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RECOMMENDATIONS FOR INSTITUTING INTEGRATED MANAGEMENT OF ENVIRONMENT AND DEVELOPMENT OF THE AQUATIC RESOURCES OF UGANDA

by

HELEN KITABURAZA BUGAARI
UGANDA

A dissertation submitted to the World Maritime University in partial fulfillment of the requirements for the award of the degree of

MASTER OF SCIENCE

in

GENERAL MARITIME ADMINISTRATION AND ENVIRONMENT PROTECTION

1995
DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature) F. Buffen
(Date) 25/10/95

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THIS DISSERTATION IS DEDICATED TO
THE MEMORY OF MY FATHER CANON FILIOMON
KAREGYESA KITABURAZA.
ACKNOWLEDGMENTS

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ABSTRACT

This study is an investigation into the Aquatic Resources of Uganda, with a view of providing recommendations towards an integrated management Framework for the resources.

The study investigates the environmental catastrophes of some inland waters that have occurred in various places in the world, with a view of providing a strong case for this study, while eluding the view that environmental threats are not real.

The study focuses on some of the problems Uganda has to overcome to attain sustainable development for its Aquatic resources. These problems include the Socio-Economic problems encountered in the country’s development process. The conclusion focuses upon recommendations for National and International institutional frameworks for attaining integrated management of Uganda’s Aquatic resources by integrating the Environment and Development processes.
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<td>IMAE</td>
<td>Integrated Management of the Aquatic Environment</td>
</tr>
<tr>
<td>AMNCEN</td>
<td>African Ministerial Conference on Environment</td>
</tr>
<tr>
<td>BOD</td>
<td>Biological Oxygen Demand.</td>
</tr>
<tr>
<td>CDR</td>
<td>Communication and Distributed Resources Report</td>
</tr>
<tr>
<td>CIFA</td>
<td>Committee for Inland Fisheries of Africa.</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment.</td>
</tr>
<tr>
<td>FAO</td>
<td>Food and Agriculture Organization.</td>
</tr>
<tr>
<td>GDP</td>
<td>Gross Domestic Product.</td>
</tr>
<tr>
<td>GLWQA</td>
<td>Great Lakes Water Quality Agreement.</td>
</tr>
<tr>
<td>GNP</td>
<td>Gross National Product.</td>
</tr>
<tr>
<td>IFIP</td>
<td>International Federation for Information Processing.</td>
</tr>
<tr>
<td>IJC</td>
<td>International Joint Commission.</td>
</tr>
<tr>
<td>IMF</td>
<td>International Monetary Fund</td>
</tr>
<tr>
<td>NEAP</td>
<td>National Environmental Action Plan</td>
</tr>
<tr>
<td>NGO</td>
<td>Non Governmental Organization.</td>
</tr>
<tr>
<td>PCB</td>
<td>Polychlorinated biphenyl</td>
</tr>
<tr>
<td>RAP</td>
<td>Remedial Action Plan.</td>
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<tr>
<td>UNEP</td>
<td>United Nations Environment Program.</td>
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CHAPTER 1

INTRODUCTION

There are tight links between development (or the lack of it) and environmental degradation. Degraded environments are not simply unfortunate by-products of the development process. They are inherent parts of the way development processes are planned and executed. Our survival as a specie on earth has become an open question because of human produced environmental degradation. The quality of the environment is put under stress by uncontrolled population growth, consumption rates, industrial activities and by careless waste disposal.

Environmental awareness is a relatively new concept that has revealed our ignorance of the complex interdependencies that occur in nature and only slowly have these come to be identified and appreciated. In some cases however these revelations have come too late at a time when too many faulty decisions have been made. It is now obvious that human decisions are at the core of most actions affecting the environment and the need for better management of human actions in relation to the environment cannot be over emphasised.

The aim of this dissertation is to point out the importance of Integrating Uganda’s development process with the Aquatic environment in order to avoid being caught into environmental catastrophes that have occurred elsewhere in the world. Uganda has an abundance of aquatic resources that need to be protected. There is a need to understand the complex interdependencies that occur in nature so as to be able to plan our development process with caution and with clear knowledge of the implications of our actions.
The aim is not to discourage the much needed economic development process in Uganda but to create awareness about the consequences of unplanned development processes taking from the real life examples as have occurred elsewhere in the world. It is also the aim of this dissertation to advance the concept of Sustainable Development in Environment and Development for the benefit of future generations.

Chapter 1 of this dissertation will give a global view of the Challenges of Environment and Development focusing on Inland waters that have undergone ecological transformation as a result of development processes. The aim of this chapter is to point out the real life examples of the effects of unplanned development and to emphasise the need for this study. Chapter 2 discusses Uganda, giving a brief presentation of the country and the aquatic resources of the country, emphasising the importance of the resources to the country. In Chapter 3, the author discusses the level and trend of development, pointing out the socio-economic problems related to the development process, with an aim of depicting the country's level of development and the problems that entail in managing the environment under such conditions. The chapter discusses the policy response to the issues related to the environment and sustainable development in Uganda.

In chapter 4, the author uses two case studies from countries with totally different levels of development; one from North America on the Great lakes, and another form East Africa on Lake Victoria, to bring out the causes, trend and degree of environmental degradation on these lakes in the development processes of the two cases. The purpose is to bring out the reality of environmental degradation as a result of unplanned development despite the level of development of that country and to compare the level of Uganda's situation with similar situations elsewhere. The author also intends to bring out the difficulties encountered in reversing the situation in a polluted aquatic environment by looking at what the Great Lakes had to go through to remedy their situation, and the implication of this for Uganda.

Chapter 5, the last chapter will propose a number of recommendations on how Uganda can succeed in achieving integrated management of the environment and development processes in order to attain sustainable development for the country's resources. Administrative and organisational aspects of a management structure that can support this kind of arrangement will be proposed, taking into account the nature of the shared aquatic resources of Uganda.
INTRODUCTION.

Today, several regions in the world are suffering as a result of unrestrained development processes. The last century and a half has seen a combination of rapid population growth and the industrial revolution that has caused significant environmental changes that affect the health and well being of humans and affect the viability of thousands of species of plants and animals. There are evidences of environmental abuses as a result of careless planning and development which are posing a threat to the stability of the future. Environmental concerns are pervasive, and are of a local, national and global nature. They require a broad-based integrated environment strategy linked with sound economic and social policies.

This chapter will investigate evidences of environmental degradation that have occurred in various parts of the world, and the significance of their conditions to the rest of the world.

1.1.1. THE ARAL SEA.

The Aral sea in the central Asian republics of Uzbekistan and Kazakhstan, is one of the examples of abuses due to careless planning and development. Once the world’s fourth largest lake in surface area, referred to as a sea because of its size, is today classified as one of the world’s worst environmental disasters with severe ecological degradation.

In the late 1950s and early 1960s huge agricultural developments and irrigation schemes began to draw upon the infinite resources of the Amu Darya and the Sir Dayra the waters that once flowed directly into the Aral sea. These waters were instead diverted to irrigate the central Asian landscape in an attempt to satisfy the Soviet’s obsession to be self sufficient in cotton. In 1973, the cost of that self sufficiency began to show. The Aral sea began to recede from the shores. The lake became more saline, and the entire region’s climate started to fluctuate (see figure 1).
It could no longer sustain its fresh water life forms. Agricultural development projects brought with them toxic pesticides which were used carelessly and soon began to pollute the already diminishing water resources. By 1992, the Aral sea region had been classified as one area of the most severe ecological degradation on this planet.

Today the entire lake region lies withered and dying, the Lake lies depleted among dunes of sand and salt beds that once comprised its body. The plight of the Aral sea is yet evidenced by its effect to the community where people are dying of throat cancer amid dust from the drying sea and birthing children plagued with a host of illnesses related to the sacrifices of the Aral sea to the growing of cotton. Most of this tragedy can be directly traced to the shortcomings of the Socialist system in pursuing their agricultural development at the expense of the environment.

The Aral region today is the responsibility of primarily Uzbekistan and Khazakhstan. The environmental problems in the region pose challenges to domestic and regional political and economic stability resulting from frustrations due to lack of clean water. The problems are being viewed as international problems because they are affecting not only political stability but the global environment with increased temperature rises in the entire region. (Bury, J.T 1990, 12)

In 1992, some measures were outlined to promote improvements in the Aral sea region. These included the construction of a municipal drinking water supply system based upon treated ground surface water, sewage removal and treatment systems were to be constructed. Use of pesticides especially defoliants were prohibited and optimised use of mineral fertilisers promoted. An effective public health and environmental awareness program was to be created. International organisations have come to the aid of this region. The United Nations has helped to promot research and studies of the region, But the scope of the problem is beyond the economic means of the region. The unfortunate part is that the Aral sea will most likely never be restored to its original state. The resulting effects such as climate change, decline in the size of the sea, damage to the surrounding plant and animal populations and health problems, are all very long term concerns. The environmental legacy of abuse and destruction heaped upon this region stands as a permanent lesson to the rest of the world.
Figure 1: The changing profile of the Aral Sea

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Level (meters)</th>
<th>Average Area (sq km)</th>
<th>Average Volume (cu km)</th>
<th>Salinity parts per million later</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>53.41</td>
<td>68,000</td>
<td>10,900</td>
<td>10</td>
</tr>
<tr>
<td>1971</td>
<td>51.05</td>
<td>60,200</td>
<td>9,250</td>
<td>11</td>
</tr>
<tr>
<td>1976</td>
<td>48.28</td>
<td>55,700</td>
<td>7,630</td>
<td>14</td>
</tr>
<tr>
<td>1989</td>
<td>39.07</td>
<td>40,394</td>
<td>3,700</td>
<td>30</td>
</tr>
<tr>
<td>2000</td>
<td>33.00</td>
<td>25,500</td>
<td>1,660</td>
<td>~70</td>
</tr>
</tbody>
</table>

Source: Bury Jeffrey T., 1970: The consequences of environmental decline in the Aral Sea region. 1993 pg. 92
1.1.2. THE CASPIAN SEA.

Not very far away from the Aral sea, we see yet another example of environmental degradation as a result of poor development practices. The Caspian Sea is located at the far part of the former U.S.S.R along the boundary of Europe and Asia. The sea occupies the largest continental depression with a surface level of about 28 meters below mean ocean level. In recent geologic times, the Caspian has undergone many geophysical and geological transformations that gradually led to its full isolation from the Black Sea and therefore from the world of Oceans.

The Economic significance of the Caspian Sea is coupled to its fisheries, the harvest of seals for skins, oil, crude oil, gas and salts. Shipping is extensive in the basin with the Volga tributaries alone accounting for 75% of the whole cargo. The Caspian was also long famous for its sturgeon caviar but this has been greatly reduced in the recent years as a result of decline in the Sea level and the connecting drying up of the most favourable places for spawning.

Today, the Caspian Sea is a polluted Lake with its main source of contamination resulting from oil field exploration and exploitation, oil and petrochemical industries, oil transportation by sea and shipping activities. In 1991, there were 21 events of accidental discharge of oil water from ships. Apart from this, other pollutants such as river inflow and sewage discharges from cities as well as waste water discharges from farms add to the pollution level of the Lake.

Today, oil and gas are the region’s most important resources. Seabed oil is extracted from derricks and artificial islands, most of which are concentrated off the shores of Azerbaijan, supplying half that republic’s total oil extraction volume.

Hydrological alterations of major rivers such as the Volga river have the potential for environmental damage on an international scale. Iran, bordering on the Caspian sea to which the Volga river is a tributary, has been harmed by the changes in the sea’s physical and biological character, which are particularly attributed to Soviet modification of the Volga’s natural flow regime. Soviet plans for southward diversion of flow from the European Arctic and Siberia, particularly intended to alleviate the
Caspian problem, could pose even more serious international hazards. Adverse consequences such as further imperilling the survival of the Atlantic Salmon, and perhaps even global warming and climatic changes are possible. Consequences of Volga developments and future ramifications of related diversion measures emphasise a need for caution as well as for international co-operation and consultation in planning for the development process. Integrated management of the water resources in the region becomes very important because the environment knows no boundaries and one nation or one organisation’s efforts alone will not solve the problem.

1.1.3. THE RHINE RIVER.

The Rhine river, the principal international watercourse of Western Europe, constitutes an essential source of water of a region of about 50 million inhabitants. As one of the most industrialised areas of the world, it is of immeasurable economic, political and cultural importance. The Rhine river is used for many purposes including providing drinking water, industrial supply, navigation, and production of electricity. It also serves as a dumping ground for many kinds of waste. It is therefore a heavily polluted river.

During 1973–74, the Rhine, at a point where it enters the Netherlands deposited 47 tons of mercury, 400 tons of Arsenic, 130 tons of Cadmium, 1,600 tons of Lead, 1,500 tons of Copper, 12,000 tons of Zinc, 2,600 tons of Chrome and 12 million tons of Chloride per year. (Kiss Alexander Charles, 1991, 214). Other than that, the River has suffered frequent accidental pollution which has contributed a lot to the already polluted condition of the river. In 1986, the Sandoz factory accident caused major pollution of the Rhine waters. Some 1,250 tons of pesticides, herbicides and fungicides containing mercury organophosphorous or organochloride pesticides, colouring agents and solvents caught fire. (Kiss, A,C 1991, 219). There was massive air pollution but the most significant pollution was that of the Rhine waters. The water which was used to put out the fire, in the absence of canals and or storage facilities drained into the Rhine river along with 30 tons of toxic chemicals. A week later, on November 7, 1986, a second wave of pollution occurred following an incident on a water canal which served to put out the fire. More of the same pollutants were discharged. Heavy metals which remained in the proximity of the accident site slowly infiltrated the Rhine riverbed.
The consequences of the accidents were so great with the most immediate results produced on animal life. Eels were the most affected, waterfowl died in high numbers and the presence of organophosphorous compound was seen in numerous species of fish. (Kiss A, C 1991, 219). Fishing was halted in the Rhine for several months and in some places such as Germany, in two of the towns, water had to be transported to the people by trucks from other sources. There were added costs of monitoring surface waters, sediment and fish, there was loss of income in the fishing and tourism industries for all the riparian countries.

Attempts were made to ameliorate the condition of the Rhine river through concerted efforts of all the riparian countries. Some of the measures taken included an elaboration of a program of action leading to the year 2000, aimed at improving the water quality of the Rhine. Species such as the Salmon were reintroduced. It was also decided that European Economic Council member states which required specific industrial facilities should submit a report on safety to responsible national authorities taking into account the necessity to protect the Rhine against accidental pollution (Kiss A, C 1991, 221).

Unchecked power, obsessions with heavy industry, economic growth, national security and secrecy are some of the factors that contributed to the environmental catastrophes unveiled in this section. The damage is so widespread that it will take decades to clean up. This Chapter emphasised the need for strengthening environmental awareness taking from the already life threatening examples. The importance of these examples is of great significance to the developing countries as they pursue their development ambitions. The implications these types of conditions could have on some of the countries with developing economies especially the least developed countries is beyond one’s imagination. Yet, the trend of development in these countries is very similar to what is taking place or took place in the industrialised countries. Use and transportation of chemicals is on the increase without proper monitoring and without adequate knowledge of the hazard these chemicals have. Continued diversion of water for irrigation purposes without adequate environmental assessment is very common. The use of irrigation in the agricultural practices of most countries with developing economies is being encouraged without proper knowledge of the implication to the quality of the water resources. The need to follow a sustainable development path in the development processes of most countries is very evident and very vital.
Having highlighted some global environmental catastrophes, the next chapter will focus on Uganda as a country of great beauty with an abundance of natural resources, emphasising the need for protection of the Aquatic resources of Uganda through an Integrated Management approach considering the nature of its resources some of which are shared with bordering countries.
CHAPTER 2

UGANDA ; THE AQUATIC NATURAL RESOURCES

2.1. NATIONAL BACKGROUND PRESENTATION OF UGANDA.

Location.

The republic of Uganda became an independent state within the commonwealth in October 1962. Located in the East Central Africa, Uganda straddles the Equator. It is at least 800 km inland from the Indian Ocean. The country is land locked, with a total area of 241,139 sq. km of which 44,081 sq. km is inland water. It is bordered by Kenya on the east, Tanzania and Rwanda on the South, Zaire on the west and Sudan in the north.

Natural resources

The main mountain mass is the Mufumbiro and the Rwenzori in the west and Elgon in the East. The Mufumbiro are volcanic highlands extending north-eastward. As a country of great natural beauty and ecological diversity, the country acquired its tourist name “The Pearl of Africa.” The rolling hills and snow capped mountain of Rwenzori and Mount Elgon enhance the beauty of the country.

Uganda contains several large fresh water lakes of which Lake Victoria, Edward, and Albert are shared by bordering states. Those three plus Kyoga and Wamala are some of Uganda’s largest lakes. Lake Victoria forms a large segment of Uganda’s southern periphery. These frontiers have a heavy social, economic and political influence both
on Uganda and on those countries adjacent to it. Covering an area of 69,484 sq. km, the lake is the largest in Africa and second largest in the world, after Lake Superior. Lake Victoria has the longest shoreline in the world. The Nile River and Lake Victoria constitute one of the world’s largest freshwater basins.

Other than having an abundance of lakes, Uganda has several rivers, with twenty-two major rivers, of which eight have an estimated length in excess of 100 km. (Uganda government 1994, 75). To the South, L. Albert is fed by L. Edward through the Semliki river. The Nile pours its waters into the western rift valley at Murchison falls and opens up into L. Albert. The combination of Victoria Nile and the Albert Nile form the longest river in the country.

Ugandan waters are shared by nine riparian states. Three of these states; Zaire, Sudan and Egypt are connected by the Nile. The stretch of the Nile from its source in Jinja is called the Victoria Nile. The Kyoga Nile connects Lake Kyoga and Lake Albert. The River leaves Kyoga to the Murchison falls and enters Lake Mobutu Sese-seko. It exits from the Lake to the Albert Nile. At the Albert Nile in Zaire, River Semuliki enters Lake Albert at its southern toe. Between this point and Malakal in Sudan, the river is known as Bar El Jebel, part of the White Nile. Beyond Marakal, the White Nile flows northwards up to Khartoum where it is joined by Atbara from the Eritrean highlands. It then makes a gentle loop southwards then northwards into Egypt where it is gently ushered into the delta on the Mediterranean, ending its 4,180 miles from Jinja, Uganda (Okidi C.O, 1980, 398).

The water resources of Uganda include direct precipitation, groundwater, runoff, evaporation, and the surface waters on major lakes and rivers. The largest lakes, rivers and wetlands cover about 18% of the total surface area. Rainfall averaging about 600 to 1,600 mm, (Uganda government 1994, 76) contributes a generous amount to the country’s water resource. About 60% of the country receives more than 750 mm of rainfall. (Zeirihun Tadesse 1993, 3) Rainfall is heaviest around the lake and mountain areas. Uganda has both wet and dry seasons each year, with an
equatorial climate modified by the altitude. There is very little seasonal variation in temperatures.

Demography

Uganda has an estimated population of 17 million people, with a population growth of about 3.1%, and a current fertility rate estimated at 7.1 births per woman. The infant mortality rate is about 18 per 1000 births. Life expectancy is about 46 years though some recent reports indicate that it has gone to 43 as a result of civil wars and diseases. Urban population is about 11%, with about 4% of the total population living in the city of Kampala.

Economy

Uganda’s economy mainly depends on Agriculture which accounts for 51% of the country’s economy. Industry contributes 12% and services 37%. Uganda remains one of the least developed countries in the world. It is a living testimony of the havoc caused by political turmoil and economic decline. Between 1970-1980, Uganda’s G.D.P declined by about 25%, exports by 60% and import volumes by close to 50%. Economic mismanagement continued in the early 1980s until 1986 when there were attempts to rebuild the economy. More details about the economic situation of Uganda will be provided in chapter 3.

Government

Uganda is at present operating under a no-party system with a broad based government which represents former political parties as well as the National Resistance Council of which the president of the country, Yoweri Museveni is the Chairman. Uganda has several ministries headed by cabinet ministers. The ministry of environment which is of special interest in this study, was created in 1986. It was charged with co-ordinating and enhancing the management of natural resources, the interests of users, monitoring of pollution levels and advising governments on policy and legislative reforms. In 1992, this ministry was absorbed in a larger ministry of Natural resources as a Department of Environment. The present situation limits
emphasis on the environmental issues in Uganda and may limit the efficiency of the environment sector. The responsibility for liaison and negotiation on international treaties and agreements such as those concerned with the shared aquatic resources is the responsibility of the ministry of foreign affairs while implementation is carried out by the relevant institutions, and not necessarily under the control of the Department of Environment.

2.2. THE AQUATIC RESOURCE BASE

2.2.1. WATER RESOURCES.

Fresh water is an essential part of the sustenance of all forms of life. It is vital for drinking, sanitation, agriculture, industry, urban development, hydro power generation, inland fisheries, transportation, recreation and many other activities. Uganda’s population derives a sense of security and pride from this abundant resource otherwise scarce in some other parts of the world. Unlike many parts of the world where there is a wide spread scarcity of fresh water resources, Uganda is well endowed with lakes and rivers. (See figure 1)

The importance of Uganda’s water resources cannot be over emphasised. Aside from the importance to human use, the lakes have intrinsic ecological and environmental values. They moderate temperatures and affect the climate of the surrounding land. They store water, thereby helping to regulate stream flows, recharge ground water aquifers and moderate droughts. They provide habitat to aquatic plants and animals which in turn provide food for many terrestrial animals, and they add to the diversity of the landscape. The rivers and streams have many of the same economic, recreational and environmental values and uses as lakes. Unfortunately, the rivers also serve as convenient and inexpensive means of waste disposal. As the rivers become more contaminated however, their ability of self cleansing becomes less. The rivers also provide a source of transportation routes and power generation.
Figure 2: Uganda's Major Rivers and Lakes.

Source: Uganda Atlas, 1967
The management of this resource becomes very complex by the fact that the use of upstream waters affects the quality and quantity of the water resources in Uganda and at the same time those downstream are affected by how Uganda uses the Nile waters. Sudan and Egypt in particular strongly depend on the Nile for consumption and for generation of electric power.

Ugandan water resources by virtue of their shared nature are of international interest. The fact that so many countries are tied into this water system originating from Uganda puts the country in a very delicate situation. The country’s responsibility to the management of the Aquatic resource to avoid a major catastrophe on these waters becomes vital. Millions of persons would be at risk in the event of a major pollution. The need to manage this resource very effectively cannot be over emphasised. Downstream countries are therefore charged with a responsibility to formulate strongly binding agreements and to update and review the existing ones most of which were formulated in the colonial days.

The development trends of the riparian countries will have to be integrated in the management processes of the resource. The riparian countries need to carry out environmental impact assessments of developmental projects and environmental auditing so as to keep track of the changes taking place in the limnology of these waters. Sustainable utilisation of the Nile waters should be the ultimate goal of all the countries concerned. This cannot be achieved only by individual countries’ efforts but through a regional framework and through adaptation of global standards for managing the resource.

Tables 1 and 2 show the major lakes and rivers in Uganda and their characteristics.
### Table 1: Major lakes of Uganda

<table>
<thead>
<tr>
<th>LAKES</th>
<th>TOTAL AREA</th>
<th>AREA IN M</th>
<th>HEIGHT ABOVE SEA LEVEL</th>
<th>DEPTH(M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victoria</td>
<td>68457</td>
<td>28655</td>
<td>1134</td>
<td>82</td>
</tr>
<tr>
<td>Albert</td>
<td>5335</td>
<td>2913</td>
<td>621</td>
<td>51</td>
</tr>
<tr>
<td>Edward</td>
<td>2203</td>
<td>645</td>
<td>913</td>
<td>117</td>
</tr>
<tr>
<td>Kyoga and Kwania</td>
<td>2047</td>
<td>2047</td>
<td>1033</td>
<td>7</td>
</tr>
<tr>
<td>Salisbury(Bisina)</td>
<td>308</td>
<td>308</td>
<td>1047</td>
<td>-</td>
</tr>
<tr>
<td>George</td>
<td>246</td>
<td>246</td>
<td>914</td>
<td>3</td>
</tr>
</tbody>
</table>


### Table 2: Major rivers of Uganda

<table>
<thead>
<tr>
<th>NAME OF RIVER</th>
<th>DISTANCE(KM)</th>
<th>MEAN FLOW(M3/SEC)</th>
<th>PERIOD OF RECORD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Victoria Nile</td>
<td>426</td>
<td>808</td>
<td>1900-1972</td>
</tr>
<tr>
<td>Aswa</td>
<td>357</td>
<td>37.5</td>
<td>1949-2968</td>
</tr>
<tr>
<td>Dopeth Okok</td>
<td>314</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pager</td>
<td>232</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Albert Nile</td>
<td>257</td>
<td>900</td>
<td>1905-1977</td>
</tr>
<tr>
<td>Mayanja Kato</td>
<td>182</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Katonga</td>
<td>175</td>
<td>0.62</td>
<td>1965-1980</td>
</tr>
<tr>
<td>Mpologoma</td>
<td>173</td>
<td>19.50</td>
<td>1949-1979</td>
</tr>
</tbody>
</table>

Water Utilisation.

The water uses in Uganda include hydro power, flood water storage, recreation, fishing, transport, ecological functions, irrigation, municipal and industrial use. There is a hydro electric power potential on river Nile, estimated at 2,700 mw, of which only 150mw is being used by Uganda. (Uganda government 1994, 82). Swamps and Wetlands provide a natural storage capacity for flood waters, and irrigation potential is very high with many irrigable areas near the lakes, the Nile and swamps.

Efforts to bring water supply to reach the rural areas has been stepped up and about 40% of the population is now reached. It is hoped that by the year 2000, 80% of the population will have safe water. Demand for water is bound to increase as a result of developmental projects and migration of the rural population to the urban areas, requiring governments to plan for these eventualities.

Water Quality.

“In developing countries, less than 10 per cent of urban waste is treated, and only a small proportion of that treatment meets the acceptable standards” (Keating, M 1993, 21). One person in three lacks drinking water and sanitation. It is estimated that 80 per cent of all diseases and over one third of deaths are caused by drinking contaminated water. (Keating, M 1993, 32)

In Uganda, water pollution is predominantly caused by domestic sewage, industrial waste, toxic and hazardous waste, suspended solids from agricultural activities and soil erosion. Fast population growth, uncontrolled migration to lake shores in urban centres and growth of industries along lake shores puts an additional stress to the water quality. The other source of pollution though often ignored, includes run-offs such as oil from driveways, streets and open garages, pesticides and fertilisers from urban lawns and careless waste disposal on streets which goes into storm sewers and then into the streams. The higher than normal concentration of nutrients in lake Victoria has also become a source of pollution to the lake with increased levels of oxygen depletion.
The threat of pollution from industrial activities is becoming a reality as the country continues to realise economic and industrial growth. Most of the new factories tend to be built on the lake shores adding to the problems arising from the ones already existing there. This is beginning to have a significant effect to the aquatic environment, and in particular to lake Victoria, as these factories continue to generate waste and dispose of it in the lake with inadequate or no treatment at all.

Some of the activities that contribute to polluting the aquatic environment of Uganda include factory activities such as the breweries, textiles, sugar factories, leather tanneries and mining activities. (These will be discussed in further detail in chapter 4.) Uganda like many parts of the world has experienced a gradual destruction and increased pollution of its fresh water resources due to untreated or inadequately treated sewage, industrial waste, loss of natural water in catchment areas, deforestation and poor agricultural practices. The inability to manage the waste puts the country at a greater risk. The growth of Industries around the lake shores is an added threat to the quality of Uganda’s water. This is exacerbated by soil erosion, household waste, and the effect of dams and irrigation schemes. The risks of pollution are also increased with higher population densities around the water areas and the degree of urbanisation which puts the resource to greater use.

The non-point sources of pollution though often ignored have an adverse effect on the water quality of Uganda. Run off such as oil from driveways, streets and open garages, pesticides and fertilisers from urban lawns and golf courses and careless waste disposal on the streets goes into the storm sewers and ends up into the lakes. Hard evidence of non-point chronic toxic contaminants in Uganda’s waters has not been the subject of wide research but with lack of adequate facilities to collect run off such as oil and pesticides, and without adequate sewer systems, steady accumulation of these contaminants over time suggest concentrations will result in progressively severe consequences. Unfortunately, the introduction of the water hyacinth in Uganda’s waters seems to attract more attention in the press and government than the more serious non point sources of pollution.
Eutrophication, the biological response caused by increased nutrients is also present on Lake Victoria. Increased population, industrialisation, intensified agricultural practices and the use of phosphorous based detergents have increased eutrophication on some of Uganda’s lakes. Oxygen depletion is evident in some of Uganda’s lakes like Victoria. Oxygen depletion is a consequence of the heavy growth of aquatic vegetation. The water hyacinth has contributed to this condition in Uganda’s Lakes.

Viral diseases can be transmitted by water, and can reach the public water supplies through the effluent of municipal sewage treatment plants and from urban and rural run off. According to the International Joint Commission Report on Pollution, (1970) although viruses require the presence of living susceptible cells to grow and multiply, current evidence indicates that they can survive outside these cells for considerable periods of time, much longer than bacteria. It is therefore worth considering that the evidence of widespread viral diseases in Uganda may be catalysed by the poor condition of Uganda’s water quality.

Many organic contaminants are persistent and of biochemically resistant compositions. They occur in pesticides, industrial and domestic wastes. Because they are persistent, many of them are toxic at very low concentrations and cause a serious threat to the health of man and to the aquatic community. In the presence of other compounds their toxicity can increase many fold. According to the environmental report on Uganda, concentrations of certain contaminants from industrial waste have already caused fish kills (Uganda government 1994, 32). Further deterioration of the water quality of the lakes can be expected as industrialisation increases.

In order to improve the management of water resources in Uganda, the government has taken some measures such as establishment of a Water Quality Pollution Control Laboratory in 1990 to try and monitor pollution levels on Ugandan Lakes. However, these measures in themselves do not constitute effective management of the quality of water in Uganda. Much more than what is already in place is needed. Knowledge of current ecological assessment of the water quality of Uganda is necessary in order to
determine status of the waters. There is a need to integrate water quality management into national, economic and social policies, including planning of land use, utilisation of forest resources, and the protection of river banks. There is a need to delegate water management to the lowest level to include public participation, youth, women and local communities.

Research into the adequacy of the available water resources for the fast growing populations in Uganda and for future generations is also necessary in order to enhance the true concept of sustainability. Protection of the aquatic ecosystem needs to be enhanced by updating the existing legislation pertaining to water pollution. Pollution prevention and control programmes have not been put in place. There is a need to carry out an environmental impact assessment of the country’s major resource development projects that might affect water quality. Treatment of waste water should be considered including recycling to maintain the water quality levels.

2.2.2. WETLANDS

Uganda has extensive wetlands covering an estimated area of about 29,580 km and occupying 12.5 % of the area of the country (Uganda government 1994, XI). Uganda’s Wetlands provide an important resource to the country though their value has not been well recognised. Some of the wetlands surround the lakes shared by bordering states. The wetland areas constitute a very important part of Uganda’s aquatic resources. A portion of the nation derives its living from the wetlands where they carry out agricultural activities and livestock grazing. The wetlands also provide a source of water for the surrounding communities. Their most important value is providing habitat for fish, birds, crocodiles and other wild life. In addition to this food support chain function, they carry out hydrological functions such as flood peak reduction, shoreline stabilisation, and ground water recharge. They in general help improve the water quality and enhance Tourism thus contributing to the economy of the Country.
The need to protect the wetlands has not been well emphasised to the populations of Uganda. Integrated management of this resource in the development policies of the country is important. Regional and international measures need to be put in place to conserve this resource.

The stresses associated with the wetlands include biological alterations from harvesting and removal of natural vegetation and animals, and from introduction of non native plants. Uganda’s wetlands also run a risk of pollution from chemical alterations such as point and non-point nutrient run off. Physical destruction resulting from agricultural practices mostly due to wetland drainage, construction of dams, dredging of rivers and streams also pose an eminent threat to Uganda’s Wetlands.

2.2.3. FISHERIES RESOURCES

Fish is an important resource to Uganda. It provides a source of food and protein supplement to the population as well as a cheap but nutritious substitute to the otherwise expensive beef diet. Fish also provide a source of income to the Government of Uganda both as a local and export commodity.

The events surrounding the wars in 1978 and 1986 had a disastrous effect on Uganda’s economy as a whole, and on the fishing sector in particular. Import restrictions and lack of foreign currency, led to the shortage of gear, while lack of transport and poor roads disrupted the fishing activities. Public fish marketing which was carried out by a government company called TUFMAC was discontinued and fish marketing co-operatives activities were greatly reduced.

The private sector fared better. This sector is still the dominant force in Uganda’s fishing industry. As a consequence of the political disruptions in the country then, there was a drastic reduction in external trade of fish products. According to FAO statistics, prices fell from 120-130 million US dollars in 1973-1975 to 4-5 million US
dollars in 1980-1983. (Due to the disintegration of the data collection system, the value of assessments made above is limited.)

The importance of fisheries resource to Uganda is seen in terms of increased fish yield, increased employment opportunities and increased nutritional opportunities which are sustainable. Among the national development objectives is also a need to increase the contribution of the of fisheries resources to the economy of the country by increasing the export of this resource. For these objectives to be realised government will have to improve the fisheries management by using efficient fishing methods, minimising post harvest losses and employing sound management strategies. About 17% of Uganda’s population derives a livelihood from fishing activities. Artisanal fishing contributes to the incomes of the rural population. It is estimated that the fisheries resource supports at least 40,000 families, with at least 73,000 people involved in small scale fishing (Uganda Government 1994, 92).

A noticeable contribution of this industry to the country’s economy is in the involvement of women. Women’s participation includes gear ownership, fish processing, mongering, actual fishing and selling of cooked fish. They are also involved in fish farming for home consumption. It should be noted that vital statistics and information on the fisheries statistics in Uganda is quite deficient as a result of political instability in the past years, but one can estimate that the catch and ultimate importance of fisheries will increase as a number of processing plants are being licensed to operate in the country.

Fisheries resource evaluation and management in Uganda.

The events surrounding the wars of 1978 and 1986 crippled the fisheries industry, and deprived the industry of quantitative information on catch data. It is therefore difficult to portray the recent trends in fisheries demand. However, based on the fact that there was an acquisition of new gear for the fishermen in 1983, and more activities thereby followed, one can say that the demand for fish increased at that time.
Today, demand for fish in Uganda is on the increase because of several reasons. The growing populations around the lakes increases the consumption of fish. The fish diet is also becoming more appreciated by bigger proportions of the population because of intermarriages and migrations to lake areas where fish is a common diet. The fact that meat is very expensive as compared to fish, increases the demand for fish. Most of the fishermen have switched from their traditional species to Tilapia and Nile perch which are now the most popular species in the Ugandan lakes.

As a result of this trend other species on the market such as the Rastrineobola have deteriorated in value. According to field staff from Uganda fisheries department, the fishermen and fish traders interviewed said that the total catch in the 1990s is three times higher than in the 1980s at most landing sites. The fishing sector has also attracted investors from other sectors of the economy. The fishing level on Lake Victoria alone is estimated to have reached about 50,000 to 60,000 tonnes per annum in 1983. It is assumed that fish catch from the Ugandan sector of Lake Victoria may have reached 80,000 tonnes per annum by now (CIFA 1989, 47). The development of Nile perch fishery in Uganda has led to significant change in gear composition, with most of the fishermen using gill nets. The present Ugandan fishing fleet size is estimated to be about 4,000 canoes.

The Government has licensed several fish processing industries which are intended to process fish for export. Already, fish is being exported to Kenya, The United Kingdom, Holland, Belgium, Zaire, Hong Kong and Sweden. It is hoped that the demand for Ugandan fish will increase as the government continues to market this resource. This will require improvement in the existing management systems to ensure the sustainability of this resource. The table below illustrates the involvement of the Country in the export trade of fish products. However there is lack of data for comparison purposes.
Table 3: Export of fish and fish products in 1989.

<table>
<thead>
<tr>
<th>Type of Fish/Product Form</th>
<th>Destination</th>
<th>Quantity (Kgs)</th>
<th>Total Quantity (Kgs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tilapia (fresh chilled)</td>
<td>Belgium</td>
<td>265</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Holland</td>
<td>5460</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>2640</td>
<td></td>
</tr>
<tr>
<td>Tilapia (smoked)</td>
<td>Zaire</td>
<td>200</td>
<td>8065</td>
</tr>
<tr>
<td>Tilapia (smoked/sun dried)</td>
<td>Kenya</td>
<td>196500</td>
<td>196500</td>
</tr>
<tr>
<td>Tilapia (salted)</td>
<td>Zaire</td>
<td>2000</td>
<td>2000</td>
</tr>
<tr>
<td>Nile Perch (fresh chilled fillet/whole)</td>
<td>Belgium</td>
<td>1130</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Holland</td>
<td>11705</td>
<td></td>
</tr>
<tr>
<td></td>
<td>UK</td>
<td>3000</td>
<td>15835</td>
</tr>
<tr>
<td>Nile Perch (frozen whole)</td>
<td>Zaire</td>
<td>2500</td>
<td>2500</td>
</tr>
<tr>
<td>Nile Perch (frozen fillet)</td>
<td>Sweden</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Nile Perch (sun dried swim bladder)</td>
<td>Hong Kong</td>
<td>13915</td>
<td>13915</td>
</tr>
</tbody>
</table>


Lack of financial resources and various other constraints have limited the systematic and effective assessment of the fisheries resources of Uganda in a systematic way. Though the magnitude of Uganda stocks is not well known, with inadequate restrictions on the exploitation of the resource, one can assume that certain species may now be exploited at or beyond their maximum sustainable yield levels. At present there is no restriction on exploitation of the Nile Perch and Tilapia. The introduction of the Nile perch by the British colonials in the mid 1950s has had both positive and negative impacts on the fisheries resources in Uganda. Some authors are of the view that the Nile Perch fishery has had positive developments for the economic benefit and food resource of the people. The country has taken full advantage of the opportunities
created by Nile Perch boom both for local consumption and for export purposes. On the other hand, negative impacts on the ecosystem of the lakes and severe depletion of the endemic fish stocks has been suggested by other authors.

The overriding management function needed to ensure sustainability of the fisheries resources of Uganda is the development of a method to prevent over exploitation. Efforts to achieve this date as far back as 1929 when four principle recommendations were established for the management of the fisheries resources. These were to;

- prohibit the use of gill-nets with a mesh size of less than 127 mm stretched;
- institute sustained research on the fisheries resources;
- set up fisheries statistics collection to monitor the fishery; and,
- establish a lake wide authority to oversee the collection of statistics and enforce fishery regulation (Uganda government 1994, 102)

Today, the fisheries department of Uganda is charged with the responsibility of controlling harvesting, licensing for each water body, monitoring the amount of fish being taken from the waters, restocking the water bodies, providing extension services to primary producers and re-introducing fish farming. It is anticipated that with stability in Uganda, and with further initiatives to strengthen statistical services that document the socio-economic importance of the fisheries, the information base required for sound management will be attained. Taxes such as trading licences and canoe licences need to be raised. Sustainable methods for the fisheries resource need to be further developed.

IMPROVEMENT STRATEGIES OF FISHERIES IN UGANDA

(i) Research Information.

The commitment of Government to evolving effective research management and extension services is not among its list of priorities. There is a need for Government to
strengthen this area. The establishment of a permanent fisheries committee by the fisheries department would help strengthen co-operation between research and management organs of fisheries. Lack of proper co-ordination and dissemination of information hinders the smooth flow of data.

(ii) Fish Gear restrictions and law enforcement.

Management measures to sustain the commercial viability of the fishery are lacking. A minimum stretch gill net mesh size at 127mm for the exploitation of Nile Tilapia and Nile Perch and 10mm for the Rastrineobola, as recommended by Ogotu-Ohwayo (et al 1989, 34) should be considered for use. Law enforcement procedures need to be strengthened. As proposed in the IFIP project report of January 1992, the creation of an independent law enforcement unit within the Uganda Fisheries Department is necessary for effective fisheries law enforcement.

(iii) Industrial exploitation of Rastrineobola.

This is a major prey of the Nile Perch and yet an important fish species for both the export and local markets. This fishery, has not been exploited to its maximum sustainable yield and yet it has a significant market in neighbouring countries. (IFIP project 1992) There is therefore an opportunity to encourage further exploitation of this specie. Commercial exploitation will require to follow a planned stock assessment.

(iv) Development of fish plants.

Recent ventures in fish processing plants for the export market have developed in the absence of any scientific and socio-economic data. It is therefore difficult to define the local market needs and the industrial needs in order to establish the appropriate levels of exploitation. Feeder roads, landing sites and fish markets need to be improved to compliment the development of fish plants. Better ovens and fish smoking facilities are required.
(v) Monitoring of the Lakes' environment in fisheries.

Particular attention should be paid to the changing environment of the lakes, in particular Lake Victoria, and the possible consequences on the future of the fish stocks considered. There is a need for an integrated management of all activities that affect fisheries and the water environment of Ugandan lakes and rivers, such as coordination and monitoring of agricultural and industrial activities on these waters. A monitoring agent should be appointed. Fisheries management should take a precautionary approach, taking into consideration the implications issues such as introduction of new species would have to the Lake's environment.

(vi) Co-operation strategy

There is a need for shared responsibilities in the effective management of the Lakes' shared resources by bordering states. A regional management body would offer the best strategy. Environmental impact assessments and Environmental Auditing should be done at a regional level and made a requirement by law for all the countries before any economic development programmes are undertaken.

2.3. THE IMPORTANCE OF THE SHARED AQUATIC RESOURCES.

The importance of Uganda's shared resources is so great that it cannot be ignored. As earlier mentioned, nine riparian states eke out a living dependent upon the water resources shared with Uganda. There is a need for serious rational planning and integrated development of these resources on a regional and international level. As a source of food, employment and drinking water for the millions of people surrounding the fresh waters, the suffering that a polluted environment would bring to the people of the region would be greater than the common sagas of wars and famine in Africa.

The challenge to manage the shared resources cannot be over emphasised. Bearing in mind that the environment knows no boundary, the challenge for Uganda and the neighbouring states to adopt international measures for sustainable development of
these resources is indeed great. One country's effort alone will not succeed in attaining this objective. The riparian countries will need to develop uniform environmental legislation that will encourage co-operation and co-ordination in the management of the shared resources.
SOCIO-ECONOMIC DEVELOPMENT; IMPLICATIONS FOR ENVIRONMENT AND SUSTAINABLE DEVELOPMENT IN UGANDA.

The common theme in the strategy for sustainable development is the need to integrate economic and environmental concerns in decision making. The Environmental concerns we are faced with today are consequences of sectoral fragmentation of responsibilities with little regard for what our decisions today will mean for the future.

As the Brundtland commission’s report spells out, in Africa for example, the main causes of environmental degradation are poverty, excessive population growth, fragile soils, inappropriate agricultural technology and a policy environment that does not easily foster solutions to the above causes. These problems can be overcome by strengthening national policy frameworks through integrating economic development with environmental concerns.

The State of the Environment Report for Uganda (1994) states that “An Important limitation in present day Uganda is that the way in which development planning information is generated does not help us to understand the environmental effects of macro economics policies and human decisions. Nor does it help us to understand how these environmental impacts affect prospects for economic development”. (Uganda government 1994, 2) Basing on the above observations, it is evident that economic development in Uganda is planned without prior considerations for the Environment.
3.1. THE ECONOMIC SITUATION.

Uganda’s basic economic problems have more to do with alleviating low levels of income and overcoming insufficient economic and social advancement. Like in many developing countries poverty, underemployment, external debt servicing and mismanagement are at the forefront of the country’s problems. For these problems to be overcome, there is a need for intersectoral connections that create patterns of economic and ecological interdependencies.

Looking back at the history of Uganda’s economy, in the 1960s, the country enjoyed one of the highest standards of living in Africa. In 1966, Uganda had a per capita income of US $160, (Uganda government 1994, 1) higher than that of Thailand. Today, Thailand has nine times the per capita income of Uganda. This means that had it not been for the disruptions already mentioned, today Uganda should be a wealthy country by Sub-Saharan African standards.

From 1965-71, Uganda’s GDP was expanding at an average rate of 4.2% (Ministry of planning Entebbe 1989, 935) mainly due to the Agricultural sector. The years between 1971-76 saw a considerable fall of the economy with an annual decline of the GDP, largely attributed to negative political policies in the Amin regime. Further decline was experienced in 1979 during the liberation war that overthrew Idi Amin. A series of political turmoil followed that caused further decline of the economy. Another factor that led to Uganda’s economic decline was dependency on coffee exports which accounted for about 96.8% of total exports in 1979, compared to 54% in 1970. When world prices fell, coffee brought only 100m dollars in 1986 as opposed to an anticipated 400m dollars (Uganda government 1994, 3).

After 1986, a report on the economy was commissioned, and a rehabilitation and development programme for 1987/88 - 1990/91 was announced and approved by the International Monitory Fund (IMF) and World bank. The programme was replaced by an Economic recovery programme 1988-92. From 1986, the government implemented tough structural adjustment programmes. By liberalising the economy
and privatising heavy beaurocratic and inefficient public enterprises, the government aimed at promoting a greater role for the private sector and improving the efficiency and performance of government enterprises.

As a result of these measures, GDP grew by about 7% against a target of 5% in 1992-1993 financial year (Uganda government 1994, 2), a high rate by developing countries’ standards. Since 1986, the country’s GDP has grown steadily averaging about 5-7% per annum for the last six years. The economic reforms undertaken by the Government under the structural adjustment programme brought about price and currency stability, greater economic freedom, more efficient markets and increased business confidence. This is a considerable accomplishment for the present Government. But this in itself is not enough. There is a need for long-term integrated economic planning that will promote sustainable development.

Today, the trend towards Uganda’s economic recovery is quite healthy, and it is hoped that if it continues on this trend, the prospects for Uganda are good, given its abundant natural resources and a favourable climate. Nevertheless, this level of growth will require more dependency on the natural resource base, and therefore better management of these resources will be required.

The rising level of production and consumption realised from the improving economy and the growing population not only implies an increasing resource flow, but also increasing discharges of residuals. As these discharges increase, so must the natural environment’s capacity to successfully assimilate these products be examined. Uganda’s need to integrate its economic development goals with the use and management of its natural resources is crucial. Though there is increased awareness to this issue, the country still needs to reform its present policy making system in order to realise the true concept of sustainable development.

The Government needs to develop clear strategies of what it intends to achieve not only for the short term period but in the next ten years. These strategies must be understood and supported by Ugandans and the donors too. A report made by an
independent working group on the Ugandan Economy suggests that some of the important early measures that need to be taken into the development and pursuit of an explicit Ugandan development strategy include:

i) Securing more overall resources (including external debt relief) and

ii) Targeting and deploying these resources more carefully. Neither the international donor community nor the Government of Uganda has yet achieved that critical minimum effort that is required to “kick start” the economy toward sustainable, longer-run Ugandan development. (Helleiner, Garry et al 1993, 10)

3.2. KEY PRODUCTIVE SECTORS;

3.2.1. INDUSTRY.

Uganda, like many third world countries has been driven to commit itself to industrial development mainly because of the fluctuating prices of agricultural products. The terms of trade for agricultural commodities have deteriorated, lowering further the country’s per capita income. Manufacturing is therefore seen as an essential compliment to the agricultural sector. The drive to reduce dependency on developed countries is another aspect that has influenced industrial growth in the country.

In the 1960s, while import substitution was encouraged to provide the essential commodities for the people, and while little effort was made into identify raw materials available in the country, there was still a marked industrial growth in that period. Industry provided the domestic market with adequate supplies and the few industries that existed at that time were able to produce quality products at maximum capacity, for export. Textiles and sugar are some of the industries that flourished during that time. The years of the 1970s and 1980 saw a significant decline in the industrial sector linked to the overall economic decline of the whole country mainly due to the political instability that prevailed then. It was not until 1988, that attempts towards industrial recovery were made. By rehabilitating some industries, and
promoting direct foreign investment some industrial growth has been realised. The figure below illustrate the trend of Industrial development in Uganda.

Figure 3: Indices of industrial production, 1982-92 (base 1987=100)

All industrial items.


Figure 4

Line 1: Chemicals and paints
Line 2: Bricks and cement
Line 3: Leather and footwear

However, even at the country’s present level of industrial development, environmental problems are significant. Though there are positive practices such as recycling scrap and oil and grease, the very effects of the recycling processes of oil and grease have negative environmental effects if not well done. It is feared that in the process, polychlorinated biphenyls (PCBs) may result as a byproduct. (Uganda government 1994) This hazardous material must be disposed of properly. The recycling processes need to be carried out with full knowledge of the potential harm from these processes and prior preparation made to reduce and safeguard the waste generated.

The industrial waste water emitted in most of the industrial activities is not treated. Industries cannot account for the amount of effluents and the pollutants emitted through their operations. The threat of industrial development in Uganda to human health is therefore evident. It becomes difficult to control industrial pollution under these conditions. The principle of Polluter Pays cannot be effectively enforced on the industrial manufacturers because of failure to quantify pollution from individual industrial activities.

An important condition that the government has established for foreign investment is that for an investor to obtain an investment licence, he shall “take necessary action to ensure that the operations of the business enterprise do not cause injury or damage to the ecology or environment or to the health and safety of its employees and the general public” (Uganda government 1994, 189). This important policy, to have meaningful effect, must be legally enforced so as to ensure compliance with its full intentions. There is still much to be done in industrial planning in order to achieve a strategy for economic growth without putting the environment at risk.
3.2.2. AGRICULTURE.

The agricultural sector in Uganda consists of both crop and livestock production. This sector generates more than 50% of the country’s GDP (Uganda government 1994,15) Uganda is primarily an Agrarian economy and because of the dominant role of Agriculture in the Ugandan economy, a vast majority of Ugandans depend on this sector. For a long time Uganda depended on coffee for the bulk of its export earnings. Until the recent decline in world prices of coffee, it represented 64% of the total exports. The government has since tried to establish a policy of export diversification to reduce dependency on this crop. The collapse in the international coffee prices had adverse effect to the economy of the country. It implied increased external financing of imports and reduced government revenue.

Other traditional export crops of Uganda include tea, cotton and tobacco. These represent about 12% of the total exports while non-traditional exports like sesame seed (simsim), beans, hides and skins, maize, fish and fish products represented about 24%. Uganda is self sufficient in food and agricultural raw materials, and is now becoming a major food exporter to neighbouring countries. The agricultural sector employs 80% of Uganda’s households (Uganda government 1994, 15), making significant contribution to the country’s GDP. The growth of Uganda’s agricultural sector is seen as a way of improving the incomes and employment opportunities of Ugandans. There is a need to raise crop yields and labour productivity through improved security of land ownership. Investment in research on crop control and livestock diseases should be enhanced. Improved transport and storage of export food products such as meat, fish and horticultural products is necessary. (CDR working paper. 1994, 23)

Promotion of the Agricultural sector is an important goal for the government if it is to achieve sustainable development. This sector is very important to the development of Uganda. Not only will it improve the living standards of a majority of rural based Ugandans but it will also promote the role of women in development, since women are the biggest contributors to this sector. This will go a long way to enhance the
policy of sustainable development as a way of reducing poverty and improving the standard of living for the rural communities.

However, the need to integrate sustainable development considerations with agricultural policy analysis planning in Uganda is very vital. The fast growing population puts more pressure on the agricultural sector as demand for food increases. Agriculture has to meet this challenge by increasing production. This will imply further encroachment on the land, increased irrigation, more use of agrochemicals all of which can have very disastrous effects on the aquatic environment if not well planned for. Irrigation is one of the practices that can have adverse effects on the aquatic environment. Today, irrigation is being looked upon as a possible way of increasing productivity of the agricultural sector of Uganda and the practice is being promoted for use on a more wider scale. Irrigation will imply more demand on the water resources.

Though irrigation enhances crop production, when poorly executed it could result in soil erosion, deterioration of soil structure, a rising water table and depletion of ground water where aquifers are not adequately recharged. It could pollute fresh water bodies with pesticides, herbicides, fungicides and fertilisers when there are no or poor drainage systems. Irrigation also creates favourable ecological environments for water borne diseases in the absence of good drainage systems. Evidences of increased diseases have been experienced in areas where irrigation has been applied on large agricultural schemes.

Mubuku is an irrigational settlement scheme of about 1,000 ha of irrigable land. The crops grown at the scheme include rice, onions, tomatoes, maize, beans, groundnuts etc. A lot of fertilisers and insecticides are used on this scheme, and water is diverted from river Sebwe. Plans to divert more water from river Mubuku are underway. The maintenance of this scheme has deteriorated with time leading to increased siltation and water logging, resulting in increased incidences of Malaria and Schistosomiasis (NEAP 1993, 41). The Kibimba rice scheme is another farm of which 756 ha are developed. In order to supply adequate water to the scheme, 302 million cubic meters
of water was created by constructing an earth dam (NEAP 1993, 41). The scheme which is now an artificial wetland has realised potential economic benefits for Uganda as well as increasing the aquatic biodiversity with rare bird species and an abundant fish stock.

In view of the serious environmental threats that can result from poor agricultural practices, policies to integrate environmental and sustainable development with policy analysis for food and agricultural sector is very important. There is a need to formulate, introduce and monitor policies, laws, regulations and incentives leading to sustainable agricultural development. Appropriate farm technologies especially low input sustainable agricultural systems should be encouraged. The Ministry of Agriculture needs to promote social and economic research policies that encourage sustainable agricultural development. The Ministry should regulate use of harmful agro chemicals and at the same time be able to provide affordable alternatives to the farmers. Methods such as composting and other environmentally friendly policies should be encouraged. More research into these methods is required.

Other sectors of development such as Tourism and Mining have not been discussed in this chapter because their contribution to the economy and their effect to the environment is still minimal.

3.3. POPULATION GROWTH; ITS EFFECT TO THE AQUATIC ENVIRONMENT

Among the many challenges facing Uganda in attaining sustainable development is the problem of a high population growth rate. During the African Ministerial conference on Environment (AMCEN) held in 1985, rapid population growth was identified as one of the key factors leading to environmental degradation. Rapid population growth was seen as:
1) Creating imbalance in the relationship between people and the environment.

2) Increasing pressure on natural resources.

3) Adversely affecting the national per capita income given the slow tempo of development.

(Zerihum Tadesse 1993)

The issue of population growth is more to do with whether the population can be sustained by the available environmental resources. The conflict of population growth and the environment is that while populations continue to grow, the environment may be stressed beyond its capacity to assimilated or neutralise polluting effluents of a large population. The question at stake for the world today is how to sustainably use the available resources so that they can meet the demands of the populations today and of the future.

To control the impact of such growth on resources, we need to limit the rate of population growth and to give education, health and proper nutrition to the populations, so as to enable them to increase their knowledge and improve their management of the resources they command. Rapid population growth can create urban and social problems such as inadequate education, unemployment, inadequate health care, urban drift and social unrest because the available resources may not be adequate for the numbers of people. The figure below illustrates the trend of population growth in Uganda over the last 80 years.
In most developing countries, and in Uganda in particular, linking population growth and development can be very complex. In the absence of advanced technology to substitute for manual labour, it becomes necessary for a family to continue producing children that will assist them to till the land. In the absence of social security, children provide a sense of security to the parents because they expect them to provide for them in their old age. In a country where there is a high mortality rate, the only consolation is in having big families so that when some die, others can remain.

Faced with such complex issues, it becomes evident that poverty is at the forefront of population growth. For Uganda to succeed in controlling population growth, eradication of poverty is the most important issue to address. This can be best achieved by improved health and education. Educating the people is “the basic human right of self-determination” (World commission, 1987 11).
The population situation in Uganda, like in most least developed countries, has two fundamental features - mortality rates and fertility rates. While mortality rates are falling, fertility rates remain high. This means that the population is growing despite high but decreasing death rate as a result of diseases. In this situation the population will continue to grow for sometime. The life expectancy rate of less than 50 years, and an annual mortality rate of 15 per 1000 depicts a poor quality of life. Development, by definition, involves reducing the mortality rate and increasing life expectancy. The rate of population growth, the age structure and the population density all influence economic performance and the environment.

The Government of Uganda like all developing countries is thus confronted with very important policy challenges. These challenges and the policy responses to them are rooted in the relationships between demography and development. The awareness of the implications of population growth has increased in Uganda since 1981, when least developed countries were encouraged to intensify their efforts to achieve appropriate population growth rates in order to strike a health relationship between population, economic resources, natural resources and the environment.

At present, awareness about the importance of birth control has only been realised by the elite populations and has not reached the indigenous populations who are the most important. The use of family planning methods in Uganda is restricted by lack of education and religious beliefs. With increased awareness, the country could progress out of this situation faster because it is estimated that 25% of the urban populations living in Kampala use contraceptives, compared to only 2% in the rural areas.

Though Uganda has not yet enacted a national population policy, it has taken steps to ensure that population concerns are adequately reflected in the planning process. Uganda is one of the few least developed countries that has taken steps to develop and implement maternal, child health and family planning welfare programmes. It has also taken a very positive step to integrate women into development efforts.
This positive trend must be backed by enacting a national population policy and creating awareness throughout the country. There is a need to integrate family planning programmes such as education, nutrition, public health and mother and child care. These programmes need to be implemented as major socio-economic programmes in the villages. More resources must be allocated to the population programmes and the international role in this programme must be stepped up. Improvement of the position of women in society by advancing policies that promote women’s rights would be an added advantage to this cause.

3.4. ENVIRONMENTAL LEGISLATION AND POLICY.

The management of the aquatic resources has been done on the basis of numerous laws and regulations, often without published policies. As a result, not much importance has been attached to these laws. Even then, the existing environmental laws are outdated and do not meet today’s needs. Some of these laws date as far back as 1962 when the colonial mentality was still looming large. This mentality did not encourage public participation in environmental matters nor in any other matter that affected the public directly but instead people’s relations with each other were regulated (Uganda government 1994, 211). This resulted in lack of public awareness and appreciation of the importance of the natural resources of the country. There were poor or no communication channels between the policy makers and the local populace.

The problem of lack of awareness and public participation in environmental issues has continued even up to today, and it is the perhaps the biggest problem that undermines sustainable development in Uganda. Environmental issues were regarded as issues of government concern and not for the public. Today, we see greater awareness and commitment by the government to environmental issues but we also see the increased
magnitude of their task to disseminate information to the grassroots level. Considering that a good number of the population is illiterate, this may not be an easy goal to achieve. The process requires additional funds and time which may not be easily available.

However, at the government level, positive steps have been taken to further awareness. An environmental law and policy have been drafted, and a National Environmental Action Plan (NEAP) set up to aid in the implementation process. The laws have been reviewed to embrace the national and international trends. These new laws will be implemented at the local, national and regional levels. Unlike the previous laws which commanded, these are more directed on providing “incentives” and “disincentives.” (Uganda government 1994, 215). A study of legislation on water resources has been done and was recently completed but there are still issues that have not been covered by legislation such as wetlands, management of waste (except sewage), management of industrial chemical and maintenance of air quality. (Uganda 1994, 215).

There are few trained personnel to carry out Environmental Impact Assessments (EIA) and Contingency Planning in development planning projects and a lack of equipment and limited financial resources to implement and enforce environmental laws. Previous laws stipulated very unrealistic fines and penalties creating a very weak attitude on both the enforcing officers and the offenders. The revised laws and regulations will need to close the existing gaps and provide strong economic consequences.

The need to implement policies that will limit environmental degradation is very vital at this stage of the country’s development. It is evident from the above facts that the Government is taking positive steps in this regard. However the underlying factor in attaining this goal lies in the ability to assess the quality of the environment of Uganda and the sources of pollution so that legislation can be applied with due consideration to the present and future state of the country’s environment. The Polluter Pays Principle that has been recommended by some authors to be incorporated in the
country's environmental legal system can only apply if the sources of pollution are identified and quantified so that each Industry or person can be held responsible for their part in polluting the environment.

3.5 ENVIRONMENTAL EDUCATION, PUBLIC AWARENESS AND TRAINING.

Education, public awareness and training are tools with which human beings and societies can reach their fullest potential. Education is crucial for promoting sustainable development. It improves the capacity of people to address environmental and development issues. Education creates ethical awareness, values, attitudes and skills and behaviour which promote public participation in decision making. It is a media through which the sustainable development concept can be incorporated at all levels of education, from basic to tertiary levels.

Although there is recognition of the need for environmental education in Uganda, there are basic constraints of poverty, illiteracy and scarcity of financial resources. There is also a lack of basic knowledge and understanding about environmental matters. As a result, there is limited public participation and consciousness of the importance of sound management of the environment. Recent developments however, have emphasised environmental awareness. There is an effort to incorporate the environment as a subject in schools and institutions.

Seminars, workshops and conferences on this subject have also increased. A major hindrance that remains however is the lack of trained personnel and absence of financial resources to support these initiatives. There is also a tendency in some sectors of society to neglect the long term environmental consequences while realising the short term gains from development schemes.
There is still a need for further promotion of environmental awareness in Uganda by integrating the issues of environment and development within the current training programmes. Practical training programmes need to be encouraged. Industries and Universities need to include an environmental management component in their relevant training. Awareness about the interrelationship between good environment and good business practices must be promoted. The educational courses offered are not specific enough to satisfy the environmental needs and create the level of awareness needed. It is only recently that Uganda has introduced an environmental course at the University level. This in itself is not sufficient. Environmental education should be provided at all levels and training activities encouraged for all those involved in environmental activities, if Uganda is to realise the true concept of sustainable development.

Uganda lacks advisory bodies to act as catalysts for environment protection and the development of the necessary supporting information. The effects of development on the (aquatic) environment and how to prevent further pollution of this environment are not emphasised. Whereas environmental issues like wild life and tree protection have had some attention in Uganda, the aquatic environment has had very little publicity and as such, very little is known about it. There is a lack of environmental training among government administrators. Also, there is no program in place to identify training needs and to conduct training.

The contribution of Women in the economic development of the country is quite evident especially in the agricultural sector. Considering that wrong agricultural practices can result in severe environmental degradation, the importance of creating environmental awareness among the women of Uganda becomes very crucial. There is a need to enhance the role of women in sustainable development of the environment through equal education and training and public participation at all levels in both rural and urban areas, and to encourage equal participation in intellectual spheres of society. The war against hunger, disease and poverty, the worst enemies of the environment, can only be won through education and sustainable management of our resources.
The discussions in this chapter suggest that Uganda is in a phase of economic development that requires sustainable development. Some of the suggestions made in the Brundtland commission for merging environment and economics that provide a good example for Uganda's situation include the following;

- a political system that secures effective citizen participation in decision making;

- an economic system that is able to generate surplus and technical knowledge on a self-reliant and sustained basis;

- a social system that provides for solutions for the tensions arising from disharmonious development;

- a productive system that respects the obligation to preserve the ecological base for development; and,

- an administrative system that is flexible and has the capacity for self correction. (World Commission, 1985, 65)
CHAPTER 4

THE EFFECTS OF UNCONTROLLED DEVELOPMENT ON THE GREAT LAKES AND THE IMPLICATIONS TO LAKE VICTORIA.

4.0. INTRODUCTION

"The environment does not exist as a separate sphere from human actions, ambitions and needs.....The "environment" is where we all live; and "development" is what we all do in an attempt to improve our lot within that adobe. The two are inseparable" (World commission 1987, xi)

The following study highlight what development can do to an ecosystem if it does not follow a sustainable development path. Using the Great Lakes case study, it will be possible to make a comparison with the development trend on Lake Victoria and to see whether the pattern of development is following a destructive path or one of a sustainable development path. The two case studies may seem far-fetched considering that one study is taken from developed countries and another from the least developed countries. But it is worth noting that the destruction of the Great Lakes did not take place only after the United states had become developed, but rather during the process of development as well. This destruction was not realised until the early part of this century, when the Great Lakes was marked by a number of crises. It is therefore possible to imagine that at this stage of East Africa's development trend, environmental degradation may be evident.

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4.1. CASE STUDY 1 - THE GREAT LAKES.

4.1.1 THE GREAT LAKES BASIN ECOSYSTEM

"As well as anywhere in the world, the Great Lakes basin exemplifies the modern tendency to push the environment to the brink." (Government of Canada 1991, 4).

The Great Lakes constitute the largest fresh water system in the world, with lakes Superior, Ontario, Huron, Michigan and Erie bestowing upon the United states the longest continuous coastline of 5,000 miles. Nearly all Great Lakes water drains through the St. Lawrence seaway on its journey to the Atlantic ocean. Its connecting bodies include: The St Clair, the St Mary's, the Detroit, the Niagara rivers as well as the Lake St Clair. The Great Lakes together with their connecting water bodies form a surface water system that includes 750,000 km of tributary streams and rivers and over 80,000 small upland lakes. Almost 20% of the world’s supply of fresh water is held in this system. The surface water system provides energy, fish, transportation, drinking water and recreational opportunities. Ground water, air, biota and land all combine with surface water to produce the richness and diversity that characterise the Great Lakes basin. (Government of Canada 1991, 4)

Early European explorers described the Great Lakes as “the earthly paradise of North America” (Allan, 1985) However, this was short lived. The Great Lakes began to undergo transformation, as the European settlers substituted subsistence resource extraction to an internationally connected industrial and service complex (Government of Canada 1991, 4)

This development trend eliminated wetlands and dammed rivers and streams for water supplies, irrigation schemes, mills and energy production. Forests were harvested for lumber, turning the land into field and fish species were fished to extinction, and the habitat of other species was destroyed. Transportation corridors were elected, harbours, towns and cities built, dismantling the whole ecosystem of the Great Lakes.
and creating one of the world’s most industrial and agricultural complexes. This trend saw an extraordinary increase in the use of chemicals with pollutants discharged in mass quantities into the air, land and water.

The ecology of the Lakes became totally different from what it was four thousand years ago. The species mix changed, the shoreline was altered with beaches and cities, and the chemistry of the water changed. The furs, trees, minerals, fish and forests disappeared. The salmon trout and white fish were displaced by other species. Toxic dumps drained into the lakes with devastating effects on the lake and populations living around the lakes. All these changes were accompanied by population growth from 100,000 indigenous people in the lake’s basin in the 1600s to the 1986 population of 35.1 million (Government of Canada 1991, 8)

4.1.2 LOSS OF HABITAT

Two thirds of all wetlands, the most biologically productive components of the Great Lakes basin have been destroyed (Calbon et al 1990, 65). Between 1967 and 1982, Kent county lost 26% of its original wetland area, Essex, Lambton and Middlesex counties 10 and 20%, between 1965 and 1984, 30% of the lake St. Clair shoreline wetlands were lost and on lake Ontario, 43% of the total wetlands were destroyed with destruction of about 75% of the wetlands in the urban areas (Government of Canada 1991, 9).
4.1.3. MUNICIPAL WASTE, NUTRIENT ENRICHMENT AND EUTROPHICATION

Pollution by bacteria, nutrients, suspended solids and oxygen demanding materials has been obvious in the Great Lakes ecosystem since the advent of industrialisation. As population increased around the lakes' basin, more and more sewage found its way into the water leading to a dramatic increase in diseases such as typhoid, cholera, tuberculosis and infant mortality. The failure to plan for safe disposal of sewage is one of the classic examples of unplanned development. It was not until 1910 that chlorination of drinking waters was initiated in Toronto, resulting into an immediate dramatic decrease of the mentioned diseases. But chlorination in itself was not enough. It only served to mask rather than solve the problem (Government of Canada 1991, 10). It was not until the 1960s when part of Lake Erie turned murky and green that a comprehensive clean up of municipal sewage was embarked upon. This clean up is still far from complete.

The situation on Lake Erie will now be described as it serves as a classic example of the development impacts of municipal waste on an ecosystem.

LAKE ERIE

Lake Erie, together with Lake Ontario occupy the terminal position of the Great Lakes. They receive wastes passed on by the Upper Lakes and wastes from the municipalities and industries they support. Being one of the smallest lakes of the Great Lakes, Lake Erie is more sensitive and responsive to the pollution pressures from various human activities. Together with Lake Ontario and the international section of St. Lawrence river, Lake Erie is a boundary water between Canada and the United States. The United States waters of Lake Erie are shared by the States of Michigan, Ohio, Pennsylvania and New York, while the Canadian waters are within the province of Ontario. The high concentration of populations and heavy industries place heavy demands on Lake Erie. (IUC Canada and United States 1970,1)

During the 1940s and 1950s, many beaches along Lake Erie were closed to the public as health hazards and the city of Cleveland was forced to move the main intake for its
water system from half a mile offshore to five miles out to reduce the high counts of faecal bacteria. As Ashworth puts it, the Lake shore waters were becoming the functional equivalent of septic tanks. In the 1950s, the most famous tourist attraction in North America, Niagara Falls started smelling and the water was marred with brown streaks. It was at this point that the Niagara began to lose its reputation as the “honeymooners’ heaven” (Ashworth 1986, 124).

By 1950s, there was massive eutrophication as the years of using Lake Erie as a garbage dump were beginning to show. The residents of Lake Erie had been living beside and drawing their water from what amounted to an open sewer. The cities of Buffalo and Detroit were pouring thousands of tons of sewage into the water in untreated form. The Detroit river alone poured more than 500 million gallons of domestic waste water, and twice that amount of industrial effluent into lake Erie every day (Ashworth 1986, 133). Overall, the tributaries of Lake Erie were heavily polluted. The Cuyohoga river was declared a fire hazard with floating logs, oils, tyres, paints etc. The river Maumee which provided 3% of Lake Erie’s water and nearly half its sediment load was heavily laden with fertilisers and biological waste. Agricultural run off and detergents together with human and animal waste containing large amounts of phosphorous ended up in the lake.

In the 1960s Lake Erie turned green and opaque. A bloom of blue-green algae emerged in the open water, and the beaches became covered in green slimy rotting masses of a filamentous algae called cladophora (Government of Canada. 1991,11) The decomposition of algae which fell to the bottom of the lake consumed oxygen, rendering the lake oxygen depleted. Indigenous species died replaced by sludge worms. Some authors referred to the lake as “dying” or “dead”. Heavily polluted tributaries that flowed into Lake Erie contributed to this condition. The Rough river which was oil black and the “brown” Maumee and the “turgid” Tames and the “flammable” Cuyohoga rivers all flowed into the Lake. The western arm of Lake Erie which turned green is 50% urbanised and has a population of 2.5 million (Hertig 1989, 426). As some scientists observing the phenomenon said, the lake looked as if it were coated with green paint.
By the 1960s, the lake’s condition had deteriorated to a point where there were cries of panic from the public to save Lake Erie. This was the crisis that forced a clean up of municipal sewage in 1960, which remains far from complete. The comforting theory that such vast amounts of water could not be altered was discarded. In 1972, the crisis led Canada and the United States to sign the first Great Lakes Water Quality Agreement which sought to reduce phosphorous levels in detergents and from point sources such as municipal sewage outfall and industrial effluent pipes (Government of Canada 1991, 11). Sewage treatment plants were upgraded. More than US 9 billion dollars have been spent on the cleanup. In 1987, the programme was strengthened and there was a move towards controlling inputs from non point source such as agriculture and urban runoff. Today, the Lake is showing a significant recovery with about a 60% reduction in phosphorous levels since 1982 and no algae blooms, but the lake is still oxygen depleted in its deep waters.

4.1.4. HAZARDOUS MATERIAL CONTAMINATION.

The source of toxic contaminants in the Great Lakes includes industries, municipalities and human activities. On Lake Huron, toxic chemicals of waste water polluted with dioxins and PCB poured into Tittibwasi river a tributary of Huron each day. On Lake Michigan, on the southern arm near Chicago was a harbour with a floor half contaminated with PCB and another with the bottom sludge composition of volatile solids involving not only PCB but Zinc, Lead, Oil, Grease and Iron. In Niagara falls, the toxic waste dump at Hyde park is between 36 and 75 tonnes of PCBs. This waste is moving towards the St. Lawrence river down stream (Government of Canada 1991, 11). The International Joint Commission in 1990 identified 11 contaminants on Lake Ontario which exceed standards and have been put on the list for primary action and identified through the Niagara River Co-ordinating committee the presence of 342 chemicals were identified, 17 of which were assigned priority action, and 70 listed for weekly monitoring.
The IJC has taken on the task of compiling inventories of chemicals present in the Lake as a way of assessing the state of the ecosystem. The monitoring strategy is intended to improve the knowledge on point source contributions to surface water database, though there will be a significant data gap related to non point discharges such as urban and agricultural run off. Since the 1980s no new contaminants have been detected in the Great Lakes and there was a general reduction in the contaminant levels during the 1970s. Although there has been a significant reduction of toxic contaminants, the problem is far from being solved. Concentrations tend to be stabilising at unacceptably high levels. (Government of Canada 1991, 11).

4.1.5. HUMAN HEALTH CONCERNS

The major route of contamination of the human population is through the consumption of contaminated food. Studies comparing the health of human populations have shown elevated health problems in the Great Lakes populations. Wild life studies have indicated that the off-spring of exposed adults suffer most problems. Women are said to accumulate large amounts of toxic substances which they pass on to their offsprings through breast feeding and during child birth (Calborn et al 1990, 68). Birth defects and cancers are some of the indicators of contaminant stresses. Children born of mothers exposed to the contamination showed signs of decreased birth weight and neuro behavioural developments. The children were said to have learning problems. The effects passed from one generation to another are currently the focus of research (Government of Canada 1991, 17).

Government in response to these revelations adopted preventive measures which advised the population on the consumption of the Great Lakes fish, by identifying the fish species, size of fish and locations from which fish should not be eaten. Recent studies do not show any negative effects on the health of people eating Great Lakes fish and some reductions in the concentration levels of contaminants in fish in Lake Ontario have been realised. The need for greater commitment to research and to reduction of exposures still remains.
4.1.6. EFFECTS ON FISHERIES.

Fish populations prior to the 1900s were composed of species such as Sturgeon, Lake Trout, Lake White Fish, Northern Pike, muskellunge, Walleye, Channel Cat Fish, and Atlantic Salmon. By the 1950s overfishing, plus the invasion of the sea Lamprey Eel, and the introduction of the exotic species along with the pollution of the Lakes led to the near collapse of many fish populations. These were replaced by commercial fish species such as the Smelt and Alewife. A parasitic sea Lamprey which was introduced during the construction of the Welland canal in 1919 fed on the Lake Trout, leading to a virtual elimination of this specie in almost all of the Great lakes.

4.1.7. LAKE INTRODUCTIONS.

ZEBRA MUSSEL

The introduction of exotic species through the ballast water from ships is a more recent concern. The Zebra Mussel which came from Europe to North America and was discharged into St.Clair in about 1985 has caused a new threat to the Lake’s ecosystem.

The Zebra Mussel is said to be a native of the Black and Caspian sea. It is a tiny bivalve specie that sticks to any surface and forms dense colonies. By 1991, it had spread down the St.Lawrence River into New York’s Hudson and Mohanuk Rivers via the Erie canal, and into the Illinosi River via the Chicago Sanitary Canal. Dense colonies of this specie have clogged the water intake and delivery systems for municipal and industrial water supplies and electric power stations. They have fouled boat hulls and water intakes of boat motors and converted sandy beaches into piles of shells. The Zebra mussel has affected the overall aquatic ecology by removing phytoplankton from the water. It is estimated that the cost of remedial measures such as chlorination may exceed millions of dollars, while the mussel is estimated to cause damage to factories, ships, power plants, fisheries and water supplies in the US and
Canada worth more than 5,000 billion dollars in the next decade. The remedial measures however will not eliminate the zebra mussel from the Great Lakes. They may reduce the populations but the Mussel is in the Great Lakes to stay. Treatment of ballast (which now exists under a voluntary regime) is being considered as a means of preventing the introduction of other exotic species (Government of Canada. 1991, 22).

EXOTIC FISH SPECIES

Many of the original fish stocks in the Great Lakes have been replaced. Exotic species have been both deliberately released and accidentally introduced into the Lakes. Some of the introduced species such as the Pacific Salmon and Rainbow trout have produced positive impacts leading to significant spot fisheries in the Great Lakes. The Pink Salmon, Common Carp, White Perch and Rainbow smelt have also contributed to commercial fisheries. However, one of the exotic species that has had negative impact is the Sea Lamprey. The Sea Lamprey invaded the Lake in the 1930s, leading to a virtual elimination of the Lake Trout in almost all the Lakes except Superior. Several measures are being taken to control the populations of this specie. Chemical control is one of the measures being used and a more recent measure that is in use is sterilising the males.

The need to strengthen measures to avoid accidental introduction of exotic species is evident from these examples. Whereas there might be benefits to be realised through deliberate introductions, the accidental ones create bigger losses and may lead to negative impacts on the ecosystem.
4.1.8. RESTORATION MEASURES TAKEN IN THE GREAT LAKES BASIN.

The Great Lakes Remedial Action Plans.

As one of the measures taken to remedy the destruction that has taken place on the Great Lakes, a boundary waters treaty was set up by an International joint commission (IJC). This commission was set up by both Canada and the United States. This is a permanent international agency that prevents and resolves disputes concerned with water along the border. It also investigates pollution problems. Through the IJC a Great Lakes Water Quality Agreements (GLWQA) was formed in 1972 establishing phosphorous control programs that limited inputs from municipal and industrial sources into the Great Lakes system. Water treatment plants were built or improved and limits placed on the amount of phosphorous allowed in detergents.

In 1978, the two countries signed a new agreement in which they added a commitment to rid the Lakes of “Persistent toxic substances”. In the same year, an Ecosystem approach was embarked upon, and the Great Lakes Water Quality Agreement undertook to restore and maintain the chemical, physical and biological integrity of the waters of the Great Lakes ecosystem. The Ecosystem approach recognised the “inter relationship among water, land, air and all living things, including people; and involving all user groups in management.” (Ambio vol. 18 no. 8 1989). This approach is a recent one after a succession of approaches. It represents the social, economic and environmental interests. This new system calls upon the interactive talents available in a variety of programmes, and it involves local communities, citizens, different organisations and governmental agencies (Ambio vol. 8 no. 8 1989). It brings together all the parties that are involved in a process to work together towards a common goal. It integrates the overlapping responsibilities for municipal and industrial discharges and urban runoff which were previously handled as separate programs.

In 1985, federal, provincial and state agencies in Canada and the United states committed themselves to developing remedial action plans (RAPs) to restore
beneficial uses in the 43 Areas of concern in the Great Lakes Basin. (see Appendices 1, 2 and 3). This commitment was reaffirmed by the respective governments with the signing of the 1987 protocol amending the 1978 GLWQA. The RAP program represents the first systematic and concerted effort to restore beneficial uses in areas of concern and offers a unique opportunity to break down institutional barriers and implement, at a practical level, the ecosystem approach called for in the agreement. In order to incorporate the ecosystem approach into the RAP program, it requires a functional re-arrangement of the many organisations with their varied interests located throughout the basin. (Hertig et al 1995, 246)

The development of RAPs represents a challenging departure from most historical pollution control efforts, where management programs were implemented to address municipal and industrial discharges, urban and agricultural runoff, fish and wildlife conservation programs, without considering their inter-relationships. The process also involves local communities and a wide range of governmental agencies at all levels. The successes of RAPs have been largely derived from public participation and education programs from communication, which has brought organisations and individuals together for frank dialogue on issues from co-operation between basin committees, stake holders’ groups and citizen advisory committees from integration as a mechanism for explicit recognition of interrelationships among different programs from implementation through control of contaminants at their sources and from direction, where RAPs have provided leadership and direction on important issues.
4.2 CASE STUDY 2: LAKE VICTORIA

INTRODUCTION:

The previous sections of this chapter have examined the Great Lakes basin ecosystem and its progressive destruction as a result of unplanned development. The next section of this chapter will examine the Lake Victoria basin ecosystem to discuss the level and extent of destruction to the ecosystem as a result of changes being made in an attempts towards development.

Lake Victoria, the source of the White Nile was long a “jewel of East Africa.” (Audubon 14 Jan-Feb. 94, 15). Nestled among the shores of Uganda, Tanzania and Kenya, it is second to size only to North America’s Lake Superior, with 69484 sq. km. As a shallow lake of 270 meters depth, and languid rivers flowing in and out, the lake takes a century to flash and replace its waters. About thirty million people living on the shores of the lake eke a living out of the Lake.

4.2.1. LOSS OF HABITAT

For centuries, the Lake provided a variety of fish for the three riparian states of Uganda, Kenya and Tanzania. The Lake held more than 400 species, said to be perhaps the greatest variety within a single fish group known as the cichlid, which offered a source of protein for millions of people. It was not until the colonial days that changes began to take place in the indigenous species and in the whole ecosystem of the Lake. In 1902, the European colonialists pushed a railroad through Mombasa to Lake Victoria, and destroyed vast tracts of forests in the Lake Victoria watershed to plant tea, coffee, sugar, cotton and tobacco. The human population exploded and people turned to the Lake not for subsistence resources but for a fishing market. (A trend similar to what we saw on Lake Erie.)
As fishing pressure began to intensify, the British introduced flax gill nets which replaced the local fish traps. Without controlled measures for fishing, by the 1950s there was over fishing leading to a commercial extinction of the famous tilapia known as the Ngege. To compensate for the lost species, the colonialists stocked the lake with new fish - The Nile Tilapia (Oreochromis niloticus) and soon after introduced a bigger predator the Nile Perch to boost their economic goals. The perch preyed upon the Cichlid and within a decade of its introduction, the Cichlid accounted for less than 2% of the fish present while the Nile Perch accounted for 98% (Audubon 14 Jan-Feb. 1994, 15). But this was not without a price. The Perch’s ascendance turned out to be “a visible symptom of much graver problems” (Discover March 1994, 73). By 1980 changes started showing up in Lake Victoria waters. There was a shift in the Lake’s fish fauna. The bottom waters of the lake appeared to be a dead zone, devoid of oxygen and fish life. The lake was choked full of algae five to ten times more than in the 1960s. There was evidence of massive eutrophication, an oxygen depleted condition caused by the high level of nutrients that encouraged rapid growth of plankton, which when decayed depleted water of oxygen. But the Perch may have rendered only a coup-de grace. Other factors too contributed to the disruption of the Lake’s ecosystem.

4.2.2. MUNICIPAL NUTRIENT ENRICHMENT AND EUTROPHICATION.

With the arrival of European settlers, the land was razed for plantations and later industries were established around the lake, increasing the populations that lived around the lake. Sewage and runoff of fertilisers, pesticides and industrial waste began to pour into the lake (Discover 79 1994, 72). By 1920s, there were increased levels of nitrogen and phosphorous, leading to a change in the plankton composition of the Lake causing a blue-green algae decay.

Today, the growing number of agro-based industries surrounding the lake is beginning to raise concern as the Lake continues to deteriorate. The role of industries particularly the agro-based industries is of increasing importance to economic
development, with little emphasis being placed on legislation to contain water pollution. Pesticides that for environmental reasons have been partially or completely banned in developed countries are still being used in the East African industries. The bulk of these materials used are hazardous materials such as insecticides, some of which are used on cotton. Fish kills have already occurred in ports of Lake Victoria (Uganda government, 1994, 92). Worse destruction is yet to be experienced as more economic development projects follow in an attempt to alleviate the poverty and economic decline that has characterised the East African countries. Increased discharges of waste with high Biological oxygen demand (BOD) and occasionally contaminated with toxic organic chemicals will find its way into the Lake.

The next section describes in detail the types of industries found on the Ugandan side of Lake Victoria shores and their discharge into the lakes and its tributaries.

4.2.3. HAZARDOUS MATERIAL CONTAMINATION

INDUSTRIAL WASTE:

Types of Industrial activities and their effects on the lake.

**Breweries:** These factories discharge untreated caustic soda, yeast, alcohol fermenting barley and other organic solids into Lake Victoria. The waste water discharged into the lake daily is estimated to be 500m$^3$. These contaminants have a high Biological Oxygen Demand (BOD) of the order of 3,500 mg per litre. Fish kills have already been experienced in areas close to the factory (Uganda government 1994, 88).

**Textiles:** Four textile factories also on the shores of Lake Victoria produce waste water from their printing and dyeing processes. The waste contains caustic soda, hydrogen peroxide, sodium silicate and a multitude of dyes. The total waste water discharged untreated into the Nile exceeds 2000m$^3$ per day (Uganda government 1994, 88).
Sugar factories: Three sugar manufacturing industries each producing waste water comprised of cane wash, cellulose matter, cane juice and alcohol, in an amount of approximately 500m³ per day, discharged these waters into the rivers untreated. It is also estimated that at one of the factories there is an indication of a BOD level of about 130,000 mg/litre and 240,000 mg/litre for the two other factories. (Uganda government 1994, 88)

Leather Tanneries: Even more problematic is the leather tanning factory on the shores of Lake Victoria, which discharges 420m³ of untreated waste water into the lake each day. This waste consists of serious pollutants such as D.D.T, dichlorobenzenes and other pesticides that can be harmful to human health and aquatic life. The waste water discharged is corrosive and has a high BOD of 700 mg/litre and includes suspended solids. There is no chemical treatment to neutralise the discharge. (Uganda government 1994, 88)

Mining: Another source of water pollutant in Uganda is the stock piles of solid waste from the copper mines of Kilembe containing cobalt sulphide. (Uganda government 1994, 88). This waste is discharged into the rivers as a result of runoff from the unprotected area that it is stored in. The waste contains iron, cobalt, copper, cadmium and zinc. These pose a serious threat to the health of the populations in the area if they take in these minerals through the water.

Hydro power development: The construction of dams is another form of development that has an added effect on the environment. The construction of the Owen falls dam is said to have caused high lake levels and edge flooding resulting from heavy rainfall in 1961 - 1962. This is said to have changed the fisheries ecosystem. (IFIP December 1992, 8)
AGRICULTURAL RUNOFF:

The main environmental problems faced by the Lake as a result of wrong agricultural practices include use of dangerous agrochemicals which enter the water as runoff. These are a cause of concern as the country continues to realise agricultural growth. Misuse of the chemicals coupled with lack of knowledge about the effects of these chemicals is a serious problem because farmers tend to use the chemicals excessively in order to increase their yields. The use of these chemicals is not regulated. The farmers tend to go for the cheaper chemicals which have more serious effects on the environment and on the health of the populations as these chemicals find their way to the water and are taken in. More and more land is being cleared for agriculture, increasing the incidences of soil erosion. The soil, in most cases contaminated with the agrochemicals finds its way into the lake's waters.

It is anticipated that with a growing economy, more demands will be put on the water reservoir to irrigate the increasing acreage of agricultural land. Examples of what this might imply if the practice is not restrained have already been cited in the Aral sea case.

4.2.4 EFFECTS OF INTRODUCTIONS TO THE ECOSYSTEM OF LAKE VICTORIA.

Introduction of plant infestation:

An aquatic flowering plant, the water hyacinth (Eichoronia crassipes) is a recent introduction into the aquatic environment in Uganda. This plant is growing at a very fast rate in various locations of the Lake Victoria and Lake Kyoga. The plant specie is said to be a native of South America and is said to have found its way into Uganda through the Kagera river around 1989.
This plant is presenting an impediment to fishing and to navigation. The fishermen are finding it difficult to pass through the thickly populated plant at the shores of the lakes. The fisheries activities have therefore diminished. The populations drinking the water contaminated with this plant also face a possible health risk. The government has sent out urgent requests to FAO and other international organisations for help in eliminating this plant from Uganda’s environment. This task however cannot be accomplished by one country alone since Lake Victoria is a shared resource. A regional long term project needs to be set up by all the affected countries, not only to control this particular plant but to have measures put in place to be able to cope with similar situations at any time.

There are few practical methods of controlling this plant. The most efficacious is likely to be control by introduced herbivores. This can only reduce but not eliminate the plant. A co-operative effort by all the affected bordering states is necessary. The effects of the Water Hyacinth to Lake Victoria pose serious difficulties in terms of developing effective management schemes and will require expensive studies will effect management of this specie.

The effects of the introduction of exotic fish species to Lake Victoria were discussed earlier on in this chapter.

4.2.5. EFFECTS OF TRANSPORT ACTIVITIES ON LAKE VICTORIA.

Several discussions have taken place on a regional basis with a view of promoting transport services across Lake Victoria. Land locked countries of Burundi, Rwanda, Uganda, and the land locked regions of Eastern Zaire and Southern Sudan have an option to use shipping services on Lake Victoria if they so wish. The possibility that transport traffic may increase as the countries in the region continue to industrialise is a likely event. So far, this industry has not developed to a level where serious environmental accidents are likely to happen but the need to plan for this development is vital.
Overall there are about twenty ferries and tugs on the lake. Waste matter from these ships is dumped straight into the lake waters. Bilges are pumped out and discharged into the Lake, lube oil is not purified on most vessels, sewage is also pumped direct into the lake. There are an increasing number of minor accidents resulting in marine generated pollution on the Lake. With this present trend, and an evident lack of management plans, increased activities may prove disastrous to the lake. The is a need to develop contingency plans that can be referred to in case of severe marine environmental accidents involving major pollution on the Lake. There is also a need to update and develop effective legislation procedures that can ensure protection of this resource. The East African Water Transport Act of 1958, needs to be updated to keep pace with the developments taking place in the region.

Further recommendations for instituting effective management measures for protection of the Lake will be provided in the next chapter.
5.1. SUMMARY.

In the four previous chapters, the author has attempted to bring out the state of Uganda's aquatic environment. From these chapters, it is evident that Uganda's aquatic resources are at a risk of severe pollution as emissions from Uganda's potential industrial and agricultural activities increase, surpassing a point where they can be readily assimilated by the environment. With the revitalisation of the mining and manufacturing industries and recycling plants coming up such as the steel recycling plants, and a likely emergence of more chemical plants, the need for more vigilance and censoring of the industrial activities and use and import of raw materials is indeed very vital. Evidence of polluted and depleted aquatic resources have already been pointed out. From this study, it is obvious that urgent measures must be taken to control further destruction of Uganda's ecosystem and more especially Lake Victoria which is a very important resource not only to Uganda but to the three East African countries.

Looking at the long term effects of polluted environments, it is worth noting that as long as the bordering countries do not come up with a system to control further pollution on their resources, all attempts at economic advancement will be futile because the costs of cleaning up a polluted environment are very high, and so are the effects of a polluted
environment on the health of the populations. Incidences of Typhoid fever, Cholera, Bilharzia and many other diseases which have their origin in water are common in Uganda. Uganda is one of the countries in the world with the lowest life expectancy. It is not that Uganda has not tried to improve its health facilities, in fact a lot has been done to rehabilitate hospitals and offer better medical services, but the problem is not in curing the diseases but in identifying the origin of the diseases and preventing further spread and occurrence of the diseases. It has been said that 80% of the world's diseases originate from water, and more recent reports indicate that viral diseases can survive in contaminated waters for a considerable period of time.

It is important that Uganda does not fall prey to the environmental problems that some industrialised countries have gone through because they have left lasting impacts on these countries. Our environmental awareness is at a stage where we do not have sufficient evidence to account for certain occurrences, but that does not mean that environmental effects are lacking. Though incidence of neuro behaviour and other drastic deformities caused by intake of contaminated water have not been reported, the possibility that these exist cannot be ruled out considering that the country still uses drastic practices such as use of chemicals that have been banned or are controlled in most developed countries. Increased chemical use without adequate and enforceable legislation to control pollution, may lead to drastic situations similar to what has been experienced elsewhere in the world. Though these chemicals are not being used in the developed countries, they are still produced for export to the developing countries.

Some of the examples of what polluted environments can do to a country were discussed in the previous chapters. The incidents occurring or that have occurred elsewhere in the world emphasise the need to enhance environmental management as an integral part of development.
The next section will provide step by step recommendations of how various development processes can be integrated with environmental activities to achieve sustainability.

5.2 A MULTIDISCIPLINARY FRAMEWORK FOR DECISION MAKING.

According to the study on Environmental decision making carried out by Tufts University Centre for Decision Making, while formal decision making can be applied in different problem areas such as business, medicine and military planning, environmental decision making requires a wide range of inputs to produce an informed decision. Environmental problems often involve physical, chemical, biological, economic, phycological, technological, ethical, legal and political factors. (Cheshire. A.R & Carisle S.(ed), 1991, 12). If any of these factors are omitted, this may oversimplify the problem and render the decision process incomplete and unrealistic. Thus, environmental decisions require a multidisciplinary understanding which require an interdisciplinary approach, which will ensure the integrated use of the natural and social sciences and the environment in planning and in decision making on issues which may have an impact on man's environment.

5.3. A REGIONAL FRAMEWORK APPROACH TO ATTAINING SUSTAINABILITY.

In Uganda where the major aquatic resources are shared with neighbouring countries, it becomes futile for one country alone to try and create sustainability because the environment knows no boundaries. Pollution on one side of the lake or river will spread all over the lake region. There is therefore a need for a regional framework involving all the neighbouring countries. Efforts have been made to establish such organisations in the
East African countries. The Kagera River basin is one such organisation and another is the Regional Office on Lake Victoria, based in Tanzania. This is a new organisation and is still in its initial stages. This depicts the commitment of the three governments in attaining sustainable development of the shared resources of the region. The successes of these organisations will depend largely on the organisation’s ability to integrate the development activities of the three countries with the environment taking into consideration the ability for the shared resources to assimilate the waste generated by all the bordering counties.

For the purpose of giving specific recommendations for an effective regional framework approach, the author will use a model example of the Great Lakes International Joint Commission (IJC) which was established between Canada and United States with the sole purpose of managing the shared resources along their borders effectively. A brief discussion of how the Commission was formed has already been presented in the previous chapter. This section will give a more detailed approach to some of the practical implementation systems used by the IJC and which have attained success.

Like the IJC, the most important concerns of a regional framework in the East African region would be to manage, monitor and restore impaired beneficial uses of the aquatic resources. The tools IJC uses to implement its goals are through the Remedial Action Plans (RAPS) and an Ecosystem approach. This section will focus only on the RAPS as a more adaptable approach to suit this purpose. The RAP process is intended to build consensus about the necessary remedial and preventive actions through broad based public participation.

The RAPs are organised in committees with each stakeholder group, basin committee, coordinating committee, public advisory committee or citizen committee made up of
individuals broadly representative of environmental, economic and social interests in an area of concern. By involving Stakeholders, the RAP process regulates the top-down command and control system (Hertig and Law 1993, 10). This system has proven to be a very strong hinderence to sustainable development processes in most developing countries. The elimination of a top-down leadership is therefore a very important factor for consideration at both the national and regional levels. Another important aspect addressed by the RAPs is broad based participation. This enables the stakeholder to educate and solicit support from thier constituencies on important decision matters. The stakeholders get directly involved in remediation and preventive processes. Broad based participation and shared decision making power are viewed as critical success factors in Hamilton Harbour, Cuyohoga, Puget Sound, Chesapeake Bay and Lake Champlain in the Great Lakes region (Hertig and Law 1993, 11)

Another aproach used by the RAPs is that of defining clearly the responsibilities of all the stakeholders and equiping them with sufficient authority to enable the institutional frameworks to perform. An important consideration is that the institutions must be free of government beaurocratic processes, and be answerable only to legitimate public agencies. The institutions’ operations should not be affected by political differences and border disputes but should be able to function independent of these pressures.

The success of a regional framework approach for integrating development processes with the aquatic environment of Uganda will depend largely on the commitment of the parties involved. There is a need for very close cooperation and coordination among the parties in the region. The commitment by the countries with shared resources in the East African region will have to look beyond one country’s short term gains which encourage competitive use of the resources to one of integrated use of the resources, using enough but leaving enough for the future generations.
It may not be possible for Uganda to copy the implementation system used by the United States and Canada considering the differences in economic development levels, but it is the view of the author that Uganda would stand to benefit from some of the concepts and mechanisms used by the IJC especially those discussed in this section.

5.4 A NATIONAL FRAMEWORK APPROACH FOR ATTAINING SUSTAINABILITY

Management responsibilities for the various environmental components of the aquatic ecosystem - the lands, waters and wetlands are fragmented among multiple governmental organisations and between the public and private sectors. The prevailing system for decision making in Uganda does not integrate the environmental components with the economic and social factors at the policy planning and management levels. There is a need to reshape the decision making process to achieve a full integration of these factors. This will require the government and the various relevant ministries to improve the use of data and information at all stages of planning and management and to encourage a broad range of analytical methods so as to provide various points of view. The government should use policy instruments such as the legal/regulatory and economic tools for planning and management.

The instruments should be reviewed and regulary adapted to ensure they continue to be effective. The government in co-operation with the relevant international organisations should strive to adopt a strategy for sustainable development based on the implementation of decisions taken at the United Nations Conference on Environment and Development (UNCED) partiuculary in respect of Agenda 21.
PRACTICAL RECOMMENDATIONS FOR NATIONAL IMPLEMENTATION STRATEGIES:

In implementing the decision to reshape the decision making process to achieve integration of the environment and development factors, an organisational unit that can develop a network for communication among agencies is desirable. This organisation would be required to adopt comprehensive analytical procedures for prior and simultaneous assessments of impacts of decisions, including the impacts within and among the economic, social and environmental spheres. This organisation should extend beyond the project level to policies and programmes. It should also include assessment of costs, benefits and risks.

An example of an organisational framework for carrying out these objectives is illustrated in figure 6.
IMAE responsibilities:

1. Development of comprehensive policies that embrace the development and environment protection concerns relative to:
   - the national fisheries
- the ports
- inland waterways
- shared resources
- tourism
- non-point source pollution from:
  - agriculture
- urban activities
point source pollution from:
- industry
- urban activities
- water activity uses

2. Coordination of inter ministerial activities to provide integrated management of the Aquatic Environment.

3. Review of all Ministries' activities that have potential to affect the Aquatic environment.

4.Drafting of legislation necessary to achieve sustainable development of the Aquatic environment.

5.5 ECONOMIC DEVELOPMENT FOR SUSTAINABILITY.

Historically, economic development has neglected environmental factors. Today virtually all sectors in society acknowledge the linkages and mutual dependencies between environment and economy, and the need for environmentally sustainable economic development. To achieve this, we must develop an ecological economics that goes beyond conventional disciplines of ecology and economics to a truly integrative synthesis. (IJC United States and Canada 1995, 37) According to Herman Daly, a senior economist
for the World Bank, sustainability can be achieved through a set of accounting rules for calculating rates of return on projects. For renewable resources, Daly (1991) suggests that:

- the offtake form the renewable resources that is being exploited should not be greater than the sustainable yield defined by ecologists;
- the harvest rates should be within the capacity for regeneration of the resources and
- waste emission rates should be within the capacity of the local ecosystem to absorb and assimilate within natural bio-geochemical cycles.

For non renewable resources, he suggests that:

- waste emission rates should be within the capacity of the local ecosystem to absorb and assimilate within natural bio-geochemical cycles; and
- part of the net revenue form the project should be set aside and reinvested in a long term renewable substitute so that you can deplete a non renewable resource but simultaneously build up a renewable resource (i.e. by the time you have depleted the non renewable resource, you have built up the renewable substitute to a level such that its sustainable yield will be equal to the amount that you were consuming out of non renewable receipts each year. (IJC United States and Canada 1995, 43)

A new concept of Inter-generational rights is beginning to come up as we talk about environment protection. This view considers the environmental rights of the generations to come. It emphasises the need to protect the resources not only for our use but for many years to come. The Environmental standards required to achieve this goal may have a direct impact on the viability of low technology and low coast Industries, and may be seen as a hinderance to development especially in the developing countries. But if these considerations are taken into account right from the beginning of a development project
plan, then greater care will be applied in the use of these resources and the short and long term goals can be achieved.

In an interview carried out at JIC offices Ontario, Peter Boyler from the Social Science department said that some of the economic instruments that could be used to reduce pollution include; taxation of the polluters, tax refunds, charging of effluent fees, and marketable permits that would determine how much pollution is being emitted by a particular process. He said this would imply looking at the kind of fees that would apply to the kind of pollution. Several other schools of thought about environmentally sustainable economic development have been expressed by several authors.

Environmentally sustainable economic development is best understood "as a dynamic process of continuous improvement in which the allocation of resources, the direction of investment, the orientation of technology, the forms of laws and institutions, and the mechanisms for decision-making at all levels are shaped not only to meet the needs of the present, but to protect the ability of future generations to meet their own needs within the capacity of natural systems" (IJC United States and Canada 1995, 38). For this to be accomplished, there will be a link between the environment and economy in decision making processes, and the ability to assess and measure progress.

5.6 PROMOTION OF AWARENESS AND PUBLIC PARTICIPATION

Traditionally, decisions about resource management and environmental quality have been made by government officials, leaving out the citizens in the decision making process, until the laws, plans or studies which affect their lives have been completed or nearly completed. Today the new trend of development requires that the public be given an opportunity to participate in the environmental decision making because the decisions made have a direct impact on the public. (The public in this case can be said to be any
person or groups of people that have a distinctive interest in an issue). It has also been widely accepted that "significant changes can be brought about rapidly only if the persons who are expected to change, participate in deciding what the change shall be and how it shall be made." (Calgary, Alberta 1988, 12) Industrialists are an important interest group to focus upon. By involving them in public participation, not only is their level of awareness raised, but also their ability to control further pollution. Medical personnel such as nurses and midwives can also be focused upon as a tool to identify symptoms related to water pollution and to advise patients on the intake of water and fish products if the situation should call for that. Newsletters, round table discussions among different interest groups to get to zero discharge should be encouraged. Sectors of industrial society such as mining, automobile, chemical plants should be involved to accomplish this goal. This approach will bring about long term pay-offs.

Public participation is in itself an educational tool. Public involvement can result in higher level of commitment to the decision by interest groups with a stake in the decision. This will minimize controversy during implementation, and thus the cost savings will more than offset the original cost of the public involvement program. The degree of public involvement can range from public information where the goal is to inform the public about a decision, to inviting the public to be heard before a decision is made. More encompassing approaches would be where the public can influence a decision directly or be given a latitude to determine the decision in partnership with the agency. Public participation should be included in the government's mandate on environmental assessment.

In order to enhance public participation, the Government needs to provide the tool, which lies in environmental education. This has to be done through educational programs starting at kindergarten levels to the highest level of education. In an interview carried out
at IJC Canada with the director of public affairs Ms Sally Cole Misch, the best and most effective level of response is attained at kindergarten level to 9th grade (equivalent to primary level) when the children are not yet confined to academic disciplines. This idea has also proved effective in other countries such as Greece and Sweden where scientific experiments are carried out by young children with simple devices to assess the level of pollution in an area.

Community participation is another tool that can be used as a means of creating awareness and to take part in the actual clean up processes and in the monitoring and management activities. To address the issue of aquatic management, there must be a concerted effort to ensure that the aquatic environment is an integral part of the community master plans. This process would include;

- compiling inventory on the aquatic environment
- developing public participation
- forming inter governmental coordinating committees, and
- developing community/governmental partnerships in plan development.

Effective communication and strong partnership will be essential to achieve this. These are long term endeavours, but the short term endeavours can include establishing a data management system which will identify existing information, management systems, determine needs of potential users and develop a strategy and actions through a partnership effort. This could be done through the fisheries department or environment department. Aquatic protection would also have to be incorporated into master land use plans, regional plans, watershed master plans thus increasing protection efforts by alerting stakeholders of the presence of the aquatic environment worthy of protection. Such practical steps will help to improve the implementation of related laws, policies and programs, making use of all levels of partnership. (Calgary, Albert 1988, 14)
<table>
<thead>
<tr>
<th>Persuasion</th>
<th>Consultation</th>
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<tbody>
<tr>
<td>The use of public involvement techniques in legitimate endeavours to change attitudes without raising public expectations of participating in the planning process.</td>
<td>Use of formal dialogue between authorities and public based on initially established mutually accepted objectives.</td>
</tr>
<tr>
<td>Education</td>
<td>Job planning</td>
</tr>
<tr>
<td>The use of information dissemination and general instruction to create an awareness of programs and issues</td>
<td>Shared decision making. The public is represented on departmental planning boards, is given voting and decision making authority. Issues should be geographically specific and understandable by local participants.</td>
</tr>
<tr>
<td>Information feedback</td>
<td>Delegated Authority.</td>
</tr>
<tr>
<td>The distribution, by the authority, of information on a policy planning situation on which the authority has a stated position for public feedback on the position.</td>
<td>The transfer of responsibilities, normally associated with the authority, to the public of other levels of government possessing the necessary expertise.</td>
</tr>
<tr>
<td>Self Determination</td>
<td></td>
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<tr>
<td>The undertaking to planning process by the public directly.</td>
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Source: Calgary, Albert 1988: Public Involvement Planning and implementing public involvement programs.
5.7. ENHANCING ENVIRONMENTAL EDUCATION AND TRAINING.

The training needs of Uganda need to be identified and attended to, with the help of the United Nations. There is a need for the government to get involved in international programmes for environmental awareness.

Environmental education programmes can be provided through guide books for schools, video tape programmes, teaching workshops and actual practical participation in environmental clean ups. One of the programs that has been successful in implementing environmental education in schools, and whose example should be emulated is the Hellenic Marine Environmental Protection Association (HELMEPA) program in Greece which carries out practical exercises for school children in environmental clean ups and site studies. This is a simple program that does not require a lot of expense and yet has achieved a high degree of success. HELMEPA was inaugurated on June 4, 1982.

To make sure that the people of Greece understood the magnitude of the pollution they inflict upon their marine environment, the association organised voluntary beach clean-ups with the participation of boy scouts and some public school volunteers. The result of the initiative was given significant publicity by the press and state television. In 1993, HELMEPA Junior was launched. The aim was to give the children a platform from which they will be able to address the issues of pollution of the marine environment in their own way. These children demonstrated in their most vivid manner what collective efforts can achieve when people are informed and dedicated. The participation of HELMEPA Junior is voluntary and the funding is based on donations. It is HELMEPA’s hope that
eventually the United Nations will proclaim one day of the year as “The World Day of Voluntary Clean-up”

5.8. PROVIDING A LEGAL AND REGULATORY FRAMEWORK.

Among the most important tools for transforming environment and development policies into action is providing a country with laws and regulations suited to the specific conditions of the country. Uganda like many developing countries has been affected by the shortcomings of laws and regulations. For Uganda to effectively integrate environment and development in the policies and practices of the country, it will have to develop and implement integrated enforceable effective laws and regulations that are based upon social, ecological, economic and scientific principles. It will also be necessary to review and enforce compliance with the laws, regulations and standards adopted. This should be done by setting up specific programmes for this purpose. The enactment and enforcement of these laws should take place at the regional, national and local level. The government should regularly assess the laws and regulations enacted with a view of rendering them effective. Judicial and administrative procedures should be established for legal redress and to remedy unlawful actions affecting environment and development.

The government should incorporate the inter-governmental and non-governmental agencies in preparing comprehensive inventories and review of national legal systems with a view of taking advantage of added expertise these organisations may have. Training programs on environment and development law should be provided by the Ministry of Education at the University level so that the level of application of the law, and the related skills of negotiating and drafting can be improved. The laws should incorporate sanctions designed to punish violations, obtain redress and deter future
violations (UNCED 1993, 487). Procedures for collecting information on legal and regulatory measures taken should be improved and a survey made of the domestic follow up action taken with a view of assessing the effectiveness of the laws.

5.9. STRENGTHENING INTERNATIONAL COOPERATION.

Uganda needs to strengthen her ties with international bodies with a view of keeping pace with new developments that affect environment and development. The country needs to accede to relevant international conventions that would enhance integrated management of the country’s resources. Some of the conventions that should be considered include;
- African convention on the conservation of Nature and Natural Resources (1968)
- Convention on Wetlands of International importance especially as Water Foul Habitat (1971)
- Framework convention on Climate change.

This chapter has offered recommendations for attaining Integrated Management of Development and the Aquatic Environment of Uganda, as a step towards attaining sustainable use of the resources for today, tomorrow and the next generation. However, in concluding remarks to this dissertation, the author wishes to emphasise that the challenges to attaining integrated management do not lie in the use of words only but rather through the use of ACTIONS.
APPENDIX I
43 AREAS OF CONCERN IN THE GREAT LAKES.
APPENDIX 2

Remedial Action Plan institutional frameworks established in Great Lakes Areas of Concern:

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<tr>
<th>Area of Concern</th>
<th>Institutional Framework</th>
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</thead>
<tbody>
<tr>
<td>1. Peninsula Harbour</td>
<td>Peninsula Harbour Public Advisory Committee</td>
</tr>
<tr>
<td>2. Jackfish Bay</td>
<td>Jackfish Bay Public Advisory Committee</td>
</tr>
<tr>
<td>3. Nipigon Bay</td>
<td>Nipigon Bay Public Advisory Committee</td>
</tr>
<tr>
<td>4. Thunder Bay</td>
<td>Thunder Bay Public Advisory Committee</td>
</tr>
<tr>
<td>5. St. Louis River</td>
<td>St. Louis River Citizens Advisory Committee</td>
</tr>
<tr>
<td>6. Torch Lake</td>
<td></td>
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<tr>
<td>7. Deer Lake-Carp Creek-Carp River</td>
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<tr>
<td>8. Manistique River</td>
<td>Manistique River Partnership Council</td>
</tr>
<tr>
<td>9. Menominee River</td>
<td>Menominee River Remedial Action Plan Citizens Advisory Committee</td>
</tr>
<tr>
<td>10. Fox River/Southern Green Bay</td>
<td>Green Bay Remedial Action Plan Public Advisory Committee</td>
</tr>
<tr>
<td></td>
<td>North East Wisconsin Waters of Green Bay Tomorrow, Inc.</td>
</tr>
<tr>
<td>11. Sheboygan River/ Harbor</td>
<td>Sheboygan County Water Quality Task Force</td>
</tr>
<tr>
<td>12. Milwaukee Estuary</td>
<td>Milwaukee Estuary Remedial Action Plan Citizens Advisory Committee</td>
</tr>
<tr>
<td>13. Waukegan Harbor</td>
<td>Waukegan Harbor Citizens Advisory Committee</td>
</tr>
<tr>
<td>15. Kalamazoo River</td>
<td>Kalamazoo River Public Advisory Council</td>
</tr>
<tr>
<td>17. White Lake</td>
<td>White Lake Remedial Action Plan Public Advisory Council</td>
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<tr>
<td>18. Saginaw River/Saginaw Bay</td>
<td>Saginaw Basin Natural Resources Steering Committee, Saginaw Basin Alliance</td>
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<td>19. Collingwood Harbour</td>
<td>Collingwood Harbour Remedial Action Plan Public Advisory Committee</td>
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<td>21. Spanish River</td>
<td>Spanish River Public Advisory Committee</td>
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<tr>
<td>23. Rouge River</td>
<td>Rouge Remedial Action Plan Advisory Council, Friends of the Rouge</td>
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Table continued.

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<tr>
<td>24. River Raisin</td>
<td>River Raisin Public Advisory Council</td>
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<tr>
<td>25. Maumee River</td>
<td>Maumee River Remedial Action Plan Advisory Committee</td>
</tr>
<tr>
<td>26. Black River</td>
<td>Black River Remedial Action Plan Coordinating Committee</td>
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</table>
| 27. Cuyahoga River | Cuyahoga Remedial Action Plan Coordinating Committee  
Cuyahoga River Community Planning Organization |
| 29. Presque Isle Bay | Public Advisory Committee for the Presque Isle Bay Remedial Action Plan |
| 30. Wheatley Harbour |   |
| 31. Buffalo River | Buffalo River Citizens Committee  
Buffalo River Remedial Advisory Committee  
Friends of the Buffalo River |
| 32. Eighteen Mile Creek |   |
| 33. Rochester Embayment | Monroe County Water Quality Management Committee |
| 34. Oswego River | Oswego River Remedial Action Plan Remedial Advisory Committee |
| 35. Bay of Quinte | Bay of Quinte Public Advisory Committee |
| 36. Port Hope | Port Hope Harbour Local Advisory Group |
| 37. Metro Toronto | Metro Toronto Public Advisory Committee |
| 38. Hamilton Harbour | Hamilton Harbour Stakeholder Group  
Bay Area Implementation Team (BAIT)  
Bay Area Restoration Council (BARC) |
| 40. St. Clair River | St. Clair River Binational Public Advisory Council |
| 41. Detroit River | Detroit River Binational Public Advisory Council  
Friends of the Detroit River |
| 42. Niagara River (Ontario) | Public Advisory Committee for the Niagara River Remedial Action Plan |


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