2km<sup>2</sup>. The climate is of the tropical humid type with two seasons; the rainy season and the dry season. The area experiences the bimodal type of rainfall with the maximum occurring in April-July and the minimum in September- November. The study area is within the moist semi-deciduous forest type (Hall and Swaine, 1976), and has a mean annual precipitation of between 1700mm and 1850mm. The average monthly temperature

ranges between 22°C-30°C (Ghana Meteorological Services, 2014). The map of the study district shows the three communities where sampling was done (Figure 3.1).

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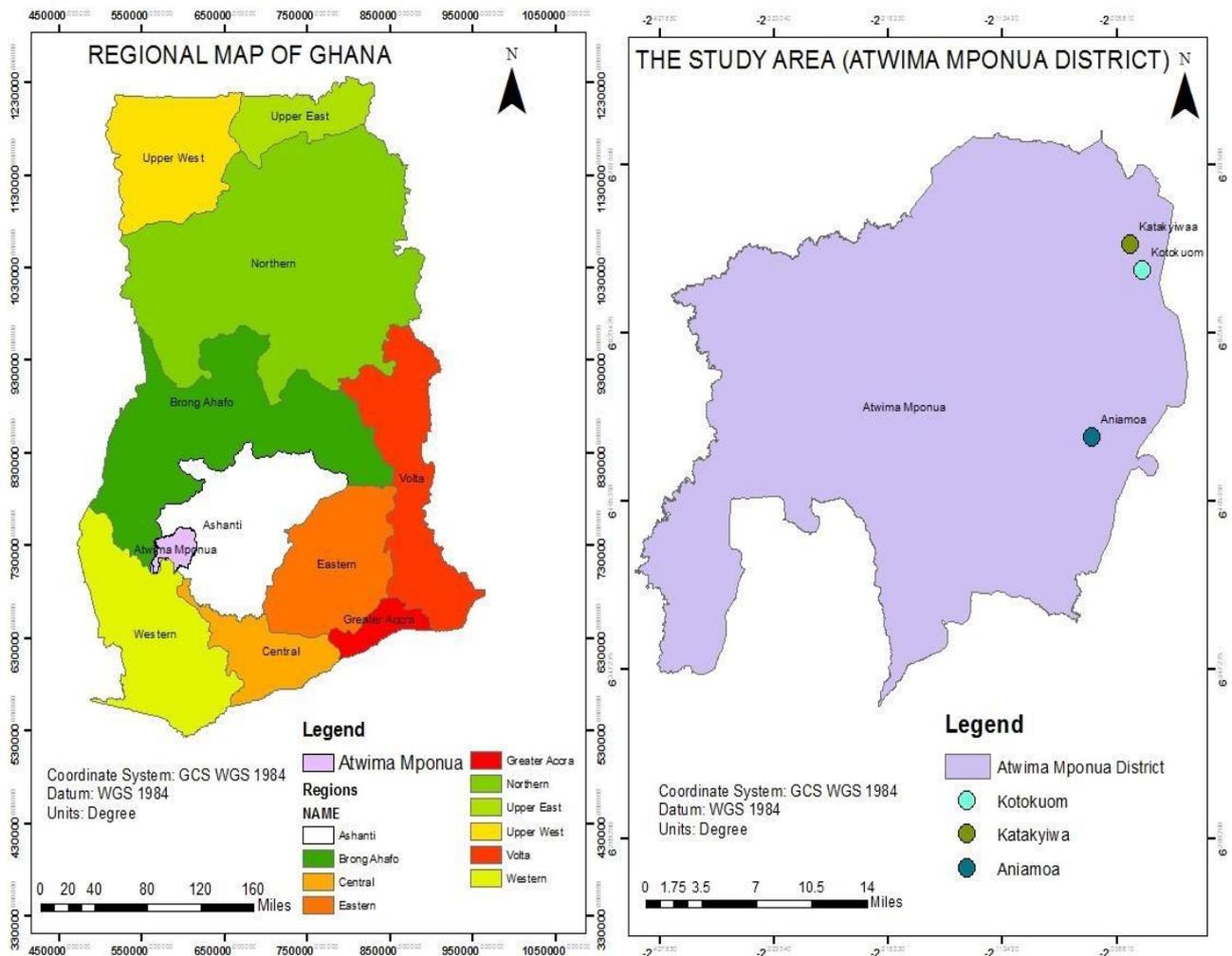


Figure 3.1 Map of Ghana showing the study communities around the Offin River

### 3.2 Research Design

The study was conducted using survey. A survey instrument based on the concept of contingent valuation was designed to gather primary data relating to the proposed water improvement in Offin River program. To test the validity of the survey instrument, two focus group discussions, made up of opinion leaders in the study areas, were organized to discuss the draft questionnaire. The information generated from the focus group discussion was used to refine the survey instrument for the contingent valuation study. In each focus group discussion, each component of the questionnaire such as the payment vehicle, scenario description and use

of photographs were discussed. It paved way for respondents to provide further information they desired in making informed decision(s).

The duration of the improvement program for the Offin River was proposed to be ten years at the focus group discussion. This type of program requires longer time both for the investment and benefits to mature. The timeframe for the program was limited to ten years on the basis of the understanding that a longer timeframe may deter some respondents' willingness to contribute and may create a sense of „too far away to see the outcome“.

The drafted questionnaire was pre-tested and amended to ensure that respondents better understood the questions. Special attention was devoted to responses given by respondents in relation to the hypothetical scenario, the payment vehicle and the willingness to pay question.

The questionnaire was structured around four sections in addition to an introductory statement and at the end a question requesting the respondent's general observation (s) about the survey. In the introductory statement, the purpose of the survey is mentioned. The sections were put under the following headings; economic and environmental issues, willingness to contribute, respondent's use of the river and household socio-economic data (Appendix A). Respondents were assured of confidentiality and that their responses are for academic purpose. This was done to eliminate strategic bias.

### **3.3 Sampling and Data Collection**

#### **3.3.1 Sampling Frame and Sample Selection**

The population targeted for the study comprises all households in communities along the course of River Offin in the Atwima Mponua District of Ghana. People in communities that are very far from the river were not considered since they may not have enough information about the existence and condition of the river and are most likely to express zero values or may decide to abstain from the survey. Three communities along the course of the Offin River were selected

based on the severity of the mining activities and the destruction to their sources of livelihood (river). The communities were categorized as „very near“, „near“ and „far“ to the river. Kotokuom was considered as „very near“, Aniamoa as „near“ and Katakwiwa as „far“ to the river.

Within each of these communities, individual houses for the interview were selected using systematic sampling design. The total number of houses in each community which was obtained from the 2010 Population and Housing Census were divided by the number of houses (50) to be selected from each community to obtain the sampling interval. Using the house numbering system in these communities, a house was selected randomly in each community. Starting with that house, every other house with the same number was selected for the interview until the 50<sup>th</sup> was reached per community. In all, fifty households were selected from each community for the in-person interview.

### **3.3.2 Data Collection**

The survey instrument (questionnaire) was administered to residents constituting the major source of primary data for the study. A number of visits were also made to the river in order to help collect detailed data on sources of pollution. In the community, the interviewer entered the selected house and asked for the household head. After introduction, if he/she agreed to participate, then the interview was started. A situation where the household head was not present, the next person in charge was asked to participate in the interview and where he/she refused to respond to the survey, the interviewer moved to the next house. Most of the interactions were in Twi, the local language. Where a respondent wanted to answer the questionnaire by himself/herself, the pictures were made available to him/her and where the respondent needed assistance, it was provided by the interviewer.

### 3.4 Data analysis

The questionnaire was coded and analysed using Microsoft Excel and Statistical Package for Social Sciences (SPSS) version 16. The total willingness to pay of respondents was calculated using the expression adopted from Alam, (2013);  $TWTP = WTC_M (GHC) + WTC_T$  (Hour), where  $WTC_M$  is willingness-to-contribute money and  $WTC_T$  is willingness-to-contribute time. Data on prevailing market rates of labour wages and salary for the study area was used to monetize time contributed by respondents. GHC 12 was arrived at as the wage for a four hour (8am-12noon) labour work in the study area. This means that an hour labour work is equivalent to GHC 3. The total time (hours) contributed is multiplied by GHC 3 in order to arrive at the monetary value of time contributed to improve water quality of the river by respondents.

An Independent Sample T-test was run to compare the mean willingness-to-pay and some socio-economic factors of the respondents. A Multiple Regression Model was run to determine the relation between socio-economic factors and WTP for improvement in water quality of the Offin River. The estimated model, which was adopted from Mitchell and Carson (1989), is specified as follows:

$$WTP = \beta_0 + \beta_1 Dist. + \beta_2 YR + \beta_3 IN + \beta_4 OC + \beta_5 HHS + \beta_6 Edu + \beta_7 Age + \beta_8 Gen + e$$

Where:  $\beta_0$  is coefficient of the constant  $\beta$ 's are coefficients to be estimated

Dist. = distance to the river

YR = Year of residency in study community

IN = Household monthly income

OC = Respondent's occupation

HHS = Household size

Edu = Level of education

Age = Age

Gen = Gender and

e = the error term **CHAPTER FOUR**

## RESULTS

### 4.1 Socio-economic characteristics of respondents

A total of 150 households in three communities within the study area were surveyed. This represents about 19% of the total households within the three communities in the study area. The sample consists of about 79% male and 21% female. The average size of a household in the study area was six (Table 4.1).

The average age of respondents in the study area is 39 years. About 41% of the respondents were within the age group 26-35, while 40% were within the 36-47 age group. Subsistence agriculture was found to be the major occupation with almost 59% of the respondents, followed by civil servants (about 19%) and industry (14%). The highest level of education attained by majority of the households was primary education with 39%, followed by senior high secondary school, 27% and people with no schooling, 15%. The average number of years a respondent has stayed in a particular community is 17 years.

Table 4.1: Socio-economic characteristics of respondents used in the WTC function

Household characteristics	Kotokuom	Aniamoa	Katakyiwa
Mean household size	6.9	6.3	5.4

<b>Age Group 18-</b>			
25	32%	32%	56%
26-35	32%	60%	32%
48-57	36%	8%	10%
Don't wish to disclose			2%
<b>Income Group</b>			
<GHC 100	8%		6%
GHC 100 - GHC 500	38%	32%	26%
GHC 600 - GHC 1000	38%	44%	44%
GHC 1100 - GHC 1500	16%	20%	14%
GHC 1600 - GHC 2000		4%	4%
GHC 2000+			6%
<b>Gender</b>			
Male	82%	80%	74%
Female	18%	20%	26%
<b>Occupation</b>			
No work			2%
Agriculture	62%	58%	56%
Household work		2%	2%
Industry	2%	30%	10%
Civil servant	22%	4%	30%
Other*	14%	6%	
<b>Level of education</b>			
No schooling	16%	22%	8%
Primary education	42%	48%	28%
Higher secondary education	28%	26%	26%
Training certificate	8%	2%	26%
Graduate degree	6%		10%
Post graduate		2%	
Don't wish to disclose			2%

\*Other include: Petty trading, chemical sellers and miners.

#### 4.2 Respondents' visit to the Offin River and purpose of the visit

Respondents were asked whether they have visited the Offin River during the past one year. Almost all the respondents (99%) said they have visited the river one or more times in the past year. Respondents were also asked to specify the purpose of their visit to the river. Among the purposes given for their visits include fishing (23%), mining (17%) and swimming, washing and bathing (17%) (Table 4.2).

Table 4.2: Preferred activities of respondents associated with the Offin River

Activities undertaken around the river	Name of community			Percent (%)
	Kotokuom	Aniamoa	Katakyiwa	
Farming along the banks of the river	13	9	5	14.6
Fishing	21	5	17	23.3
Irrigation	10	13	10	17.8
Mining in and around the river	6	20	7	17.8
Swimming, washing and bathing	17	1	14	17.3
Selling at the mines	2	8	3	7
Reference point when teaching water pollution	4	0	0	2.2
<b>Total</b>	<b>47</b>	<b>48</b>	<b>40</b>	<b>100</b>

Note: Multiple responds were allowed.

#### 4.3 Environmental concerns about the river

About 99% of the respondents said the overall environmental conditions of the river are getting worse. This is based on their knowledge of the current environmental conditions of the river (Figure 4.1).

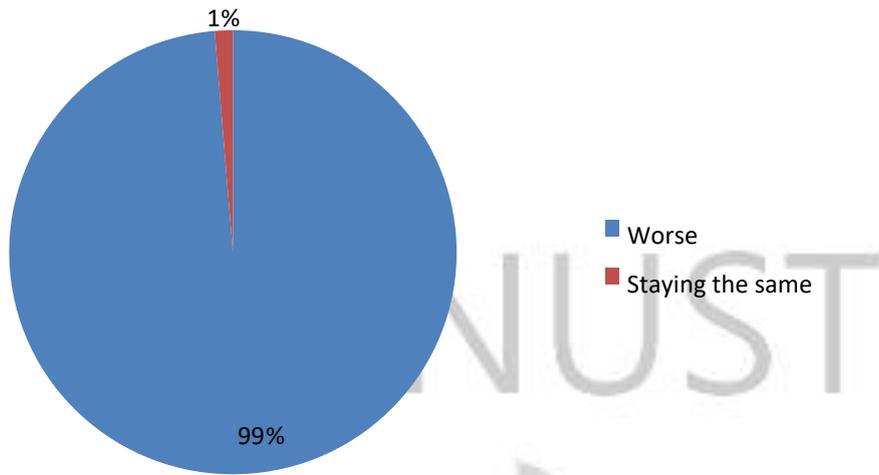


Figure 4.1: Percentage respondents stating the environmental condition of the Offin River

Environmental concerns of the river were expressed on a variety of issues such as water pollution (40%), loss of fish and other aquatic resources (27%), loss of natural beauty (17%) and lack of water flow (16%) (Figure 4.2).

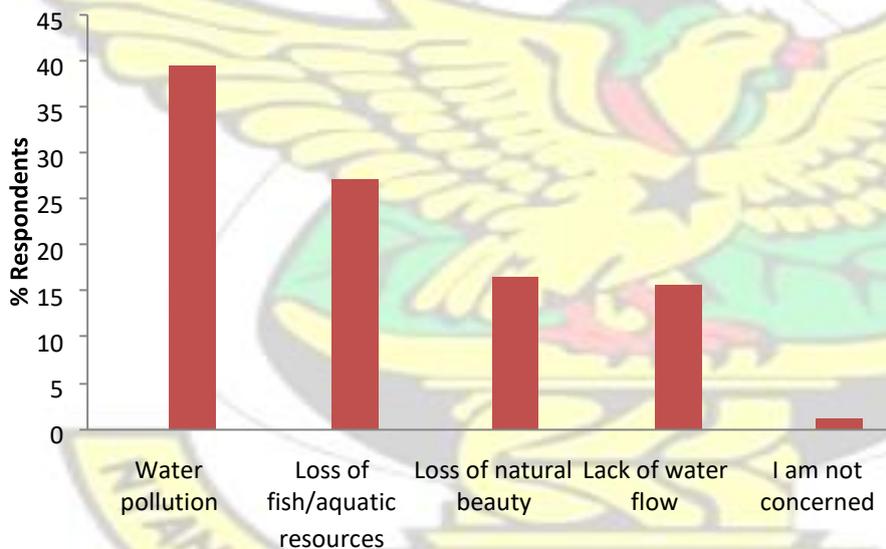


Figure 4.2: Environmental concerns expressed by respondents (N=150). Note: Multiple responses allowed.

#### 4.4 Causes of Pollution of Offin River

Respondents were asked to state the factors leading to the degradation of the water quality in the Offin River (Table 4.3). Majority of the respondents (43%) were of the view that illegal

mining in and around the river is a major contributor to its water quality degradation. Twenty-six percent attributed the degradation of the water quality in the river to lack of enforcement of mining laws around the river while about 13% attributed it to farming close to the river.

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Table 4.3: Respondents (%) stating the causes of water quality degradation in the Offin River

Causes of Pollution of the River	Frequency	Percent respondents (N= 150*)
Nothing is impacting seriously, the water in the river is ok	1	0.3
Untreated mining effluent into the river	39	11.9
Illegal mining in and around the river	142	43.2
Lack of enforcement of law regarding mining around the river	84	25.5
Disposal of garbage into the river	19	5.8
Farming close to the river	43	13.1
Don't know/refuse to answer	1	0.3
Total	329	100

Note: Multiple responses were allowed.

#### 4.5 Future use of the River

Respondents were asked to indicate their future use of the Offin River if the water quality is improved. Details of respondents' future use of the improved river water quality are provided in Table 4.4. Thirty-one percent of those who responded were of the view that they would want to use the river water for household purposes such as drinking, bathing, cooking and washing. Twenty-nine percent of the respondents would want to do fishing and about 16% would use it for irrigation.

Table 4.4: Percentage respondents indicating future use of the Offin River

	Percent respondents
--	---------------------

<u>Future use of the river</u>	<u>Frequency</u>	<u>(N=150)*</u>
Use of river water for household purposes	98	31.3
Fishing	90	28.8
Swimming, boating and other water activities	32	10.2
Irrigation	49	15.7
Visit heritage/historical sites on the riverside	27	8.6
Picnic and recreation	17	5.4
<b>Total</b>	<b>313</b>	<b>100</b>

*Note:* \* multiple responses were allowed

#### 4.6 Supports for Improvement of Water Quality in the River

Many of the respondents were willing to support the water quality improvement program; out of the 150 households surveyed, 94% were in support of the improvement program (Table 4.5).

Table 4.5: Respondents (%) willingness to support water quality improvement program for river Offin in study area

<u>Support rate</u>	<u>frequency</u>	<u>percent</u>
Very strongly	133	88.7
Support somehow	8	5.3
Not sure	4	2.7
Don't support	5	3.3
<b>Total</b>	<b>150</b>	<b>100</b>

#### 4.7 Reasons for and against respondents' Willingness to Support the Program

To all the respondents who answered „yes“ or „no“ to the willingness to contribute money question were asked why they had replied the way they did. For respondents who answered „yes“, and went ahead to select WTP amount, they were then required to state why they were willing to contribute towards the improvement program (Table 4.6).

Table 4.6: Respondents (%) reasons for contributing money for the improvement of water quality in the Offin River

<u>Reasons for contributing money</u>	<u>Frequency</u>	<u>Percent</u>
People should pay for the services they expect to be provided.	2	1.4
Concerned about water quality in the river.	27	19.6
Concerned about the loss of livelihood provided by the river	18	13.0
Satisfaction that the river will be free from pollution through mining.	34	24.7

Satisfaction that the river water may be used for future household needs.	57	41.3
Total	138	100

About 41% of those who were willing to support the program stated that their willingness to pay stem from the satisfaction that the river water may be used for future household needs.

Twenty-five percent of the respondents would support because of the satisfaction that the river is free from pollution through mining and 20% were concerned about water quality.

The reasons given by respondents who were not willing to support the program are presented in Table 4.7. They expressed reasons such as „government’s sole responsibility to undertake such program“ (29%), „lack of confidence in the success of the proposed program (29%) and „do not have enough money to pay for such an activity“ (21%).

Table 4.7: Percentage of respondents indicating reasons for not supporting water quality improvement program for river Offin in the study area

Reasons for not supporting the program	Frequency	Percent
Lack of confidence in the success of the proposed program	4	28.6
I am not a polluter, polluters must pay	1	7.1
Do not have enough money to pay for such an activity	3	21.4
Money may be misappropriated/misused	2	14.3
It is government's sole responsibility to undertake such program	4	28.6
Total	14	100

#### 4.8 Estimation of Willingness to Contribute Money (WTC<sub>M</sub>)

One hundred and thirty-eight respondents out of the 150 households, who took part in the survey, were willing to contribute money (in the form of cash or food stuff and in some cases both) towards the water quality improvement program. This represents about 92% of the total respondents (Table 4.8).

Table 4.8: Distribution of sums of money respondents are willing to contribute (per month) towards water quality improvement program for river Offin in study area

Amount (Range)	Mid-point(GHC)	Frequency(F)	Mid-point x Frequency (GHC)
----------------	----------------	--------------	-----------------------------

Below GHC 5	GHC 3	45	135
GHC 5 - GHC 10	GHC 7.5	66	495
GHC 11 -GHC 15	GHC 13	18	234
GHC 16 - GHC 20	GHC 18	4	72
GHC 21 -GHC 25	GHC 23	0	0
GHC 26 -GHC 23	GHC 28	2	56
Above GHC 40	GHC 40	3	120
Total		138	GHC 1112

The Dollar to Cedi ratio as at November 2015 inter-bank exchange rate was 1:3.7

Greater number (66) of the respondents were willing to contribute between GHC 5 – GHC 10 per month followed by those willing to contribute any amount below GHC 5. Three households were willing to contribute the highest amount (above GHC 40). The average amount of money respondents are willing to contribute per month to improve river Offin is GHC 7.41. The total amount of money respondents are willing to contribute per month for all respondents is GHC 1112 (USD 301).

#### 4.9 Respondents' Willingness to Contribute Time towards the Program.

Apart from eliciting respondents' monetary contribution towards the program, respondents' contribution in terms of time was also elicited. This was an opportunity given respondents who were unable to pay cash or contribute food stuffs towards the program. About 91% of the respondents were willing to make available their time to help the improvement program (Table 4.9).

Table 4.9: Distribution of respondent' willingness to contribute time (per month) towards the improvement program of the Offin River

Time (hrs)	Mid-point (hours)	Frequency (F)	Mid-point x Frequency (hours)
Below 5	3	27	81
6 – 10	8	54	432
11 – 15	13	18	234
16 – 20	18	4	72
21 – 25	23	10	230

26 – 30	28	1	28
Above 36	36	23	828
Total		137	1905

The average number of hours a respondent is willing to contribute to the improvement program per month is 12.7. The total number of hours respondents are willing to contribute per month for all respondents is 1905, which is approximately 79 days. Respondents were willing to contribute time to provide services such as physical labour, campaign and public awareness creation, participating in meetings and rallies, providing consultancy and participating in technical and non-technical office work.

#### 4.10 Total Willingness to Contribute (Money and Time)

The distribution of respondents and their willingness to support the program by contributing both money and time are indicated in Table 4.10. One hundred and thirty-five of the respondents were willing to support the program by contributing both money and time.

Table 4.10: Total number of respondents willing to contribute both money and time towards the improvement program of river Offin

Willingness to contribute both money and time	Yes to	No to	Total
	WTC <sub>T</sub>	WTC <sub>T</sub>	
Yes to WTC <sub>M</sub>	135	3	138
No, to WTC <sub>M</sub>	2	10	12
Total	137	13	150

#### 4.11 Total Willingness to Contribute Expressed in Monetary Terms

The average monthly total willingness-to-pay, which comprises of the average WTC<sub>M</sub> and the average WTC<sub>T</sub>, towards the water quality improvement program per household, is GHC 45.51. The average monthly total WTP for all the respondents surveyed is GHC 6826.5. The

total monthly WTP expressed by respondents who were willing to make both time and monetary contributions is GHC 6143.85 (Table 4.11).

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Table 4.11: Respondents' average TWTP towards the water quality improvement of the Offin River

Respondents' WTP	Total WTP (GHC) ( $WTC_M + WTC_T$ )	Monthly WTP (GHC)	Annual WTP(GHC)	Number of households
Average WTC*	7.41 + 38.1	45.51	546.12	1
Apply average to all Households **	6826.5	6826.5	81918	150
Apply average to 90% of households ***	<u>6143.85</u>	<u>6143.85</u>	<u>73726.2</u>	<u>135</u>

\*per household, \*\* total households surveyed \*\*\* respondents willing to contribute both money and time.

## 4.12 Factors that Influence Respondents' Total Willingness-To-Pay

Respondents' willingness to pay towards the improvement of water quality in the Offin River was assumed to vary in terms of a number of socio-economic factors such as gender, distance to the river, years of residency, etc. An independent samples t-test was conducted to test the influence of these factors on the mean total willingness-to-pay (MTWTP) amount (Table 4.12).

There was no significant difference between the MTWTP and most of the factors with the exception of age. A significant difference exist between the active age group ( $M=6.97$ ,  $SD=5.663$ ) and non-active age group ( $M=8.88$ ,  $SD=5.905$ ;  $t(147) = -1.987$ ,  $p=0.049$ ).

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Table 4.12: Summary of independent samples t-test for the socio-economic factors that affect respondents WTP towards the water quality improvement program

Factors	N	Mean		SD		T-test	P-value
		<1km	2-3km	<1km	2-3km		
Distance	150	8.62	9.06	5.087	7.558	$t(98) = -0.342$	$p = 0.734^{**}$
Years of Residency	150	<u>&lt;10yrs &gt;10yrs</u>		<u>&lt;10yrs &gt;10yrs</u>		$t(148) = -1.57$	$p = 0.119^{**}$
Household Income	140	<u>&lt;GHC1000 &gt;GHC1000</u>		<u>&lt;GHC1000 &gt;GHC1000</u>		$t(148) = -0.751$	$p = 0.456^{**}$
Occupation	150	<u>Salary Non-salary</u>		<u>Salary Non-salary</u>		$t(148) = 0.376$	$p = 0.708^{**}$
Household Size	147	<u>1-6 7-12</u>		<u>1-6 7-12</u>		$t(145) = -0.670$	$p = 0.504^{**}$
Level of Education	149	<u>Illiterate Literate</u>		<u>Illiterate Literate</u>		$t(147) = 1.675$	$p = 0.094^{**}$
Gender	150	<u>Male Female</u>		<u>Male Female</u>		$t(148) = 1.375$	$p = 0.171^{**}$
Age	149	<u>Active^ non-active^^</u>		<u>Active non-active</u>		$t(147) = -1.987$	$p = 0.049^*$

\*Significant at 0.05 level; \*\*Not significant at 0.05 level. ^Active age (<37 years), ^^Nonactive age (>37 years).

#### 4.13 Maximizing the Goods and Services Produced by the River

Restoring the natural flow of water in the Offin River and to help improve the water quality in the river, a number of management options/strategies were listed in the survey instrument. These options/strategies are specific methods to improve the quality of water in the Offin River. Forty-one percent of those who responded to the survey were of the view that galamsey (illegal mining) activities in and around the river must be stopped (Table 4.13).

Table 4.13: Percentage of respondents indicating strategies to improve and conserve the Offin River

Conservation strategies	Responses	Percent respondents (N=150)*
Prevention of illegal mining activities	139	41.0
Re-planting of trees and vegetation around the river	53	15.6
Dredging of riverbed	14	4.1
Clearing of overgrown bushes in the river course	11	3.2
Prevention of disposal of sewage into the river	13	3.8
Formulation and implementation of strict laws	109	32.2
Total	339	100

*Note* \* multiple response allowed

Thirty-two percent of the respondents wanted formulation and implementation of strict laws to curb illegal activities around the river, whilst 16% wanted re-planting of trees and vegetation around the river.

#### 4.14 Multiple Regression Analysis of Factors Influencing TWTC

Regression analysis was conducted to determine which socio-economic attributes of respondents influence their WTC. WTC towards the water quality improvement program of the Offin River was modelled as a function of a number of variables comprising of distance to the

river, number of years of residence, household income, level of education, age, household size, occupation, and gender. Alpha level of 0.05 is used for all the statistical tests.

Results from Table 4.14 show household monthly income ( $b = 0.201, p = 0.039$ ) to be positive and significant. Years of residency of respondents ( $b = 0.232, p = 0.030$ ), is significant and the sign on the coefficient is positive. From the multiple regression (Table 4.14), household size was also found to be significant ( $b = -0.207, p = 0.047$ ). The sign on the coefficient is negative, meaning the higher the household size, the less they are willing to contribute towards the improvement program. Distance to the river was found not to be significant but negative ( $b = -0.129, p = 0.151$ ), implying the shorter the distance of respondents to the river, the higher their WTC. The results also revealed occupation not to be significant and negative ( $b = -0.101, p = 0.373$ ).

Table 4.14: Results from multiple regression

Independent variables	Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>P</i> -value
	<i>B</i>	Std. Error	Beta		
(Constant)	8.673	3.543		2.448	0.016
Distance to the river	-0.601	0.416	-0.129	-1.443	0.151
Years of residency	0.634	0.289	0.232	2.191	0.030
Household monthly income	1.207	0.578	0.201	2.087	0.039
Occupation		0.456	-0.101	-0.894	0.373
Household size	-0.558	0.278	-0.207	-2.006	0.047
Level of education			-0.090	-0.838	0.403
Gender	-1.460	1.154	-0.103	-1.265	0.208
Age	0.822	0.801	0.106	1.026	0.307

Dependent variable: Total WTC,  $R^2 = 0.135$  Std. Error of Estimate: 5.589

$F(8, 141) = 2.74, p = 0.008$  NB: \*\* Significant at  $p = 0.05$ , \* Not significant at  $p = 0.05$

Another socio-economic variable that was tested is respondents' level of education. It was revealed not to be significant ( $b = -0.090$ ,  $p = 0.403$ ) and the sign on the coefficient is negative. Results on gender indicate a non-significance ( $b = -0.103$ ,  $p = 0.208$ ) and is negative. Age ( $b = 0.106$ ,  $p = 0.307$ ) is positive but not significant.

## CHAPTER FIVE

### DISCUSSION

#### 5.1 Socio-economic characteristics of respondents

Respondents' willingness-to-pay in a CV survey is mostly influenced by their socioeconomic characteristics. The average household size of the sample (6) of this study is close to the average household size of the study district (GSS, 2010). Subsistence agriculture was found to be the main occupation in the study area and this is in line with the 2010 Population and Housing Census conducted by the Ghana Statistical Service. This confirms the result from this study that about 79% of the populace in the district are engaged in subsistence agriculture (GSS, 2010). The socio-economic characteristics of the surveyed sample are found to be very close to those of the population of the study district.

#### 5.2 Causes of Pollution of the River

About half of the households sampled from the study areas attested that illegal mining in and around the river is the major cause of degradation of the river. The Offin River is polluted by solid suspensions and mercury which are commonly discharged into the river during the sluicing and amalgamation processes in gold mining (Awatey, 2014). Residents surveyed in the communities recount that they no longer depend on the river for drinking water; and those who do so are at risk of contracting water-borne diseases. The extent of pollution of the river water

was confirmed by field observation. This is consistent with similar findings by Kessey and Arko, (2013) study conducted on small scale gold mining and environmental degradation in some selected communities along the Offin River.

Respondents were also worried about the fact that the rules and regulations guiding alluvial mining are not enforced by the statutory bodies tasked to do so. Similar observation has been made in Kessey and Arko, (2013) study of small scale gold mining and environmental degradation along River Offin. Miners are required by law (Small-Scale Gold Mining Law, PNDC L 218), to ensure best practices such as use of amalgam retort to effectively separate gold from mercury to prevent pollution. They are also to ensure that lubricants and other oils do not drain into water bodies, cover open pits after mining and not diverting river course during mining. Mining operators within the study areas have the liberty to operate without the supervision of the institutions mandated to do so. They therefore, do not observe any best practices or guidelines in their operations.

Dry season farming was also cited as one of the causes of pollution of the river. To make room for farming, farmers usually remove the trees and vegetation that provided shade for the river. Also, chemicals (fertilizer, weedicide, pesticides) used by farmers gradually find their way into the river body, thereby contributing to the degradation of the river. This assertion by respondents is in consonance with a study conducted by Pate and Loomis, (1997). The focus of their study was to reverse the negative water quality effects through agricultural runoff on the San Joaquin River in California, USA. Disposing of untreated mining effluent into the river by the mining companies and disposal of garbage into the river also contribute to the degradation of the Offin River. These practices are of concern to a section of the respondents in the study areas.

### 5.3 Willingness-To-Contribute towards water quality improvement program

The willingness-to-contribute towards the river water improvement program was expressed in money (cash/foodstuffs) and/or time. The results show that the mean  $WTC_T$  is greater than the mean  $WTC_M$ . This means that most of the respondents, who were willing to support the program, were willing to do so by contributing their free time. This may be due to the fact that most of the respondents are peasant farmers and may find it difficult raising cash to pay towards such program. It may also be due to the timing of the survey; there were no farming activities at the time of survey as most of the respondents were home expecting the rains to begin which will commence the farming season. This therefore explains the high mean  $WTC_T$  value. Respondents were better off contributing to the program by participating in it than paying money for other people to carry out the program.

Respondents were willing to make an average monthly contribution of over GH¢ 45 (\$12.3 at November 2015 interbank exchange rate) per household, to support the program. This amount is very significant in the context of a developing country. The result of this study shows the value respondents attach to the river and the benefits they derive from it. A comparison with other studies conducted in developed countries reveals that respondents' WTP for the improvement program is high. A study conducted by Pate and Loomis, (1997) to estimate respondents' WTP for wetland improvement, contamination control, and salmon improvement programs in the San Joaquin Valley, California found the average annual WTP to be in the range of \$67.80 to \$215.55. MacDonald *et al.*, (1998) determined the mean annual WTP for two non-point source pollution control programs which would improve water quality in Lake Sinclair to be about \$69 per household in Georgia, USA. In another study, Beran, (1995) estimated respondents WTP for the passive use values associated with preservation of freshwater wetlands in South Carolina to be within the range of \$6.03 to \$45.40 as one-time contribution.

## **5.4 Factors Influencing Respondents' WTP**

This study anticipated that respondents' willingness-to-pay towards the water quality improvement of the Offin River is influenced by a number of factors.

### **5.4.1 Future use of the River**

The perception of benefits received from the river was an influential factor in respondents' willingness-to-pay in this study. Residents were willing to support the program because of the future benefits they will derive from the river after the improvement. Similar relationships are reported in the literature. In a study conducted by Kideghesho *et al.*, (2007) in Tanzania, conservation attitudes were positive only when interests of local communities were not affected by the use of protected areas. Brunson and Steel (1996) argue that attitudes towards resource management are strongly associated with value orientations towards the role of humans in nature.

The results of this study are in line with Brunson and Steel (1996) observations as respondents perceive that the river actually benefits them, or that it could benefit them in the future (option value), or that their children and grandchildren could benefit from it latter (bequest value). It is on this basis that they were more inclined to support/pay for the improvement efforts.

### **5.4.2 Socio-economic Factors**

The size of a household's income, according to many studies, determines people's willingness-to-pay towards environmental protection (Carson and Mitchell, 1993; Carson *et al.*, 2001; Carson *et al.*, 2003; Sanjurjo and Carrillo, 2006; Menegaki *et al.*, 2007). Imber *et al.*,

(1993) contend that as income of respondents rises, their WTP for environmental improvement would also rise and therefore there is a statistically significant relationship between household income and WTP.

This study found income to be statistically significant and influenced respondents' WTP towards the program. As income of respondents increases, their willingness-to-pay towards the improvement program of the Offin River also increases. It was also noted that the higher a respondent's income, the larger the amount he/she is prepared to contribute towards the program. This confirms the assertion that the existence of no relationship between WTP and income would be cause of concern about the plausibility of the CV method (Russell, 2001).

Another variable which significantly influenced respondents' WTP in this study is number of persons in a household (household size). The negative sign on the coefficient means that a large household size is a disincentive to contribute towards the program. A smaller household size encourages respondents to pay towards environmental protection. Smaller households may have smaller expenditure and might have extra income to spare. This might explain their willingness to pay more towards the program than households with large household size. This result is consistent with the findings of Ojeda *et al.*, (2008) and Mbata (2006) which predict or show that household size determines respondents' willingness-to-pay.

The number of years a respondent stayed in the community was found to have significant influence on their WTP. As the years of respondents' residency increases, the tendency to pay towards the improvement program increases. Perhaps respondents who have stayed in the communities for a longer period might have seen and benefitted from the river before the deterioration and degradation of the river or might have developed attachment or sense of ownership to the river. Respondents who have stayed in these communities for a short time were not willing to pay as they might not have benefitted from the river. This finding appears

to support findings from research conducted by Mendonca and Tilton, (2000) and Phuong and Gopalakrishnan, (2003) that number of years of residency determine respondent's WTP.

It was anticipated that people living far from the river may not be concerned with the degradation of the river and for that matter, may not contribute towards the improvement program (Sutherland and Walsh, 1985; Pate and Loomis, 1997; Bateman *et al.*, 2006). The statistical results of this study found distance to the river not significant. The results show that people living far from the river were not willing to pay towards the improvement program. This could be as a result of respondents in these areas not receiving any benefit directly from the river. Similar observation has been made by Sutherland and Walsh (1985) when they used CV survey to determine the value of preserving water quality in the Flathead River Basin in Montana, USA. They found out that preservation value has a negative association with distance from that resource.

Positive trends in the respondents' educational level and their WTP exist in a number of studies (Carrillo-Guerrero, 2005; Sanjurjo and Carrillo, 2006; Veisten *et al.*, 2004). The influence of education on WTP was found to be not significant and therefore not a determining factor in this study. Menegaki *et al.*, (2007) posit that education of farmers in Crete, an island in Greece, is not synonymous with experience in agriculture and therefore their WTP to use recycled water was not influenced by their levels of education. A similar situation applies in this study. It was found that respondents' levels of education do not affect their WTP towards the program. The ability of an individual to read or write does not necessarily make him/her environmentally conscious neither does it mean that one's inability to read or write means he/she is less environmentally conscious. A person's exposure and interaction with the resource makes him/her aware of the environmental conditions of the resource and may be willing to pay towards the protection of such resource. Respondents are well aware of the environmental

conditions of the Offin River and were therefore willing to pay towards the water quality improvement program.

Occupation was found not to have any significant influence on how much respondents were willing to pay towards the program; although it was hypothesized to influence the amount respondents would be willing to pay. This is inconsistent with the findings of Mendonca and Tilton, (2000) and Phuong and Gopalakrishnan, (2003), which found occupation to positively influence people's willingness-to-pay in studies they conducted. The implication for this study is that respondents value the river and were willing to pay towards the program independent of their occupation. Despite the tight schedule of the civil servants and the laborious nature of the work of farmers in the study area, their willingness to contribute either their time or money was not affected.

Gender as a variable did not significantly influence respondents' WTP, even though more males than females took part in the survey. This is inconsistent with the findings of Jones *et al.*, (2008) and Zhongmin *et al.*, (2003) studies which found gender to have significant influence on respondents' WTP. This could be explained by the fact that gender is not considered in deriving benefits from improved river ecosystem. Unlike a study conducted by Ndebele *et al.*, (2014), which found age to significantly affect people's WTP towards wetlands conservation in New Zealand, this study found no statistical correlation between respondents' WTP and their age. Age, in this study, is important but it is not significant to influence respondents' WTP towards the water quality improvement program of the Offin River.

An independent-sample t-test found a significant difference between the mean total willingness-to-pay for active age and non-active age groups of respondents. It shows that respondents in the non-active age bracket were willing to pay more towards the water quality improvement than those in the active age bracket. Although, WTP is mostly influenced by direct use value (Pearce and Moran 1994), older people (non-active age) who responded to this

survey attached much importance to non-use value such as bequest and existence values. They recount when water in the river was used for every household chore and also when fish abounded in the river. Their expectation is that there would be such a program to improve the quality of water in the river which would lead to increase in fish stock, for the future generations to depend on. The older respondents were willing to contribute towards the program because of the knowledge that future generations will benefit from the goods and services produced by the river and not necessarily they benefitting from the improvement program. This result is in line with the opinion expressed by Barbier *et al.*, (1997) that bequest value is usually high with local people who use a resource and would want the resource inherited by future generations.

## **5.6 Governance Implication on River Bodies**

Studying attitudes and motives of respondents is important for understanding how they value environmental goods (Milon and Scrogin, 2006). This was applied in this study. Respondents were asked to give reasons for supporting or not supporting the water quality improvement program of the Offin River. Respondents perceive the river as a major livelihood asset on which they depend and therefore, had positive attitude towards the improvement program of the river. Most of the respondents' livelihood activities centred on the goods and services produced by the river and find it difficult looking for alternative livelihood sources. This is evidenced in the preponderance of households who were willing to support the improvement program.

People were willing to pay to support the program because of existence and bequest values. Their WTP stem from the satisfaction that the river water may be used for future household needs. People are prepared to contribute to improve water quality of the river even though they might not benefit from it and would want their future generation to benefit. This finding is in agreement with an opinion expressed by Barbier *et al.* (1997) that people's WTP for

environmental improvement could be influenced by bequest or existence value and not necessarily use value.

A section of the respondents contend that their willingness to support the program stem from their concern about the quality of water in the river and the satisfaction that the river will be free from pollution through mining. The water in the river cannot be used for any household activity posing further hardship on them. Respondents lament that, their wives and children spend long hours searching for alternative sources of water and in some situations, are forced to spend part of their meagre income on these alternative sources of water. Farmers who formally used water from the river while in their farms now have to carry water over long distances from alternative sources to their farms for drinking and cooking. They are therefore in support of any program which will lead to water quality improvement of the river.

Negative attitudes were evident when respondents gave responses such as “lack of confidence in the success of the proposed program”, “I am not a polluter, polluters must pay” (incredulity) or “government’s sole responsibility to undertake such program”, “money may be misappropriated/misused (institutional mistrust). There is a general disbelief in the success of the program and mistrust in institutions among respondents who were not willing to pay. This could be attributed to lack of confidence in institutions mandated to oversee the activities of the mining operations within the study area. These institutions, instead of carrying out their mandated duties by supervising the operations of the mining companies, fail to do so even after numerous complaints made to them by leaders of these communities (Kotokuom Assemblyman, *pers. Comm.*, 2015).

Another reason for not supporting the program is related to income, when respondents said they do not have enough money to support such program. This was not surprising as it was anticipated in an extremely poor economy where a greater number of the respondents are

peasant farmers. This is in line with other studies which identify income constraint as a main reason for non-payment towards environmental improvement (Arimah, 1996; Bateman *et al.*, 1995; Lauria *et al.*, 1999).

The findings of this study are in agreement with a study by Bright *et al.*, (2002) conducted in Chicago to assess people's attitudes towards ecological restoration. The results indicate that positive and negative attitudes of respondents are determined by perceived outcome of restoration initiatives. They concluded that positive attitudes are related to perceived values while negative attitudes are related to emotions. In this research, households who were willing to support the program had positive attitudes towards the program because of the perceived values or use of the river. Those who were not willing to support the program had negative attitude towards the success of the program and also lack of trust in statutory institutions mandated to regulate river use in the district.

### **5.7 Governance Arrangements and Institutional Structures to Maximize Goods and Services Produced by the River**

Institutional structures and governance arrangements are very important in order to protect and ensure sustainable use of river bodies by people living along its course. Respondents proposed a number of strategies which will help in improving the water quality of the river in a bid to maximize the goods and services that the river produces.

To improve the quality of water in the river, respondents suggested that illegal mining activities (galamsey) in and around the river must be curbed. They wanted activities such as disposing mining effluent, tailings and garbage into the river associated with both legal and illegal mining to be stopped. Similar observation has been made in a study conducted by Awatey, (2014) in the Amansie West District in Ashanti Region of Ghana to examine the awareness of residents on the perceived environmental impacts of small-scale mining.

Formulation and implementation of strict laws to regulate all activities in and around the river was proposed by the respondents. They expect strict implementation of the already existing laws guiding the use of the river resources. Respondents were of the view that the public environmental regulatory bodies such as Environmental Protection Agency, Minerals Commission and the District Assembly, who have the mandate to monitor activities along the river, must be resourced in order to carry out their statutory functions. This assertion is in agreement with the findings of a study by Kessey and Arko, (2013), on small scale mining and environmental degradation in Ghana. They concluded that strict laws must be formulated and implemented to help regulate uses of river resources in Ghana.

Another proposal put forward by the respondents is re-planting of trees and vegetation around the river. It was proposed that, trees and vegetation that once provided shade for the river and were removed through the mining activities be re-planted. Respondents posit that, when these patches of forest, mangroves and sacred groves are restored along the river, the rate of evaporation of the river water would minimize. It will also create a very conducive environment for fish spawning which will lead to increase in fish stock in the river.

Respondents also proposed that in order to restore and improve the natural flow of the Offin River, dredging of the riverbed is essential. The dredging will remove tailings and sediments that have filled the river bed, making it shallow. This will increase the volume of the river water, improve river water flow and also prevent flooding.

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## CHAPTER SIX

### CONCLUSION AND RECOMMENDATION

#### 6.1 Conclusion

This study estimated the total economic value of improving the quality of water in the Offin River and also investigated the relationships between respondents' attitudes and their socio-economic characteristics with respect to their WTP towards the program. It was observed that almost all the respondents had visited the river in the past one year. Majority of the respondents were willing to support the water quality improvement program of the river. A greater number of the respondents were willing to contribute both money and time to improve the water quality of the river. The average amount of money respondents are willing to contribute per month per house is GHC 7.41 and that of time is GHC 38.1. The total willingness to contribute per household is GHC 45.51 per month, towards the improvement program.

Factors such as future use of the river, household income, household size and years of residency of respondents were found to be drivers of WTP for the water quality improvement of the Offin River. The idea that the river could be used for almost all basic household chores and for drinking is enough motivation to influence positively, respondents' contribution towards the program. Income was found to influence respondents' WTP in that the bigger the household income among respondents, the higher the amount they are willing to pay. Also, the higher the household size, the less their willingness-to-pay towards the program. Years of residency of respondents also have influence on respondents WTP as the longer a respondent

has stayed in the community, the higher the contribution one is willing to make towards the water quality improvement program.

Other factors such as distance to the river, level of respondents' education, occupation and gender, had no influence on respondents' WTP towards the program. An independent-samples t-test conducted to test the influence of the socio-economic factors on the mean total willingness-to-pay (MTWTP) amount, found age to be the only variable with significant difference between the active and the non-active age groups. These results should be motivation for decision-makers and environmental managers of the river to implement educational programs and enforce existing laws and where necessary, make new laws, to help improve the river water quality.

## **6.2 Recommendations**

The study recommends the following actions be taken to help improve the water quality of the Offin River based on the results and findings obtained.

### **6.2.1 Policy and Governance Reforms**

A number of laws (Water Resources Commission Act, 1996, Ghana National Water Policy, 2007) exist to ensure efficient protection of the Offin River, the enforcement and monitoring of these laws is ineffective. This is partly due to lack of trained enforcement officers and the capacity and legal powers of local authorities to enforce them. The DA, Chamber of Mines, EPA and the law enforcement agencies must up their game to enforce these laws to protect the river. The DA should train local leaders and back them with the necessary legal powers to enforce these laws at the local level.

Licensing procedures for small-scale miners needs to factor into it comprehensive environmental training to ensure environmental sustainability. Groups such as the Small Scale

Mining Companies (SSMCs), created in mining communities should be strengthened in terms of human and technical resources by the DA, EPA and the Minerals Commission so as to enhance their capacity of informing and guiding others on processes that inures to the benefit of the environment. The unregulated purchase of mercury by small-scale miners for their operations should be assigned to these committees so as to reduce the proliferated usage and curb the pollution of water bodies.

### **6.2.2 Pollution Control Measures**

It is recommended that the EPA ensures that all sources of pollution to the river are contained and treated properly before disposing into the river. The EPA should also educate miners on the use of chemicals and safe effluent discharge procedures in their mining operations. There should also be extension education by the Minerals Commission and the FSD on the acceptable limit of cultivating and mining lands bordering river bodies. This will prevent farmers and miners from carrying out their activities close to river bodies.

### **6.2.3 Local People's Participation**

Local people living along the Offin River should be involved in making decisions concerning the use of the river. Many of the existing decisions on the river use were made by people who do not depend on the river for their livelihood and therefore did not consider the benefits derived from the river by these inhabitants. These local people could be mobilized by their leaders into planting of trees along the banks of the river as well as be involved in dredging the river. Non-Governmental Organizations and Community Based Organizations in these communities must get involved in awareness creation, mobilizing public support for action and education of the general public on the benefits of the river. It is recommended that all stakeholders should be represented in water resource decision making and management.

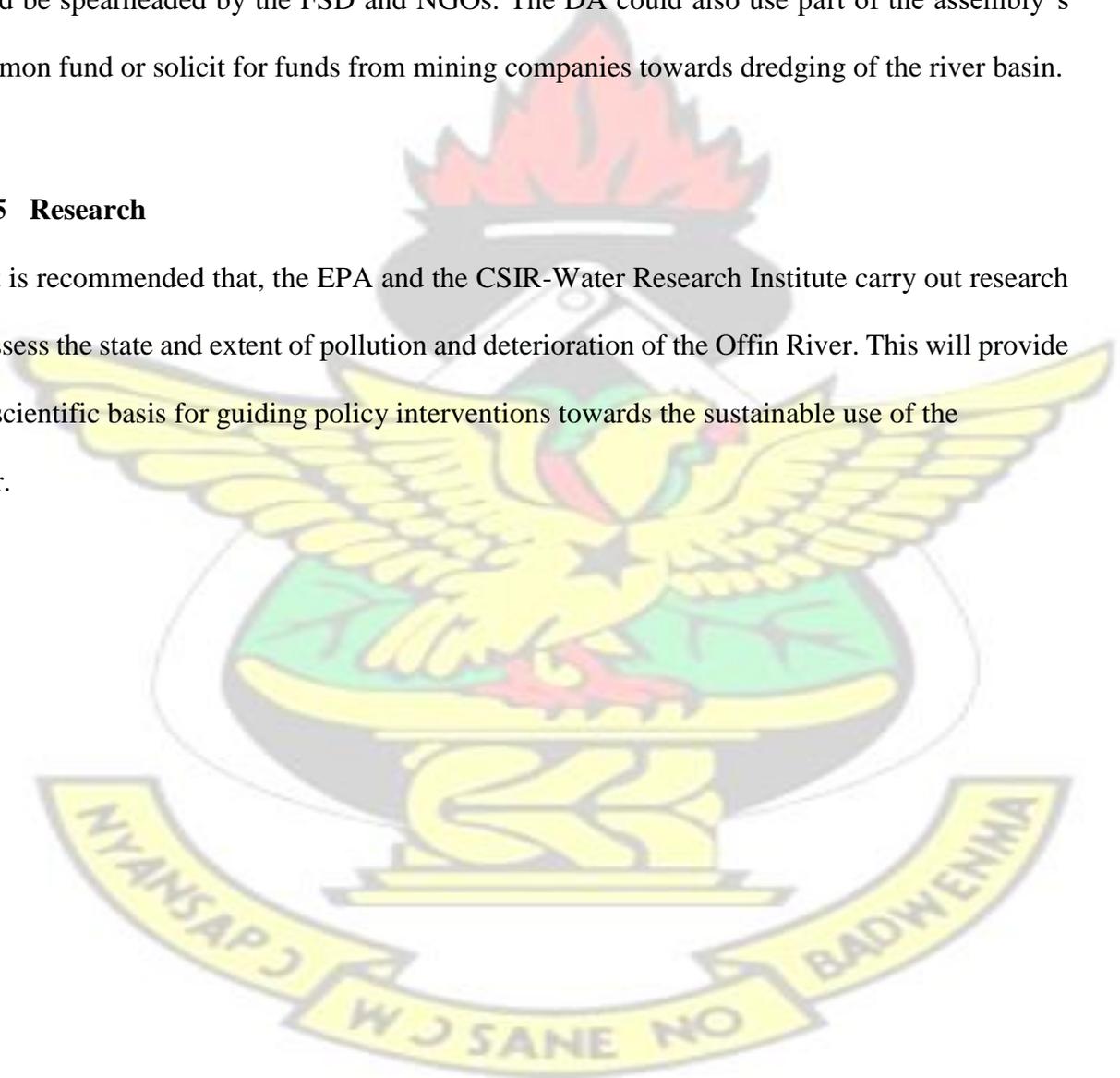
#### **6.2.4 Better Coordination among Statutory Agencies**

There are a number of statutory agencies involved, in one way or the other, with the management of the Offin River.

Inter-institutional approach is therefore needed to improve water quality in the river. This may include facilitating communities to embark on tree planting to restore the river banks. This could be spearheaded by the FSD and NGOs. The DA could also use part of the assembly's common fund or solicit for funds from mining companies towards dredging of the river basin.

#### **6.2.5 Research**

It is recommended that, the EPA and the CSIR-Water Research Institute carry out research to assess the state and extent of pollution and deterioration of the Offin River. This will provide the scientific basis for guiding policy interventions towards the sustainable use of the river.



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## APPENDICES

## Appendix 1

### Kwame Nkrumah University of Science and Technology, Kumasi Department Of Silviculture and Forest Management

#### Questionnaire

##### Introduction

This research is being conducted by an MPhil student of Kwame Nkrumah University of Science and Technology in Kumasi. The purpose is to collect information on the economic, social and environmental importance of the Offin River. I assure you that your responses to the questions during the in-person interview will be completely confidential.

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##### SECTION A: ECONOMIC AND ENVIRONMENTAL ISSUES

A.1. State two problems that are most important for your district assembly to solve in your locality.....

A.2. Suppose your local government (district assembly) was given money to help solve some environmental problems in your locality over the next five years, which problems would you hope the government worked on first and second?

1st. ....

2nd. ....

**Here are pictures of two rivers that are managed differently.**

(Show Picture A, which shows a river managed sustainably and Picture B, which shows a river which is managed unsustainably)

PICTURE A

PICTURE B



A.3. Based on what you see in the pictures, do you prefer a river that looks like the one shown in Picture A or Picture B?

1. [ ] Picture A

2.  Picture B
3.  No preference

**Here are some more information about River A and River B.**

<b>RIVER A</b>	<b>RIVER B</b>
Is a productive and diverse river.	It is a non-productive river.
Is in its natural historic state.	Has been altered by humans.
Provides habitat for many types of aquatic animals and birds.	Does not support animal habitation.
Can be used for all domestic chores and other recreational activities.	Cannot be used for any domestic chores.
Is protected from flooding.	Can cause flooding to adjacent properties.

A.4. Now that you know that River A supports fish and other aquatic lives and has the potential to produce abundant fish, which river do you prefer?

1.  River A
2.  River B
3.  No preference

A.5. Now that you know that River B has been altered by humans and River A is in its natural state, which river do you prefer?

1.  River A
2.  River B
3.  No preference

A.6. Now that you know these things about the two rivers, which river do you prefer?

1.  River A
2.  River B
3.  No preference

A.7. Have you ever visited the Offin River before?

1.  Yes
2.  No
3.  Refuse to comment

A.8. If yes, how many times have you visited the river in the last one year?

1.  Once
2.  2-5 times
3.  6-10 times
4.  More than 10 times
5.  Can't remember
6.  Never visited

A.9. What was the main purpose of your visit(s)?

1.  Fishing
2.  Swimming, washing and bathing
3.  Collection/ use of river water for household purposes
4.  Mining
5. Others (specify).....

A.10. In your opinion, has the overall environmental condition(s) of the Offin River been getting?

1.  Better
2.  Worse
3.  Staying the same in the last five years.

A.11. About how often have you seen, heard, or read about pollution in the Offin River from TV, radio, newspapers, or magazines in the last year?

1.  Never
2.  A few times (1-4)
3.  Several times (5-10)
4.  Many times (more than 10)
5.  I don't know

A.12. Are you concerned about the state of the Offin River?

1.  Yes
2.  No
3.  I don't know

A. 13. What makes you concerned regarding the state of the Offin River? (Multiple answers are accepted)

1.  I am not concerned
2.  Water pollution
3.  Loss of fish and other aquatic resources
4.  Loss of natural beauty
5.  Lack of water flow
6. Others (specify): .....

A.14. To the best of your knowledge, what causes the degradation of the water quality in the Offin River? (Multiple answers are accepted)

1.  Nothing is impacting seriously, the water in the river is ok
2.  Untreated mining effluent into the river
3.  Illegal mining in and around the river
4.  Lack of enforcement of law regarding mining around river bodies
5.  Disposal of garbage into the river
6.  Farming close to the river
7.  Other (specify)
8.  Don't know/refuse to answer

A.15. What effect(s) can the water quality in the Offin River cause? (Multiple answers are accepted)

1.  No effect
2.  Health problems
3.  Loss of livelihood
4.  Loss of earnings
5.  Water crisis
6.  Flooding
7. Others (specify): .....

A.16. Do you feel that reducing water pollution in the Offin River is important?

1.  Don't know/ refuse to answer
2.  Yes
3.  No

A.17. How do you want to see the environment surrounding the Offin River?

1.  As it is
2.  Improved
3.  Don't know

A.18. If you want to see improvements, what are the things you want to see done to and around the Offin River? (Multiple answers are accepted)

1.  Prevention of galamsey activities in and around the river banks
2.  Re-planting of trees and vegetation around the river
3.  Dredging of riverbed
4.  Clearing of overgrown bushes in the river
5.  Prevention of disposal of solid and liquid sewage into the river
6.  Formulation and implementation of strict laws
7.  ] Others  
(specify).....

A.19. What do you want to use the Offin River for in future? (Multiple answers are accepted)

1.  Use of river water for household purposes
2.  Fishing
3.  Swimming, boating and other water activities
4.  Irrigation
5.  Visit heritage/historical sites on the riverside
6.  Picnic and recreation (walking along the river bank)

## SECTION B

Suppose there was a proposal or a program to improve the Offin River such that it can provide abundant fish, it becomes swimmable and could also be used for all chores like drinking, washing, bathing and cooking. The improvement program would involve a lot of investment in the form of money from the community. The money would be contributed by the community through community levy and it could be in the form of farm produce or cash or in the form of time.

**Please answer the following questions thoughtfully.**

B.20. If an improvement program for the Offin River is undertaken, would you support the program?

1.  Very strongly
2.  Support somehow
3.  Not sure (Skip to A.24)
4.  Don't support (skip to A.24)

B.21. Are you willing to contribute money and/or time to improve the Offin River to an acceptable level so that it can be used for fishing, swimming and other house chores?

1.  Yes I am willing to pay
2.  No, I am not willing to pay (Skip to A.24)
3.  Prefer not to have anything to do with this issue (Skip to A.24)

B.22. How much money are you willing to contribute as a communal levy (or in the form of food stuff or time) from your household budget monthly for the proposed improvement over a period of ten year? NB: Nobody is going to ask you to pay the money right now; it is only to judge your willingness and ability to contribute money.

A. GHC

1.  Below GHC 5
2.  GHC 5 – GHC 10
3.  GHC 11 – GHC 15
4.  GHC 16 – GHC 20 5.  GHC 21 – GHC 25
6.  GHC 26 – GHC 30
7.  Above GHC 40

B. Food Stuff/other commodities

1.  Grains..... (To be valued in cedis)
2.  Tubers..... (To be valued in cedis)
3.  Plantain..... (To be valued in cedis)
4.  Cocoa..... (To be valued in cedis)
5.  Refuse to answer

C. Time (Please, specify the number of hours per month you are willing to contribute voluntarily). Could be stated in days and would be converted to hours.

1.  Below 5 hours
2.  6 – 10 hours
3.  11 – 15 hours
4.  16 – 20 hours 5.  21 – 25 hours
6.  26 – 30 hours
7.  31 – 35 hours
8.  Above 36 hours

B.23. Why do you want to contribute money and/or time towards the improvement of the river?

1.  On the basis of the understanding that people should pay for the services they expect to be provided.
2.  Concerned about water quality in the river.
3.  Concerned about the loss of livelihood provided by the river
4.  Satisfaction from knowing that the river is free from pollution through mining.
5.  Satisfaction from knowing that the river water may be used for future household needs including drinking either for own or for future generations.
6.  Others (specify): .....

B.24. Why would you not support the improvement program associated with the Offin River?

1.  Lack of confidence in the success of the proposed program
2.  I am not a polluter, polluters must pay
3.  Do not have enough money to pay for such activity
4.  Money may be misappropriated/misused
5.  Government's sole responsibility to undertake such program
6.  Others (specify).....

B.25. Are there any other ways in which you could contribute to the improvement of the Offin River regardless of whether you want to pay or not?

1.  Physical labour
2.  Campaign and public awareness building
3.  Participate in meeting and rally
4.  Participate in non-technical office work
5.  Participate in technical office work
6.  Consultancy
7.  Other (specify).....

B.26. In the hypothetical program, it has been proposed that money would be collected through communal levy (or contribution of food stuffs) by residents of this community. Do you agree with this payment mode or do you want to pay in another way? (Multiple answers are allowed)

1.  Agreed with the proposed levy
2.  Voluntary contribution
3.  Fines on polluters
4.  User's fee

5.  Additional income tax
6.  Other (specify)
7.  Do not support the program/not willing to pay

**SECTION D YOUR USE OF THE OFFIN RIVER**

D.27. What activity/activities do you undertake in or around the Offin River? (Multiple answers are accepted)

1.  Farming along the banks of the river
2.  Fishing
3.  Using the river water for irrigation
4.  Mining in and around the river
5.  Swimming, washing and bathing
6.  Other (specify)

D.28. Do you obtain any livelihood support through the use of the Offin River?

1.  Yes
2.  No
3.  Refuse to answer

D.29. What direct benefit(s) do you obtain from the Offin River? (Multiple answers are accepted).

1.  Irrigation purpose
2.  Domestic/household use of river water
3.  Fishing
4.  Spiritual or ceremonial purposes
5.  visit heritage/historical site on the riverside
6.  Swimming
7. Other (specify).....

**SECTION E PERSONAL AND HOUSEHOLD PROFILE**

The following questions ask about you and your household. Please remember that this information will be kept confidential. Your responses to these questions will help the in understanding of how others like you might have responded to the questions in the questionnaire.

E.30. What is the name of your community? .....

E.31. To which age group do you belong?

1.  18 - 25 years
2.  26 – 35 years 3.  36 – 47 years
4.  48 – 57 years
5.  Don’t wish to disclose

E. 32. What is your gender? (Don’t ask).

1.  Male
2.  Female

E.33. How would you describe your current marital status?

1.  Never married
2.  Currently married
3.  Widowed
4.  Divorced/separated
5.  Refuse/don't wish to disclose

E.34. What is the highest level of education you have obtained?

1.  No schooling
2.  Primary education (1-15)
3.  Higher secondary education (16-19)
4.  Training certificate
5.  Graduate degree
6.  Post graduate
7.  Don't wish to disclose

E.35. Including yourself, how many adults and minor members live in this household?

1.  Number of adults ( $\geq 18$  years).....
2.  Number of minors ( $< 18$  years).....

E.36. What is your main occupation?

1.  No work
2.  Agriculture
3.  Household work
4.  Industry
5.  Civil servant
6.  Other (specify).....

E.37. Do you belong to any environmental organizations? (If yes specify)

.....

E.38. What is the range of your total monthly household income last year from all sources?

1.  Below GHC 100
2.  GHC 100 – GHC 500
3.  GHC 600 – GHC 1000
4.  GHC 1100 – GHC 1500
5.  GHC 1600 – GHC 2000
6.  Above GHC 2000

E.39. Type of dwelling (wall material of main house) (Record if possible)

1.  Straw/bamboo
2.  Mud/unburnt brick
3.  Corrugated iron sheet
4.  Cement/brick

5. Others (specify).....

E.40. How many years have you been living here?

- 1.  1 – 5 years
- 2.  6 – 10 years
- 3.  11 – 15 years
- 4.  16 – 20 years
- 5.  21 – 25 years
- 6.  26 – 30 years
- 7.  Above 30 years

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E. 41. Which of the following categories best describes you?

- 1.  A native
- 2.  A settler
- 3.  A government worker
- 4.  Miner
- 5. Other (specify).....

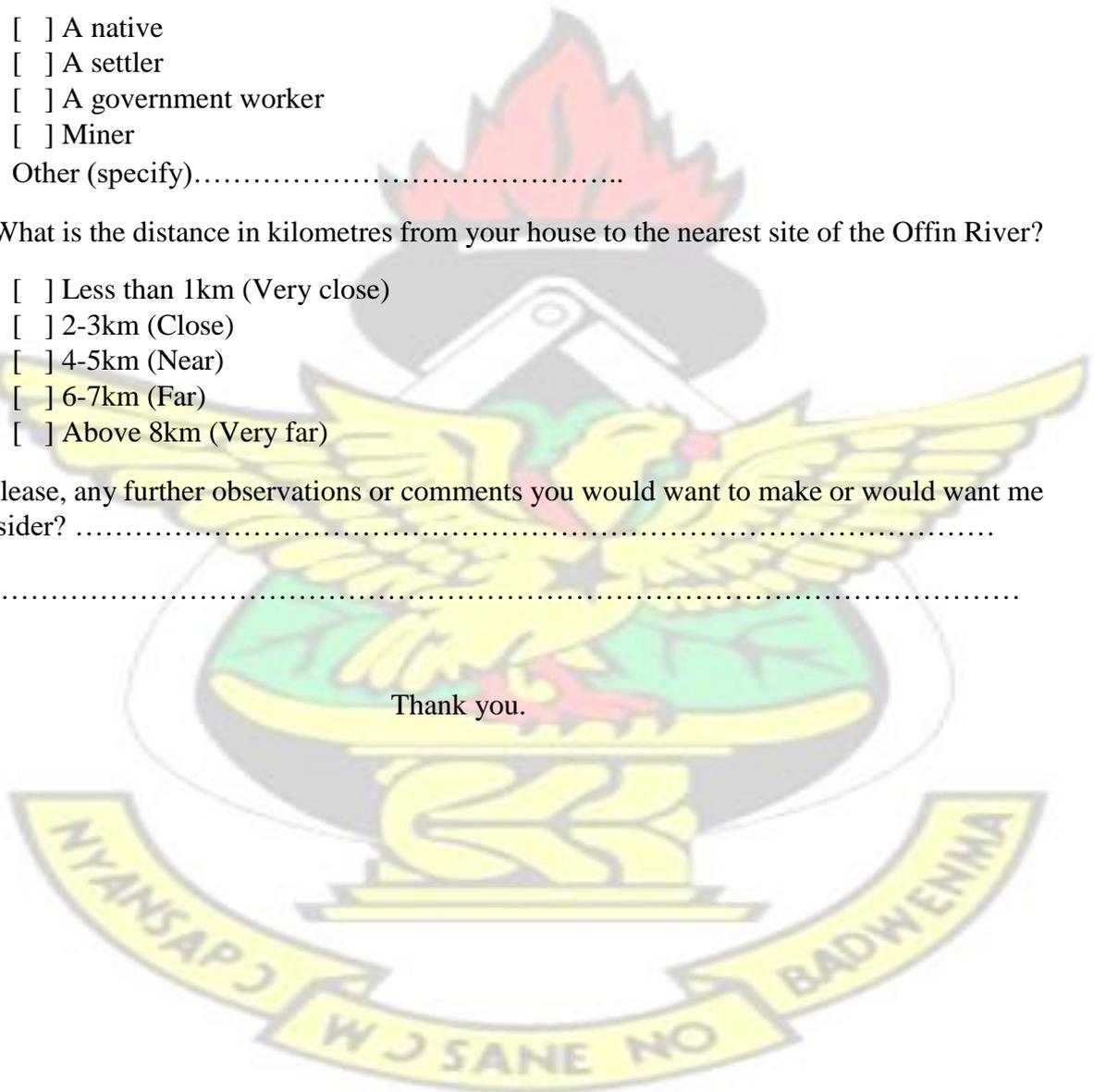
E.42. What is the distance in kilometres from your house to the nearest site of the Offin River?

- 1.  Less than 1km (Very close)
- 2.  2-3km (Close)
- 3.  4-5km (Near)
- 4.  6-7km (Far)
- 5.  Above 8km (Very far)

E.43. Please, any further observations or comments you would want to make or would want me to consider? .....

.....

Thank you.



## Appendix 2

Appendix 1(a): A picture showing a hypothetical restored river



Appendix 1(b): A picture depicting the current state of the Offin River





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