

# Community Awareness of the Sources and Impact of Pollutants with Emphasis on Endocrine Disruptors in Lake Victoria: The Case of Jinja in Uganda

C. P. Msuya,<sup>1</sup> D. Byarugaba,<sup>2</sup> R. Mdegela,<sup>3</sup> P. Kamundia,<sup>4</sup> & P.G Mbuthia<sup>5</sup>

<sup>1</sup> Faculty of Agriculture, Sokoine University of Agriculture, Tanzania

<sup>2</sup> College of Veterinary Medicine, Animal Resources and Bio-security, Makerere University, Uganda

<sup>3</sup> Faculty of Veterinary Medicine, Sokoine University of Agriculture, Tanzania

<sup>4</sup> Faculty of Veterinary Medicine University of Nairobi, Kenya

<sup>5</sup> Faculty of Veterinary Medicine, University of Nairobi, Kenya

---

## Abstract

*Despite its potential, Lake Victoria faces many challenges, including pollution. This study was conducted within Jinja District in, Uganda to establish the sources of pollutant; in particular, those likely to contain endocrine disruptors and their impact on fish productivity. Qualitative data were collected using focus group discussions, case stories, key informants interviews and observations. The collected data were analysed using the inductive thematic analysis method. The findings reveal that pollutants that find access into the lake have the potential to disrupt the endocrine systems of organisms in the study area. However, awareness of the pollutants among community members was low. Human, animal, industrial, agricultural, hospital and domestic waste were the main sources of pollutants likely to contain endocrine disruptors. These pollutants were handled poorly and most of them were disposed into the lake without treatment. This calls for efforts to conduct education and extension programmes for awareness creation and for extending information to the community regarding sources and impacts of these pollutants. Such initiatives will enhance the awareness of local people such that they will be more alert when handling such pollutants in order to improve fish health which will in turn enhance the productivity of fish in Lake Victoria.*

**Key words:** *Community Awareness, pollutants, endocrine disruptors, Lake Victoria*

## Introduction

Lake Victoria is the largest in Africa and it is shared by three countries namely Tanzania, Kenya and Uganda. The lake is the main source of fresh water fish consumed within the East African region and is also exported to other countries outside the region. The River Nile originating from this lake is vital to the life of people living in various counties including Egypt, Sudan, Ethiopia, and Eritrea (Odada *et al.*, 2004). While this lake contributes significantly to the economic development of these countries, there are several challenges facing its sustainable use leading to sub-optimal productivity of fish caused by climate changes, diseases (both infectious and non-infectious) and overfishing. Mwamburi (2003) contends that other major challenges facing the Lake include pollutants from industries, urban waste discharges, runoffs, and agrochemicals. The endocrine disruptors (EDs) are regarded as an important group of pollutants that lead to direct loss of fish through mortality and indirect effects such as reduced quality of fish and fish products. There is a wide range of known EDs, which include but are not limited to natural and synthetic hormones as well as industrial chemicals and pesticides (Crews *et al.*, 2000).

Endocrine disruptors (EDs) are exogenous substances such as chemicals or mixtures of various substances, which have the potential to alter function(s) of the endocrine system or hormonal activities of human and wildlife (Damstra *et al.*, 2002). The endocrine system is the organisms' mechanism through which all biological processes of the body are controlled. This is achieved through biochemical messengers called hormones and cellular receptors that control the body's functions such as growth, sexual development and reproduction, intelligence and other body metabolic processes that life depends on (Nussey and Whitehead, 2001). With such life supporting essential role of regulating metabolic, behavioural and reproductive processes of animals, any disruption would consequently cause adverse health effects if a healthy organism is exposed. Such health effects may be transmitted to the affected organism's progeny, or sub-populations (Ankley, 1997; Matthiessen, 2003a; Matthiessen, 2003b).

Generally, EDs are regarded as silent killers and invaders of an affected organism because disorders arising from EDs are insidious and their effects are noted long after the damage is done (Lawrence and Hemingway, 2003). Some of the disorders in humans that are linked to EDs include; reduced fertility, early puberty, cancer (breast, ovarian, testicular and prostate) and autoimmune diseases (WHO, 2012; Diamanti-Kandarakis *et al.*, 2009). In fish, EDs have been known to cause organ dysfunction of gills, liver and

other organs, pathological abnormalities, disruption of larval and embryological development (Lawrence and Hemingway, 2003). Although EDs are generally released in the environment, little is known about the community's awareness regarding the sources of EDs and their impact in the environment in which they live and operate.

According to Endsley (1995), awareness is knowledge that is created through interaction between an agent and its environment. In simple terms, awareness entails "knowing what is going on;" it is a state of having knowledge about something. In this paper, awareness refers to the respondent's understanding or knowledge about the sources and the impacts of EDs. This study was conducted in Jinja, Uganda along the shore of lake Victoria in 2010 to assess community awareness of the sources and impact of pollutants, with emphasis on endocrine disruptors (EDs).

### **Methodology**

The study was conducted at Masese, Kishma I, Kishma II, Wanyange, Nalubaale-Wairaka fish landing sites (hereafter referred to simply as landing site) on the shores of Lake Victoria within Jinja district. Jinja district, which stretches to all these landing sites, is characterized by industrial activities especially around the municipality. The district is also famous in other economic and social activities such as fishing, agriculture, livestock keeping, recreation, retail businesses, and marketing and health services. All these activities are believed to produce enormous amounts of waste, some of which has been known to end up in Lake Victoria. This presented an ideal site from which to draw participants in order to gauge their awareness regarding sources and the impact of pollution in the Lake.

Using a cross sectional research design as justified by Babbie (1990), qualitative data were collected using focus group discussions (FGD), which were used in combination with data from interviews with key informants from within the communities, case stories and observations. Fifteen FGDs were conducted; each comprising of 7 to 8 members, which is within the range of an ideal group size (Ndiwaita, 2001). Discussions were held with fisher folk, community members and children aged 12 to 17 years. Children were selected for participation in discussions because of the role they play in cleaning fish for cooking and therefore likely to have some knowledge about abnormalities in fish. They are also involved in waste disposal from households. Furthermore, interviews with seven key informant, four case stories and observations were conducted.

Once collected, data were analysed qualitatively by employing thematic analysis. This is a method used to identify prominent themes related to the research objectives (Braun and Clarke, 2006; Gray, 2014). Several stages were followed during the process of analysis. These included review of the collected data to check for their accuracy. This was followed by coding, identifying the themes related to the study objectives and collating all codes relevant to each theme. Then there was a thorough review of identified themes to check their validity in relation to the entire dataset. Finally a thorough review was done to ensure that each theme fitted well to maintain good flow of information throughout the discussion.

## **Results and Discussion**

This section presents the research findings, highlighting the sources of pollutants with emphasis on EDs and their impacts as perceived by the community members. Findings are discussed under two broad categories namely; community awareness of the sources with potential to disrupt the endocrine system and community awareness of the impacts of the pollutants on aquatic and human life.

### **Community awareness of the sources of pollutants**

#### *Human, animal and medical Waste*

Generally, the community members had knowledge about the sources of pollutants in Lake Victoria but had low knowledge about pollutants with potential to disrupt endocrine system and their impact. The major sources of pollutants were reported at the landing sites and around residential areas included; human waste, agricultural chemicals, animal waste, industrial waste, and medical waste as well as polythene bags as explained below. Similar sources of wastes in the Lake Victoria were also reported by Rolph (2004).

Human wastes including faecal matter disposal was highly reported as a big problem in the fishing communities at all focus group discussions and consultations with key informants. In one of the FGDs at Wanyange landing site, it was reported that faeces took the first position as the most common waste in their community. Explaining how serious the problem was, FGD participants at Nalubaale – Wairaka landing site commented that *“This is a landing site where people defecate anywhere they want”*. A related response was given during discussions with other groups, community members and key informants who confirmed that fishermen use the lake for faecal disposal since they spend many hours on the waters, from 4 p.m. to the next day. Moreover, there are local beliefs which do not see such behaviour as posing any problem. The response from one of the

key informants confirms this: *“We still have people who have beliefs and attitudes of disposing faecal matter in the lake to enhance their chance of catching fish”*. They further added that *“We built toilets but people do not utilize them. You find them using any place for faecal disposal.”* During the survey people were also seen carrying out various activities along the lake like washing their clothes and bodies (Plate 1).



**Plate 1: Community members washing clothes and other activities on a fish landing site**

Controlling pollutants from human wastes require special attention because contraceptive pills and injections for birth control (containing hormones) were reported to be used for birth control among residents in the study area. When these hormones are excreted from the human body through urine or faeces, and if they are poorly disposed, they may find their way into the lake water where they will serve as a source of endocrine disruptors (Rolph, 2004).

Animal waste was also common along the lake shore. The most common animal waste was cow dung and goat droppings since cows and goats were the animals reared around the landing sites. Chicken droppings were reported to be less common. As in the case of human beings, animals consume chemicals in the form of medicines and hormones for various reasons. When these are excreted in the form of urine or faeces and if they are poorly disposed they get into the lake when it rains and serve as sources of endocrine disruptors (Rolph, 2004).

Medical wastes came from clinics, hospitals, health centres, pharmacies and drug stores. These included used syringes, bottles, cotton wool, contraceptives, soiled sanitary pads and different drugs whose names could not be established. Among these, the most likely source of endocrine disruptors included contraceptive pills and soiled sanitary pads. Contraceptive pills were among the waste being discharged into the Lake, which was noted as a matter of serious concern. If they are not properly disposed off, such wastes have the potential to cause endocrine disruption in fish (Mdegella *et al.*, 2013). However, community members in the study area were unaware that such pollutants have the potential of disrupting the endocrine system of fish and consequently that of human being if contaminated fish and water are consumed over long periods of time.

#### *Industrial waste*

Industrial waste was mentioned in all the three landing sites located in the vicinity of the industrial area (Masese, Wanyange and Nalubaale-Wairaka). The industries surrounding the lake were engaged in soap manufacturing, leather and tannery, packaging fish and processing cooking oil. They produce waste as paper, oils, other liquids and untreated fish residues. The landing sites located at islands (Kishma I and Kishma II) did not report any industrial waste since no industries were located there. According to Crews *et al.*, (2000) industrial waste is an important source of EDs and therefore precautions should be taken when disposing such wastes.

#### *Domestic wastes*

Domestic waste include food leftovers, charcoal remains, broken bottles (plastic and non plastic), leaves from trees, sacks, tins, nails, paper boxes and old clothes. These were identified as the most common type of waste at Masese, which was the busiest landing site among those selected for this study. A child respondent at Wanyange landing site also indicated sources of pollutants in their area to include potatoes peelings, maize remains, sugarcane remains, faeces and polythene bags". Other landing sites similarly produced large quantities of domestic waste. A garbage skip with some of the aforementioned wastes was observed at Masese landing site (Plate 2). Such overflowing waste and others, that are dropped carelessly anywhere around the landing site and its vicinity, and not collected for proper disposal, are left to litter the landing site grounds. Some of the waste is burnt while the rest finds its way into the lake when it rains.



**Plate 2: Overflowing Garbage skip at Masese landing site**

During FGD, one of the respondents at Nalubaale-Wairaka landing site contended that *“people dump rubbish anywhere which is composed of so many things that serve as sources of pollution in our environment and the lake in particular. These include polythene, tins, nails and bottles”*. He further added that *“We also have water hyacinth, which brings a lot of rubbish into our community when it rots, especially that which is at the shores.”* These results are similar to those by Scheren *et al.*, (2000) and Rolph (2004) who established domestic pollutants as the major source of pollution in Lake Victoria.

#### *Agricultural chemicals*

Agricultural activities especially growing crops such as tomatoes and cabbages takes place along the shore. These agricultural activities use pesticides like Diamether, Diamethod, Ambush, and Thonex. Rapid expansion of growing these crops was reported at all landing sites in the study area. According to Crews *et al.*, (2000) and Mdegella *et al.*, (2013) most of the chemicals used in agriculture including the aforementioned pesticides have the potential to disrupt the endocrine system when they flow in the lake and get in contact with fish and human beings. Based on these findings, it is evident that the shores of Lake Victoria in the study area, which is probably also true at many other landing sites along the lake, especially those within large metropolitan areas such as Mwanza and Bukoba in Tanzania, and Kisumu in Kenya, most likely face similar problems. Knowing the sources of ED pollutants is an important step towards addressing the problem, but the awareness of the local community members regarding the sources of such pollutants and their likely impact on

aquatic and human health is equally important. This aspect of the study is discussed next.

### **Community awareness of the impacts of pollutants**

Generally, the community members had some knowledge about the impact of pollutants in Lake Victoria but, they were less informed regarding the impact of pollutants having the potential to disrupt endocrine system of fish and human. The impact of pollutants they mentioned included; changes in the colour of the lake water, decrease in fish catch, increasing frequency of observed fish abnormalities and health impact on humans as explained below.

#### *Changes in lake water*

All FGDs and key informants clearly reported about the changes they have observed in the colour of the lake water. It was informed that during the past three years the water especially along the lake shore has lost its clear aqua colour, turning green and oily instead; and the water smells bad. Children from Wanyange landing site also noticed different colours of the water. They observed yellowish, brownish and dark colours which they said keep changing to green when the wind blows. They attributed this change to faeces and waste from industries that goes into the lake. A key informant from Jinja district similarly noted that the colour of the lake water has become darker and tends to be brown. Participants of FGD also noticed that the vegetation around the lake especially near factories has turned dry. The outcome of such polluting impacts is best summarized by one FGD members who said “*whenever you get fish from this water, it is already dead.*” These impacts of pollutants in water are in line with findings reported in <http://eschooltoday.com/pollution/water-pollution/effects-of-water-pollution.html>.

#### *Decrease in fish catch*

Changes in the volume fish caught were observed by all key informants and FDGs, particularly the fishermen. It was reported that nowadays, the catch per boat is 0-5 kgs per fishing trip compared to 5 years ago when fishermen could fetch 20 – 50 kgs per fishing trip. It was added that the Nile perch has become the scarcest. The reduction in fish catch was mainly associated with poor fishing methods and death of fish from polluted water as pointed out earlier. As far as poor fishing methods are concerned, it was reiterated that some of the boats used for fishing are small, enabling them to enter into fish breeding ground, hence killing young fish including their eggs. Some of the nets do not conform to approved standards such that when they



are used, undersized growing fish and eggs are also caught, thereby disruption the equilibrium of fish population within the lake.

Reduction in fish catch was further associated with the increased demand for fish due to the growing population and a high number of people (including women) who have taken up fishing as an economic activity. It was informed that in the past, women were not engaged in fishing but nowadays they do. Other reasons identified for reducing fish catch were; overfishing which has been attributed to established factories that process fish. One of the Community members at Masese landing site observed that *“We no longer eat fish as in those old days during the 1990s when we ate fish everyday to an extent that children were refusing to eat any more fish.”* He further pointed out that *“during the good old days, whenever children saw their mother preparing fish for the next meal, they would say lament ‘fish again !!, we are tired of eating fish;’ they would complain to the extent of crying because the mother brought fish at home for another meal. Now things have changed. Family members look for fish but they cannot get it because the limited fish available is expensive. These findings are in line with what was reported by Odada *et al.*, 2004 and Mwamburi (2003) who contend that Lake Victoria has been facing various challenges including sub-optimal productivity of fish caused by overfishing and pollutants from industries, urban waste discharges, runoffs, and agrochemicals. It was also reported that incidences of abnormal fish being caught have become more frequent, and this has been attributed to increasing levels of pollutants.*

#### *Fish abnormalities*

Changes or abnormalities observed in fish slightly varied from one FGD to another. Children were quick to report about these changes compared to adults due to their involvement in cleaning fish for cooking. All participants observed that some fish have wounds and that within a day's catch, out of every ten fish one or two would have wounds. The wounds are normally near the gills and around the tail. Fish with one eye and change in the colour of fish from the normal dark or reddish colour towards pale white were frequently reported. A child respondent from Wanyange landing site whose main activity is cleaning fish for clients at the landing site contended that *“I have observed fish that has changed its original dark colour to white. I have observed this about twice out of every ten times I have cut fish”*. Similar response was reported by a respondent from Nalubaale-Wairaka landing site. The abnormalities identified by these respondents are similar to those reported by Lawrence and Hemingway

(2003). Similar abnormalities involving fish with wounds were also reported by Kamundia *et al.*, 2010 in a study conducted in Kenya.

Another abnormality involved lame fish such as those with uneven jaws. During FGD with fishermen from Nalubaale – Wairaka landing site it was reported that two to four out of every ten fish may have such abnormalities. Fishermen in Wairaka also reported short fish in five out of every ten fish, and fish with big stomachs full of water in two out of every ten fish. It was further clarified that intestines of such fish are usually very small, and they normally die. One of the fishermen said *“Fish with big stomach have been there but the number has increased since 2007. We think the cause is the dirty water they drink. We do not eat them ourselves instead we sell them to other people after piercing on their stomachs to let out the water.”* Children, who often fish close to the shore, also reported catching fish without tails; at the rate of one or two out of every ten fish and four out of ten fish did not have heads. The observed abnormalities are in line with similar findings by Mbuthia *et al.*, (2012); Mdegella *et al.*, (2013) who reported fish abnormalities in Mwanza Tanzania.

Whereas the causes of abnormalities were not quite well known, majority of the people contacted thought the wounds could be due to fish fighting or due to damage by hooks during fishing. Some abnormalities were attributed to several factors including; changes in the colour of water, reduction in the volume of water, pollution due to the waste that goes into the lake, biological factors, change in the environment where fish live and grow, and change in the physiology of the fish. Change in the water colour and the waste that goes into the lake were the most perceived causes of abnormalities in fish reported by the respondents which is consistent with studies by Mbuthia *et al.*, (2012) and Hemingway (2003) who similarly purported that the identified fish abnormalities may be caused by pollutants with potential to disrupt the endocrine system.

The combined effect of climate changes (warming lake waters) and pollutants has brought another problem. Fishermen observed that nowadays fish spoilt very fast after being caught. One of the fishermen said that *“You can even touch the water and feel it is hot; fish can also be seen floating on top of the water, looking weak and sometimes dead.”* This adds to the list of problems which reduce the quality of fish, hence reducing returns to fishermen while also reducing the supply of good quality fish to consumers.

*Health impact on human*

The impact and severity of pollutants on humans was mainly associated with skin infection, itching of the body, and abdominal disorders. A respondent in Masese landing site contended that *“I am usually worried about faecal matter because it brings us a lot of disease especially when it goes into the lake. We are worried about getting cholera and diarrhoea.”* A child in Nalubaale-Wairaka expressed his fears by saying that *“My worry is that this rubbish which is thrown anywhere brings us diseases especially when it rains. The diseases we get are bilharzias and when we drink the water, we get stomach problems”*. During a visit at Wanyange landing site, the researchers came across a person who suffered from skin infection around the shoulders and along the back. He got confirmation from hospital that the skin problem arose due to using contaminated lake water.

The impacts of pollutants such as; change in water colour, abnormalities in fish, decrease in fish catch, fast spoiling of fish and skin diseases among humans have been observed and reported by respondents of this study residing or working within or in the vicinity of fish landing sites. Their responses portrayed some perceived knowledge among community members regarding the problems pollutants have brought to them. Such awareness will assist to mobilize them so that they become more vigilant to protect the lake from pollutants. This however, requires education, organization and mobilization of the community members. According to Endsley (1995), Rogers (1983) and Semgalawe (1998), awareness helps to make the community more alert, informed, and capable of participating in activities aimed at improving their environment.

## **Conclusion and Recommendation**

This study set out to investigate community awareness regarding the sources and impact of pollutants with emphasis on endocrine disruptors in Lake Victoria. The findings have demonstrated the status of pollution in Jinja district in Uganda. Some of the pollutants, which have been reported and observed, have the potential to cause endocrine disruption in fish and eventually impact on their productivity and human beings in general. These pollutants originate from among others human, medical, industrial animal and domestic wastes. The community members had some knowledge regarding these pollutants and their impacts on the fish they catch and consume as well as on their own bodies, in terms of skin diseases. However, people in the study area generally had low knowledge regarding the sources and the internal impacts of pollutants on the fish and humans. They were not aware for example that the pollutants had the potential to

disrupt endocrine systems not only of fish and other aquatic life but of humans as well. This calls for education and extension programmes aimed at raising awareness and extending information to the community regarding sources and impacts of pollutants with potential to disrupt the endocrine system. Such programmes will assist them to be more vigilant when disposing such pollutants. By doing so, fish health will improve and fish productivity in Lake Victoria will improve, contribution to increasing volume of fish caught, hence income, and reduced pollution related risks for humans around Lake Victoria.

## Reference

- Ankley, G.T; Johnson, R.D.; Toth, G; Folmar, L.C., Detenbeck, N. E. and Bradbury, S.P. (1997). *Development of a Research Strategy for Assessing the Ecological Risk of Endocrine Disruptors*. Environmental Protection Agency.
- Babbie, E. (1990). *Survey Research Methods*. Second Edition. Belton, California. Wadsworth Publishing Company.
- Braun, V. and Clarke, V. (2006). *Using thematic analysis in psychology*. Qualitative Research in Psychology.
- Crews, D.; Willingham, E.; Skipper, J.K. (2000). *Endocrine Disruptors: Present Issues, Future Direction*. Institute of Reproductive biology and the section of Integrated Biology, Division of biological Sciences, The University of Texas, Austin, Texas 78712 USA.
- Damstra, T., Barrow, S., Bergman, A., Kavlock, R. and Kraak, G. (2002). *Global assessment of the state of the science of endocrine disruptors*. International Programme on chemical safety/ World Health Organization. pp. 1-7.
- Diamanti-Kandarakis E, Bourguignon J, Giudice L, Hauser R., Prins G., Soto A., Zoeller T. and Gore A (2009). *Endocrine-Disrupting Chemicals: An Endocrine Society Scientific Statement*. Endocrine Reviews 30(4):293-342.
- Endsley, M. (1995). *Towards a Theory of Situation Awareness in Dynamic Systems, Human Factors*, 37(1), 32-64, 1995.
- Gray, D. E (2014). *Doing Research in the Real World*. SAGE Publications Ltd.
- <http://eschooltoday.com/pollution/water-pollution/effects-of-water-pollution.html>. A site visited on 7<sup>th</sup> July 2014.
- Kamundia P.W., Mbuthia P.G., Waruiru R. M., Njagi L. W., Nyaga P. N. , Mdegela, R.H., Byarugaba, D. K., Msuya, C. and Otieno R.O. (2010). *Some pathological changes in tilapia and Nile perch from Lake Victoria: Is pollution the cause?* Aquaculture cluster Workshop organized in Mwanza, Tanzania from 12<sup>th</sup> to 15<sup>th</sup> December 2010.

- Lawrence, A and Hemingway, K (2003): *Effects of pollution on fish molecular effects and population responses*. Blackwell Science; p. 150.
- Matthiessen, P. (2003a). Historical perspective on endocrine disruption. *Pure and Applied Chemistry*. Vol. 75, Nos. 11–12, pp. 2197–2206.
- Matthiessen, P. (2003b). Endocrine disruptors in Marine Fish. *Pure and Applied Chemistry*. Vol. 75, Nos. 11–12, pp. 2197–2206.
- Mbuthia, P. G.; Mdegela, R.H.; Msuya, C.P.; Byarugaba, D. K. and Kamundia, W. (2012). *Enhancement of Sustainable Productivity of Fish in Lake Victoria: an overview of pathology and microbiology*. A paper presented in a Workshop organized by ViCRES held in Kisumu Kenya.
- Mdegella, R.; Byarugaba, D. and Mbuthia, P.G. (2013). *Detection of Endocrine Disruptors in the Lake Victoria*. A paper presented in a Workshop organized by EPINAV held in Morogoro.
- Mwamburi, J. (2003). *Metal sources and distribution in rivers within the Lake Victoria (Kenya) catchment area*. Lake Victoria Fisheries: Status, biodiversity and management. Edited by M. van der Knaap and M. Munawar.
- Odada, O.; Olago, D. O.; Kulindwa, K., Ntiba, M. and Wandiga, S. (2004). Mitigation of Environmental Problems in Lake Victoria, East Africa: Causal Chain and Policy Options. *Ambio*, Vol. 33, No. 1/2.
- Ndiwaita, G.N. (2001). The role of farmer research groups in Agricultural technology generation in the coffee-banana based farming systems. Dissertation for Award of MSc Degree at Sokoine University of Agriculture, Morogoro, Tanzania, 113pp.
- Nussey, S., Whitehead, S. Endocrinology: An Integrated Approach. Oxford: BIOS Scientific Publishers; 2001. Chapter 1, Principles of endocrinology. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK20/>.
- Rogers, E.M., 1983. *Diffusion of Innovations*. Third Edition. The Free Press A Division of Macmillan Publishing Co., Inc. New York.
- Rolph, P. and David, O. (2004). The Negative Impacts of Human Activities in the Eastern African Region: An International Waters Perspective. *Ambio*, Vol. 33, No. 1/2, Transboundary Issues in Shared Waters pp. 24-33 Published.
- Scheren, P.A.G.M. Zanting, H.A. and Lemmens, A. M. C (2000). Estimation of water pollution sources in Lake Victoria, East Africa: Application and elaboration of the rapid assessment Methodology. *Journal of Environmental Management*, Vol. 58, 235–248.
- Semgalawe, Z.M. (1998). *Household adoption behaviour and agricultural sustainability in the Northern Mountains of Tanzania: The case of*

*soil conservation in the Northern Pare and West Usambara Mountains.* PhD Thesis submitted to the University of Wageningen, The Netherlands.

World Health Organization (WHO) (2012). Endocrine disruptors and child health: Possible developmental early effects of endocrine disruptors on child health. Accessed at [http://apps.who.int/iris/bitstream/10665/75342/1/9789241503761\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/75342/1/9789241503761_eng.pdf). A site visited on 7th February, 2014.