

**Influence of Biology Education on the Use of Wetland Resources by School
Leavers in Uganda: A Case of Pece Wetland, Gulu District**

By

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Declaration

I, Sarah K. Odong Ojokit, hereby declare that this dissertation is my original work and has not been submitted for any other award of degree or published at any university.

Signed.....

Date.....

Approval

This dissertation has been approved for submission to the Research and Graduate School of Makerere University.

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Dedication

This dissertation is dedicated to my parents. My beloved father and late mother, Mzee Daniel Ojokit and Mrs. Loice Mary Ojokit, who demonstrated love and wise-use of environmental resources especially at their late 60s when they physically planted trees and made a comfortable living thereafter. It is also dedicated to my dear family; children Isabella, Mary, Ruth, Emmanuel and Isaac, and husband Bernard Odong for the encouragement, love and support accorded to me throughout the Masters programme.

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Table of Contents

	Page
Declaration.....	ii
Approval	iii
Dedication.....	iv
Acknowledgment	v
Table of Contents.....	vi
List of Table.....	ix
List of Plates	x
Acronyms.....	xi
Abstract.....	xii
Chapter One: Introduction.....	1
1.1 Background.....	1
1.1.1 Histocial Perspective	2
1.1.2 Theoretical Perspective	4
1.1.3 Conceptual Perspective	4
1.1.4 Contextual Perspective	5
1.2 Statement of the Problem.....	6
1.3 Purpose of the Study	7
1.4 Objectives of the Study	7
1.5 Research Questions	7
1.6 Scope of the Study	8
1.8 Significance of the research.....	10
Chapter Two: Literature Review.....	12
2.0 Introduction.....	12
2.1 Theoretical Review	12

2.2	Conceptual Framework	12
2.3	Related literature	14
2.3.1	Investigation of the Application of the Knowledge from Biology Education Learnt at School in the Use of Wetland Resources	14
2.3.2	The identification of Conservation Skills Acquired through the Learning of Biology that are Necessary in the use of Wetland Resources	16
2.3.3	The Non-formal Education Influence on the gain of Knowledge on Wise-use of the Wetland Resource	18
	Chapter Three: Methodology	20
3.0	Introduction	20
3.1	Design	20
3.2	Population	20
3.3	Sample	21
3.4	Data Collection	21
3.5	Research Instruments	22
3.6	Validity of Research Instruments	22
3.7	Procedure	23
3.8	Data Management	23
3.9	Limitations	23
	Chapter Four: Data Presentation, Analysis and Interpretation	25
4.1	Introduction	25
4.2	Respondents' Background	25
4.3	Objective One: Investigation of the Application of the knowledge from biology education learnt at school in the Use of wetland resources	31
4.4	Objective Two: The identification of conservation skills acquired through the learning of biology that are necessary in the use of wetland resources	40

4.4.1 Testing for Skills Acquired and Identified from Biology Education Taught at School.....	41
4.5 Objective Three: Assessment of Non-formal education that contribute to the use of wetland resources in Pece wetland.....	43
Chapter Five: Discussion, Conclusion and Recommendations	50
5.1 Introduction.....	50
5.2. Discussion.....	50
5.2.1 Investigation of the Application of the Knowledge from Biology Education Learnt at School in the Use of Wetland Resources from Pece Wetland by Schol Leavers	50
5.2.2 The Identification of Conservation Skills Acquired through the Learning of Biology that are Necessary in use of Wetland Resources	53
5.2.3 To Assess the Non-Formal Education Influence on the Gain of Knowledge on Wise-use of the Wetland Resources	57
5.3 Conclusion	58
5.4 Recommendations.....	59
5.4 Further Research	62
Appendices.....	68
Appendix A: Chi Squares	68
Appendix B: Self-Administered Questionnaire on Influence of Biology Education on Use of wetland Resources by School Leavers in Pece Wetland, Gulu district Uganda.....	70
Appendix C: Interview guide on research problem / questions:.....	79
Appendix D: Introductory letter.....	80

List of Tables

	Page
Table 4.1: Background information collected from Resource users of Pece wetland	26
Table 4.2: Educational background of respondents at Pece wetland.....	28
Table 4.3: BIdentified wetland resources of Pece wetland and the percentage level of their usage at households per population.....	29
Table 4.4: Percentage level of Usage of wetland resources in teaching/learning of biology per educational background.....	31
Table 4.5: Level of Knowledge of functions and services of Pece wetland	32
Table 4.6: Application of biology education on extraction of wetland resources by school leavers around Pece wetland.	34
Table 4.7: Chi-square values for education background	36
Table 4.8: The percentage of biology education influences on skills of extraction and wise-use of wetland resources	40
Table 4.9: Assesment of non-formal education on the use of wetland resources from Pece ..	43
Table 4.10: The categories of people by employment and the Level to which they protect and conserve the wetland resources	47

List of Plates

	Page
Plate 1: Young people make use of the wetland resources at the wetland site.....	27
Plate 2: Older people process extracted wetland resources at their homes.....	27
Plates 3a, 3b: Harvesting of papyrus and transporting it either home for processing or for sale in its raw form. Note the regenerating papyrus in Plate 3b.	28
Plates 4a and 4b: Wetland resources from Pece wetland processed for sale: ropes and mats from papyrus at a roadside market, and bricks from clay/soil within the wetland. ...	30
Plate 5a and 5b: Papyrus crashed locally at people’s home as a value addition process for making sanitary pads.....	33
Plate 6: Ponds for fish farming under preparation from clay extraction burrows left after making bricks.....	39
Plate 7: Borrows pits of Sand extraction at a water collection point that make it difficult and hazardous for the residents in use of water resource.	47

Acronyms

FGD	-	Focus Group Discussion
GWPE	-	Government White Paper on Education
LC	-	Local Council
NCDC	-	National Curriculum Development Centre
NEMA	-	National Environment Management Authority
NGO	-	Non -Governmental Organization
SESEMAT	-	Secondary Science and Mathematics Teachers
UBOS	-	Uganda Bureau of Statistics
UNDP	-	United Nations Development Programme
UNEB	-	Uganda National Examinations Board
MOES	-	Ministry of Education and Sports

Abstract

This study was prompted by the increasing news and reports of degradation of the environment and over exploitation of natural resources from natural habitats. The over-exploitation goes on amidst the fact that biology, as a science subject where issues to deal with nature use, has been taught for many years. The purpose of this study was therefore to assess the influence of biology education on the use of wetland resources using Pece wetland, a natural habitat in Gulu district. To achieve this purpose, the study sought to investigate what was learnt in biology lessons at school and what was being applied by school leavers in the use of wetland resources. This study focused on applied knowledge from biology education; conservation skills practiced and identified, and other sources of knowledge outside school.

The study was both quantitative and qualitative, guided by a cross sectional survey design, involving 54 school leavers, five local council leaders, three environment officers with four field workers and 13 local community resident in Pece wetland alongside four teachers and one curriculum biology subject specialist. Data was collected using a self-administered questionnaire and interview guide so as to assess and establish the influence of biology education after school and the use of wetland resources. Data was analyzed and variables tested for significances using the chi-square test. Themes were determined to describe patterns observed and discussed.

The findings revealed that the knowledge from biology education learnt from secondary schools had no significant influence on the use of wetland resources after school. There was no significance influence between employment sector and the level to protect and conserve the wetland resources. Furthermore, water resource from the wetland was used most by just an average number of residents. There was another source of water which most residents used, while papyrus /grass/reeds was the least used wetland resource. Conservation skills were most learnt at school followed by the informal education by the family or community source but the application levels varied.

Biology education hence does not adequately contribute to gain of skills and expression of values, although some people who have completed tertiary institutions applied some of the skills and values gained. In view of the above findings, the study recommended an enhanced teaching-learning approach with field work to make learners acquire knowledge, skills and values and apply them on use of wetland resources to make biology education more effective and influential. Environmental values should be emphasized in every topic of biology, during teacher education pre-service and in-service trainings. Teaching of environmental literacy should be promoted as a practical aspect. Pece wetland in Gulu district should be gazetted as an environment education centre for the promotion of practical conservation knowledge, skills and values for sustainable use. Further research to be carried out on sustainable wetland use by fish farming projects and human populations as a biological resource in conservations.

Chapter One

Introduction

1.1 Background

There are reports especially in media concerning environmental degradation. The degradation has reportedly resulted into droughts, landslides, flooding, deforestation, wetland degradation and over exploitation of natural resources (NEMA, 2010, Kizito, 2008). Such degradation has continued to occur in many ecosystems in Uganda and is responsible for the poor health, poverty and lack of alternatives to improve household incomes (Mwanje, 2010) The misuse of natural resources goes on despite the fact that many of the resources users and beneficiaries have been exposed to the dangers through the biology taught at school. Although the degradation is largely blamed on irrational needs for survival, it is done by people who have been to school and have studied science in primary school and probably been exposed to the importance of environmental studies through biology lessons in secondary school.

One of the main effects of environmental degradation is manifested in biodiversity and habitat loss. The loss is caused by people who extract resources without appreciating the fact that they are beneficiaries of the biology education they got during their studies. The result of their activities on natural resources include wetland reclamation, pollution, soil erosion, deforestation and water loss to mention a few. School leavers who learned biology should be seen to put into application what they studied for a number of years while using natural resources. The value of learning biology therefore becomes questionable. If people with knowledge continue to degrade the environment and destroy wetland resources as reported by Gerald Tenywa: *“Everyone is*

guilty of wetland destruction” (New Vision, Jan 29th 2009) then there is a continued threat to the environment caused by ignorance and lack of impact from what is taught in biology lessons. Even in presence of policies and guidelines for sustainable resource use (Wetland Policy 1995, Environment Statute 1995, Land Act 1998, and others) there is continued degradation of wetland resources despite a number of awareness programme in print and electronic media. One would expect that such policies should be strengthened by a well-informed population from the kinds of knowledge they obtain from learning of biology.

1.1.1 *Historical Perspective*

Biology is a component of the science curriculum and is a compulsory subject at the Uganda Certificate of Education, that is, it is taught up to ordinary level (‘O’ level) of education nationally. The subject exposes learners to scientific biological knowledge, skills and values needed to understand life and its processes together with the environment. The learning of biology focuses on enabling learners to manage common diseases and infestations in both families and communities (National Curriculum Development Centre [NCDC], 2008). It also includes elements of ecological aspects that enable learners to appreciate the role of habitats and ecosystems integrity in driving life processes. Hence because of its importance, the Government of Uganda passed a policy that biology is among the compulsory science subjects to be done by every ordinary level student (MoES, 2005), for it addresses the linkages between life processes and environments and their relationships with human beings. In particular Biology aims at equipping students with knowledge that enables them to eradicate the basic environmental illiteracy that surrounds them; empowers them with basic skills to exploit the environment for self- development, better health, nutrition and family life, and the capacity for continued learning

(Government White Paper on Education, 1992). Indeed a good number of people have gone through school to ordinary secondary level and have had an exposure of biology education. Many others who do not have opportunity for formal secondary education have presumably done biology as integrated science in primary schools. This in addition to other non-formal education: community based training, sensitization programmes and traditional knowledge that would enable people to use the resources from natural environments sustainably and avoid ways that lead to degradation of the environment. Biology as a subject is a useful guide to enable one to be conscious of the effects of environment degradation.

Previous studies done on benefits of biology in Uganda (Kafuko, 2001) were on the relationship between biology learning and environment awareness among students at National Teachers' Colleges. The findings revealed that the aspects of ecology in biology would be a suitable subject to facilitate environment literacy. Isingoma (2005) investigated the teaching of biology in O' level schools in Masindi District and found that in modern instruction, ecology topics are very useful to learning environmental issues. The level of environment awareness, attitudes and practices of secondary school biology studies was under taken by Asimo (2007) in schools around Kampala and Kumi districts and concluded that this would vary according to the school setting, location, sex and year of study.

This study has attempted to investigate the use of biology education by school leavers in extraction of wetland resources from a natural environment set up of Pece Wetland, in Gulu District. It ascertains the relevance and application of biology education from schools on sustainable use of wetland resources.

1.1.2 Theoretical Perspective

The Human Capital Theory, 1961, of Schultz Theodore, did underpin this study. Schultz (1971), in *Investment in Human Capital*, argued that both knowledge and skills are a form of capital, and that capital is a product of deliberate investment. It increases the opportunities and choices open to individuals for development. Based upon the idea of Educational Capital of Schultz 1971, the Human Capital Theory applied the assumption that formal education was highly instrumental and even necessary to improve the production capacity of a population. This theory argues that an educated population was a productive one and not a destructive one. On the basis of this theory, this study propositioned that Biology education could influence the use of wetland resources in terms of the knowledge applied; the skills acquired and identified, the values identified and presence of non-formal education. If knowledge, skills and values were well acquired and applied there would be a positive sustainable use and value of wetland resources in Pece Wetland, Gulu District.

1.1.3 Conceptual Perspective

The assumption in this study was that users of resources from natural environments make reference to the knowledge they acquired during the learning of biology while at school and apply it in the collection, consumption, procession and monitoring of wetland resources such as water, air, soil, plants and animals found in this natural environment. Wetlandre sources in this study were referred to as renewable naturally extractable things that include wildlife, plants, water, land, fisheries and energy (Kisembo, 1997). These are known to be a measure of the health of an ecosystem and express a degree of variation of life forms within their ecosystem (Metcalf Energy Centre, 2010). Hence if the knowledge of their importance was learned during instruction of biology while resource users were still at school, Pece wetland would not be

affected the way it is today. With Biology education as an independent variable in this study one would assume that basic knowledge; skills, and value systems needed in order to understand and appreciate life processes, structure and function of body systems, were obtained by learners and can be applied while using various ecosystems. In this study, biology education is thought to be the applied scientific skills required by resource users in the sustainable extraction and use of natural resources from a wetland. The study investigated the understanding and application of biology education in everyday life and whether users appreciate the ecological and economic potentials that exist by putting in practice what they learnt during their biology studies up to secondary school level. The learnt biology would impart the wise-use concept for conservation and sustainability of biodiversity, to use while being mindful of future generations, for a healthy ecosystem, life and development. Before the beginning of this study resource users at Pece wetland in Gulu district showed little knowledge-use linked to application of biology education in extraction of the natural resources from the wetland.

1.1.4 Contextual Perspective

Although at Ordinary level, biology is inevitably studied as per the Uganda National Examinations Board (UNEB) syllabus, not all school leavers in Uganda completed O' level. There are a number of people whose livelihood depend on extraction of natural resources as it is was observed at Pece wetland where there is continued use of the wetland for settlements, and extraction of resources without regard to whether these people went to school or not. Ecosystem degradation in the district is evident for other resources which are not wetlands such as forest vegetation, springs pollution, and contamination of land, water, air and food stuff. Indicators include constant food shortages, disease prevalence, high population growth, induced laziness and dependency among others as reported in the District State of Environment Report (2006).

One would think this was ignorance, but people have been to school. This has made Pece wetland vulnerable besides being a fragile ecosystem. The biology education applied by school leavers seem not to empower them on the use and extraction of the wetland resources they depend on, and not related to developmental issues, conservation values and real life situations. One would be cautious while using the resources if it is assumed that a number of users attained a certain level of science education. However it looks like this is not the case for Pece wetland.

1.2 Statement of the Problem

The Government of Uganda through its curriculum emphasizes an education that should benefit human beings and their surroundings. This was in the view that many people were dependent on natural resources (National Curriculum Development Centre [NCDC], 2008). However, use of wetland resources seems not to recognize the fact that the natural environments could be destroyed, depleted and consequently affect the ecosystem balance. Pece wetland, a natural drainage of the Gulu municipality run-off rain water, stretches from an urban to a rural area. Degradation of wetland resources occurs in both urban and rural settings and includes back-filling and re-claiming of the wetland with construction of big commercial centres like Uchumi Super market Gulu; human settlements; the temporarily relocation of the municipality market; municipality waste disposal site; sand and clay extraction; and reduction of wetland vegetation and safe water collection points. The many years of formal education including biology, would contribute to the sustainable use of wetland resources without the kind of degradation observed. The application of biology education by school leavers in understanding such fragile ecosystems is the main problem of this study. Learners who do not continue with biology careers should still be able to use it in their daily lives. There is little information regarding the impact of the

biology taught at school to resource users of a fragile ecosystem like Pece Wetland, Gulu District.

1.3 Purpose of the Study

The purpose of the study was to investigate the application of the biology education acquired by secondary school leavers in use and extraction of wetland resources from Pece wetland, Gulu district.

1.4 Objectives of the Study

The objectives of the study were to:

- (i) Investigate the application of the knowledge from biology education learnt at school in the use of wetland resources from Pece wetland.
- (ii) To identify the conservation skills acquired through the learning of biology that are necessary in use of wetland resources.
- (iii) To assess the non –formal education influence on the gain of knowledge on wise – use of the wetland resources.

1.5 Research Questions

- (i) Does the biology learnt from formal school contribute to the knowledge of wetland resource users and influence resource extraction at Pece wetland?
- (ii) Is it valuable to continue going for extraction of these wetland resources or there are alternatives?
- (iii) Are there other ways in which resource users are educated about the natural resources in Pece wetland.

1.6 Scope of the Study

This study was done in Pece Wetland and its surroundings within Laroo division, Gulu Municipal Council, Gulu District.

Satellite map of Gulu Municipality showing Pece Wetland, Laroo Division



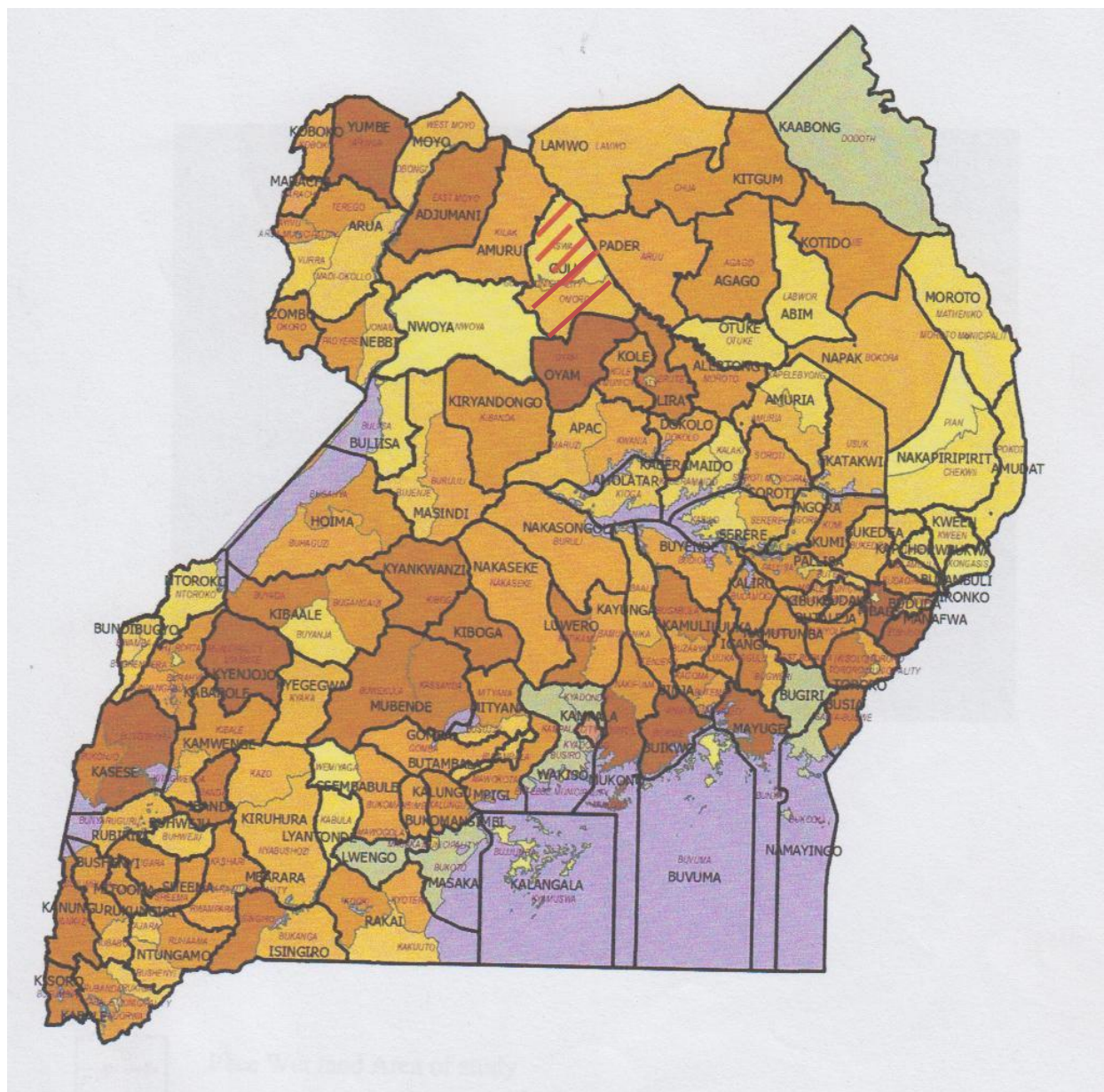
Source: Microsoft © Encarta 2009

Key: —→ Pece wetland area of study

—→ The sewerage lagoon in Pece Lukung ward

Located in Northern Uganda, Gulu District is 333 km from Kampala City.

Map of Uganda showing the location of Gulu District in which Pece Wetland is found



**Source: Google Maps.*

Key  Gulu District

Pece Wetland lies in the eastern direction of the municipality, drains much of the municipality flow of water and wastes, and has a natural wetland vegetation with a permanently wet zone. The community around consists of varied educational and socio-economic backgrounds. Various trades, activities and settlements due to effects of the recent war (1986-2006) and population growth were observed in Pece wetland. The school leavers who had benefited from biology education and interact with the wetlands in various ways were specifically targeted for information gathering on relevance of biology education on skills development on extraction and use of wetland resources. The non-formal education source on resource use in this wetland was of natural interest to this study. The study also involved residents around Pece wetland who had not had a formal education up to O' level, local leaders, environmental officers and curriculum developers and implementers for comparisons. This study was conducted in the period of February 2011 to February 2012 which was presumed to cover both dry and wet seasons with varied activities taking place in this wetland.

1.8 Significance of the research

This study of the influence of biology education on use of wetland resources could propose amendments in curriculum that will favour opportunities and choices open to individuals for improved production at the present time and for the future, that is a sustainable development. Learners, stake holders and careers who do not continue with biology may gain and express the biology knowledge, skills and values as a science for development. Indigenous knowledge and other sources of education from the community deemed valuable can be integrated into the formal biology education curriculum. Education policy makers and stakeholders need to review the parameters of education achievements in terms of wise use, applicability, innovations and affordability of resources for better life and sustainable development, the ultimate goal of

education. The theoretical significance of this study is the investment in education that is necessary to improve the productive capacity of a population for a better livelihood without compromising on the renewable natural resources they use. This knowledge from Pece wetland could be applied to other natural ecosystems like forests, where natural resources are found. Environment policy implementers, local leaders and researchers could explore more on the influences of non-formal educational programmes.

Chapter Two

Literature Review

2.0 Introduction

This chapter reviews the theory which underpins the study, presents a conceptual frame work and the literature related to the research to the respective study objectives.

2.1 Theoretical Review

The theory to underscore this study is Schultz 1961, Human Capital Theory in which he argues that formal education is highly instrumental and even necessary to improve the production capacity of a population. That is to say the Human Capital Theorist urges that an educated population is a productive population. Education makes people productive and good healthcare keeps the education investment around and able to produce. The implication of the Human Capital Theory according to Olaniyan *et al* (2008), prepositions that investment in education is not only as an attempt to impart knowledge and skills to individuals. It also imparts values, ideas, attitudes and aspirations which may be in the nations' best development interest. The challenge presented was that the traditional educational institutions are not as relevant as they could be (Bouchard 1998). Things change so fast that the school leavers and graduates tend to learn on the job. Thus the use of wetland resources could be influenced by the local community's traditional activities than what was taught at school.

2.2 Conceptual Framework

Consequent to the review of Schultz' (1971) Theory of Investment in Human Capital, Figure 2.1 provides a framework relating the variables in the study.

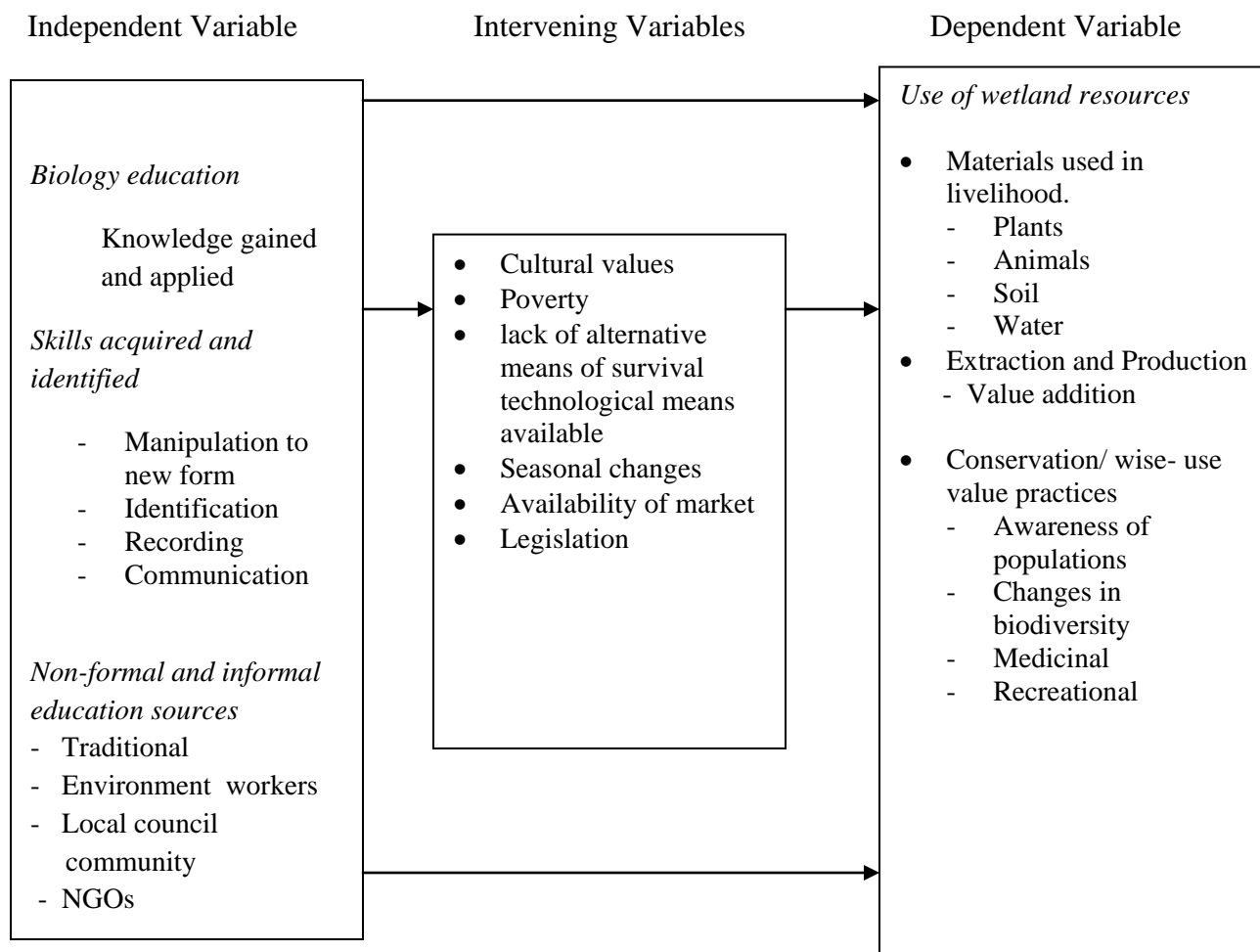


Figure 2.1: Conceptual framework relating the independent variable, biology education to the dependent variable, the use of wetland resources.

Source: Self-constructed based on Barifaijo, *et al* (2010).

The conceptual framework, figure 2.1 models the study objectives as biology education influence on the use of wetland resources by school leavers, in the case of Pece wetland. The biology education is defined as the knowledge gained and applied, conservation skills acquired and identified, and the values practiced. The other sources of non – formal and informal education was assessed.. While the use of wetland resources is operational as materials used in daily life,

materials extracted and produced and conservation practices in use. In this model technological means, funds availability, seasonal changes and human values such as market, cultural, and legislation were sought to have intervening effects on biology education's influence on use of wetland resources.

The true influence of biology education on use of wetland resources could be assumed to be reflected on the state of Pece wetland and the productivity status of the community. This study covered both awareness and activities all as influences of biology education on use of wetland resources by school leavers. This was related to that of the non- schooled community members, local leaders, environment officers and curriculum specialists and teachers.

2.3 Related literature

2.3.1 Investigation of the Application of the knowledge from biology education learnt at school in the Use of wetland resources

The teaching of a key topic area of application and use of biology education, that is ecology, has been researched on. Boghenn (1998) as in Isingoma (2005) identified that the ultimate goal for ecology studies is to develop the awareness of students and concerns about the total ecosystem and its associated problems. It also shapes behaviour concerning the environment and conservation. This could have an influence on use of natural resources. Ecology, according to Poromey (1986), is an outdoor science, concerned with how plants and animals interact and survive 'in the field'. Ecosystems are ecological systems of defined limits that can be considered, for practical purposes, to be self-contained as is the case of Pece Wetland. Pomeroy (1986) further quotes Ward and Dubos (1979).

“The biological effects of environmental changes vary greatly as Man builds for himself, using his science and dreams, an environment obedient to human purpose and direction”.

In Uganda this human purpose and direction has raised concern, and so has the biology education attained. The concept of wise-use needs to be highlighted. The destruction of living resources can cause damage to human population despite their being potentially renewable. This underscored the need to study the influence of biology education on the wise-use of natural resources in an ecosystem like Pece wetland. The perception and impact of science education on everyday life was only usually considered in terms of higher education advancement, science and technology advancement, according to (Arinatwe, 2007). The value of the elementary biology education for the students who do not continue with science needs to be made prominent.

A National Assessment of Education (2009) report, *Review biology syllabus, teachers plead*, revealed that students fail in biology examinations because they depend on cram work. Students fail to grasp what is being taught to them because their respective teachers fail to relate concepts to daily life situations and problem solving when teaching. The quality of biology teaching had an influence on the outcome of performance in the subject and its application. Ntale (2003) research findings were in line with this. The ‘O’ level biology teachers’ choice of teaching methods in Kampala district were based on big classes, the availability of funds to buy specimens, students’ preference for a particular teaching method and the wide biology examination syllabus with the practical aspect rarely performed. These affected learners’ creative thinking and could be the limiting factor to application of biology education on the wise use of wetland resources after school.

On the other hand, Byaruhanga (1991) revealed that teachers taught for examination purposes and passing of examinations became the major objective of the school. Examinations were mainly based on the cognitive domain of the curriculum objectives, yet the psychomotor and affective domains contained in the school curriculum objectives, concerned with manipulation of skills or use of hands, feelings and emotions such as interest, attitude, appreciation and methods of judgment were least considered by Uganda National Education Board (UNEB). These objectives were the ones which were usually applied and used on natural resources in everyday life. Over time there have been interventions such as Secondary Schools Science and Mathematics Teachers (SESEMAT), an in-service training programme focusing on teachers' attitudes and innovations among others, to be passed onto learners with more emphasis on 'hands on' in the teaching and learning process. This could positively influence the wise-use concept of natural resources.

2.3.2 The identification of conservation skills acquired through the learning of biology that are necessary in the use of wetland resources.

A bulk of parents and learners alike associate science education to very few outlets like becoming doctors and engineers, other scientific fields are not considered important. The learners henceforth get negative attitude towards science and mathematics right from their caretakers! This was revealed by a survey on the SESEMAT project (Mbidde and Miho, 2009). The teachers' commitment to the teaching of science, which demand for sacrifice, were greatly reduced due to factors of poor remuneration, high student to teacher ratio, and few science laboratories which are often ill- equipped. Students are denied the chance to acquire scientific practical skills, thereby hindering their interest in science disciplines. In response, government

was in a process of establishing technical colleges and polytechnics to impart skills to school leavers so that they can be economically productive (Arinatwe 2007). This implied the science practical skills, including of biology education, were wanting or then their applicability after school which had failed.

Obanya (2004) in *New Goals, New Curricula*, recommended types of educational instructions that must prepare young people to face the challenges of their time and place, and satisfy the demands of communities and families, formal and non-formal sector businesses. These include developing their ability for critical thinking, scientific and technological knowledge, sense of democratic citizenship, and life skills concerning health, nutrition, hygiene, environment and population. Achieving these goals calls for further research in science practical skills acquired their development and application. This study was limited to acquired biology practical skills, knowledge and values taught at 'O' level schools and how these were applied on use, including extraction of wetland resources. The extent of teaching Environment Education on the other hand depended on the personality of the teacher, (Asimo, 2007). Even where local policies were in place, provisions in schools remain patchy and heavily reliant on the interest and will of a small number of committed teachers (Nixon *et al* 1999, as in Asimo, 2007). Studies of the community's utilization of Pece wetland (Aryemo 2008) revealed that wetland resources like papyrus had disappeared from some parts of Pece due to over-exploitation. This strengthened the need to focus on biology education, and its influence on sustainable use of the wetland resources. Biology adequately caters for interests of environment education through its objectives.

2.3.3 Assessing the Non-formal education influence on the gain of knowledge on wise – use of the wetland resources

Recent household surveys indicate that land, water and forests were the principal natural resources discussed by local people (UBOS 2007 as in NEMA 2008). Wetlands did not seem to be identified as a principle natural resource. The State of Environment Report for Uganda (2008) cites *The Uganda Human Development Report 2007* which noted that little was achieved in improving environmental sanitation and living standards in the slums; and reversing the loss of the environmental resources such as wood fuel sources, lack of soil erosion control, and other environmentally related services (UNDP, 2007). This study on the influence of biology education on use of wetland resources sought to explore more causes and relations of human impact and therefore enhance a healthy ecosystem. Indeed Elroy Bos *et al*, (2005) disclose that Communication, Education and Public Awareness (CEPA) are a set of strategies and methods to promote sustainable wetland management. Historically, many wetlands have been misconceived to be ‘wasteland’. They were drained or degraded by human activity without factoring in their numerous functions, benefits and values (Williams *et al*, 1990 as in Amamure 2002). Wetlands were also regarded as homes of pests and refuge for outlaws and rebels among others. As a refuge for humans out of natural, civil or economic turmoil like war or poverty, wetlands were not identified.

In Pallisa, Eastern Uganda, Amamure (2002) revealed that a combination of population increase and fertile soils of the wetland manifested as pressure factors that led people to cultivate in wetlands. Also the resultant poverty of the people emanating from loss of their cattle after the political turmoil of the 1980s’ and the collapse of cotton as a cash crop contributed to cultivation

of wetlands. Many farmers turned to cultivation of rice as a substitute cash crop. There was lack of alternative source of income by the poor. These findings of Amarure (2002) however did not present the educational background or other parameters of users such as age, gender and household size.

In Kumi district, Eastern Uganda too, Ikanut (2009) observed that wetland resource user-groups, were not uniformly distributed. Due to inequitable wetland resource endowment, varied interests in wetland use and different productivity level of the wetland occurred. These however change with time. The driving factors of these causes of changes need be identified. To Ikanut (2009), the existence of alternative tastes and skills for a given area might be responsible for this change. Education played a part in the extent of these changes and Biology education could be the differentiating factor. This could assist to change attitudes, behaviours and compliance. The education strategy on one part therefore highlights teachers and students as stakeholders of sustainable wetland management. The non- formal and informal education occur in various ways including traditional knowledge passed on at family level and other government programmes like mass media and workshops. Government policies and natural resources management bodies like NEMA, line ministries like Ministry of Lands and Natural Resources, communicate to the population and educate them through publications like Environment Management Operational Guide for Local Governments (NEMA 2006) and The National Environment Regulations, 2003(Statutory Instrument 2003 No. 85), NEMA News Letters and the Constitution of the Republic of Uganda, 1995 (Chap. 15, Sec. 245).

Chapter Three

Methodology

3.0 Introduction

This chapter presents the design, population, sample, research methods and instruments, quality of instruments, procedure and data management that was obtained in the study. It explains the various approaches and methodologies together with data processing techniques that were useful to address the objectives and research questions of the study.

3.1 Design

The study took a qualitative and quantitative approaches described in (Amin, 2004). Interviews, questionnaires and focus group discussions (Appendices B & C) along with observations were used to obtain data. This included a section of the residents of Pece wetland who use the natural resources in the wetlands. Where possible, the secondary data was collected from existing literature.

3.2 Population

The population consisted of people living in the sub-urban areas of Awere Rd, Holy Rosary and Pece Lukung, stretching to the rural setting of Pece Prisons ward found in Laroo Division, Gulu Municipality. The Population Projection Report for Laroo division 2011 was estimated at about 12,100 people (Sub National Projection Report, UBOS 2008). Furthermore, the percentage of adults and that of the educated population in Northern region was reported at about 60%. Hence the study estimated a population of 2000 school leavers who were expected to reside near Pece wetland. It is important to note that a majority of school leavers were involved in the use and

extraction of materials from Pece wetland and consisted of different age groups, some of whom were employed.

3.3 Sample

The study targeted a sample of 200 school leavers based on Krejcie and Morgan (1970)'s Table of sample size determination cited in Barifaijo *et al* (2010). Data was collected from resource users randomly distributed in unit areas defined as wards where the wetland is located in the Laroo division. Out of the 200 targeted people only 54 respondents fully participated in the questionnaires survey. Another group of 30 participated in focused group discussions and interviews. These included 13 community residents; 5 Local council leaders: 3 Environment officers; 4 field officers (agro-forestry department); 4 teachers; and one biology subject specialist (Curriculum developer).

3.4 Data Collection

The researcher contacted local council chairpersons and secretaries for introduction and distribution of questionnaires. Respondents were contacted for first-hand information using the survey method involving use of Self-Administered Questionnaires (SAQs). This approach enabled the researcher get an overview of the application levels of biology education. Furthermore, the SAQs were suitable for the target group on the account that they could read to a reasonable level. Four focus group discussions involving the Environment officers and field staff, Local Council leaders and community at Pece Prisons ward, a rural setting, local community at Holy Rosary ward, a suburb setting, and four teachers sampled from a Curriculum Development Workshop, were held based on a guide and used to gain a better insight into the

research problem and to draw more participation. The interviews varied and took a period of about one hour each. A one-to-one interview using a questionnaire was applied in specific cases for thirty minutes each, to the Municipal Environment Officer, one resident and the biology subject specialist. This resident, a family head, was found in the wetland with four of his family members moulding bricks from clay. Observations on use of wetland resources and the state of the wetland resources were recorded. This was to reduce variations that can arise due to intervening factors.

3.5 Research Instruments

The study used the Self-Administered Questionnaires (SAQs) for soliciting school leavers' views. The SAQ featured a main title, and a few sections. Sections had questions to help classify respondents by category (age, educational level, occupation): use of wetland resources; identification of resources and conservation activities of the resources in the wetland. These were operationized as knowledge applied on materials (resources) and services identified; sources and levels of knowledge. One section was a qualitative nature of research with open-ended questions to capture opinions. Questions in the instrument were closed-ended for ease of administration of the quantitative data. The interview guide for the Focus Group Discussion (FGD) on non-schooled, local leaders, environment officers and curriculum developers and implementers were derived from the structured questionnaire.

3.6 Validity of Research Instruments

The researcher tested the validity of the instruments by administering it on science graduate students at Makerere University to ensure that the questions or items in it conformed to the

study's conceptual frame work (Figure 2.1). The instruments were piloted in the study area and improved upon.

3.7 Procedure

An Introductory letter was obtained from the Dean of School of Education for local council officials who were research assistants, environment officials and any other interested officials. This was presented to any respondent approached and on their request, while the Local council leaders conducted the general introduction.

3.8 Data Management

The data collected was analyzed. The data (on SAQs) was edited, categorized, coded and entered into computer. Statistical Package for Social Sciences (SPSS) was used for generation of a summary frequency tables and the Chi-square was used. The non-formal education and values were related based on school leavers and their categories of literacy levels, age and employment type. Data from interviews and focus group discussion was coded, categorized and summarized for generalizations and patterns.

3.9 Limitations

Most respondents who were teachers did not reside in the wetland and so could not be effective research assistants as originally designed. Industrial action by staff of the university and structural reorganization of the Library affected data analysis and the period for discussion and report writing. The researcher's workplace, though close to the study area, was quite far from Makerere University. These restricted timely movements to meet the supervisors, besides the

demands from work place were high. However the local council officials participated in the study with an element of authority. This helped residents to be co-operative in the focus group discussions and observations. The fact that the researcher was a teacher did not make respondents so suspicious of the discussions. They were even appreciative of the gesture to involve them in the teaching and learning 'preparation' for their children.

Chapter Four

Data Presentation, Analysis and Interpretation

4.1 Introduction

This chapter presents the data, the analysis that followed and the interpretation that arose from this data and the respondents' background. These were used to address the objectives of the study and make inferences.

4.2 Respondents' Background

This section presents the background of the respondent's information age (years), the time respondents left school, gender, marital status, educational background and occupation of the respondents. The importance of this data was to establish the level of school leavers who are associated with wetland resource use and livelihood. The socio- economic attributes of the users and beneficiaries of the wetland resources in Pece wetland were recorded. Table 4.1 shows a summary of the respondents' information.

Table 4.1: Background information collected from Resource users of Pece wetland

<i>Factor</i>	<i>Category</i>	<i>Frequency</i>	<i>Percentage (%)</i>
Age (in years)	<20	4	7.4
	21-30	29	53.7
	31-40	11	20.4
	>41	10	18.5
Sex	Male	43	79.6
	Female	11	20.4
Household population	<5	18	14.8
	6-10	32	22.2
	>10	04	63
Marital status	Married	38	70.4
	Single (including widowed)	16	29.6
Age at which married (years)	<20	12	22.2
	21-30	30	55.6
	>31	01	1.9
Total		54	100%

From the table above, the highest percentage (53.7%) of the wetland resource users was in the age bracket of (21 – 30 years) consisting of youths who had left school and were the physically active group. Respondents aged below 20 years were few at 7.4% while those above 41 years were 18.5%. These two categories were active in the research focus group discussion and in the activities observed. The wetland resources namely clay, sand, water, and reeds/grass/ papyrus, were extracted and used to support livelihood. Respondents of 45 years and above were observed to be actively involved in the use of the wetland resources subsistently at their residences. They responded as follows when interacted:

‘We always make bricks from here, for sale to get school fees and other personal requirements.’

“I prepare these papyrus for making mats and the strings for other works. My daughter in-law cuts them and brings them here, after making; she carries the mats to the market (for sale).”



Plate 1: Young people make use of the wetland resources at the wetland site.



Plate 2: Older people process extracted wetland resources at their homes

Regarding gender, there were more male respondents (79.6%) than females although females participated more in the focus group discussions. In fact, the Local council 1 Chairperson of Holy Rosary ward, where one FGD was held, was a woman. This implied the wetland offers opportunities to both men and women. Most of the respondents were married (70.4%) and were involved in other employment sectors. Some people in the wetland were seen extracting the resources collectively as husband and wife. This implied that with some people the wetlands

provide for their entire needs, to others it is subsidizing their incomes and support. The wetland is therefore a source of employment to many school leavers. The economic stability of an individual or a household has a bearing on the sustainable use of wetland resources.



Plates 3a, 3b: *Harvesting of papyrus and transporting it either home for processing or for sale in its raw form. Note the regenerating papyrus in Plate 3b.*

Table 4.2: Educational background of respondents at Pece wetland

<i>Factor</i>	<i>Category</i>	<i>Frequency</i>	<i>Percentage(%)</i>
Educational level attained	Secondary level not completed	14	25.9
	Secondary level completed	26	48.2
	Tertiary level (career) completed	14	25.9
Years since left school	<10	34	63
	11-20	12	22.2
	>21	08	14.8
School environment setting	Urban	26	48.1
	Peri-urban	17	31.5
	Rural	11	20.4
Occupation/employment sector	Formal employment(salaried)		
	Informal employment(self)	20	37.0
	Unemployed(not earning)	22	40.7
		12	22.2
Total		54	100%

From the above table, a majority of respondents (63%) left school less than 10 years ago. School leavers found opportunities from wetlands to get startup capital for other businesses. Wetlands also have ‘free’ available resources such as water, clay, grass and other materials used for construction of huts or houses. This implies that wetlands are a good support to livelihood if well used because people depend on them for livelihood for a long period of time. Interestingly some respondents (48.1%) studied in urban schools. They all used the wetland resources equally like the rural –schooled counterparts.

The use of wetland resources, the dependent variable in this study was conceptualized into materials used in livelihood, production and conservation. These were summarized into five quantitative items on use of wetland resources. Respondents were requested to carry out self-rating on these using a 3-Likerts scale summarized to: L = little A = Average M = Much.

Table 4.3: Identified wetland resources of Pece wetland and the percentage level of their usage at households per population

<i>Household population</i>	<i>Papyrus/ Grass/ree</i>			<i>Water</i>			<i>Animals</i>			<i>Agriculture /Food items /crops</i>			<i>Soil/clay/ Sand</i>		
	L	A	M	L	A	M	L	A	M	L	A	M	L	A	M
<5	12.9	12.9	7.4	3.7	14.8	14.8	20.4	11.1	1.9	7.4	11.1	14.8	5.6	9.2	18.5
6-10	25.9	12.9	20.4	9.3	27.8	22.2	12.9	25.9	20.4	9.2	22.2	27.8	14.8	25.9	18.5
>10	1.9	1.9	3.7	0	1.9	5.6	5.6	0	1.9	1.9	1.9	3.7	1.9	3.7	1.9
Total %	40.7	27.8	31.5	12.9	44.4	42.6	38.9	38.9	22.2	18.5	35.2	46.3	22.2	38.9	38.9

L=Little; A=Average and M = Much

The results from Table 4.3 indicate that some people in addition to extracting resources also use the wetland for agriculture (46.3%) mainly by households that consist of population 6-10 people. The use of water resource was the highest in all the categories of households (42.6%), while the extraction of soil/clay/sand was lower at (38.9 %). Differences in use of wetland resources by

family household was significant at $X^2 = (p < 0.05)$. The population in family of 6-10 persons used the wetland resources more than the larger households who mainly composed of many dependents (young children) and school going children. The family size of 6-10 people composed of youth who make a living from the wetland resources and are not employed at formal salaried sector. The general interpretation of these findings suggest that wetlands resources are useful to the population as they provide food, water, sand, soil and clay, papyrus and grass used in construction of houses and income generation. Environment officers and local council leaders in Pece prisons ward concurred with these findings as they reported:

“Many people settle in the wetland for easy survival. Wetlands provide a livelihood for many people at a perceived ‘free cost’”.



Plates 4a and 4b: Wetland resources from Pece wetland processed for sale: ropes and mats from papyrus at a roadside market, and bricks from clay/soil within the wetland.

Papyrus/grass/ reeds were recorded the least used wetland resource at 40.7% and by the 6-10 household population. The animals of the wetland were responded to as least used by the category of >5 and <10 households sizes. Alternative materials like plastic crafts for mats, ropes and baskets, packed processed foods like maize meal, meat from butchery and charcoal fuel for cooking supplied from afar, are most likely used by these categories of household size.

4.3 Objective One: Investigation of the Application of the knowledge from biology education learnt at school in the Use of wetland resources

The first objective of this study was to investigate the knowledge from biology education applied by the school leavers in use of wetland resources around Pece wetland. The objective was divided into two sub-themes: knowledge recalled and referred on materials used, and knowledge recalled and identified on services and functions. The key issue was: did they learn these resource uses and functions from class. The findings are presented in Table 4.

Table 4.4: Percentage level of Usage of wetland resources in teaching/learning of biology per educational background.

<i>Educational Background</i>	<i>Papyrus / Grass/ reeds</i>			<i>Water</i>			<i>Soil/ sand/ clay</i>			<i>Animals</i>			<i>Food items /crops</i>		
	L %	A	H	L %	A	H	L %	A	H	L %	A	H	L %	A	H
Below Secondary level	7.4	7.4	11.1	12.9	0	12.9	16.1	1.9	7.4	11.1	12.9	1.9	9.3	9.3	7.4
Completed Secondary level	16.7	12.9	18.3	14.8	16.7	16.7	14.8	11.1	22.2	20.3	11.1	16.7	12.9	9.3	23.9
Completed Tertiary level	12.9	9.3	3.7	7.9	5.6	12.9	9.3	9.3	7.4	11.1	9.3	5.6	12.9	3.7	9.3
Total %	37	29.6	33.3	35.1	22.2	42.5	40.7	22.2	37	42.5	33.3	24	35.1	22.2	42.5

Key: L= low A= average H= high

All the categories recorded a high percentage usage of water at 42.5% for teaching/learning of biology. It is a government policy for every school in this country to have a water source as a minimum basic requirement. The percentage level of usage of water for teaching varied due to the content of the curriculum and the teaching method applied by respective teachers. The

categories who have completed secondary level reported a higher usage of all the materials of wetland resource. The recall of knowledge from biology education was high. The category of below secondary level and those who completed tertiary level recorded a low usage of the wetland resources except for water, which is used in the teaching/ learning of biology. The teaching method had an effect on the recall of materials used for the learning process. Practical lessons promote recall but then the application of that knowledge thereafter was the gist of this matter. There was need to find out how much of the wetland attributes the school leavers knew. Table 4.5 presented some of the wetland functions and services recalled and identified.

Table 4.5: Level of Knowledge of functions and services of Pece wetland

<i>Function and service</i>	<i>Frequencies</i>			<i>Percentages</i>		
	<i>L</i>	<i>A</i>	<i>H</i>	<i>Low %</i>	<i>Average %</i>	<i>High %</i>
Water storage	23	9	22	42.6	16.7	40.7
Water filtration	19	9	26	35.1	16.7	48.1
Flood regulation	21	13	20	38.9	24	37
Raw material provision	18	12	24	33.3	22.2	44.4
Habitat for animals	28	14	12	51.9	25.9	22.2

Water filtration was the highest known function by respondents of Pece wetland (48.1%). The clear flowing water of the wetland was evidence of this function to the residents as they stated:

“We observe the dirty water running on surface, and it drains into the wetland when it rains, but what flows along Pece wetland is clean water.”

The other paramount function known to the residents was provision of raw materials, at a record of 44.4 %. The wetland resources were perceived to be extracted, processed, used and/or traded

upon for a livelihood. These were named as papyrus, water, clay, grass, and clay used for making houses and mats for sale. A local council leader of Pece Prisons ward affirmed this in stating that:

“The natural resources like papyrus attract people here for money making”.

Value addition on papyrus was reported as applied for making sanitary pads. However, the extraction of these materials was not related to what was learnt in secondary schools. The District Environment Officer did not know where the residents got this knowledge from. To him, there were a few outlets for extraction and value addition of these wetland resources.



Plate 5a and 5b: Papyrus crashed locally at people’s home as a value addition process for making sanitary pads.

The other functions like water storage and flood regulation were known to some extent by the respondents (Table 5). Some respondents did not know these functions, for example (42.6%) for water storage. This implied that the content of the biology education taught at school was short of aspects of use of wetland resources. Only (22.2%) knew the wetland as a habitat for wildlife. Not many animals were now seen and known around the Pece wetland, as urbanization was spreading over the area. The most observed and named animals were domestic animals; cows,

goats and chicken. Respondents did not frequently observe most of natural resources in the wetland probably because they did not have value for them. A resident of Pece prisons ward expressed as such in the focus group discussion:

“We know this wetland for papyrus, water and clay. These are the major things we get and use from Pece. Fish and other animals, maybe those olden days, but we don’t really see them.”

The most applied sub-category of wetland resources by school leavers was tested for significance using Chi-square according to procedure described (Gay1996, Kothari 2004). Table 4.6 shows the comparison of application of the biology learned on wetland resource use.

Table 4.6: Application of biology education on extraction of wetland resources by school leavers around Pece wetland.

	<i>Total usage frequency and their Percentages</i>		
	<i>Low</i>	<i>Average</i>	<i>High</i>
Grass / papyrus/ reeds	17 (31.5%)	7 (13.0%)	30 (55.5%)
Water	17 (31.5%)	6 (11.1%)	31 (57.4%)
Soil/ sand/ clay	16 (29.7%)	18 (33.3%)	20 (37%)
Animals	33 (61.1%)	12 (22.2%)	9 (16.7%)
Food items	31 (57.4%)	13 (24.1%)	10 (18.5%)

Use of water was the most recalled knowledge (57.4 %) followed by use of grass/papyrus/reeds at (55.5%). These are universally extracted, processed and used items by both male and females, young and old, schooled and non-schooled, employed and unemployed, and at all seasons. Some knowledge on Soil /clay /sand was also recalled (37%) as wetland resources that support biodiversity that is, different kinds of living things. However the use of the wetland resources would depend on the seasons, locations and at times the gender involved. Moulding of bricks from soil and clay was dominated by young men and boys. The Female population mainly got soil to smear the floor and walls of the huts. Cultivation of some plants like sweet potatoes was

seasonal while vegetables and sugar was named to be grown throughout the year due to the constant and above the land surface water levels. A community member from Holy Rosary ward expressed that:

“At least in the wetland we can survive by digging and making brick but we do not learn this from schools”.

For the wetland animals and food items, their presence was acknowledged but these were not common probably because they had been over exploited.

Although some people appeared to use the knowledge from biology education to exploit wetland resources, the employed category with a steady source of income to buy food, did not cultivate in the wetland. People depend on peri-urban trading centres and market for food and livelihood. A good portion of foodstuff, especially vegetables, was produced from the wetland during the dry season. This implied that the education in secondary school would benefit people who target wetlands for residence and survival. The Focus group discussion at Pece prisons ward revealed that many women move round buying and selling vegetables and other food stuff, a petty trade called “*Awaro*”.

*‘Much of these vegetables grown in the wetland are bought from the garden by the women and again sold to people at their homes or by the road side market. The other women wait by the roads to buy foodstuffs from afar then sell to the people around. We call these women “the **Awaro**”’*

Some people are known to specialize in cultivation in the wetland for vegetables throughout the year. Testing these results against education background for objective one, the chi-square values were analyzed and presented as follows in Table 4. 7.

Table 4.7: Chi-square values for education background

	Chi-square	df
Grass / papyrus/ reeds	3.38	9
Water	0.277	8
Soil/ sand/ clay	0.654	8
Animals	0.180	8
Food items	0.430	8

The chi-square values of the *df* are all greater than the *critical value* ($P < 0.05$). This implied that the education background has no significant influence on the use of biological resources. Thus, the recall and reference of knowledge from biology taught at school had no significant influence on the use of wetland resources by school leavers around Pece wetland.

The interview with the curriculum developer, biology subject specialist also revealed similar inferences. He noted that indeed the teaching and learning of biology was now tending to focus on passing of examinations only. He regrettably said:

“Cram work nowadays is more appealing to students rather than understanding, yet biology as a subject is dynamic”.

In spite of emphasis accorded in the introduction of the subject for beginners at secondary school such as values, health, nutrition and environment conservation, these become unclear and uncertain later on as one completes school. This raises concern, on the application of biology education by school leavers. The communities’ use of wetland resources appears to be based on knowledge passed to them through other sources rather than that from classroom.

“I saw it from my mother, so I learnt. We have been making mats and ropes from papyrus for sale for many years. ”

This was one response during the focus group discussions in Holy Rosary ward. One other resident found in the wetland in Pece Prisons ward expressed as follows in the interview:

‘My parents used to dig in the wetland during the dry seasons. When I was of age I joined them in the cultivation for vegetables during the dry season in the wetland in the village. Now I also bring my children and teach how to dig and even fish in Pece wetland here’.

The family or traditional values were still influential in aspects of natural resources use.

However there was some trend from the research participants who applied the knowledge as learnt from school biology on wetland resources when exposed to use of water, animals and food items. A retired prisons officer in Pece prisons expressed as follows in the FGD in Pece prisons ward:

“While at school in the study of nature science, we saw fish growing in small ponds. Now after government service, my plan is fish farming. I have set on digging some ponds besides the wetland for fish farming, somewhere in Pece there. Those early days, we used to get big fish from this wetland, and I believe fish can still do well there. Some field workers, specialists on fish farming are helping us in setting up this project”.

The general direct -benefit values from use of wetland resources named by respondents was the source of income to support livelihood. Seasonal prices change and demands can be high for papyrus and other products. Papyrus products serve far away areas like Kitgum (the neighbouring district to the north which does not have papyrus swamps), because it is mainly used for thatching and making mats. With this in mind, papyruses were harvested carefully only mature ones were observed to be harvested as young one were left to mature. This was noted as a case of wise use of that resource. The labour used was free and voluntary. This however was a common oversight in the economic valuation of wetland resources.

Production of sanitary pads from papyrus for lack of a better alternative was observed. This is an initiative by an NGO, Living Hope, under the theme of *Restoring Dignity to Women*, the activity branded: Technology for Tomorrow (T4T). Skills were taught to women on value addition to the papyrus. The end products, the sanitary pads were to be supplied to schools and organizations as a pilot project. The wetland proved important in this aspect too. This however was a high level value addition with a high cost of labour of crushing the raw material, the papyrus. This was not probably valued in the proper system and the amount of papyrus used could lead to over-harvesting. If valued in a proper system, the price offered for the sanitary pads may not probably be worthy the production cost. The positive aspect of it all remains as value addition skills gained.

Fish, as a wetland resource, was used for diet supplement. This however was also affected by over-harvesting of the other wetland resources like papyrus. Fish was highly depleted but the alternative lay in fish farming which was viable if the wetland was used sustainably. One resident, a family head, was found in the wetland in Pece prisons ward with four of his family members moulding bricks from clay. This resident was preparing the open burrow pits resulting from extraction of the clay for a fish farming pond and had this to say when interviewed.

“Our current population does not have enough food to eat especially for proteins. Fish farming is one means out and they can grow from here even naturally. We used to have fish in this wetland, and I am going to introduce them into these ponds. With maintenance, these ponds will not dry up and the fish will also supplement my income.”



Plate 6: *Ponds for fish farming under preparation from clay extraction burrows left after making bricks.*

This case of planned fish farming was noted to be one of integration of knowledge from biology education into the sustainable use of the wetland resources. Though wetland water levels reduced due to seasonal changes, most respondents could not figure out Pece wetland ever drying up as most of them replied:

“It is a permanent wetland” ‘Pece [wetland] cannot dry up’.

Papyrus and water resources were identified to have restricted alternative sources. Much as water could be got from water taps and boreholes, this was subject to accessibility in some areas. It was sold for some money, not ‘free’ as the natural resources in the wetland. Papyrus could be transported from far off regions but transport costs would make them very expensive. The other alternatives included upland settlements or rural homes away from the Pece wetland. This should also involve diverse projects to be encouraged and given to the community like poultry, piggery and fruit growing to alleviate poverty and sustain livelihoods. Biology education could clearly be

seen as a likely intervention in sustainable livelihood and so its knowledge, skills and values be translated into natural resources use and conservation.

4.4 Objective Two: The identification of conservation skills acquired through the learning of biology that are necessary in the use of wetland resources.

The levels of education and the application of skills of biology education in extraction of materials from the wetlands are shown in table 4.8 below.

Table 4.8: The percentage of biology education influences on skills of extraction and wise-use of wetland resources (L = low A = average H= high)

<i>Educational Level</i>	<i>Papyrus/grass</i>			<i>Water</i>			<i>Animals</i>			<i>Food crops</i>			<i>Soil/clay/sand</i>			<i>Mean</i>		
	<i>L</i>	<i>A</i>	<i>H</i>	<i>L</i>	<i>A</i>	<i>H</i>	<i>L</i>	<i>A</i>	<i>H</i>	<i>L</i>	<i>A</i>	<i>H</i>	<i>L</i>	<i>A</i>	<i>H</i>	<i>L</i>	<i>A</i>	<i>H</i>
Completed Secondary	16.7	2.9	18.5	14.8	3.7	16.7	14.8	11.1	22.2	20.4	11.1	18.5	12.9	9.2	25.9	43	26	54
Below Secondary	7.4	7.4	11.1	12.9	12.9	12.9	16.7	1.9	7.4	11.1	12.9	1.9	9.2	9.2	7.4	31	27	22
Completed Tertiary	12.9	9.2	3.7	7.9	5.6	12.9	9.2	9.2	7.9	11.1	9.2	5.6	12.9	3.7	9.2	29	20	19

Where by low was counted and rated as 2 or less times; average as 3 – 5 times; high as 6 or more times.

The wetland resources of water and soil/ clay/ sand were recorded the highest extracted and used both at 42.5%. It was highest amongst those who had completed secondary school education. Soil and clay was mostly used for moulding bricks used for construction of huts and houses. These processed soil and clay was also one of commonest source of income for school fees and making a livelihood for the young people in the wetland. The use of these wetland resources was lowest among the bracket of those who had completed tertiary education showing the lowest percentage (7.9%) for the ‘high use’ response. They could afford to get alternative materials to

these wetland resources from elsewhere. This category of ‘completed tertiary education’ also commonly rented already constructed houses and so did not experience high use of these wetland resources. This skills application on use of wetland resources of Pece wetland could be attributed to attainment of biology education as it was high amongst those who had just completed secondary school. However the wise –use aspect was not identified. The researcher suggests that biology education attainment through teaching and learning at school should include the wise -use of the resources people extract from natural environments. The teaching of biology could be inadequate in addressing the link of resource identification to wise-use of natural resources in the environment. The curriculum development officer noted that specific emphasis on conservation of biological or natural resources such as wetlands resources was generally lacking.

“It is just the individual teachers who emphasize the issue of conservation through various teaching methods and in the content of their interest”.

The teachers’ responses during the focus group discussion generally concurred that they teach what is presented in the syllabus but focus on aspects needed to pass examinations.

“Practical environmental conservation can be done in wildlife, environment and other clubs.”

These teachers did not however indicate whether they are involved in such club activities or how effective these clubs were in conservation themes and projects. Probably it was for the other non-science teachers to handle.

4.4.1 Testing for Skills acquired and identified from biology education taught at school

Basically this was to find out if the biology education the respondents acquired from school had some relevance to consciousness that could lead to destruction of the wetland.

Testing objective two; Skills acquired and practiced from biology education taught at school had significant influence on extraction of biological resources by school leavers in Pece wetland. The chi-square values of the category of primary level completed was df 0.68; completed secondary levels at df 0.25; and secondary school not completed at df 0.045: all were greater than the critical value, ($p= 0.05$). These results of $p > 0.05$ implied that skills acquired and practiced from biology education taught at school had no significant influence ($p < 0.05$) on extraction and use of wetland resources by school leavers in Pece wetland and did not influence their conservation. However, the chi-square value for educational background of tertiary education completed was at 0.003; and less than the critical value of $p < 0.05$. In this case the results indicated that skills acquired and practiced from biology education taught at school had significant influence ($p < 0.05$) on extraction of wetland resources by school leavers of tertiary education resident in Pece wetland. It goes on to imply that a higher level of education enhances the skills acquired at secondary school level. The means, such as a steady income to process these wetland resources sustainably could be the main factor that influenced the biology education to have significant influence to this category of tertiary level of educational background. Thus the employment aspect and level of income could be the differing factor. It could be that the biology science-oriented tertiary education leavers were the majority residents and respondents. The age factor could be the determinant factor with the older age brackets (31-40, >41 years) having more skills acquired from non-formal education sectors such as workshops and media, besides family and traditional knowledge passed onto the young ones. The younger age groups (<20, 21-30 years) really could be with less interest in environment-related community meetings, workshops and media programmes, and they were sought to have different values. This was expressed by the Local council leaders in Pece prisons ward FGD.

“The youth have more interest in other issues of entertainment like Sex Education, drama and music”

A specific approach to environmental education related issues needs to be designed or improved to capture more attention of the youth, the researcher noted.

4.5 Objective Three: Assessment of Non-formal education that contribute to the use of wetland resources in Pece wetland

In this study objective three sought to assess sources of non-formal education in the community and the level to which they contribute to skills development for wise use of wetland resources.

The findings were presented in Table 4.9 as follows. A comparison of formal and non-formal sources of education by frequency of skills and values applied on wise-use of wetland resources.

Table 4.9: Assessment of Non-formal education on the use of wetland resources from Pece

Activity on wetland resource	Source of education on wise use									
	<i>Primary School</i>		<i>Secondary school</i>		<i>Workshops</i>		<i>Family/ community</i>		<i>Mass media</i>	
	<i>Freq</i>	<i>%</i>	<i>Freq</i>	<i>%</i>	<i>Freq</i>	<i>%</i>	<i>Freq</i>	<i>%</i>	<i>Freq</i>	<i>%</i>
Drainage of water	12	22.2	14	25.9	9	16.7	13	24.1	6	11
Encroachment	3	5.6	12	22.2	14	25.9	13	24.1	13	24.1
Over-exploitation	9	16.7	15	27.8	9	16.7	9	16.7	13	24.1
Pollution	13	24.1	16	29.6	11	20.4	9	16.7	5	9.3
Farming	13	24.1	13	24.1	8	14.8	13	24.1	6	11.1
Total	50	92.3	70	129.6	51	94.1	57	105.7	43	79.6

Sources of learning the values and skills of use of natural resources from wetlands, alongside school

Secondary school recorded the highest percentage responses of frequency 70 = 129.6 % as source of knowledge and skills on conservation of wetland resources. This was followed by family or community setting recording frequency 57 = 105.7 %. However it also followed that most of the respondent were fresh from school. They responded and expressed the recall of very few skills that were linked to conservation.

In the family or community teaching, drainage of water, encroachment and farming activities were recorded most learnt at 24.1 % whereas over exploitation and pollution was least taught at 16.7 %. Through the mass media; encroachment and over exploitation were most taught at 24.1% while pollution was least at 9.3%.

A response from the local community FGD in Holy Rosary ward pointed out that:

“What is taught at school is similar to the home teaching”.

This could imply that the knowledge learnt at school was just gained but not applied.

Workshops ranked the next source of learning closely followed by primary schools at 51= 94.1% and 50 = 92.3% respectively. Workshops target a specific category of people whereas primary school was universal but limited in scope and time. The mass media was recorded as the least influence source of learning on knowledge and skills of conservation. The commonest means of mass media, the radio and newspaper may not be widespread and less attention accorded to them by the residents of the wetland. Mass media programmes may be taken for granted as entertainment.

In the content, the respondents' data indicated that the highest learnt topic at secondary school was pollution at a frequency of 54. This was followed by over-exploitation, drainage of water, and land use activities, while encroachment was the least learnt. In workshops; encroachment

followed by pollution was most discussed issues while land use activities were least learnt. Pollution and farming activities were most learnt in primary schools at 24.1% while encroachment was least learnt. Issues with scientific concepts were more learnt at school and workshops, while practical aspects such as drainage of water and encroachment were more taught in community and mass media non-formal education. The local council leaders of Pece prisons ward in the FGD response on workshops and community training was that:

“No organization comes here to teach us or meet us on environment or wetland matters, but we just hear of environment officers from the radio”.

On another note, Aryemo (2008) reported of being chased by a suspicious old man with a ‘panga’ when she was gathering data from the community in Pece wetland.

Some residents are suspicious of ‘visitors’ such as Law enforcement officers, News reporters and researchers due to the uncertainty of the land ownership where they are settled. Environment Officers are cautious of such reactions from some residents and together with limitations of facilitation from their office, field work programmes are highly limited as revealed by the District Environment Officer.

Wetlands provide water to various categories of people. It was identified to be used for domestic purposes including building houses and feeding animals. The community confirmed that this water was not safe for drinking, but was used for any other purposes like washing, watering animals and building houses. Animals from the wetlands were the least used resource in the study. They are used for diet, sold for income, and cows are milked. The named wild animals were antelopes, monkeys, fowls and fish. Now it was mainly the domestic animals: goats, pigs,

cows, birds and farmed fish that the respondents mentioned. The wetland was already depleted of animals due to urban settlements and deforestation of the surrounding areas.

The community was aware that the wetland resources had reduced; fish, papyrus, sand and safe water for human to drink.. The spring water wells which were safe and clean for human consumption had dried up. The water available in Pece wetland was not safe for drinking as reported by the residents and only used for domestic and industrial work. Technological advancements aligned to application of biology education was observed and named at the sewerage lagoon located in Pece Lukung ward, a peri-urban area. This was set up some time in the early years of 1980's by the Gulu Town Council then, and the current residents of Pece Lukung were not involved.

The community was also aware of health hazards posed to them by the open burrow pits resulting from the extraction of some resources like clay and sand, namely breeding of mosquitoes and snakes. These became sources of communicable diseases like malaria and non-communicable conditions which affect health due to critical accidents. Cases of accidents of drowning and fractures were named especially of people (most likely drunk) crossing the wetland waters at night and children playing around as part of their recreation. Accidents also occurred during the extraction of wetland resources as in the unprotected water collection points to both adults and children.

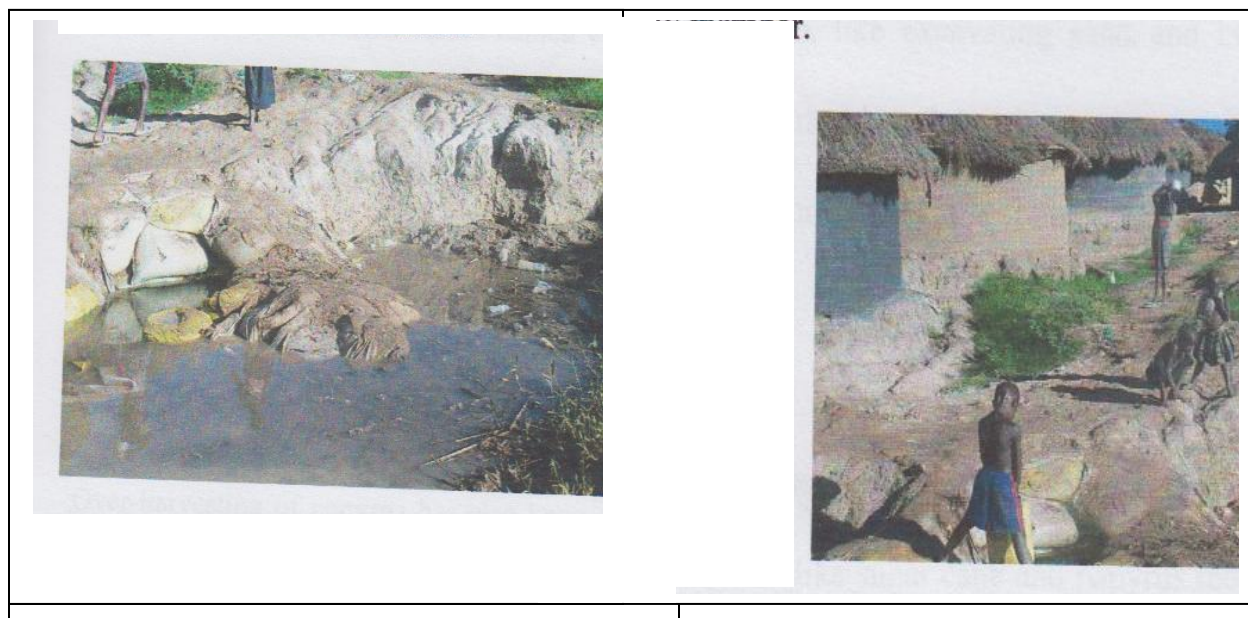


Plate 7: Borrows pits of Sand extraction at a water collection point that make it difficult and hazardous for the residents in use of the water resource.

In relation to sources of education on wise use of the wetland resources, this study investigated on the level of conservation practices per kind of employment of the residents of Pece wetland.

The results were presented as in Table 4.10.

Table 4.10: The categories of people by employment and the Level to which they protect and conserve the wetland resources

	<i>Regulation of resource Harvest</i>			<i>Control of pollution</i>			<i>Regulation of resource production</i>			<i>Control of mining</i>			<i>Conduct Meetings & demo.</i>			<i>Total mean</i>		
	Mean number of times of this activity																	
Employment category	R	A	O	R	A	O	R	A	O	R	A	O	R	A	O	R	A	O
Salaried	16.7	3.7	16.7	20.4	7.4	9.2	11.1	9.25	16.7	18.5	3.7	14.8	18.3	3.7	14.8	85.9	27.8	72.2
Self-employed	20.4	1.4	12.9	14.8	11.1	14.8	18.5	9.2	14.8	14.8	9.2	16.7	25.9	7.4	7.4	94.4	44.4	66.7
Unemployed	7.4	1	4.8	11.1	1.9	9.2	11.1	5.6	5.6	12.9	1.9	7.4	11.1	5.6	5.6	53.7	18.5	37
Total	44.4	14.8	40.7	46.2	20.4	33.3	40.7	24	33.3	46.3	14.8	38.9	55.6	16.7	27.8			

R- Rare rated as consisted of three or less times in one year: A -average consists of 4-6 time in a year : O- often is rated for 7 or more time in one year.

Generally the highest response for all the three categories of employment of the residents was Rare, then followed by Often. This implied that little was really done for conservation and protection of the wetland resources. It could be lack of awareness of the need to protect this source of livelihood and yet all categories of people use it. The value and extent of biology education applied was raised. The salaried employment sector scored highest (72.2 %) in often applying some conservation skills. The salaried employment categories are the same ones who had completed tertiary education. Their income most likely was steady and gave a secure livelihood, ability to plan and therefore avoid exploitation of wetland resources thereby conserving and protecting them. They were also in position to practice wise- use concept as they could afford alternatives of synthetic materials as the wetland resources recover for harvest and use.

Values were normally expressed in individual and collective behavior. This included the choice of where to stay, what to consume and the kind of livelihood. It was surprising that even people in the formal employment sector went to use the wetland resources. One would have thought the wetland would be for the unemployed. Most activities were now market driven though based on science. Indeed the percentage of self- employed sector was the highest. Seedling raising, fish farming and agriculture would be based on school knowledge attained and the market forces if biology education was influential.

Fish farming at low level was practiced and tried out. As mitigation, leaders claim they restrict sand excavation and prohibit burning of papyrus, stated as a bye –law. This was observed in some parts of the wetland.

There was no significant influence between the employment sector type and the level to protect and conserve the wetland resources of Pece wetland as the chi-square values of 3.786 – 9.590 are greater than the critical value ($p < 0.05$) at a *df* of 8. Therefore, values imparted and expressed from biology education taught at school had no significant influence on use of wetland resources by school leavers around Pece wetland. The community's use of wetland resources was by knowledge passed to them through other sources of non-formal education rather than from formal education.

Chapter Five

Discussion, Conclusion and Recommendations

5.1 Introduction

This chapter sets to bring together information from major parts of the study. It focuses on the on the discussions of findings in Chapter four. This is in relationship to the objectives guided by the research questions of the study.

5.2. Discussion

5.2.1 Investigation of the application of the knowledge from biology education learnt at school in the use of wetland resources from Pece wetland by school leavers

The application of biology education taught at school had no significant influence on the use of biological resources by school leavers in Pece wetland. The result of this study found that the extraction of wetland resources was more aligned to the age factor, size of household, type of livelihood or employment, and to the level of education one attained. Although the younger age brackets in this research identified knowledge from biology education they did not really apply it in extraction and use of the wetland resources. The older age brackets identified family knowledge as the most applied and influential in the use of wetland resources. It follows that the applications of the knowledge attained from the school biology education losses appeal to the other non-formal kinds of education such as the family as the individuals grow older.

Findings by Oonyu (2000) are in line with these kinds of results. He agreed that different groups based on age and responsibility in the community had different perceptions of environmental issues and the values they attached to the natural resources. Oonyu (2000) called for educational

packages to be designed to facilitate non-formal environmental educational programmes for the different cohorts; youth, women, elders and local leaders. This study found out that men had more time to attend to issues of printed matter related to reading and writing, while women readily shared issues verbally. The cultural norm also sets the men to discuss and document issues concerning land and the community. Therefore a higher response from the male gender was recorded in this study. The formal education, socio-economic and political system however had empowered women to be more involved in all sectors of life. One of the local council leaders for this study was a woman (LC 1 chairperson Holy Rosary ward) and so many females were brought on board for the local community focal group discussion. The natural wilderness of the Pece wetland, such as high water levels and thick vegetation makes it prone to natural calamities and this however reduced females' participation on wetlands resources use.

Mature papyrus were harvested as they grew every year. This was mostly done by women and sustainability was exhibited. However in some parts of the wetland burnt down papyrus were observed. This was noted to be destructive and also condemned by the local leaders. Sand and clay extraction (for brick making), mainly by men was also identified to be done in a destructive way. This called for soil to fill up the pits and further led to wetland reclamation. Wetland expansion though was noted to have occurred where water was constant and left undisturbed after such clay, a wetland resource was extraction at one point in Pece prisons ward.

Formal education packages are designed to cater for the different educational domains of cognitive, psychomotor and affective of the learners. The formative age while at school is taken to have a greater influence on one's future way of life. (GWPE 1992, NCDC 2008). Much as the objectives of the biology curriculum really presents the knowledge, love and use of the

environment, the tangible output namely application on extraction and use of these natural and environmental resources is not significant. Wise-use of wetland resources did not appear to be achieved yet there are all the opportunities while at school (Oonyu and Busulwa 2009). There are still more opportunities to strengthen the teaching and learning of biology to result in application of knowledge from biology education on wetland resources. The National Development Curriculum Centre therefore should integrate wise-use of the natural resources into the primary level to benefit people who do not complete secondary education. Already some instructional materials for wetlands education have been designed for primary and secondary schools; they have not yet been integrated into the curriculum.

Elsewhere in the world, Dyke *et al* (1996) asserts that modern college education, particularly in the sciences, is often a fragmented and disconnected intellectual meal. This creates individuals who are themselves disconnected, that is professionally separated from their own persons. The approach of teaching and learning which makes ‘connected’ individuals needs to be identified to make more meaningful formal science for the biology education knowledge application for life. The FGD with teachers of secondary schools, who are curriculum implementers, contended that teaching students in the present situations of very many students and the ‘all promotion’ policy had made it become difficult.

“These learners these days just want to receive what will make them pass examinations without being involved highly in the classroom activities.”

These teachers recommended that guidance and counseling be conducted to students concurrently as teaching/learning goes on. This would help learners’ attitude on what education really is, and the realities of life. The application of knowledge from biology education on the

extraction and use of wetland resources would be a reality for life. Teaching of life skills as Obanya (2004) recommended was one of the types of educational instructions to prepare young people to face the challenges of their time and place. This would also satisfy the demands of communities and families, formal and non-formal employment sectors.

5.2.2 The identification of conservation skills acquired through the learning of biology that are necessary in use of wetland resources.

The skills and levels of processing, value addition and conservation varied. The skills that were identified to have been acquired from school and applied were minimal. In the contrary traditional or indigenous knowledge seem to be more applied and therefore acquired by the respondents. The results indicated that the skills acquired and applied from the biology education while at school had no significant influence on use and extraction of wetland resources by school leavers in Pece, and had no significant influence on their conservation. However the skills acquired and applied from the biology education by the tertiary school leavers (after O'level) had a significant influence on extraction of wetland resources in Pece wetland. These results were realized from the researcher' findings and comparisons of the category of the respondents who completed higher education (tertiary institution after secondary). These findings were in agreement with discussions and presentations as per by Olaniyan *et al* (2008) and Bouchard (1998) on the Human Capital Theory. They assert that whereas education also imparts values, ideas and attitudes on a country's development interests, the traditional education institutes, that is primary and secondary schools, are not as relevant as they could be.

One of the difficulties identified in teaching of biology (Mbidde *et al* 2009) was failure of biology teachers to use the immediate natural environment: they found field work expensive to conduct, took plenty of time and the large numbers of learners hindered carrying out fieldwork. Thus skills and values acquired and applied from biology education while at school were minimal. The most extracted and used wetland resource were water and soil/clay/ sand and by school leavers who had completed secondary school. As they look into the future after school, full of energy, the notion of independence was high. They set to have their own huts (houses) using skills acquired at school to design and construct one from natural resources available, particularly soil, clay, sand, water, grass, reeds, papyrus and trees. This rather prematurely lead to the next agenda after school: marriage. The respondents generally got married at 21-30 years, soon after leaving school. Even at less than 20 years, marriage seemed an easier way to go. The availability of natural resources in the wetland and their 'free' access appeared to favour and promote marriage life. Wetland resources were used for survival. This implied that the initial capital for a livelihood was minimal. This was usually valued as 'free' not considering ones' labour, skills and values applied.

Many of these categories of completed secondary school, together with those of 'not completed school' who responded highly on low use of wetland resources then end up in self-employment. Some of these school leavers would directly use wetland resources while others work in the urban centre but depend on the wetland resources on subsistence basis. They also then set up their own households, families and propel population growth, land fragmentation and therefore further settlement in the wetland was bound to result. Thus much as biology education skills were applied higher pressure was exerted onto the wetland resources.

According to Aryemo (2008) community members in Pece wetland also had knowledge pertaining environment management, but not all was applied. This led to much impact on the wetland through their different activities carried in their livelihood support. Her study did not consider the skills pertaining extraction of wetland resources and the household population factors. In this study the results on levels of extraction and use of wetland resources were lowest on the category of school leavers who had completed tertiary education. This category also formed the salaried employment and could afford to get alternatives to natural resources of Pece wetland. They tend to delay marriage, or stay single while able to keep large families. They did not impact heavily on the wetland. All the different employment categories used natural resources of Pece wetland. Respondents from Pece prisons ward FGD expressed measures and cautions on protection and conservation of the wetland.

“We have bye-laws set to protect Pece wetland but these are still not well observed. We stopped people from burning the papyrus, but some bad people still do it.”

The paddy rice growing that was not observed in Pece wetland could be a result of such bye-laws. Though hiring out plots was named, it was not identified as a pronounced activity and not covered in the bye-law. Fishing activity identified as a means to wise-use of the wetland was yet to be set up an so reflect the application of biology education on skills of conservation of wetland resources. This project of fish farming in Pece wetland presents an area of further research.

School leavers who completed secondary and those who did not complete secondary school applied the least conservation skills for use of wetland resources compared to those who completed tertiary education (Table 4.8). Skills for use of wetland resources do not have to be

elaborate to need a technical institute, as presented by (Arinaitwe, 2007). The secondary school biology curriculum with its objectives was an accomplishment to education if well implemented. The school curriculum apparently covered all aspects of conservation but their application was attributed to the teaching methods applied (Isingoma, 2005). These could be conducted as outdoor activities, club or project lessons on understanding wetlands or other ecosystems. The skills, methods and materials should be integrated in the use patterns at school and at home. This calls for common learning sites such as Pece wetland for the values, skills and interests of conservations.

The salaried employment sector scored highest in the application of conservation skills. Their application of biology education skills on wetland resources was significant on the chi-square test. There was no significance influence between employment sector and the level to protect and conserve the wetland resources. The results further show that the water from the wetland was the most used resource by an average number of residents. This implies that there is another source of water which most residents used. Papyrus /grass/reeds had the highest count as least used wetland resource. This was to say many residents of Pece wetland did not use papyrus/grass/reeds. Papyrus used for making mats and ropes, reeds are used for baskets and other crafts while grass for thatching hut and grazing animals could now be replaced by synthetic materials. Alternatives for these materials were available in the market. The wetland was already depleted of animals which explain the little use of grass. Besides, urban settlement restricts keeping of animals like cows and goats.

5.2.3 To assess the Non –formal Education influence on the gain of knowledge on wise – use of the wetland resources.

The identification of the skills acquired particularly from school, and then other sources, and how much are applied showed that in the family or community teaching, drainage of water, encroachment and land use activities were recorded as most learnt, whereas over exploitation and pollution were least taught. Through the mass media; encroachment and over exploitation were most learnt and recorded, while pollution was least known. Conservation skills were most learnt at school followed by the family or community but the application levels varied.

In his study of Mt. Elgon Park, Oonyu (2000) observed that the number of local people participating in the environment education sessions varied from 1-20. During drama and film shows, numbers could go to beyond 50! A wetland community could perceive an environment education session differently. In this study, response to discussions was good rated at 70%, while to the SAQ was not good: rated at 45%. In her findings, Basemera (2003), found similar results and related to Warren (1995) report on Kenya, a neighbouring country:

“The youth are indoctrinated mainly with Western ideologies in schools. This belittles their traditions and culture. By the time they leave school, they shun traditional life and resent most of what their parents and relatives would like to see them doing”.

More media coverage and greater popular awareness however do not necessarily mean real changes or lasting solutions according to (Dyke, 1996). He admits that the loss of wetlands was not so well documented. The importance of wetlands was probably not understood and so they were neglected. This tends to be the case in Uganda today. For the wide media coverage on dangers of wetland degradation, more dams construction and reclamations of wetlands was observed as reported in the press. In ‘Mpanga dam an eye- opener’, (New Vision, Feb.23, 2012)

Ruguma T.F. asserts that the main cause of reduction of water levels of lakes and rivers in Uganda was mismanagement of wetlands. Thus Mpanga (River) small hydropower station delivers only 0.3MW of power supply yet its installed capacity was 18MW! How unsustainable a development this was! It was recommended (Dyke, 1996) that we begin to teach students how to celebrate creation and not merely measure it. Rather absurd in Uganda today, the school and the public at large seem to have neglected the main aim of school by laying all emphasis on passing national examinations highly. The application of the knowledge, skills and values gained and wise- use of resources available for sustainable development needs to be addressed. The non-formal education thus stands out to fill in these gaps.

Teachers teach for examination purposes which is mainly the cognitive domain of the objectives where most examination questions fall. The right education should include all the three domains of the objectives of the curriculum of a country's education system at every level. The researcher suggests affirmative action policy for co-curricular activities on Environment education. This would promote the education strategy objective of environment awareness and sustainable use of resources as recommended by Bos *et al* (2006).

5.3 Conclusion

Knowledge learnt on use of wetland resources is not from school. Biology education does not contribute to gain of skills and appreciation of values on use of wetland resources. However some of the skills and values were applied by people who had completed tertiary institutions. Value addition on products was found to be minimal.

The application of the knowledge from the biology taught in secondary schools is still wanting in areas of skills and values as expressed in competences of livelihood development, conservation and value practices. Though the economic benefits are an aspect of many topics of biology education, environmental benefits were not highlighted.

To make the teaching and learning of wetland resources, and biology education in general, more influential and significant, an enhanced approach must be employed which includes fieldwork, films and movie clips, debate and drama. This is to raise more interest, make learners creative and practical knowledge from biology education learnt to be applied after school for wise use of wetland resources for better livelihood.

Non-formal education, which includes traditional knowledge, teaches skills and values which influence the use of wetland resources at a later age. Age factor and occupation background had significant bearing on the application of knowledge on use of wetland resources.

Educational level background significantly influenced the local community's use of wetland resources. Ordinary level of education was not enough for skills applied on wise – use of wetland resources. Tertiary education is necessary for the promotion of skills and values of extraction and use of wetland resources.

5.4 Recommendations

Basing on the findings already presented and discussed, the researcher wishes to make the following recommendations. These are put forward to help the relevant stakeholders namely the

National Curriculum Development Centre, Education Policy makers, Environment officers, Local Council leaders, researchers, teachers and students in designing a more sustainable and implement an applicable biology education.

The Education Policy makers need to increase real education to the young minds; incorporate environment education heavily at school- primary and secondary. To make the application of knowledge of biology education on use of wetland resources more influential, an enhanced teaching-learning approach is needed. This should include use of environmental resources, excursions/ fieldwork, invitation of Guest Resource speakers, debates, drama, film or movie clips. Terminal and National exams should incorporate continuous assessment of non-academic (co-curricular) aspects such as project writings, report profiles and creativity in environmental issues. Clubs and societies on environment and Health issues such as Life skills should have an affirmative action policy.

The Teachers and Students in formal education should involve the more child-centered approaches with their various ideas received and recognized, followed up and be built upon. To make the teaching, learning and application of biology education real and on natural resources in general more influential and significant later in life, an enhanced approach must be employed which includes use of environmental resources, fieldwork, invitation of Guest/ Resources speakers, films and movie clips, debate and drama. This is to raise more interested and make learners creative and apply the biology education acquired from school for better livelihood.

To the National Curriculum Development Centre, environmental values must be emphasized as an objective in every biology topic, during educational pre-service and In-service trainings. This then will be spread down to classroom Scheme of Work, Lesson plan and assessment. These should be clearly spelled out.

The NCDC should coordinate and pattern with Intervention programmes like SESEMAT. In curriculum development, from every topic taught identified environmental and economic values be practically done. These could be followed up as a project work to enhance the use of wetland and natural resources in general.

Life skills teaching and learning needs to be integrated especially on issues concerning environment, health, and population as they are highly interrelated. For skills enhancement and application, every topic taught at school the environment importance needs to be identified and highlighted as currently practiced with the topic's economic importance. These should be carried on to co-curricular and club activities to enhance values such as 'animal rights' and 'humane ways'.

To the Environment Officers, Teachers and Local Councilors media programmes can be more integrated with environmental issues, always relating and showing the inter-relations in the natural resources and school subjects. Pece wetland in Gulu District be gazetted or protected as an ecological/ environment educational centre on wetlands. Every district /division/ sub region should have such environment educational centres.

Integrate traditional/ family/ indigenous knowledge of the locality into biology education to promote wise –use of respective natural resources right from the young age and at a formative stage experienced while at school.

5.4 Further Research

Above all the recommendations presented, it calls for the will to implement accordingly. These recommendations would go a long way to improve and help realize the objectives of biology education. However some areas still call for further research to strengthen the application and influence of knowledge from biology education while at school. These include:

- Wise-use patterns of natural resources in other ecosystems.
- Sustainability and conservation of wetlands through more formal and non-formal education programmes.
- Human population as a biological resource in wetlands conservation.
- Fish farming projects and activities in the wetlands.

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Appendices

Appendix A: Chi Squares

Application of knowledge of biology education taught at school has significant influence on the use of wetland resources by school leavers around Pece wetland.

	Chi-square	<i>df</i>
Grass / papyrus/ reeds	3.38	9
Water	0.277	8
Soil/ sand/ clay	0.654	8
Animals	0.180	8
Food items	0.430	8

The chi-square values are greater than the critical value ($P < 0.05$). This indicates that there is no significance influence between the education background and the use of wetland resources. Thus, application of knowledge of biology education taught at school has no significant influence on the use of wetland resources by school leavers around Pece wetland

Chi-square between educational background and the level to which materials are manipulated to new forms

	Chi-square value
Primary level only completed	0.68
Secondary level completed	0.25
Secondary level not completed	0.045
Tertiary education	0.003

Comparing Influence of Employment sector to Conservation levels using Chi-square Tests

	<i>Chi-square value</i>	<i>d.f</i>	<i>Asym. Sig.(2-sided)</i>
Regulation of resource harvest	3.786	8	.876
Control of pollution	4.244	8	.834
Regulation of resource production	6.762	8	.562
Control of mining	7.164	8	.519
Conduct Meetings & demo.	9.590	8	.295

**Appendix B: Self-Administered Questionnaire on Influence of Biology Education on Use of
Wetland Resources by School Leavers in Pece Wetland,
Gulu District**

Research Measurement and Evaluation Unit
East Africa Institute of Higher Education Studies,
and Development, School of Education
Makerere University Kampala,

June 2011

Dear Respondent,

This is a survey on the influence of biology education and how it relates to use of natural or living resources in a wet land. Since you have completed some level of school and are resident around Pece wetland, you have been selected to participate in this research. School leavers like you are expected to be update with biology education knowledge, skills, concerns and practices. It would be helpful if you kindly assist by answering the questionnaire, in your opinion and as per the instructions at each section. Do not include your name, and your responses will be kept confidential. Kindly fill the questionnaire within two weeks and return it to the person who handed it to you. Thank you.

Yours faithfully,

Sarah K. Odong Ojokit

Lead Researcher

Influence of Biology Education on Use of Pece Wetland Resources

Section A: Personal Information

Please assist me and tick or write in the space the most appropriate response.

A: 1 Background information

1. How old are you (nearest whole year).....
2. When did you leave school (year).....
3. Gender: Female Male
4. Marital Status: Married Unmarried..... Single Widowed.....
5. Married at what age (nearest whole year)
6. What is the population of your household / family

A: 2 Educational background

- | | |
|----------------------------------|------------------------------|
| 1. Primary only level completed | 2. Secondary level completed |
| 3. Secondary level not completed | 4. Tertiary education |

A: 3 Previous school (secondary) status

- | | |
|---------------|--------------------|
| 1. Day school | 2. Boarding school |
|---------------|--------------------|

A: 4 School environment setting

- | | |
|----------|---------------|
| 1. Urban | 2. Peri-urban |
| 3. Rural | |

A: 5 Occupation / career

Formal employment sector (salaried)	Informal employment sector (self-employed)	Unemployed (school leaver)
Teacher Medical Accountant Social worker Local administration Engineer Security personal (police, army, prisons, guards)	Trader Driver Cyclist / boda Farmer Car washer Constructor Local council leader Retired	

Section B: Dependent Variable – Use of wetland resources

B1: Identification

Write in the space provided and tick accordingly

This is scored as; 1- very few 2- few 3- average 4- much 5- very much

	The materials(resources) that are available in Pece wetland And to what level they are used	1	2	3	4	5
i.						
ii.						
iii.						
iv.						
v.						

B2: Evaluation of uses

This is scored as; 1- very little 2- little 3- average 4- much 5- very much.

	How much of that material is used at the household/ family per month / year	1	2	3	4	5
i.	Grass / reeds / papyrus					
ii.	Water					
iii.	Soil / sand / clay					
iv.	Animals					
v.	Food items					

Section C: Independent Variable – Biology Education

*Objective 1**C1: Knowledge recall and reference on materials used*

This is scored as; 1- very rare 2- rare 3- average 4- often 5- very often

	Indicate the level of usage of materials in teaching / learning biology.	1	2	3	4	5
i.	Grass / reeds / papyrus					
ii.	Water					
iii.	Soil / sand / clay					
iv.	Animals					

C2: Knowledge of Biology education recalled and referred on services and functions

Scored as 1-very low 2- low 3- average 4- high 5- very high

	The level of knowledge of functions and services of Pece wetland.	1	2	3	4	5
i.	Water storage by plants					
ii.	Water filtration / purification					
iii.	Flood regulation					
iv.	Provision of raw materials					
v.	Habitat for animals					

Objective 2

C4: Skills acquired and practiced

This is scored as 1- very low 2- low 3- average 4- high 5- very high

C2	Indicate the level to which materials are manipulated to new forms, that is value addition	1	2	3	4	5
I	Grass / reeds / papyrus					
Ii	Water					
Iii	Soil / sand / clay					
Iv	Animals					
V	Food items					

This is scored as; 1- very low 2- low 3-medium 4- high 5- very high

	To what extent does biology education influence on appreciation of wetland resources in Pece wetland	1	2	3	4	5
I	Grass / reeds / papyrus					
ii	Water					
iii	Soil / sand / clay					
iv	Animals					
V	Food items					

Objective 3

C5: Values gained

C3: Various uses and level of Conservation skills taught

This is scored as: 1- Primary school 2- Secondary 3- Workshop / Seminar

4- Family/ Community activity 5 – Mass media.

	Where did you learn about these:	1	2	3	4	5
vi.	Drainage of water in wetland					
vii.	Encroachment by settlements					
viii.	Over-exploitation of resources; as soil mining					
ix.	Activities that pollute; as sewage, refuse dumping					
x.	Land use activities e.g. crop farming, horticulture and grazing					

C6: Individual Conservation Activities

This is scored as; 1- very rare 2- rare 3- average 4- often 5- very often

	The level to which individuals protect and conserve wetland resources by wise use in your sub ward (parish)	1	2	3	4	5
I	Regulation of harvesting goods					
Ii	Control of pollution, e.g. dumping					
Iii	Regulation of processing products, as bricks					
Iv	Control of mining products, as sand					
V	Conducting meetings and demonstrating methods					

C7: Community Conservation Activities

	Are you aware of the level to which community protect and conserve wetland resources ; Yes No	1	2	3	4	5
I	Regulation of harvesting goods					
Ii	Control of pollution, e.g. dumping					
Iii	Regulation of processing products, as brick making					
Iv	Control of mining products, as sand					
V	Conducting meetings and demonstrating methods					

C8: How has the knowledge of biology education, skills and values helped you?

.....

Section D: Intervening variables

D1 What aspect(s)/ topics of biology influence on the: i) Perception of wetland resources?

.....
.....

ii) Appreciation of wetland resources?

.....
.....

D2 What did you learn in biology that is relevant to wise use of the wetland resources in Pece wetland?

.....
.....
.....

D3 At what level of education should the wetland resources and their wise use be taught?

.....
.....

D4 What did you miss that you think is important in biology education?

.....
.....

D5 What other institutions participate in the education programmes of the wetland resources?

.....
.....
.....

D6 What is the added value or skills for the natural resources you are using from the wetland

.....
.....
.....

D7 What dangers, limitations or challenges are experienced while extracting and using the wetland resource named

.....
.....

D 8 What are the alternatives if these wetland resources get depleted?

.....
.....

D 10 What other work do you do?

.....
.....

D10. i) Does the Pece wetland dry up?

.....
.....

ii) Which time of the year?

.....
.....

iii) Is it related to climate change, populations increase or other factors? (Specify)

.....

Thank you for your time and cooperation

Appendix C: Interview guide on research problem / questions:

Use of natural resources in Pece wetland 29th June 2011

Environment officers, Local leaders, unschooled community

1. Do people go to the wetland because they learn about it?
(while at school, in community educational programmes, traditional setting or in local administrative structure).
2. What limitations/ restrictions are imposed on community on wetland use?
3. What factors influence the wetland resource extraction at Pece wetland?
Knowledge of Biology education, skills acquired; science knowledge, cultural knowledge, market values.
4. How valuable is it to continue going for extraction of these wetland resources?
5. What problems are faced with use of wetland resources in Pece wetland?
6. What problems are faced with destruction of wetland resources?
7. How can the wetland resources be improved in case of destruction?
8. What alternatives resources are there?

Curriculum developers (on Research hypotheses)

1. How is the concept of wise-use of wetland resources highlighted in the curriculum context?
2. Do the methodology stress on skills acquirement and practices for the extraction and use of wetland resources?
3. How is the impacting of biology education values and attitudes designed?
4. What indicators can the
 - a- Teacher and
 - b- Curriculum developer, use as an expression of biology education values on use of wetland resources.

