EAST AFRICAN COMMUNITY

LAKE VICTORIA BASIN COMMISSION SECRETARIAT

LAKE VICTORIA BASIN WATER HYACINTH SURVEILLANCE, MONITORING AND CONTROL STRATEGY

2012 to 2030

WATER HYACINTH ON THE RIVER MOUTH TO LAKE VICTORIA 2011

World Bank

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ACRONYMS

CBO	Community Based Organization
EAC	East African Community
EACJ	East African Court of Judicature
GIS	Geographical Information System
GPS	Global Positioning System
KARI	Kenya Agricultural Research Institute
LVB	Lake Victoria Basin
LVBC	Lake Victoria Basin Commission
LVBCS	Lake Victoria Basin Commission Secretariat
LVEMP	Lake Victoria Management Project
LVFO	Lake Victoria Fisheries Organization
MINERA	Ministry of the Environment and Lands (Rwanda)
MINAGRI	Ministry of Agriculture and Animal Resources (Rwanda)
MP	Member of Parliament
MRPMG.	Mary River Pest Management Group
NARO	National Agricultural Research Organisation- Uganda
NaFIRRI	National Fisheries Resources Research Institute
NEMA	National Environment Management Authority
NEYP	National Environment Youth Project
NEMC	National Environment Management Council
REMA	Rwanda Environment Management Authority
NGO	Non Governmental Organization
PAIGELAC	Inland Lakes Integrated Development and Management Support Project
RTWG	Regional Technical Committee Working Group
S&C	Surveillance and Control
ToR	Terms of Reference
WHSMCS	Water Hyacinth Surveillance, Monitoring and Control Strategy

Preface

Lake Victoria is the world's second largest freshwater body and is found in East Africa. Lake Victoria Basin is shaed by all EAC partner States; Burundi, Kenya, Rwanda, Tanzania and Uganda. Water hyacinth is considered to be the most serious aquatic weed in the Lake Victoria basin. It was officially recognized as an invasive weed in Lake Victoria in the late 1980's. Although the harmful effects of the water hyacinth are generally known, it has been very difficult to stop the spread.

Water hyacinth (*Eichhornia crassipes* (Martius) Solms-Laubach) and other invasive aquatic weeds once established are very difficult to manage and total eradication is often not possible. The costs of invasive weeds infestation on the environment, social and economic systems

Since the recognition of water hyacinth as a serious problem in the lake, various management activities have been implemented by the governments of Kenya, Tanzania and Uganda with support from International Partners. Various methods of water hyacinth control have implemented mainly in Lake Victoria. These control methods include biological, mechanical, manual/physical and chemical. By 2005; 80% of water hyacinth was removed by LVEMP I project; but then just after one or two years, then resurgence of water hyacinth was witnessed at high rates.

Main factors associated with resurgence of water hyacinth, includes, the inability of countries to provide funds to continue with water hyacinth monitoring and control, most of Countries didn't have well equipped special units to deal with this weed, no regional coordination was in place to coordinate Partner States initiative.

It is from this background that LVBC through LVEMP II, deceived to develop this Lake Victoria Basin Water Hyacinth Surveillance, Monitoring and Control

Strategy. This strategy is aimed at aligning organizational resources in order to remove and maintain water hyacinth levels at ecologically acceptable levels within the short-, medium- and long-terms.

The strategy is going to address the key factors mentioned above, by establishing effective and efficient regional coordination unit at LVBC Secretariat, and national units to mobilise resources and key stakeholders to monitor and remove water hyacinth.

The LVBC Secretariat is committed to coordinate the EAC Partner States to apply this strategy to remove water hyacinth at 80% and maintain if possible above this level.

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In Lake Victoria Basin Commission Secretariat appreciations are to Dr. Tom Okurut the first Executive Secretary LVBC; Dr. Canisius Kanangire the Executive Secretary LVBC; Mr. Samuel Gichere the Deputy ES LVB, Dr. Raymond Mngodo the Regional Coordinator LVEMP; Fredrick Mngube the Environment and Natural Resources Officer LVBC; and Ms Lily Kisaka the LVEMP Senior Operation Officer for coordination and supervision of the consultancy and the report writing. Thanks go to Mr. Qureish Noordin, Mr. Said Matano, Mr. Mathias Chemonges and Eng. Omari Mwinjaka for valuable experiences related to this strategy.

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EXECUTIVE SUMMARY

Aquatic weeds adversely affect water quality, biodiversity, amenity and recreational values of water bodies. Community, social, cultural and economic values derived from such water bodies are therefore impaired. Invasive weeds also have adverse impacts on the structure and functions of wetlands and other riparian ecosystems. Water hyacinth (*Eichhornia crassipes* (Martius) Solms-Laubach) and other invasive aquatic weeds once established are very difficult to manage and eradication is often impossible. The costs of invasive weeds infestation on the environment, social and economic systems though recognised are difficult to calculate but estimated impacts may be in the range of millions of dollars.

Lake Victoria the world's second largest freshwater body was severely infested by water hyacinths, to catastrophic levels in the late 1980's. The lake's riparian governments of Kenya, Tanzania and Uganda with support from development partners successfully responded to the menace by applying a variety of water hyacinth control methods such as biological, mechanical and manual/physical removals. Chemical control method remained at only trial level and was never done on large scale. Control of evasive weeds is one of the components of an integrated approach to the management of the LVB.

This document is the Lake Victoria Water Hyacinths Surveillance, Monitoring and Control Strategy that has been prepared by the Lake Victoria Basin Commission Secretariat. The aim of the strategy is to assist the partner states to monitor, assess and control the water hyacinth in the Lake Victoria Basin in order to improve the environment, safeguard human health, ensure the effective use of water resources and facilitate the development of the populations living within the Lake Basin for the benefit of the Partner States.

In preparing this strategy, LVBC Secretariat through Ecotech Consulting Environmental Management Firm Ltd, reviewed literature on water hyacinth

and other invasive weeds in the LVB including GIS based maps. The effectiveness of earlier surveillance and control methods implemented in the LVB were assessed and the experience gained by the EAC member states since the 1980's in the management of water hyacinth was obtained and informed the development of the strategy. Further, information accessed from the riparian countries; the EAC and LVBC Secretariats was used to evaluate and determine the current basin-wide water hyacinth spatial distribution; the effectiveness of invasive weed control methods employed by the member states and the effectiveness of regional efforts in surveillance, monitoring and control.

Available data indicate that water hyacinth coverage in LVB increased to peak levels between 1995 and 1998 and then receded. It again peaked in some areas of Lake Victoria between 2006 and 2007. The member states implemented a mix of weed control methods in varying combinations. Biological (*Neochetina bruchi* and *Neochetina eichhorniae)* and manual control were the most preferred combination, since mechanical methods had problems with machinery breakdown and high costs. Uncertainty of the potential impacts and public opinion contributed to making chemical control unattractive in the region. Overall, the integrated water hyacinth control approach was found to be a very effective mode of weed control.

Informed by the review findings, the proposed strategy provides a realistic and sustainable approach for surveillance and control of water hyacinth in the LVB. A situational analysis of the water hyacinth proliferation indicating hotspots within the LVB is presented in Chapter 1 and chapter 2. Monitoring and control (including preventive measures) measures being implemented by the member states are analysed. The strategy is presented in chapter 3 and chapter 4. Strategies to address institutional, coordination and capacity needs at the national and regional levels are clearly highlighted. The methods for effective communication to inform and interact with all stakeholders on water hyacinth control issues are well articulated in this strategy. The roles and responsibilities of the different stakeholders are presented. Finally, an 'Action

Plan' with detailed activities and the cost estimates for the implementation of the water hyacinth surveillance and control strategy are presented. Overall the coordination, monitoring and evaluation of the implementation of the strategy will be the responsibility of the LVBC.

CHAPTER 1

INTRODUCTION

1.1 Geographic and economic setting of Lake Victoria Basin

Lake Victoria, the second world largest freshwater body, has a surface area of 68,870 sq km, a mean depth of 40m and maximum depth of 80m (Crul, 1995). The Lake Victoria Basin (LVB) covers an area of 193,000 sq km, shared by Tanzania (44%), Kenya (22%), Uganda (16%), Rwanda (11%) and Burundi (7%) (Hutchinson 1957, LVBC b 2011). The catchment encompasses the Rwanda, Burundi, Kenya, Tanzania and Uganda who are the member states of the East African Community (EAC). The gross annual economic product from Lake Victoria catchment is in the order of US$3–4 billion, and it supports an estimated population of over 25 million at per capita annual incomes in the range US$90–270. The lake catchment is therefore provides for the livelihood of large populations of Kenya, Tanzania and Uganda, and about one third of the combined gross domestic product (Mailu 2001). The lake catchment economy is principally an agricultural one, with a number of crops and a high level of subsistence fishing and agriculture (Mailu 2001). Commercial fishery with fish export is a main source of revenue in the Lake Victoria Basin (LVB).

1.2 Water hyacinth infestation in the Lake Victoria Basin

In recent years, the Lake Victoria and its rivers system has been greatly affected by the water hyacinth and other noxious weeds proliferation and this has resulted into several social, economic and environmental challenges to the countries as well as the dependent riparian communities. The impacts are

in terms of loss of livelihood by fisher folks, declining commercial fisheries in the lake, increasing environmental pollution and clogging of hydroelectric dam and water abstraction points for water utilities (see LVBCa , 2011). The rapid urbanization and industrialization in the Lake Basin have increased uncontrolled pollution discharges into Lake Victoria that cause the shallower parts of the lake to become rich in nutrients and promote weed infestation. The root causes of pollution are nutrient rich discharges from wastewater treatment plants, industrial effluents, urban storm water and poor agricultural practise and land degradation (e.g. soil erosion) that discharge nutrients into the lake. Since the 1980s the member states have been grappling with invasive aquatic weed problems and trying various control methods to obviate their impacts. The LVB has sub-catchments having rivers that discharge into the lake (Fig 1).

Figure 1: The Lake Victoria basin showing the sub-catchments and tributary rivers (source: Clean Lakes Inc. 2001)

Most of these rivers (e.g. Mara, Kagera, Katonga, and Nzoia) in these catchments are infested by water hyacinth. The River Kagera system remains a major source of the water hyacinth input into Lake Victoria. When it reaches Lake Victoria, the water hyacinth is spread rapidly within the lake by the south easterly winds (Fig.2) and water currents influenced by the River Nile current system that cause the spread of propagules into sheltered bays and inlets along the lake shores.

Some of these bays are nutrient rich (eutrophic) and support rapid proliferation of water hyacinth. The water hyacinths become resident (trapped) in sheltered bays causing serious social, economic and environmental effects.

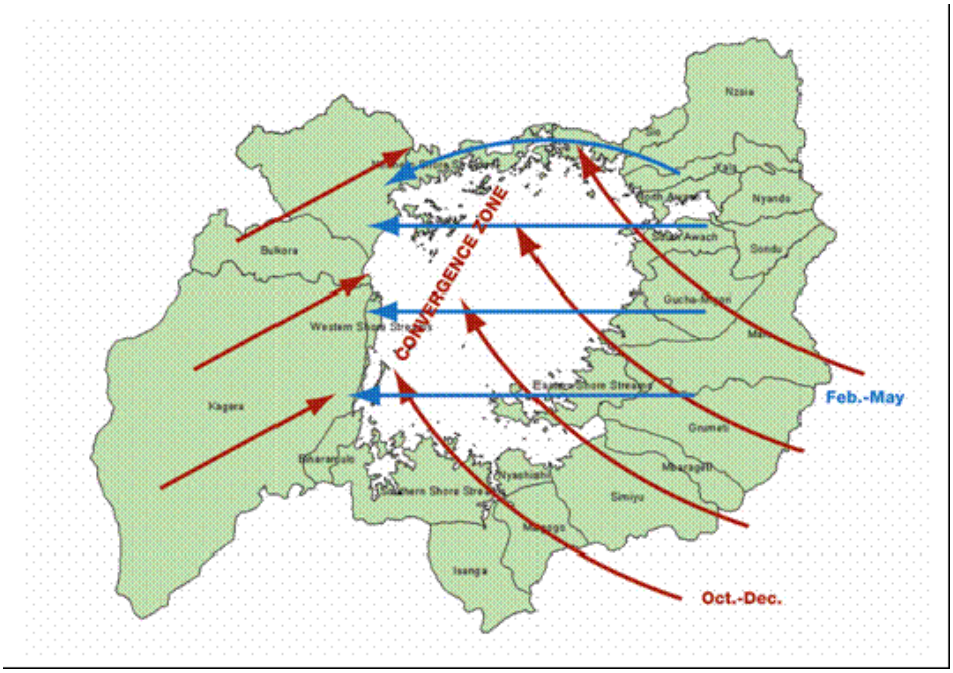


Figure 2: Seasonal wind pattern over Lake Victoria (Source: LVEMP 2005)

1.2.1 Water hyacinth control efforts

In Uganda efforts to control water hyacinth started slowly because many decision makers were not convinced of the serious nature of the weed given that this was the first time for such massive infestation to occur. It was the fisher-folks who were being directly impacted who started to voluntarily physically clear the weeds. Having recognised the community efforts, the government created the Water Hyacinth Unit at the Ministry of Agriculture Animal Industry and Fisheries to coordinate all initiatives. This Unit distributed hand tools to help in removing the weeds to various fish landing sites. Physical removal of water hyacinth was only successful in small fish landing sites, but ineffective and unsustainable in large landings.

The shortcomings of physical removal caused nutrient rich and sheltered bays to be completely covered with water hyacinth and cut off, while the water intakes for water works and the Owen falls dam were clogged with the weed that caused serious operational interruption. At this stage the mechanical removal option was introduced to remove weeds at the Owen Fall dam and the piers at Jinja and Port Bell. The mechanical harvesters however proved unaffordable because of frequent break down, repair costs and the loss of time. The application of biological control agents (*Neochetina bruchi* and *Neochetina eichorniae*) was introduced thereafter. This control option was to become the most predominant and largely acceptable method for the control of water hyacinth not only in the waters of Lake Victoria.

It may also be worth noting that, in the region, trials of chemical control using a pesticide namely: Diquat, 2, 4-D amine and Glyphosate were undertaken in Uganda but because of inconclusive results combined with public pressure mainly driven by the fear of loss of market for Nile perch, it was never adopted or used in the control of the weeds (LVBC 2011).

Meanwhile, Tanzania at the onset basing on the lessons from Uganda adopted the most efficient approach: the Integrated Weed Management (IWM) approach involving using the biological control agents (weevils) and manual removal of water hyacinth at strategic locations (Mallya *et al.,* 2001). The control programme coordinated by the Ministry of Agriculture and Food Security put in place efficient mechanism for collaboration with communities while at the same time implementing quarantine regulations and nutrient influx management towards attaining sustainable management of the weed. Communities and NGOs were involved in manual removal of water hyacinth and government provided hand tools to the communities. Water Hyacinth Control Regulations were also prepared in 1999 based on the National Plant Protection Act (No. 13 of 1997) to guide the entire control process.

In Kenya the mechanical and biological control methods were the two main options employed to manage water hyacinth. Mites were also used in Kenya for water hyacinth control and the mites have now spread throughout Lake Victoria. The effectiveness of the mites is not well documented. The mechanical option, unlike as applied in Uganda, involved removal, shredding and dumping of the shredded weeds back into the waters. This aspect was particularly applied at Kisumu bay but with disastrous effects on water quality in the long run when the weed rotted and sank. The communities were involved in the biological control programme by rearing the weevils. The project managed to significantly reduce weed coverage in the bays between 1999 and 2000 and the process was guided by the Kenya Agricultural Research Institute (KARI) although by the end of the life time of the Lake Victoria Environment Management Project (LVEMP) that supported Kenya Agricultural Research Institute (KARI), the routine control arrangements were not well institutionalised or anchored in a specific government ministry.

Water hyacinth control efforts in Kenya, Uganda and Tanzania registered significant results whereby weeds cover in Lake Victoria, in hectares dropped between 1999 and 2001 (Fig 3).

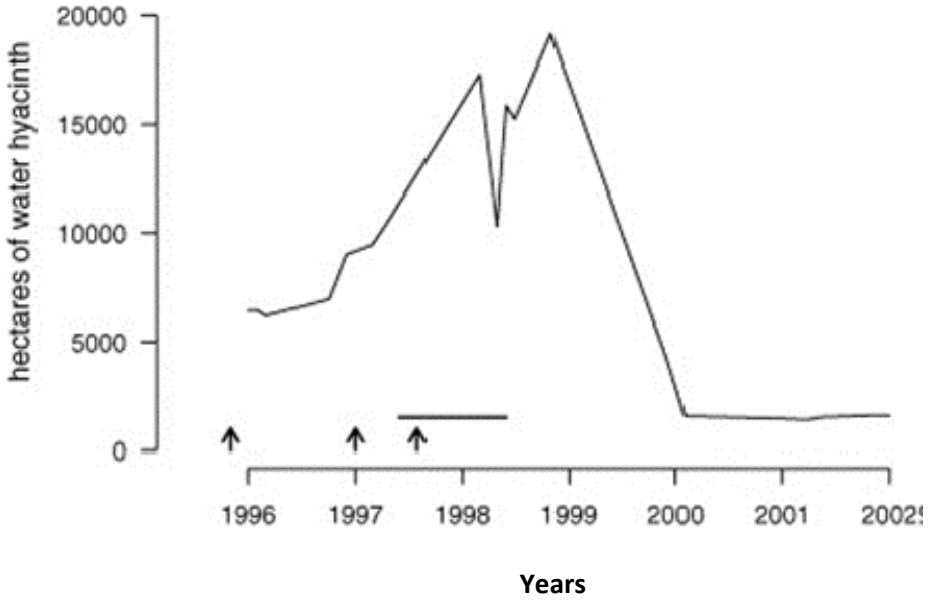


Figure 3: Water hyacinth coverage on Lake Victoria based on remote sensing data (adapted from Albright et al., 2004). The arrows show the date of first release of weevil species onto different parts of the lake (Uganda, Kenya, and Tanzania, respectively, in order of date). The line shows the occurrence of an El Niño weather pattern (Source: Wilson *et al.*, 2007).

1.3 Occurrences, extent, density, and likely increase of water hyacinth infestation in the Lake Victoria Basin

In this section analysis of the extent of water hyacinth proliferation of water bodies in the LVB and hotspots that should be targeted during the strategy implementation are detailed.

1.3.1 Overview

Currently, water hyacinth is one of the most noxious aquatic weeds found in water bodies of all the five EAC Partner States In this section, historical and recent water hyacinth infestations, in each Partner State are reviewed in the following subsections.

1.3.2 Burundi

Water hyacinth occurs mostly in Lakes Rweru and Kanzigiri and River Kagera regions of the LVB of Burundi. Both Lake Rweru and River Kagera are shared between Burundi and Rwanda. Water hyacinth invades the Rwanda portion of Lake Rweru during the rainy season. However, it is known that the water hyacinth trans-located by the lake waters has so far not established extensive resident mats. Water hyacinth mats that get established on Lake Rweru, in Burundi, are brought by the flooding of River Kagera. The water hyacinth observed in Lake Rweru was of a dwarf nature, in full blossom but chocked by native water plants typical of most other water hyacinth observed elsewhere in the Lake Victoria Basin as illustrated in Figure 4. Shoreline infestations about three meters wide were reported to occur in parts of the southern extremity of the lake. Fishermen reported the presence of much more water hyacinth and islands of papyrus floating about the lake from the Rwanda portion of the lake during the rainy season.

Spatially, the historical extent and occurrence of water hyacinth (within the Lake Victoria part of Burundi) has not been mapped in Burundi. To obtain

recent water hyacinth infestation data a GPS was used to map the 2011 occurrence in Burundi (Fig 5).

Figure 4: A highly prolific patch of water hyacinth in the lower floodplain of River Kagera that illustrate how the weed infests the Lake Victoria Basin (Source Twongo, *et al.*, 2002).

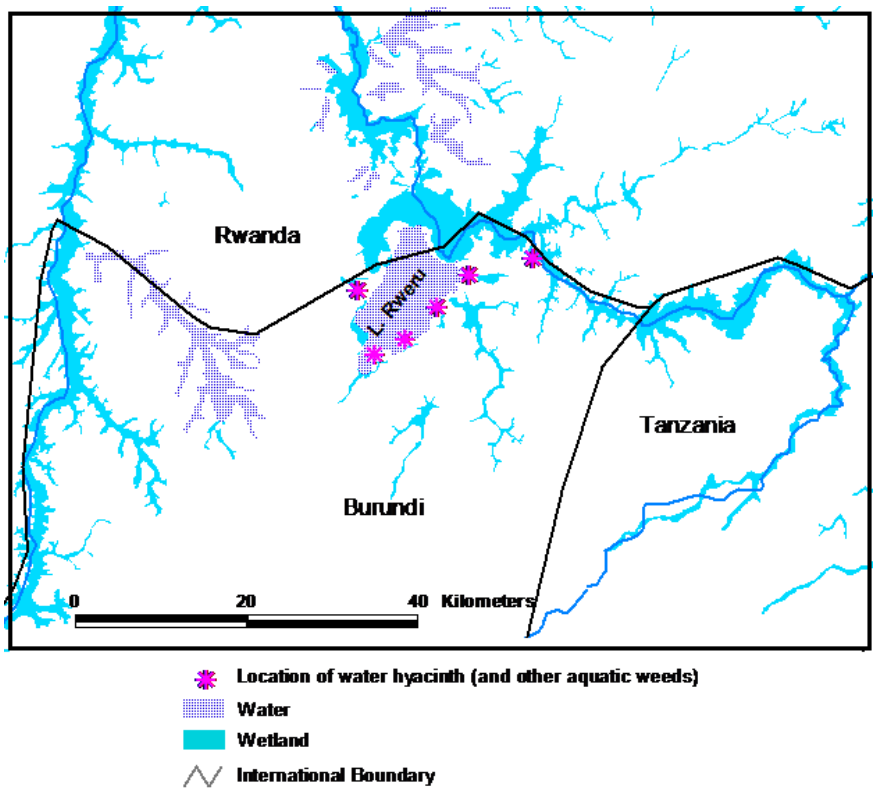


Figure 5: Occurrence of water hyacinth (2011) within the Rweru and Kagera region mapped using a GPS.

As illustrated in Figure 5, the distribution of water hyacinth in 2011 is still concentrated within the Rweru and Kagera region at the border between Burundi and Rwanda as the historical account of water hyacinth presented in the previous paragraphs indicated. Additional spatial information on the distribution of the weed that includes the geographic distribution, density and geographic extent of the water hyacinth (and other aquatic weeds) within the Lake Victoria Basin of Burundi will be collected during the implementation of this strategy.

1.3.3 Kenya

In Kenya water hyacinth was first reported in 1988 in Lake Naivasha and the weed appeared in Lake Victoria part of the country in 1992. Water hyacinth

subsequently gained access to many other surface water bodies in the Lake Victoria basin of Kenya including rivers, dams, and ponds. However, explosive proliferation of water hyacinth got established in the nutrient-rich bays such of Kisumu, Kendu, Nyakach and Homa in the mid 1990s. Water Hyacinth proliferation peaked to 6,000 ha in Kenyan waters of Lake Victoria (EAC 1999) and dropped to lowest coverage in February 2000 at approximately 500 ha following biomass collapse largely attributed to the effects of biological control weevils and strong wave action.

Spatially, the proliferation of water hyacinth in the Kenya waters of Lake Victoria (in the mid 1990s) translates into a geographic extent and distribution shown in Figures 6, 7 and 8.

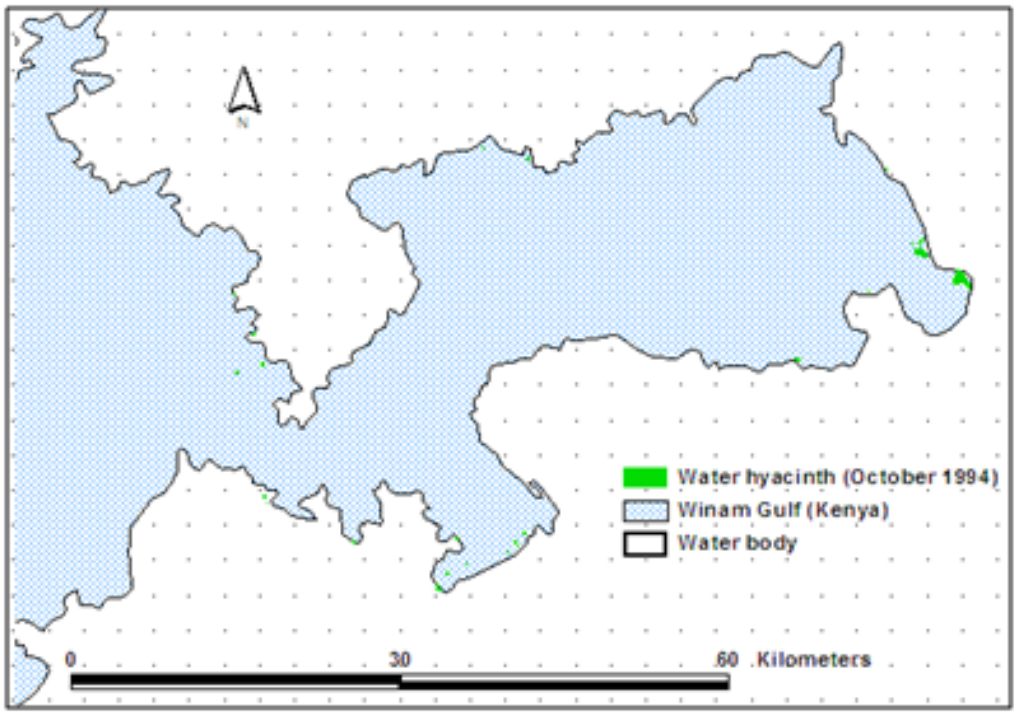


Figure 6: Winam Gulf (Lake Victoria) depicting water hyacinth distribution in October 1994 [source: Clean Lakes Incorporated, 2000].

While Figure 6 shows that there were visible mats of water hyacinth in the Winam Gulf, in October 1994, the geographic extent of the weed was still limited, accounting for only about 470 ha (Clean Lakes Incorporated, 2000).

However, at the peak of water hyacinth infestation, Winam Gulf had widespread and extensive mats (Figure 7). Based on the water hyacinth maps produced by Clean Lakes Incorporated, it was estimated that the water hyacinth mats present in the Winam Gulf covered an estimated area of about 17,200 ha, making it the largest coverage of the weed recorded for an observed area on Lake Victoria for the period 1989 – 2001.

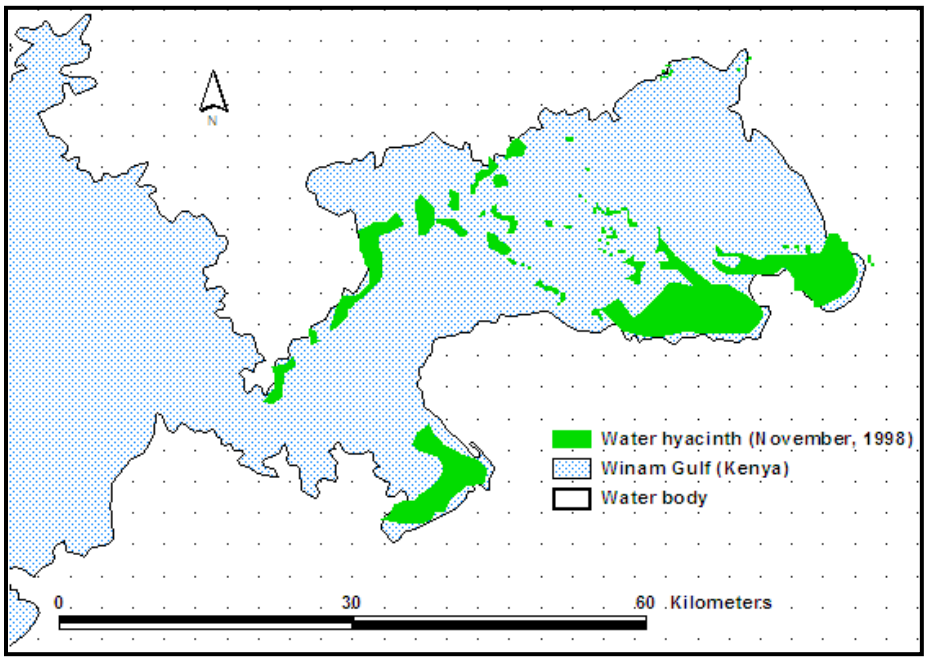


Figure 7: Winam Gulf depicting widespread and geographically extensive water hyacinth mats in November 1998 [source: Clean Lakes Incorporated, 2000].

However, based on Figure 8, by 2001 the extent and distribution of water hyacinth in the Winam Gulf was about 1690 ha. As reported earlier, if by February 2000 water hyacinth infestation had declined to only 500 ha in the Winam Gulf, it may imply that there was a resurgence of the weed in May 2001. A follow up analysis of remotely sensed images, by the Lake Victoria Basin Commission, illustrated a significant resurgence of water hyacinth in Winam Gulf between 2002 and 2004 (LVBC 2011). The resurgence peaked in July 2007 with a weed cover of approximately 9,300 ha (Figure 9).

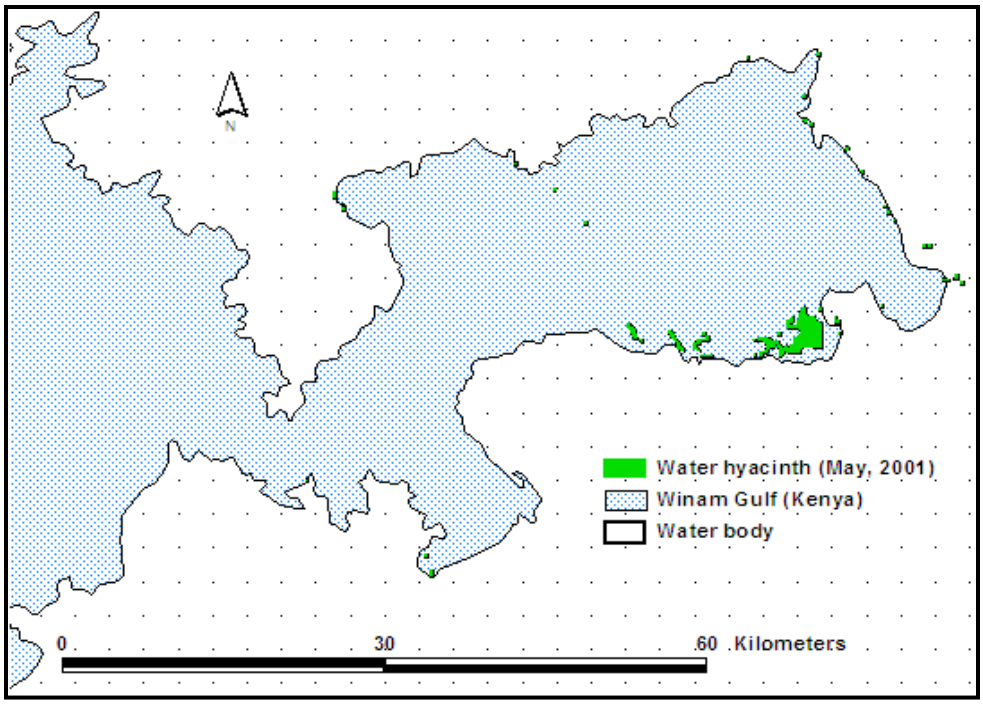


Figure 8: Winam Gulf depicting the occurrence of hyacinth mats in May 2001 [source: Clean Lakes Incorporated, 2000].

Figure 9(a): Extent and distribution of water hyacinth (and other macrophyte species) in Nyanza Gulf in May 2006 [source: LVBC 2011].

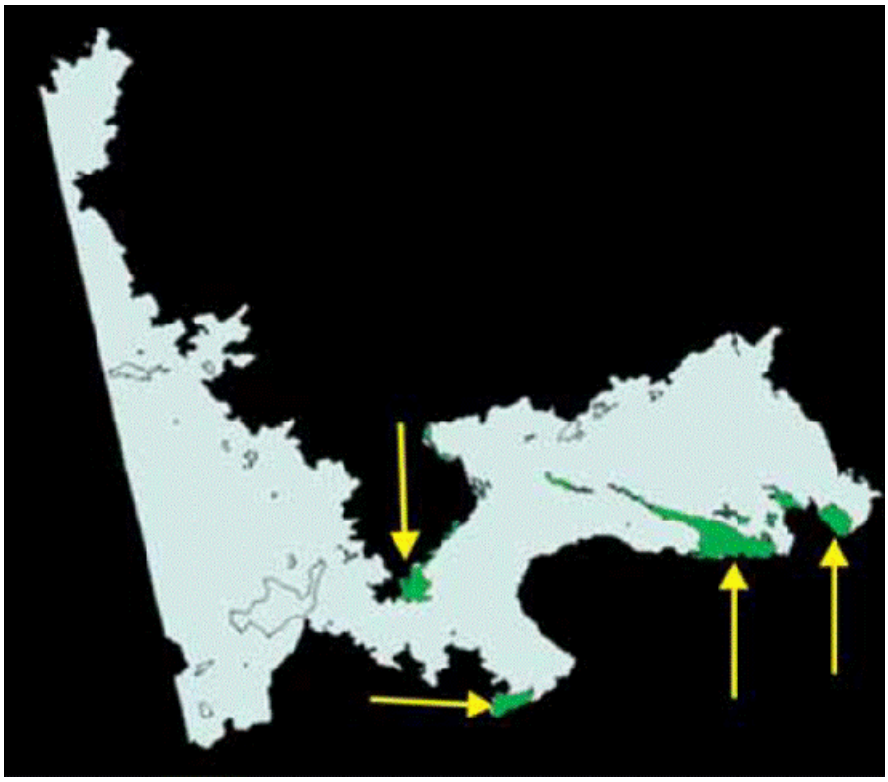


Figure 9(b): Extent and distribution of water hyacinth (and other macrophyte species) in Nyanza Gulf in July 2007 source: LVBC 2011].

Figure 9(c): Extent and distribution of water hyacinth (and other macrophyte species) Nyanza Gulf in February –September 2008[source: LVBC 2011].

Within the *Winam* Gulf, ground truthing exercise undertaken to assess the species composition of the macrophytes in the resurgence revealed co-dominance of water hyacinth and hippo grass, the climax vegetation of the ecological succession that often occurs during the rainy season. Several native plants such as *Leersia hexandra*, various sedges, *Ipomoea aquatica* and the wandering jew (*Commelina bengalensis*) usually initiated the succession, followed by aquatic ferns and or hippo grass (*Vossia cuspidata*). Other aquatic weds common in Lake Victoria are *Pistia stratiotes*, *Azolla spp, Lemna spp, Trapa natans, Nympaea lotus* and submerged *Potamogenton schweinfurthii, Vallisneria spirallis, Ceratophyllum demersum, Najas horrid*.

The climax succession of hippo grass in Winam Gulf seems to last much longer (LVBC 2011). A spectacular example was the vast expanse of hippo grass dominated succession that settled in Kisumu Bay in the 2008 (Figure 10). Clearly ecological succession involving hippo grass in Winam Gulf creates significant ecological and socio-economic constraints. What keeps the hippo grass mats in Kisumu Bay intact for much longer may inform the development of management strategies for the hippo grass succession in Winam Gulf. In 2010, the location and distribution of water hyacinth within the Lake Victoria of Kenya is depicted in Figure 11.

Figure 10: Hippo grass dominated succession covered a large zone of Kisumu Bay - Kenya in the late 1990s (Source: NARO – NaFIRRI, 2002).

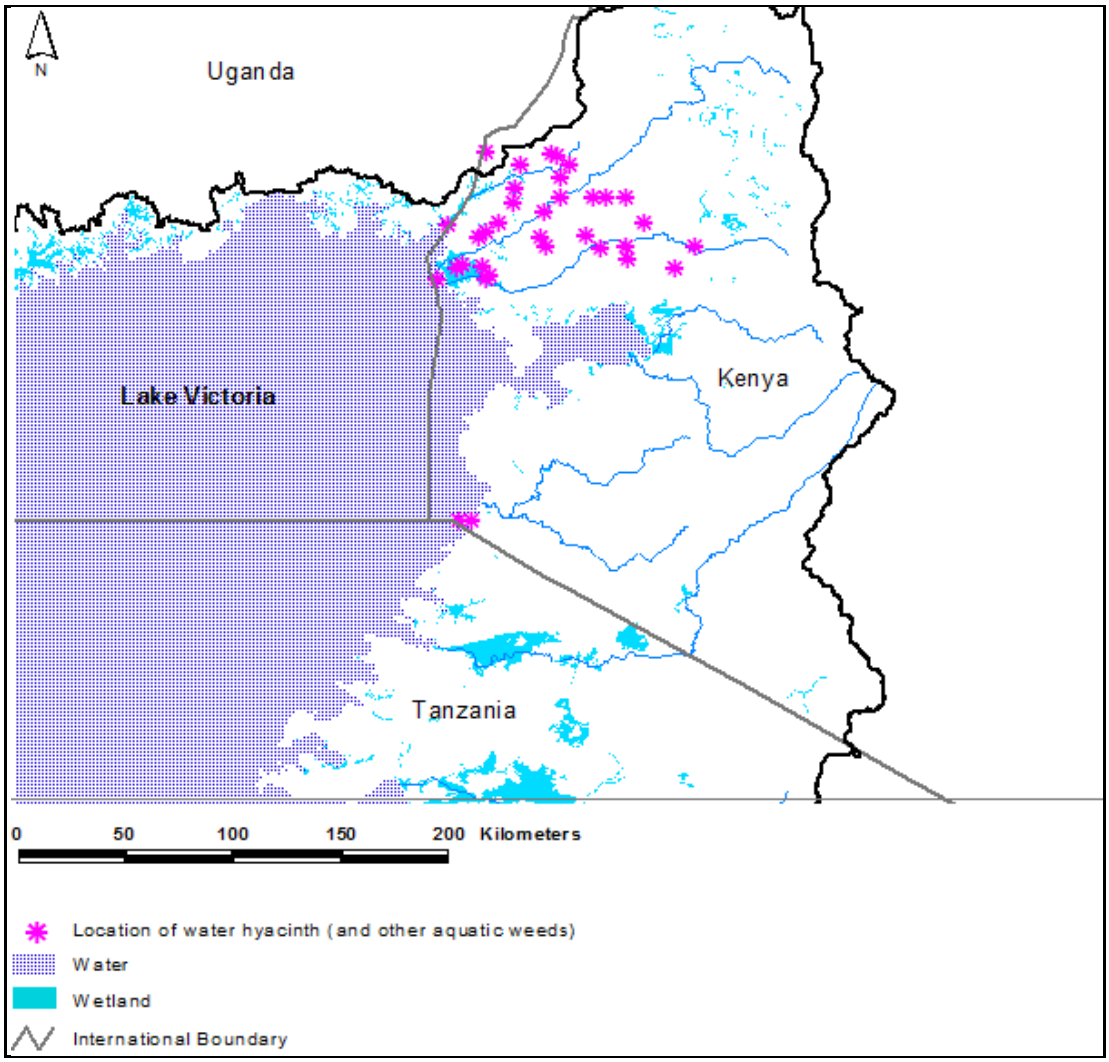


Figure 11: GPS-based occurrence of water hyacinth (2010) within the Lake Victoria Basin of Kenya.

Annex 1.1 provides the overall water hyacinth coverage changes on the Kenyan side of Lake Victoria, while Annex 1.2 displays water hyacinth infestation hotspots and their status.

1.3. 4 Rwanda

The highest altitude location of water hyacinth within the Lake Victoria Basin is perhaps Lake Ruhondo and the tributaries of River Nyabarongo in Ruhengeri Prefecture, Kagera River System in north-western Rwanda. The presence of

water hyacinth in the upstream lower reaches of River Akanyaru was reported as early as the mid 1980's. The Nyabarongo and Akanyaru join to form River Kagera of Rwanda. The River Kagera that arises from the Rivers Nyabarongo and Akanyaru is probably the most prolific water hyacinth production zone of the entire river system. Water hyacinth proliferation occurs along the riverbanks as well as in an extensive system of small lakes, water pools and canals. When River Kagera is in flood, water hyacinth is seasonally flushed into and possibly flushed out of some of the satellite lakes. Lake Rweru that is shared by Rwanda and Burundi receives water hyacinth from River Kagera but does not seem to support luxurious mats of the weed. Substantial quantities of water hyacinth however cover the lake only after the transfer from the River Kagera during the rainy season.

River Ruvubu from Burundi joins the Kagera at the Rwanda/Tanzania border and it is free of water hyacinth. When water hyacinth reach the Rusumo falls across River Kagera at the Rwanda and Tanzania area they are continuously crushed to pieces on the rocks (Figure 12). During floods River Kagera floods water hyacinth is deposited and multiplies in some lakes including lakes Mihindi, Nasho, Cyambwe, Ihema, and Mpanga. Moorehouse (2001) estimated water hyacinth coverage in these lakes at 270 ha in December 1996 and at a peak of 610 ha in April 1997.

Water hyacinth from River Kagera continuously enters Lake Victoria. It was visually estimated by CLI (1997) that within 1km of Lake Victoria the daily rate of water hyacinth flowing down the Kagera River ranges between 0.2 and more than 1.5 ha/day (average 0.75 ha/day or 300 ha/year). Others have estimated water hyacinth flow rates at 3.5 ha/week or 0.5 ha/day (Twongo and Balirwa 1995). Future estimates of water hyacinth inflow into Lake Victoria, from River Kagera, are required to update some of these flow rates which are now at best historical information.

There are few reports with spatial information of the weed in Rwanda. However Lake Mihindi was mapped indicating widespread water hyacinth infestation in 1995 showing some signs of decline in 1999 and 2001 (Figure 13). The distribution of water hyacinth for Rwanda mapped in 2011 is displayed by Figure 14, which was estimated at about 100 ha of water hyacinth in Rwandan water bodies.

Figure 12: Water hyacinth crashed to pieces on the rocks at Rusumo Falls, Rwanda-Tanzania border (Source Twongo, *et al.*, 2002).

Figure 13: Lake Mahindi showing the distribution of water hyacinth in 1996 (top), 1999 (middle) and 2001 (bottom)

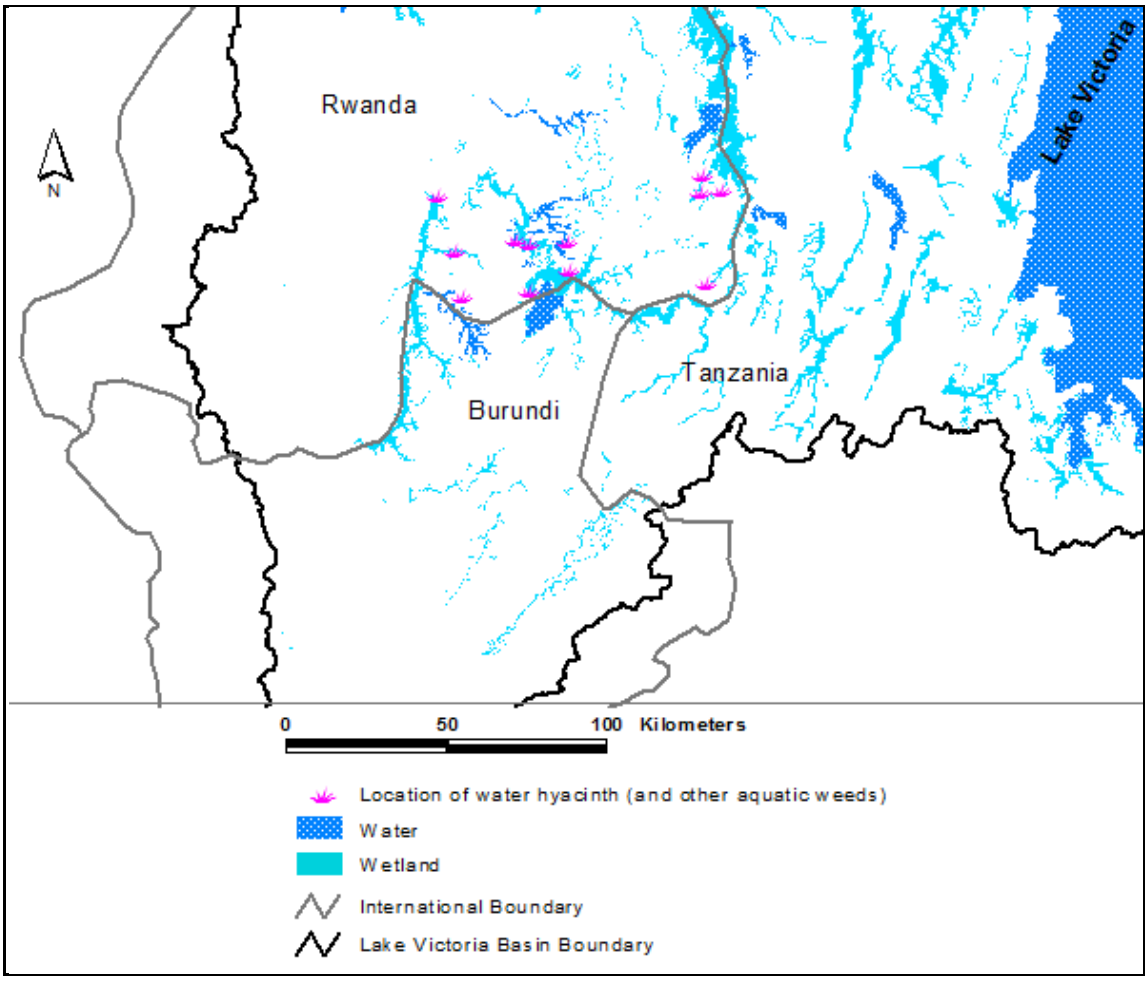


Figure 14: Location of water hyacinth/other aquatic weeds in Rwanda in 2011.

1.3.5 Tanzania

Tanzania was the first country in East Africa where water hyacinth was seen in Tanga region along River Sigi in 1955. Additional sightings later followed in River Pangani in 1964. All these sightings were outside Lake Victoria Basin. However, water hyacinth invaded the Tanzanian portion of Lake Victoria in the late 1980s via River Kagera. The spread of water hyacinth to the eastern sheltered shores of Lake Victoria was rapid and it was from here that extensive distribution and proliferation occurred to other parts of the country and beyond. In Tanzania, the infestations were mostly located in Mara Bay,

Bauman Gulf, Speke Gulf, Mwanza Gulf and Emin Pasha Gulf; and Rubafu Bay all in Mara, Mwanza, and Kagera regions respectively. Peak infestation was estimated at 2,000 ha by 1998 (LVEMP 1999).

Spatially, the infestation of water hyacinth in Tanzanian waters (Lake Victoria) in the 1990s and early 2000s is exemplified using Emin Pasha Gulf [Figure 15(a)-(c)]. Water hyacinth peaked (about 3550 ha) in Emin Pasha Gulf around March 1998 [Figure 15(b)].

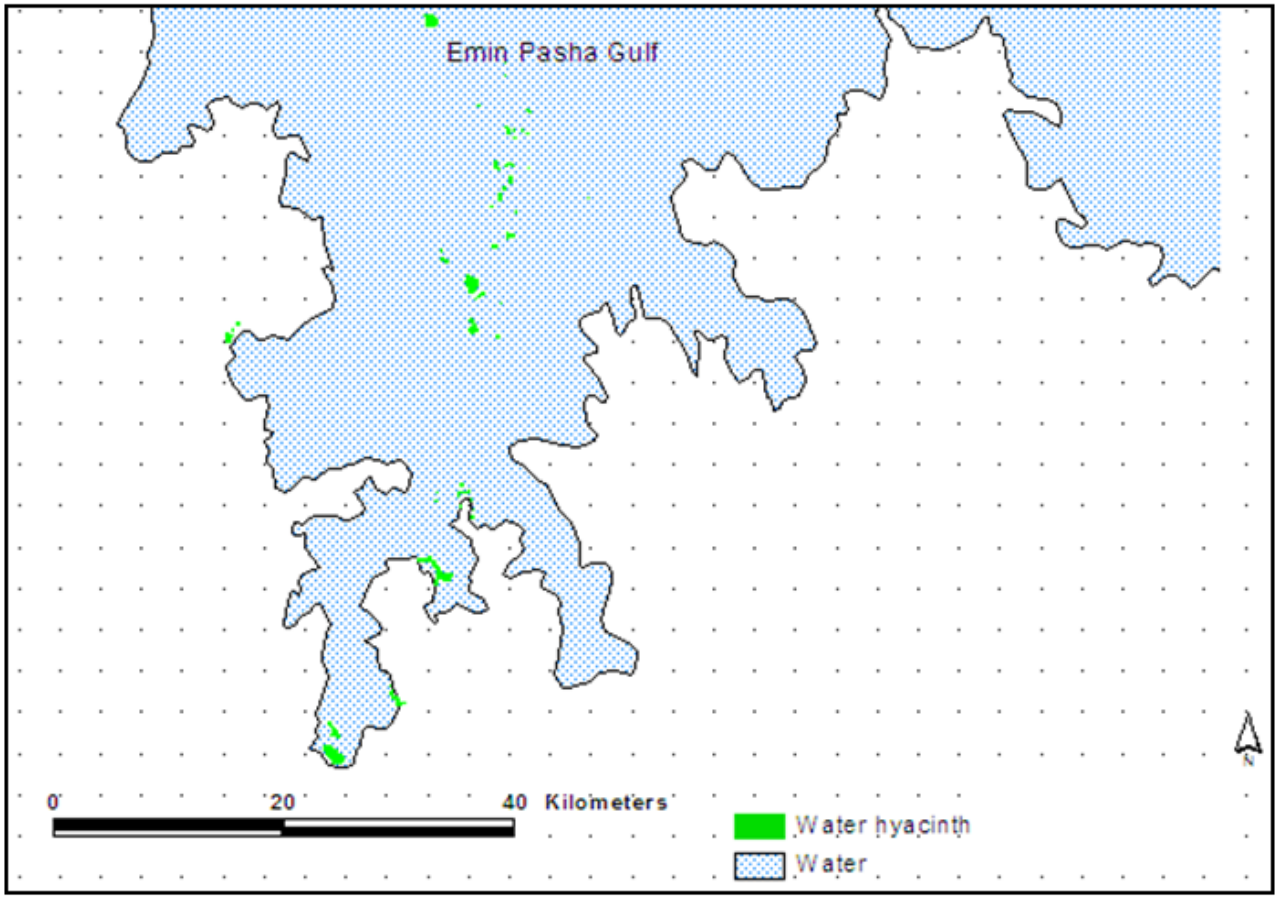


Figure 15(a): Emin Pasha Gulf (Tanzania): Water hyacinth distribution in December 1996 [source: Clean Lakes Incorporated, 2001].

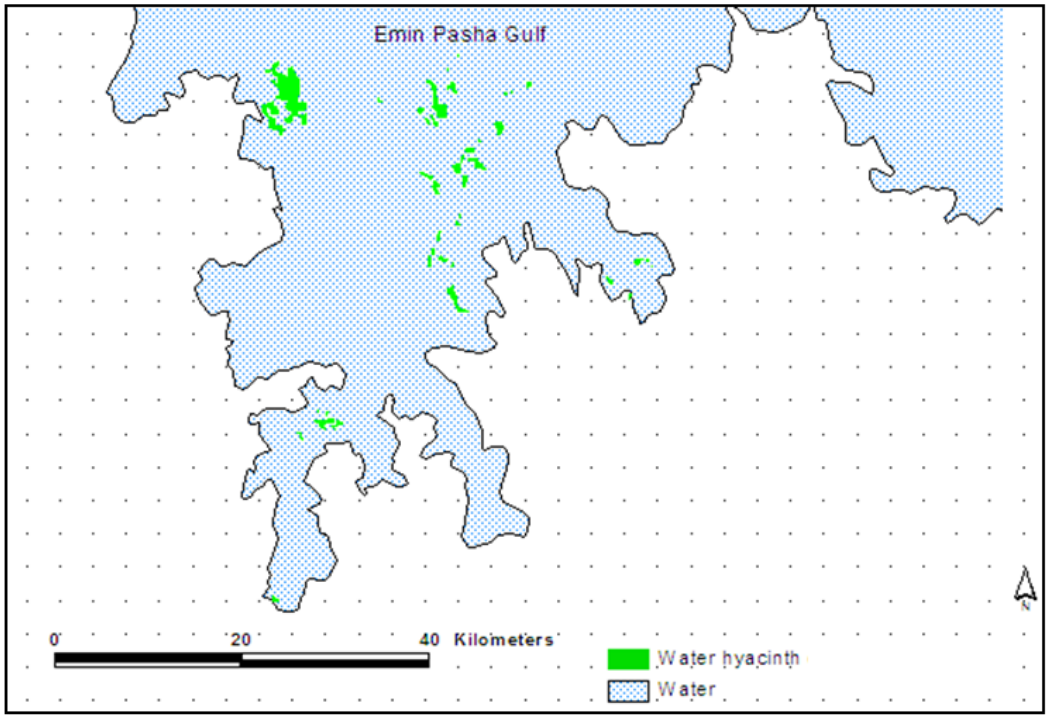


Figure 15(b): Emin Pasha Gulf (Tanzania): water hyacinth distribution in March 1998 [source: Clean Lakes Incorporated, 2001].

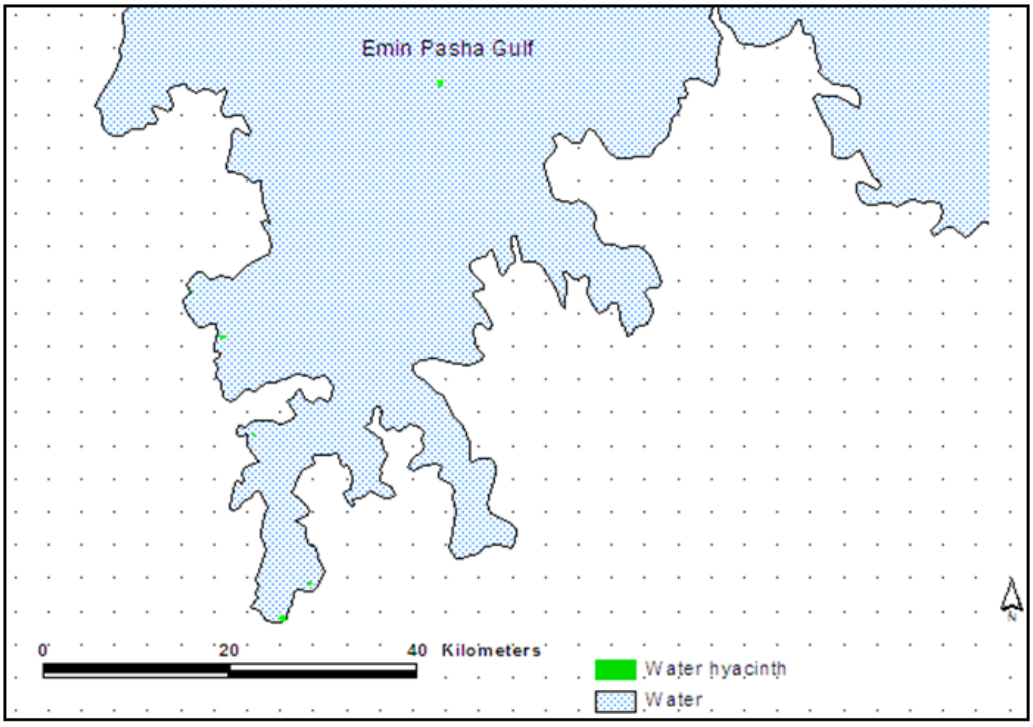


Figure 15(c): Emin Pasha Gulf (Tanzania): water hyacinth distribution in November 2001 [source: *Clean Lakes Incorporated, 2001*].

By 2001 water hyacinth had dramatically reduced (as a result of intensive control) as depicted in Figure 15(c). Data from the most recent ground surveys (December 2010) indicates presence of water hyacinth to be about 519 ha (Annex1.3) in the Lake Victoria Basin of Tanzania. Figure 16 depicts where the survey was conducted for the data shown in Annex1.3.

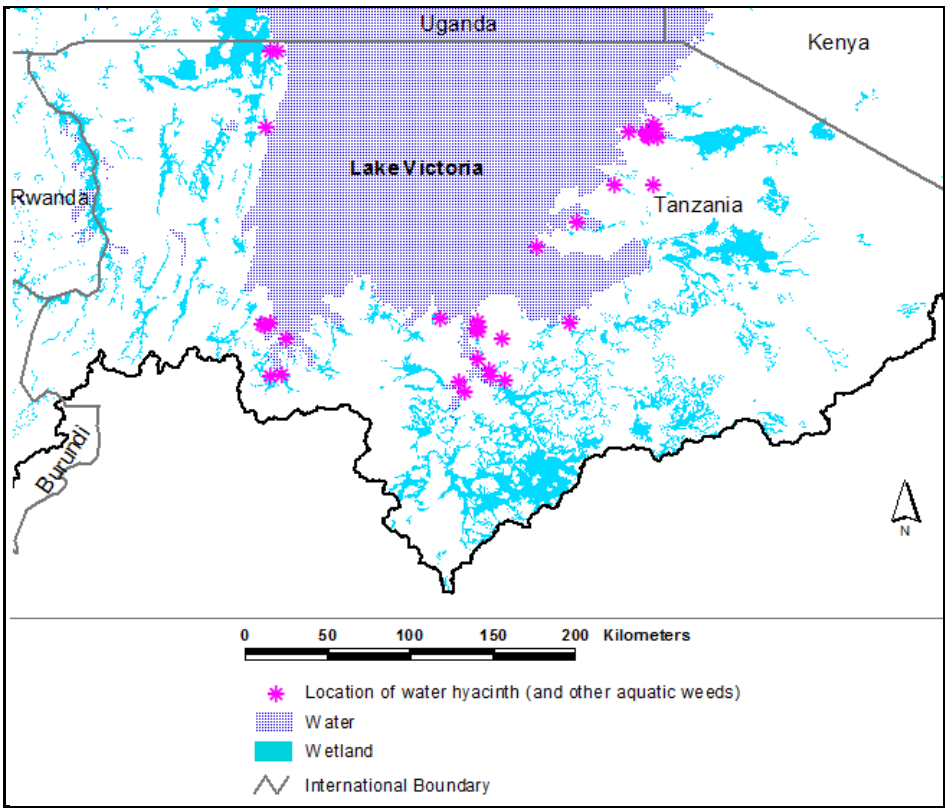


Figure 16: Distribution of water hyacinth in Tanzania in December, 2010.

1.3.6 Uganda

Water hyacinth was first reported in Uganda in Lake Kyoga (outside the Lake Victoria Basin) in 1988. By 1990, the water hyacinth had spread down the River Nile to Lake Albert and the Albert Nile. Water hyacinth entered Lake Victoria via River Kagera around the end of 1987 (Mallya et al., 2001). The noxious weed was not reported in the Ugandan sector of the lake, in significant

quantities, until 1989 (Taylor 1993). The numerous sheltered bays and inlets typical of the western and northern shoreline of Lake Victoria were the initial suitable habitats and acted as breeding grounds and proliferation of water hyacinth in the Lake Victoria of Uganda (Twongo *et al.,* 1995). At their maximum extent stationary water hyacinth mats were estimated to fringe about 80% of shoreline length in Uganda, and covered an estimated total area of 2,200 ha (NARO-NaFIRRI, 2002).

Formation of mobile water hyacinth mats started during the early 1990s when stationary water hyacinth along the shores expanded beyond the maximum shelter threshold provided by shoreline topography. This event signalled the beginning of extensive weed redistribution on Lake Victoria. Murchison Bay was the most efficient 'nursery' for water hyacinth production in Uganda due to input of enriched effluents from Kampala city. Murchison Bay was also the source of water hyacinth to other sheltered bays in Uganda. During the last quarter of every year, gusts of strong winds convey mobile weed mats from some sheltered bays notably from Murchison Bay to the open lake. For Uganda, Murchison Bay has been used, in this report, to exemplify the spatial distribution of water hyacinth for the period 1995-2001 as shown in Figure 17 (a)-(c). By January 1995 there were extensive mats of water hyacinth in the Murchison Bay. The mapped data [Figure 17(b)] suggests that the weed peaked around the 1995/1996 period.

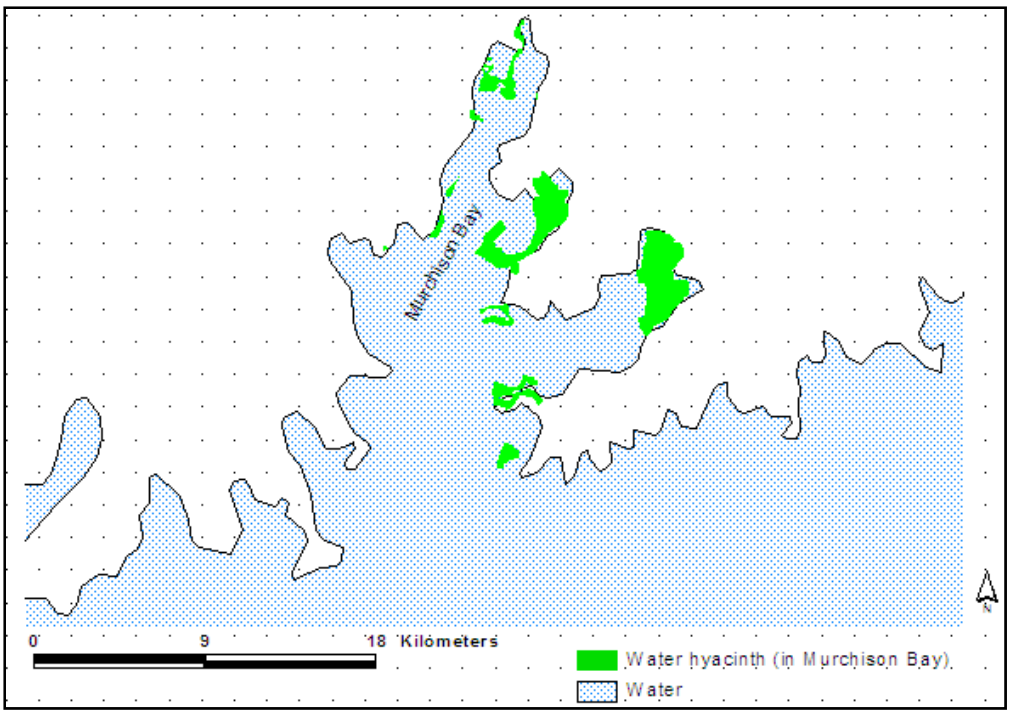


Figure 17(a): Water hyacinth distribution in Murchison Bay (Uganda) in January 1995 [source: Clean Lakes Incorporated, 2001].

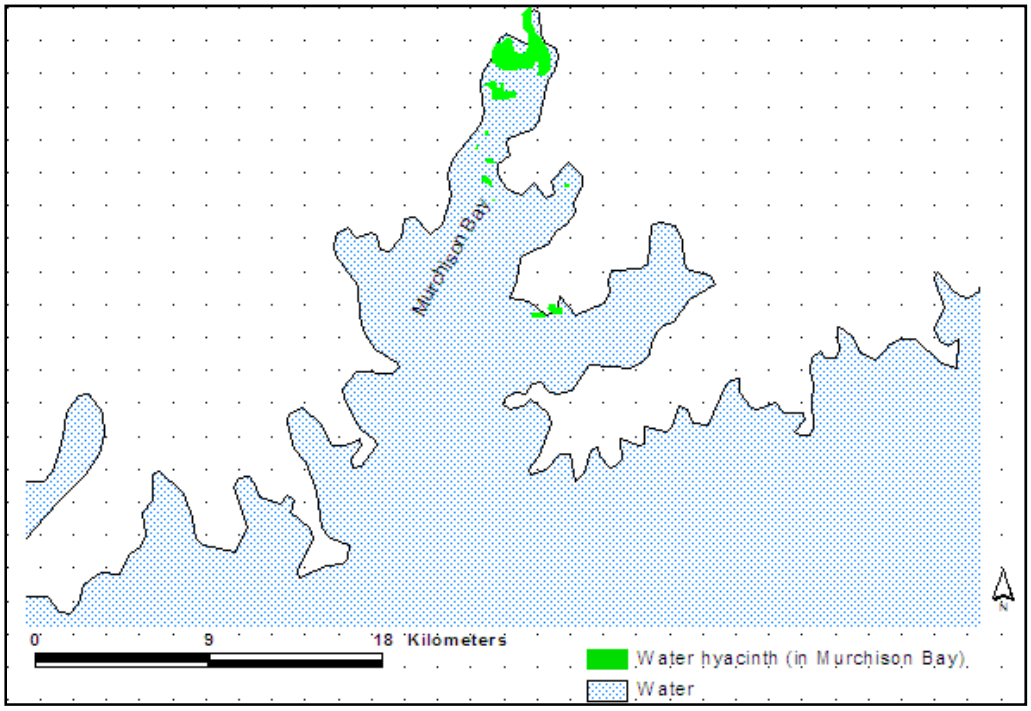


Figure 17(b): Water hyacinth distribution in Murchison Bay (Uganda) in November 1998 [source: *Clean Lakes Incorporated, 2001*].

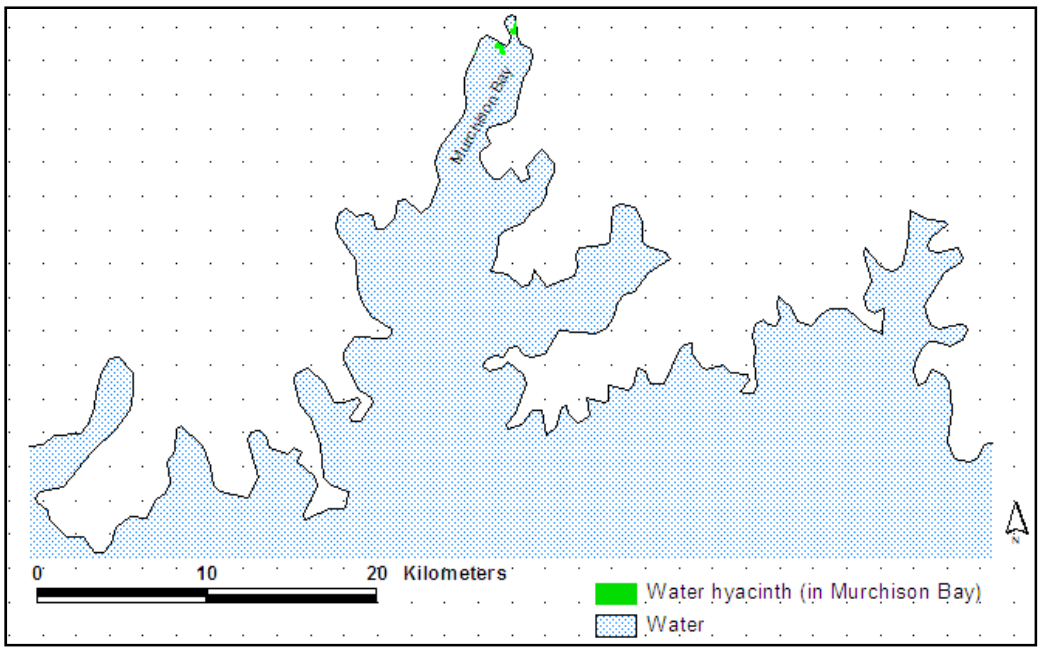


Figure 17 (c): Water hyacinth distribution in Murchison Bay (Uganda) in April 2001 [source: Clean Lakes Incorporated, 2001].

While the extent and distribution of water hyacinth, in the Murchison Bay, was estimated at 658.8ha in 1998, it was only 50.5 ha in 2001. Prevailing winds relocated most of the mobile weed biomass into three strategically positioned sheltered bays of Waiya, Thruston and Hannington (Figure 18) in the northern part of Lake Victoria in Ugandan (Schouten *et al.,* 1999). Once in these three sheltered bays, the water hyacinth biomass was rarely evacuated. Weed biomass was accumulated and confined in the bays from about 1992 to 1997. The temporal water hyacinth production and storage capacity of a number of sheltered bays in northern Lake Victoria in Uganda are illustrated in Annex1.4.

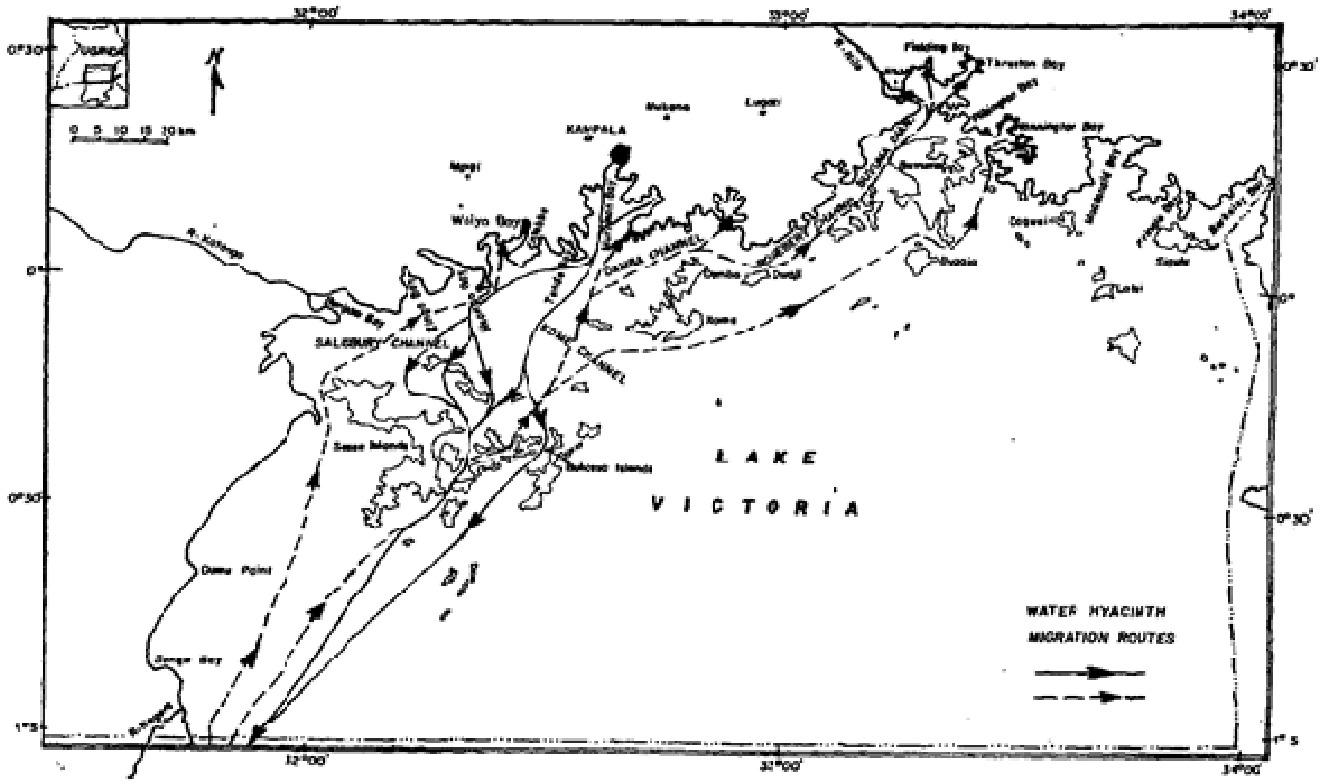


Figure 18: Water hyacinth migration routes from the production bay (Murchison) to the storage bays (Thruston, Hannington and Waiya). Re-drawn from Schouten *et al.*, (1999).

The weed cover diminished in some of the bays such as Macdonald and Pringle. This decline was attributed to the decline in reserves of essential nutrients especially Phosphorus. The drastic decline in water hyacinth cover/biomass especially in sheltered bays that occurred starting in the second half of 1998 (Annex1.4) was mainly attributed to biological control (Ogwang and Molo, 1999) enhanced by complex environmental dynamics in the vast Lake Victoria (Kayanja, 2000).

Water hyacinth infestation level estimates during a survey in December 2006 indicated that 36.8 ha of water hyacinth existed in the major hot spot areas at the 16 sites. In 2010 the weed covered about a few hectares in the Lake Victoria Basin of Uganda (Figure 19). In 2011, it was found out that only

limited re-occurrence of water hyacinth had taken place in the previous hot spot bays of Murchison, Hannington and Thruston. It was also observed that other aquatic macrophytes continue to exist in these bays either singly or in succession form and were mainly *Cyperus mundit*, *Typha domingensis*, *Azola*, Nymphaea, *Ceratophylum, Najas horrida* and *Pistia stratiotes.*

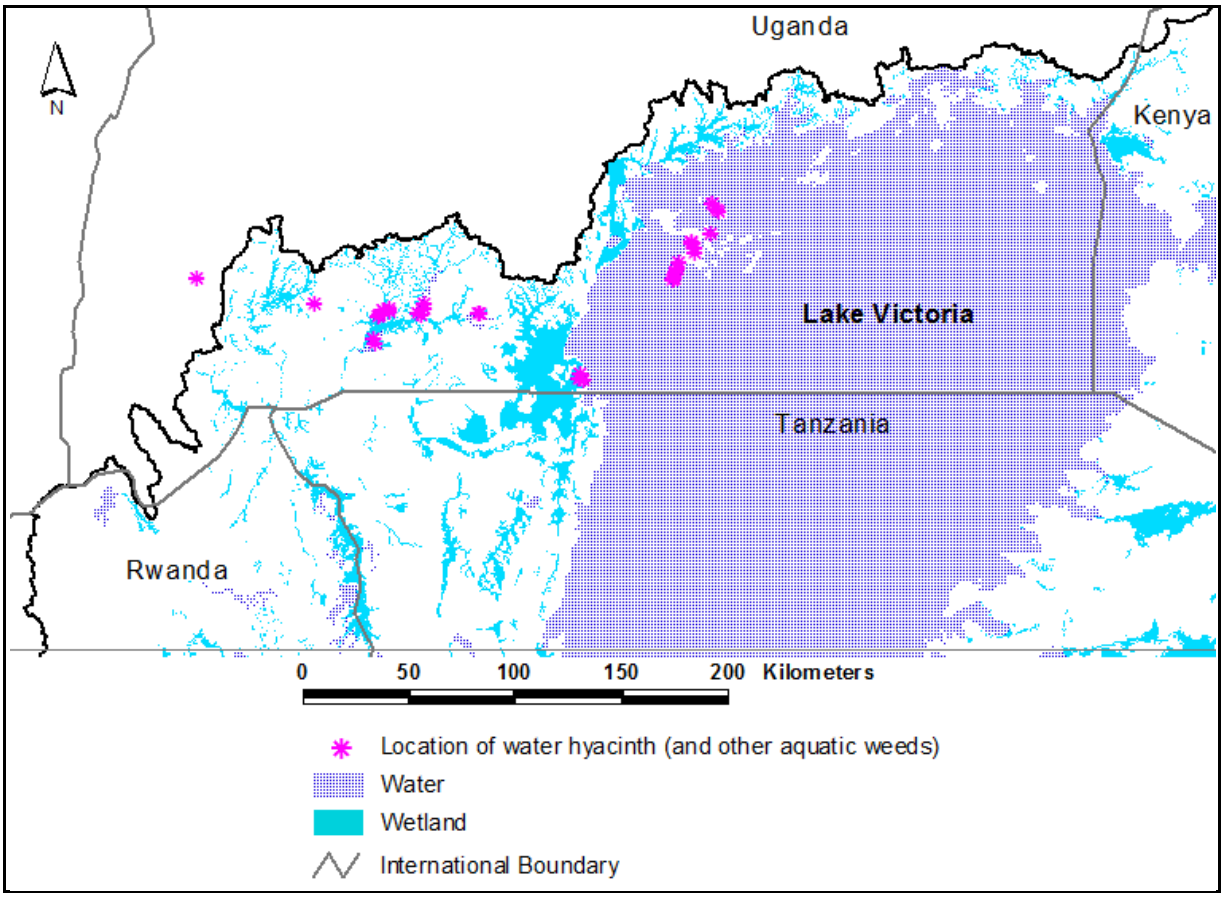


Figure 19: Distribution of water hyacinth in Uganda, 2010.

1.3.7 Hotspot areas for water hyacinth in the Lake Victoria Basin

Current (2010/2011) and secondary data were used to generate a general picture of where water hyacinths are located in Lake Victoria. Field visits were done within the basin to ascertain whether water hyacinth infestations are

extensive or not. Field visits findings indicated that while there are small patches of water hyacinth across the Lake Victoria Basin, the situation was not out of control. However, given the dynamism of water hyacinth, what was observed may turn out to be a temporary situation.

However using secondary data derived from previous studies, areas prone to infestation by water hyacinth were mapped. A total of 36 hotspots that are considered hotspot areas for Kenya, Tanzania, and Uganda were mapped. Of the 36 hotspots, 13 were mapped in Uganda, 7 from Kenya and 16 from Tanzania. River Kagera, a major hotspot is shared between Tanzania and Uganda (Figures 20& 21).

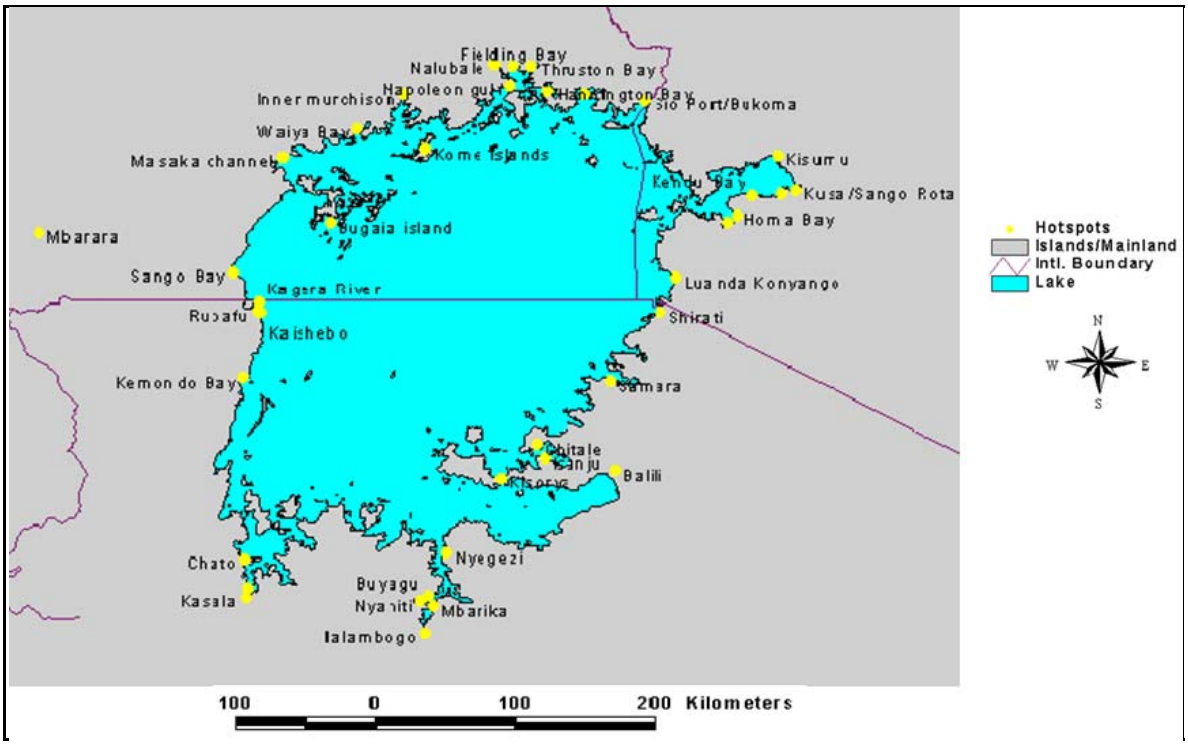


Figure 20: Areas (hotspots) prone to infestation by water hyacinth in Kenya, Tanzania, and Uganda.

For Burundi and Rwanda, the actual hotspot areas shall be mapped in the course of implementing the strategy but suffice to state that the small lakes,

river and wetland systems as described in Sections 1.3.2 and 1.3.4 appear to be suitable candidates.

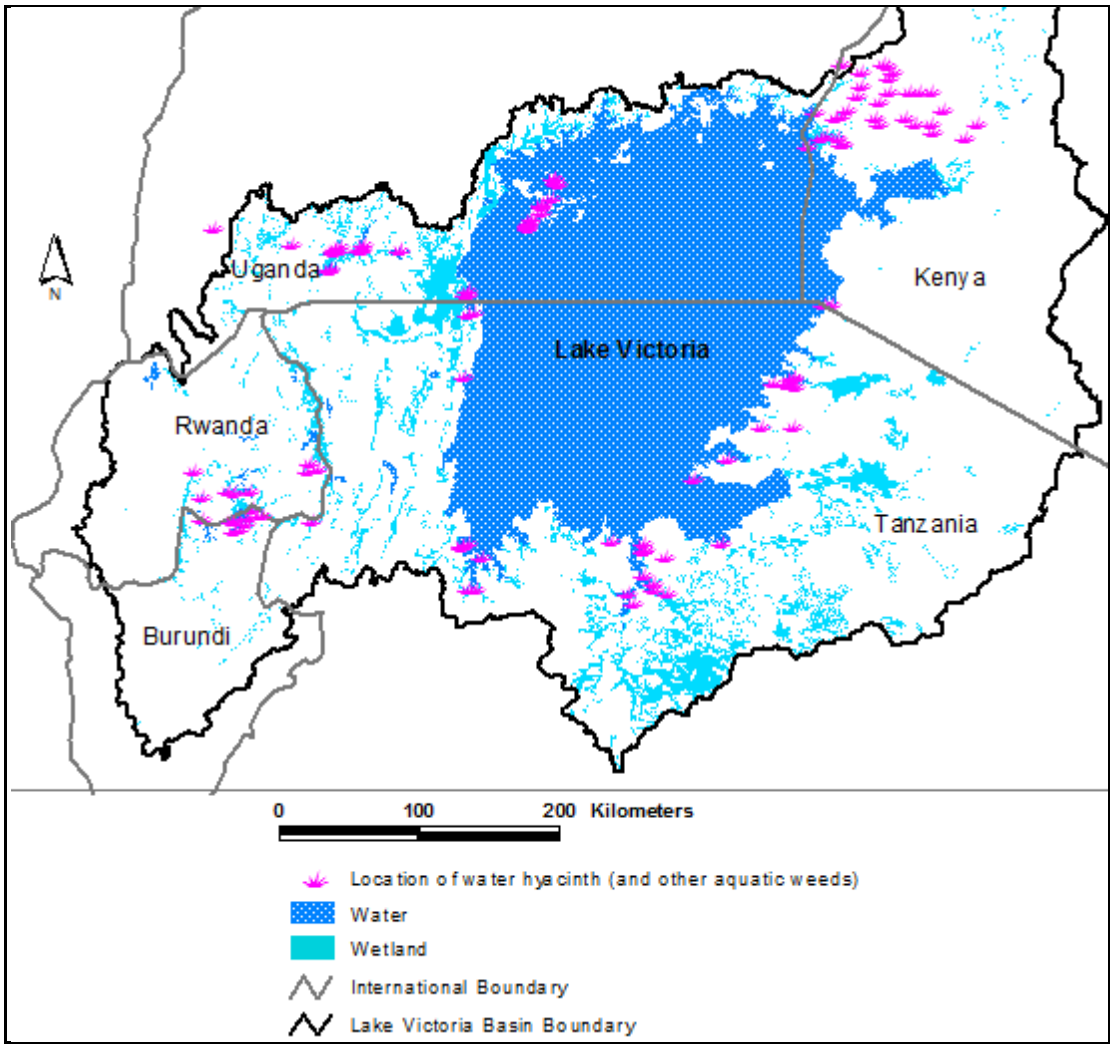


Figure 21: Occurrence of water hyacinth and other aquatic weeds in all Partners States in 2010– 2011.

1.3.8 Purpose and scope of the Strategy

From the above background information, it is evident that Water hyacinth in Lake Victoria has been a challenging phenomenon since 1988 and it has caused serious socio-economic impacts on the riparian communities and economies of the governments of the region. Despite the various control methods employed by the Partner States to control the water hyacinth, the weed has not been eradicated and has demonstrated high capacity of resurgence.

The LVBC Secretariat under the LVEMP II project has prepared this strategy guided by the overall aim to improve the environment, safeguard human health, ensure effective use of water resources and facilitate the development of the populations living within the Lake Victoria Basin (LVB) for the benefit of all the Partner States. To provide the background information, the first part of this strategy document provides a situational analysis of the water hyacinth problems and of national and regional legal, policy and management frameworks. It also analyses the control and surveillance employed by the member states, which is followed by a synthesis looking at internal and external factors that could affect the strategy implementation. The second part the strategy document contains the strategy for effective surveillance, control and management of water hyacinth. It also includes the implementation mechanism for the strategy and an outline of stakeholders' roles and responsibilities for the strategy implementation, action plan and budgeted activities.

This strategy was developed through consultations with the key stakeholders in the Partner States that included government lead agencies, local authorities and the community and the Lake Victoria Basin Commission (LVBC) Secretariat. The LVBC Secretariat together with the Regional Technical Committee Working Group (RTWG) provided guidance in developing the strategy.

CHAPTER 2

SITUATIONAL ANALYSIS

In this chapter, a situational analysis of the necessary systems for the surveillance and management of water hyacinth is detailed. This is in respect to the policy, legal and institutional arrangements and; to surveillance, control and management methods applicable to manage the invasive weed.

2.1 National and Regional Frameworks (policy, legislation and Institutions) on water Hyacinth Management

The efforts at national and regional level to control the menace of water hyacinth in the waters of the Lake Victoria Basin is a function of the policy, legal and institutional frameworks in place at both country and regional levels. A review carried out in the entire five EAC partner States identified relevant policies and laws in place that could be used to effectively control Water hyacinth and associated invasive aquatic weeds.

2.1.1 National Policy and legislative frameworks

Environment policy in the EAC partner states has been evolving from the post independence methods that emphasized protectionist utilisation to the current conservation and management methods. The development of environmental management framework in the LVB member states has been influenced by global events such as the Stockholm Conference of 1972 and the World Summit on Sustainable Development of 1992. From the late 1980s through to the 1990s, the EAC partner states engaged in the formulation and implementation of numerous policy processes that included the National Environmental Action Plans (NEAPS). The outcome was the emergence of several pieces of policy and legislative documents for the management of the environment within the EAC member states.

The main policy, legal and institutional arrangements governing environmental management in the Lake Victoria Basin are presented below. These are considered for each of the member states and regionally. The Operational Principles of the East African Community (EAC, 2000) recognises the need for the Partner States to provide adequate and appropriate enabling environment, such as favourable policies and basic infrastructure, the principle of subsidiarity and the involvement of a range of stakeholders. These principles therefore put the burden of achieving the EAC objectives to the Partner States through the use of their national policy, legal and institutional frameworks. The policies and legal instruments highlighted for each member state are considered essential for the management of aquatic weeds in the Lake Victoria basin.

2.1.1.1 Burundi Policy and legislative framework

The policy, legal and institutional framework for managing and regulating natural resources in Burundi is not elaborate as for other EAC Partner States. Most of the existing laws were by decree. However, there are several challenges such as lack of the requisite subsidiary legislation (regulations) for implementation of laws and lack of compliance and enforcement. The main and relevant laws with regard to the factors that influence proliferation and utilization of water hyacinths include the Environment Act (2000).The Environment Act is the principle legislation for regulating environmental resources in the country. It provides for an institutional framework; an elaborate procedure for carrying out Environmental Impact Assessment and for protection of water from pollution. In 2007, the National Institute for Conservation of Nature, which later became the National Institute for Environment and Conservation of Nature, was created as the institution responsible for environment management in Burundi. While the Environmental Act of 2002 is the overall instrument for natural resources management, the Water Resources Management Decree-Law (1992) with the key objective of

protection of aquatic environments is very relevant to the strategy implementation by providing a rational method for management and harmonization of rules for control of water hyacinth. It also regulates wetlands and shared water bodies under specific provisions of the Act.

The Public Health Act (1982) is relevant in as far as waste management is concerned since pollution from wastes can enrich water bodies with nutrients that promote water hyacinth proliferation.

2.1.1.2 Kenya Policy and legislative framework

The policy, legal and institutional framework for Environment resources management in general and for water hyacinth in particular is quite elaborate in Kenya. These frameworks together with the specific enabling Regulations that may be applied in reference to the proliferation and utilization of water hyacinth and to deal with emerging issues do exist and include the following: The Land Policy (2007). This Policy guides the country towards efficient, sustainable and equitable use of land for both prosperity and posterity. It provides an overall framework and defines the key measures required to address issues such as; land administration, access to land and land use planning, etc. This is relevant because poor land use leads to erosion that discharges nutrients into water bodies enriching them with nutrients that support water hyacinth proliferation. The National Water Policy (1999) defines how waters in Kenya are utilized and managed. The policy is relevant to water hyacinth management through the conservation and regulatory instrument provided therein.

The new Constitution of Kenya (2010) specifically provides for the management of Environment and Natural resources in part 2, sections 69-72 in respect to obligations by state and citizens, enforcement of environmental rights,

Agreements relating to natural resources and legislation relating to environment.

Environment Management and Coordination Act (1999) is the principal environmental legislation in Kenya. EMCA sets the legal framework for environment and natural resources management. It is comprehensive legislation that harmonized environmental legislation previously found in pieces within the national laws of the country. EMCA defined and created the institutional arrangements for environment management – the National Environment Management Authority (NEMA); the latter is mandated to coordinate other relevant Sectional laws.

The Water Act (2002) is the principal legislation governing protection, development and management of water resources in Kenya. This legislation provides diverse safeguards to protect water resources and the implementation of water hyacinth control could be one of such safeguards.

Suppression of Noxious Weeds Act (1983) Cap 379 Laws of Kenya provides the Minister with power to declare a plant to be a noxious weed in any area or in the whole of Kenya. This is very relevant to the implementation of the strategy

The Agriculture Act (Cap 318) Seeks to promote and maintain a stable farming environment, to provide for the conservation of the soil and its fertility and to stimulate the development of agricultural land in accordance with the accepted practices of good land management and good husbandry and the encouragement of good land use would prevent land degradation that would pollute water and encourage weeds proliferation.

2.1.1.3 Rwanda Policy and legislative framework

Until 1994, the Rwanda policy, legal and institutional framework was based on the colonial system. However from 2005 new policies, laws and new institutions were set up or strengthened for environmental management in general and these can be applicable to deal with aspects of water hyacinth proliferation and utilization. Rwanda Environmental Policy (2003) with the overall objective to improve the citizen's well being and to judiciously utilize natural resources and to protect ecosystems for sustainable development. The policy makes provision the overall environmental management legislations to promote sustainable socio-economic development principles and public participation in planning and management of natural resources. Its provisions are therefore crucial in the implementation of the strategy.

The National Water Resources Management Policy (2007) by emphasising a holistic approach for the management of water resources integrates it to other relevant policies that are vital for the implementation of the strategy. While the Land Policy (2004) that emphasises rational use and sound management based on land use suitability prevents erosion that could cause water pollution and encourage weed proliferation. It is therefore relevant to the implementation of the strategy.

Water and Sanitation Policy (2004) provides for pollution control in the catchment that is vital during the implementation of the strategy.

The constitution of Rwanda adopted through a Referendum in 2003 provides the overriding framework for natural resources management and therefore provides direction to the various sectors in the legislating environment and natural resources management that are vital to use when implementing the strategy.

Organic Law on Envir**o**nment Protection, Conservation and Management (2005) is the principal legislation of the country that translates the aspect of constitution in environment protection into action. It also sets out environment as one of the priority areas of concern of the nation. The law provides for a regulatory institution for implementing the Act; the Rwanda Environment Management Authority (REMA). At the level of the provinces, the city of Kigali, Districts and cells, there are Committees responsible for the conservation and protection of the environment. The law provides, among other key issues, an elaborate process for undertaking Environmental Impact Assessments (EIAs). The operation of the Organic law is vital for the implementation of the strategy.

2.1.1.4 Tanzania Policy and legislative framework National

The main and relevant policies, legal and institutional frameworks that are applicable to water hyacinth management are the National Environment Policy (1997). National Environment Policy (NEP) seeks to provide the framework for making fundamental changes that are needed to bring environmental and social considerations into the mainstream of decision making in Tanzania. It seeks to provide policy guidelines, plans and give guidance to the determination of priority actions, and provides for monitoring and regular reviews of policies, plans and programmes. It further provides for sectoral and cross sectoral policy analysis in order to achieve compatibility among sectors.

The Environmental Management Act (No.20) 2004 is the principal document governing all environmental and natural resources management issues in Tanzania. It is a cross-cutting law linking to other sectoral laws. Institutionally it provides for the continuation of the National Environmental Management Council (NEMC) and the National Environmental Advisory Committee.

National Water Policy (NAWAPO, 2002) seeks to address cross- sectoral interests in water, watershed management and integrated and participatory approaches for water resources planning, development and management. This policy specifically recognizes Lake Victoria as a shared resource by the three East African countries hence the need for regional approach to its management.

The Water Act (No.42), 2009 is the principal legislation for the protection of water resources. It also provides for transboundary water resources management

Plant Protection Act (No. 13) 1997 is the main document for invasive weed control in Tanzania. From this Act the Plant Protection (Control of Water Hyacinth) Rules was produced in 1999, which is a detailed document that provides for the monitoring, control and management of water hyacinth in Tanzania.

The National Land Policy (1996) advocates for the protection of land resources from degradation and sustainable development. The policy addresses land use planning and ensures proper management of coastal/urban/rural land resources. Proper land use planning prevents land degradation that would lead to pollution of water sources.

2.1.1.5 Uganda Policy and legislative framework

In Uganda the main and relevant policies, legal and institutional frameworks that are applicable to water hyacinth management are the National Environment Management Policy (1994); The National Environment Management Policy is a multi-sector cross cutting policy whose overall goal is 'to encourage sustainable development by wise use of natural resources while enhancing environmental quality without compromising the ability of future

generations to meet own needs.' The Environmental Policy provides an enabling environment for investment and development of the natural resources.

The National Water Policy (1999) promotes integrated approach to water resource management, promotes both social and economic value aspects of water and emphasizes participation of all stakeholders, including women and the poor in the planning, implementation and management of the water and sanitation sector.

The Decentralization Policy (1993) that was; amended in 1997 makes Local Governments centres of self-governance, participation, local decision-making, planning and development. This Policy encourages the involvement of the private sector and local communities in the development processes as well as in the management of the vast basin natural resources.

The National Environment Act, 1995 Cap 153, provides tools for environment and natural resources management that hitherto had not been deployed, including Environmental Impact Assessments (EIAs). The Act provides for the establishment of the National Environment Management Authority (NEMA) as a government agency for coordinating all aspects of Environment Management in the Country.

The Water Act 1995, Cap 152, provides for the use, protection and management of water resources and water supply. It sets up and gives powers, functions and mandates to persons and institutions in the management of water resources.

Land Act, 1998 Cap 227, provides for the tenure, ownership, control and land use and management of land at national and district levels and for to be utilized in accordance with the various laws in Uganda including the Water Act and the National Environment Act.

The Local Governments Act, 1997 Cap 243, provides for the system of local governance, based on the district as a unit under which there are the lower local government and administrative units. These are the units that will be directly involved in the implementation of the strategy. Town and Country Planning Act, 1951 Cap 246, provides for an orderly and progressive development of land, towns and other areas whether urban or rural, public utility services, buildings and other structures. It provides for development to be based on designated planned area as established by law. This in combination ensures orderly land use that prevents degradation that would cause pollution usually ending in water bodies.

There are regulations such as the Environment (Waste Management) Regulations (1999), the Water (Waste Discharge) Regulations (1998) and the Sewerage Regulations (1999) provide for pollution prevention and licensing of waste management activities in Uganda

Conclusion

From the national frameworks above, it is evident that each of the five Partner States and more so Uganda, Kenya and Tanzania have applied the relevant policies and laws defining the methods used for the surveillance and monitoring of water hyacinth but at different levels of effectiveness and efficiency. The existence of these policies and legislative instruments however is a strong point from which opportunities for harmonisation, reviews exist and synchronised implementation of the water hyacinth monitoring, surveillance and control strategy can be achieved.

2.1.2 Regional Policy and Legislative framework

The East African Community (EAC) has approved and adopted a variety of instruments and actions to guide the development and management in the Lake Victoria Basin. The Treaty for the Establishment of the East African Community, 2000, under Chapters 112-114 provides the basic policy and legal direction for the control of weed proliferation and utilization and elimination of the invasive weeds from the waters of East Africa. Under specific instruments namely: the Protocol of Sustainable Development of Lake Victoria (2004) and the Protocol of Environment and Natural Resources (2010), there are specific provisions that give the direction for the Control of the invasive weeds in more detail. In addition to the above, periodic directives of the Council of Ministers have already been applied in the initial regional undertaking in controlling the massive water hyacinth infestation of the 1990's and the recent resurgence observed mainly in the Winam Gulf (EAC, 2000; LVB Protocol, 2004 and ENR Protocol, 2010*).*

The Lake Victoria Basin Commission (LVBC) establishment was provided for under Article 114 of the Treaty for the Establishment of the East African community (1999). The mandates of LVBC is provided for under Article 33 of the Protocol for Sustainable Development of Lake Victoria Basin, among which is to promote sustainable utilisation and management of natural resources and to promote the protection of environment within the Lake Victoria Basin. The Protocol for Sustainable Development of Lake Victoria Basin details the scope of cooperation among the member states.

2.1.2.1 East African Community Vision and Mission

The vision of the EAC is *'to have a prosperous, competitive, secure and politically united East Africa'* and the mission is *'to widen and deepen economic,*

political, social and cultural integration in order to improve the quality of life of the people of East Africa through increased competitiveness, value added production, trade and investment'.

Lake Victoria Basin Commission is the institution that is directly responsible for Lake Victoria management under the EAC. It vision is to have *'A prosperous population living in a healthy and sustainably managed environment providing equitable opportunities and benefits'*, and the mission is *'to promote, facilitate and coordinate activities of different actors towards sustainable development and poverty eradication of the lake Victoria Basin'*.

The Shared Vision and Strategy Framework for the Management and Development of the Lake Victoria Basin (2003) is a strategic framework that guides the LVBC and all stakeholders in the LVB. The strategy has five policy areas; policy area 1- Ecosystems, Natural Resources and Environment, with the ultimate objective of attainment of *'A prosperous livelihood and enhanced management of ecosystems, natural resources and a clean and healthy environment'*. Under this thematic area, water resources management is one of the prioritised sector strategies that provided for intensive water weed monitoring and control. Policy area 5- Governance, Institutions and Policies, with the ultimate objective to ensure that there is *' An empowered and gender sensitive community that observe the rule of law and human rights, well integrated institutional framework enabled by a policy environment that facilitates their involvement in the management of resources'*. Under this thematic area, cross-cutting strategies: good governance, harmonisation of laws and policies, institutional framework, law enforcement and gender issues among others are provided for as prioritised strategies.

2.2 National Institutions mandated to manage water hyacinth

The water hyacinth surveillance, monitoring and control strategy (WHSMCS) will be implemented by lead institutions in the member states. This section elaborates key institutions in the partner states that have been actively involved in water hyacinth monitoring and control. These lead institutions for the implementation of the WHSMCS in the Partner States include:

2.2.1. Burundi

The National Institute for Environment and Conservation of Nature is the government institution responsible for environment management in Burundi. However, there is no particular designated institution, either governmental or nongovernmental, which is directly responsible for the management of water hyacinth in Burundi. Organizations which could be involved in water hyacinth control strategy include:

i. Ministry of the Water, Environment, Land Management and Town planning
ii. Directorate in charge of water the environment in the Ministry of the Water, Environment, Land Management and Town planning
iii. National Institute for the Environment and Wildlife Conservation
iv. Directorate in charge of fishing and the Breeding in the Ministry of Agriculture, which takes care of the supervision of fishermen in the lake
v. Local or international NGOs working in the environmental protection areas
vi. Environmental Associations recognized in Burundi.

2.2.2 Kenya

The Ministry of Environment and Mineral Resources is responsible for water hyacinth control in Kenya. It therefore the lead government agency and that is charge of the control of noxious weeds. It should therefore be the appropriate institution to lead and coordinate the implementation of this strategy. The other ministries and institutions that should be partners in the implementation of this strategy include:

i. Ministry of Agriculture
ii. Ministry of fisheries development
iii. Water Resources Management Authority (WRMA)
iv. National Environment Management Authority (NEMA)
v. Kenya Agricultural Research Institute (KARI) Kenya Fisheries Research Institute (KEMFRI)
vi. Kenya Plant Health Inspectorate Services (KEPHIS)

2.2.3 Rwanda

Rwanda Environment Management Authority (REMA) has the overall mandate to regulate environment in Rwanda including evasive weeds such as water hyacinths. It therefore shall be the lead institution in implementing the strategy. Other government agencies with related mandates that should participate in the strategy implementation include:

i. Institut de Sciences Agronomique due Rwanda.
ii. Ministry of Lands and Environment (MINERA) under the PAIGELAC Watershed Management Project
iii. Kigali Institute of Science and Technology
iv. Rwanda Environmental Management Authority (REMA)

2.2.4 Tanzania

In Tanzania it is the Ministry of Agriculture, Food Security and Cooperatives that is mandated to control invasive species in the water bodies of the country. It will therefore be the most suitable lead institution for the implementation of the water hyacinth control strategy. Other government institutions that should participate in the implementation of the strategy are:

i. Ministry of Water and the Basin Water Offices;
ii. Vice Presidents Office – Directorate of Environment
iii. Ministry of Livestock and Fisheries Development
iv. Prime Minister's office-Regional Administration and Local Government
v. National Environmental Management Council (NEMC)
vi. Tanzania Fisheries Research Institute

2.2.5 Uganda

In Uganda the Ministry of Agriculture, Animal Industry and Fisheries is the mandated government institution to deal with the control and management of alien species –flora and flora of which water hyacinth is the main target. The Ministry has a unit for the control of water hyacinth. It will therefore be the lead institution for the implementation of the water hyacinth control strategy. Other government institutions with related mandate that should collaborate in the strategy implementation are:

i. Ministry of Water and Environment;
ii. Ministry of Local government
iii. Ministry of Energy and Mineral Development
iv. Ministry of Labour Gender and Social Development
v. National Environment Management Authority (NEMA)
vi. Fisheries Resources Research Institute(NaFIRRI)

vii. Uganda Electricity Generation Company (UEGCL)

2.2.6 Beach Management Units (BMUs)

In all the lake riparian countries, the Districts and Beach management units (BMU) are the critical partners for the strategy implementation and hence will have to be integrated early enough in the planning stages.

Conclusion

The efforts at the national and regional level to control the menace of Water Hyacinth and the other invasive weeds in the waters of the Lake Victoria Basin is a function of the policy and legal frameworks in place at both country and regional levels. From the above analysis it is evident that Partner States have relevant policies and laws in place that could be used to effectively control Water hyacinth and associated invasive aquatic weeds.

2.3 Lake Victoria water Hyacinth Surveillance, Monitoring and Control Methods

The surveillance, monitoring and control methods for water hyacinth in LVB is described in this section

2.3.1 Water hyacinth surveillance methods

Three methods were tried for surveillance of water hyacinth in Lake Victoria but only two were successfully operated. In Uganda, a canoe with outboard

engines was used to estimate the area of stationary mats in bays as well as mobile mats after they settled along the shore at dusk. A method based on a canoe of known length and the number of canoe-lengths covered per unit time was used to estimate the length or widths of a generalised rectangle along the mat. The average width or length (of the rectangle) across the mat was independently estimated by three people on the canoe. The area was thus calculated. The canoe-with-outboard method was later improved when the GPS was included to record location and provide more accurate distances of the water hyacinth mats. Mapping the mats became practical.

The second method involved aerial surveys using hand held photographic cameras to record, obliquely, areas infested with water hyacinth mats. It was tried unsuccessfully in Uganda due to administrative challenges. Use of Aerial Digital Photographic System (ADPS) for the vertical surveillance and monitoring of water hyacinth is a recommended method. The camera allows for instant feedback by providing in flight-viewing capability and the data can easily be integrated with existing GIS maps to allow monitoring of water hyacinth and other weeds. Integration of the images acquired by the data acquired by the ADPS is easily done with existing spatial data because it is fitted with a Differential Global Positioning System (DGPS) so that precise geographic location of the camera (centre of an image taken) is known. The camera also has flight planning software that can help in organizing the images with the desired amount of adjacent image overlap or pre-determined image sampling for a given terrain/water body.

The third method uses satellite images for water hyacinth surveillance. The method was successfully used in Kenya during an East African study on the rapid assessment of ecological succession and the dynamic status of water hyacinth in the Nyanza gulf in December 2008. Same technology applied in Uganda led to the compilation of the synoptic report on water hyacinth (Thompson, 1991; Twongo, 1994; Bagnall, 1994; Baarveld *et al.*, 1995). In

Rwanda, IKONOS (1 m panchromatic and 4 m multispectral satellite images) were used to map the extent of water hyacinth for Lake Mihindi in Rwanda. The work was undertaken by Clean Lake Incorporated, USA as part of USAID-funded project to map the distribution of water hyacinth in the Lake Victoria Basin. However in Tanzania, efforts to procure satellite images for Kagera River were futile since at the time of the study, there was heavy cloud cover in the area that greatly interfered with the images. Table 1 gives a summary of the effectiveness of each of the surveillance methods as applied then.

Table 1: Comparison of methods used in the surveillance, and monitoring of water hyacinth and associated invasive weeds.

Surveillance method	Efficiency	Effectiveness	Challenges
Ground survey with canoe and outboard	Inefficient for surveillance – does not give location;	Was used by Uganda to estimate areal cover of water hyacinth in bays. Comparability with areal cover of satellite acquired images was commendable (Schouten et al., 1999); Effective for operational monitoring to guide control	Data may not be integrated with image processing software and GIS; A lot of time required, safety at sea not guaranteed for open lake surveys; Time consuming
Aerial surveys with hand held camera undertaken on Lake Victoria	Inefficient as it just gives photos on weed presence	Can be effective in known areas/sites	Data may not easily be integrated with image processing software and GIS.
Aerial Digital Photographic System (ADPS) procured for aerial surveys	Effective	Digital camera allows instant feedback by providing in flight-viewing capability and the data could easily be integrated with image processing software and GIS.	Equipment need to be procured earlier Lack of skilled technicians
Satellite Imagery	Effective	Efficient	cloud cover – hinders visibility

2.3.2 Options used to control water hyacinth and their effectiveness

Control of water hyacinth in the Lake Victoria Basin has so far been attempted using three options namely: biological control, manual weed removal and

mechanical extraction. Chemical control was also available as the fourth option but its use beyond experimental trials was not adopted by member countries of the LVB due to perceived fears of the likely impacts of the chemicals on water and aquatic life in general. Watershed management aimed at reducing the influx of excess nutrients into surface waters is one of the key long term options for control of water hyacinths.

Concurrent application of any two or more of the methods to control water hyacinth acquired the label "integrated control option". Several factors influence the choice of the combination of the options integrated. The factors included ecological and social-economic importance of the surface water body infested with water hyacinth and the cost effectiveness and applicability of the control options to be included in the package. The options used to date by individual member states of the LVB to control water hyacinth are outlined below.

2.3.3 Control options used

Uganda, Tanzania and Kenya adopted the integrated approach to control water hyacinth during the 1990s. Biological control using two weevil species *Neochetina bruchi* and *Neochetina eichhorniae* was selected by Uganda, Tanzania and Kenya as the sustainable option mainly because it was deemed the most cost effective. Biological methods was tried in River Kagera (Agaba et al., 2009, Moorhouse et al., 2001), though not very effective. Kenya also reared and released mites (*Orthogalumna terebrantis*) into the lake which are reported to have established and spread (Twongo *et al.*, 2005); the release of the moth, *Sameodes albiguttalis* did not succeed.

Physical (manual and mechanical) weed removal was used for immediate relief from the impacts of water hyacinth at selected socio-economically important facilities and installations. Manual weed removal by lakeside communities was encouraged and facilitated by the Governments through provision of hand implements and protective gear mostly gumboots and hand gloves. Initially, manual removal was the only available weed management measure especially at landing beaches. Mechanized removal using a variety of appropriately designed mechanical weed harvesters was subsequently promoted at selected economic installations such as the Nalubale hydroelectric power generation plant in Jinja, the Wagon Ferry Terminals at Port Bell and Kisumu Pier as well as at the mouth of River Kagera with Lake Victoria. Manual weed removal is the only option so far used to manage water hyacinth on the minor lakes in Rwanda and Burundi. The use of herbicides to control water hyacinth was not adopted by the riparian countries around Lake Victoria.

Ecological succession in the control of water hyacinth in Lake Victoria is often not recognised but it actually takes place in Lake Victoria. Ecological succession often culminates in total displacement of water hyacinth by hippo grass and this is most spectacularly in Kenya (see Figure 10). Uganda reported total displacement of about 70% of the estimated 2,200ha of stationary water hyacinth mats along the shore of lake Victoria by hippo grass.

2.3.4 Effectiveness of control options

Evaluation of the effectiveness of the options used by the LVB countries was limited by the insufficiency of available information on the processes involved.

(a) Biological control

Under favourable conditions, biological control using the weevils *N.eichhorniae* and *N.bruchi* can reduce weed infestations to between 20% and 5% of its original cover within 3-5 years. Biological control weevils were introduced on infestations of water hyacinth in the Uganda waters Lake Victoria in 1995 and in the Kenya and Tanzania waters in 1996 and 1997. A spectacular collapse of water hyacinth mats in Uganda waters was credited to the effects of the weevils that occurred between late September and early October of 1998. A similar collapse in 2000 was reported in Kenya and Tanzanian waters of the lake. Lake Kyoga in Uganda became nearly weed free within 4 years under partial influence of the two *Neochetina* weevils (Ogwang and Molo, 1997). Subsequently, the stationary mats along the lake shore were killed off by ecological succession most of them were carried downstream with the Nile current. Biological control of water hyacinth by *Neochetina* spp. normally takes 3–5 years to be effective (*Julien et al.*, 1999).

The biological control using the two species of *Neochetina* on Lake Victoria demonstrated clearly the option's suitability, cost effectiveness, specificity and hence environmental friendliness. The weevils are entirely specific to water hyacinth for their reproductive cycle and in nature depend entirely on water hyacinth for food. Ogwang (undated report) estimated that US$4,000 was required to set up weevil rearing units (fencing, rearing tanks, personnel) and another US$10,000 - 25,000 to obtain motor boats that release the weevils onto the plants and pay personnel. These costs however become negligible once the weevils become established in the ecosystem; a viable weevil population being 5-8 weevils per plant depending on density of infestation. Unverified studies by Lwasa and Mwanje (2002) averaged the cost of biological control using weevils to USD 900 per ha (360 per acre). A comparative analysis of some of the methods used to control water hyacinth is made in Table 3. Biological control using the two species of *Neochetina* has so far stood out as the first

choice sustainable long term control option for water hyacinth on Lake Victoria and other lake environments in the LVB. The weevils do not, however, build sufficient populations on water hyacinth in riverine situations with fast flowing water.

(b) Manual removal

Manual removal has the benefit of offering employment to people, is suitable for clearing small infestations or delimited areas like landing sites but is also a very labour-intensive method. It does not require any skills and has no perceived environmental risks beyond the risks posed to the people clearing the weed by snakes, crocodiles and disease vectors. Over larger areas or for heavier infestations, the operating costs become prohibitive and the cost effectiveness of the method becomes unacceptably low because the overall rate of weed removal is low. Where water hyacinth mats are periodically imported by wind, the removal rate may not match that of weed importation leading to continuous pile up. However, a recent survey in Kenya revealed that communities were mostly in support of manual removal than other methods although this could be linked to their stated motivation to be engaged – cash payments (LVBC, 2011). In Rwanda, manual removal is also highly favoured because it provides employment to vulnerable groups and the removed weed serves as raw material for craft-making (*verbal report from* NEYP). In other areas, the preference is linked to making communities more responsible for the integrity of their environment and the observation that local communities do a better job of removing the weed than do contractors using mechanical harvesters (*verbal report from* PAIGELAC). The cost of manual removal is highly variable depending on the country, location or site and prevailing labour rates in the country. The range, based on data from the various countries, varies from USD 90.00 – USD 150.00 per acre (equivalent to USD225 – USD375 per ha).

(c) Mechanical harvesting

Mechanical removal clears larger areas of weed in a shorter time than manual removal because the harvesters remove larger quantities of weed biomass each time and clear more hectares (6-8ha, depending on size of the harvester) per day than manual labour. For example 100 men may clear only 1ha in a day. The advantage of mechanical harvesting is that within limits of the size of the infestation, the weed burden may be alleviated within a matter of hours or days. Re-infestation may be prevented or delayed by use of physical barriers, depending on the size and momentum of the incoming weed mats. Suitably designed barriers are used to keep or divert water hyacinth away from economic installations or recreational facilities. During the 1990s barriers were installed above the Nalubaale hydropower generation facility near Jinja town to hold hectares of water hyacinth as two mechanical harvesters hauled away tonnes of the weed. Unfortunately this mechanical removal exercise was not able to clear the weed partly due to periodic re-infestation from nearby bays of Lake Victoria. The physical barrier restrained the weed from swamping the hydropower plant for months until the effects of biological control halted fresh inputs and also reduced the vigour of the accumulated water hyacinth above the physical barrier. Eventually mechanical harvesters successfully hauled up the rest of the frail weed biomass.

The main disadvantage of mechanical harvesters is the initial and running costs that are often beyond the budgets of the institutions running them. Apart from the high cost, harvesters have other disadvantages and limitations. Harvesters are not suitable for very shallow and rocky areas or for remote areas not easily inaccessible from land for easy discharge of their load. The massive quantities of weed harvested require that large disposal sites be secured preferably near the lake (to minimise transportation costs). Unrestricted translocation of the discarded weed biomass may also lead to introduction to new weed-free sub-catchments. Use of bulk water hyacinth biomass to produce

compost or biogas is often proposed but not very viable. Experimental use of compost from water hyacinth was made in Sudan (Reference unavailable) but only limited increase in yield for some trial crops was reported. Deterioration of quality of soils mixed with the compost was reported for certain soil types.

Costs per acre vary with accessibility of site to be cleared, density and extent of weed biomass, who (public entity or private contractor) does the work. Precise costs of mechanical control in the East African region are hard to come by. Drawing on reports from elsewhere, mechanical control can cost anywhere between US$250/acre to over US$ 10,000/acre.

(d) No action option

If no action is taken to control water hyacinth, the subsequent costs will be unprecedented and include, but not be limited to, loss of income, adverse environmental impacts and social strife as the livelihoods of fishing and lake/river-dependent communities become compromised. During peak infestations of water hyacinth on Lake Victoria in the mid-1990s, electricity generation and lake navigation were compromised, volumes of capture fisheries reduced considerably rendering redundant several hundred people involved with the fishing industry, and the costs of availing potable water increased. While actual figures for the cost of taking no action were not available to the Consultant, the potential magnitude of loss may be gleaned from the gross economic product of the LVB catchment that exceeds USD 3-4billion annually; the majority of activities that generate this money would cease if water hyacinth was left to proliferate.

(e) Cost–effectiveness of various methods for controlling water hyacinth infestations

The costs of a control method include financial as well as socio-economic and environmental considerations. The most effective method is one that is able to

control and maintain the weed at insignificant densities within a reasonable time frame with insignificant adverse social and environmental impacts and at reasonable costs. Attention is also given to sustainability of control with respect to technical expertise/ease of application, availability of inputs, institutional roles and capabilities and 'social acceptability'. In Table 2 a summary comparison of the options used by the Lake Victoria Basin countries to control water hyacinth is made with respect to efficiency of application and effectiveness to reduce the target quantity of the weed.

Table 2: Summary comparison of options used to control water hyacinth in Lake Victoria Basin

Country	Control method	Efficiency	Effectiveness	Comment
Rwanda, Uganda Kenya Tanzania	Manual extraction	Limited	Effective on small quantities of Water hyacinth and hippo grass	Tedious and ineffective on large fields of Water hyacinth or hippo grass; hence unsustainable
Uganda Kenya	Mechanical removal	Efficient	Effective but not sustainable due to very high costs	Very high operating costs often limiting;
Rwanda, Uganda Kenya Tanzania	Biological control	Efficient in the Long run but Lag period long; Not efficient for rivers	Effective in the long run but not on rivers	Possibly the most cost effective and most sustainable
Kenya Uganda	All three methods Integrated in space and over time	Efficient	Effective	Variety of methods integrated in space and time provided flexibility for different environmental settings and enhanced effectiveness
Tanzania Rwanda	Two methods manual removal and biological control integrated in space and over time	Efficient	Effective	Choice of method provided some flexibility but ability to clear /remove large volume of weed quickly reduced effectiveness considerably missed

**Data from several publications worldwide*

2.3.5 Proposed appropriate and costed control methods

(a) General Recommendations

An integrated approach combining several methods and watershed management is recommended as the most suitable for long-term sustained control and prevention of large-scale infestations as seen in the mid-1990s in the region.

Given that water hyacinth infestation occurs in both lacustrine and riverine environments in the region, the emphasis on various methods will differ with environment. Within lakes, it is proposed that biological control is the main method; biological control is not known to work within riverine environments. Within riverine environments, mechanical and/or manual control will be the main method deployed at identified hot spots, to minimise proliferation and infestation of downstream areas.

For infestations of less than 1ha coverage or those in isolated areas, one method can be adopted. Continuous or regular control implementation is also recommended to prevent such infestations from developing to epidemic proportions.

Training will be necessary for producing a cadre of staff to implement control measures and carry out surveillance and monitoring activities. Rwanda and Burundi with very little experience of water hyacinth control may have a higher demand for capacity building than the other three partner states.

(b) Estimate Inputs and Cost

Manual removal for any site

Manual control is suitable for areas of such economic importance that justifies the cost of implementing the method. Such areas include fish landing sites, sites of hydropower generation, water abstraction points, port and piers, irrigation canals.

Major Inputs:

i. Hand tools: 3- & 4-tine short & long handle forks, short & long handle rakes, hoes, long sleeve gloves, long boots/waders, life-jackets, machetes, wheel-barrows. Assembled as 15 pieces of each item to constitute one set of tools for each team of labourers. About 7 teams are estimated to clear 1ha of water hyacinth per day.
ii. Select, hire and assemble removal teams
iii. Identify sites of operation (for removal and dumping of weeds)

Sample costing for manual removal of water hyacinth is shown hereafter (Box 1).

Box 1: Sample costing for manual removal of water hyacinth

Item		**Unit cost/ha*, US$**
i.	Hand tools & protective wear per set (15 pieces per set) for 7 teams of persons/ha	626.3
ii.	Unskilled labour (removal of weed from water & disposal onto near-shore site)	10,437
Total/ha		**11,063.3**

**Costs estimated from operational costs of manual removal at Kisumu*

Mechanical removal for one site

Mechanical removal requires mechanical harvesters, self-tipping dump trucks, personnel (site supervisors, mechanics, labourers), disposal site for the removed weed biomass, push-boats, floating barriers and fuel, as the minimum items for implementation. Costs of removal per hectare are dependent on size of the infested area, density of the weed and potential for re-infestation.

Major components:

i. Identify sites of operation (for removal and dumping of weeds)
ii. Hire mechanical harvesters [@USD600 per day] + procure fuel
iii. Hire push-boats (35hp) [@USD820 per day]
iv. Hire dump-trucks + procure fuel
v. Procure barriers and booms
vi. Select, assemble and train removal teams
vii. Site supervisors

Sample costing for mechanical removal of water hyacinth is shown hereafter (Box 2). Monthly operating costs for one site using an elevator (estimates derived from costs at Kasensero landing site; month = 25 days).

Box 2: Sample costing of mechanical removal of water hyacinth

Item		**Unit cost, US$**
i.	Mechanical harvester; hire/day	596.4
ii.	Fuel for harvester, 100lt/day	201.3
iii.	Hire of three 10-ton dump trucks	626.2
iv.	Fuel for dump-trucks, 300lt	603.8
v.	Push-boat with front rakes, 50 hp or 120hp diesel engine; hire/day	208.7
vi.	Fuel for push-boat, 100lt/day	201.3
vii.	Total cost for 2.4ha =	2,437.8
viii.	Cost for equipment hire/ha =	1,015.8
ix.	Semi- and skilled labour/ha	14,910
x.	Total cost/ha	15,925.4
xi.	Additional costs:	
xii.	Weed barriers, type 1	596,400,000
xiii.		

xiv.	Weed barriers, type 2	37,275
xv.	Site supervisor	894.6per month

Note: assumption id is that one mechanical harvester able to clear six (6) acres of water hyacinth per day, and requires 100lt fuel/day. Three (3) 10-ton dump-trucks required per day, with each consuming 100lt fuel/day; @lit fuel = USD1.35. Six acres = 2.4ha. Thus, total cost per hectare = USD 681.3. Costs would increase with harvesters that work on fewer acres/day and labour costs estimated from operational costs indicated for manual control with unskilled labour.

Biological control for one site

These costs are based on those computed by Ogwang (undated report) for a weevil rearing unit consisting of 5 rearing tanks and 1 motorboat. The costs were computed from records of expenditure incurred during the biological control (of water hyacinth) programme in Uganda. These costs do not include personnel costs (at least 3 needed per unit) and no research costs (e.g. for host specificity testing) but only rearing and release of the weevils.

Costs per unit of area (e.g. acre or hectare) can be computed if data is availed on number of weevils to be released per square meter and cost of rearing a specified number of weevils over a specific time period. These figures are not forthcoming at the time of compiling this report. Therefore the figures indicated below serve only as a guide. Sample costing for biological control of water hyacinth is shown hereafter (Box 3).

Box 3: Estimated cost for biological control of water hyacinth per year

Item		**Unit cost, US$**
i.	Rearing unit	18.637.5
ii.	Technicians, 2	10,735.2
iii.	Site supervisor	10,735.2
iv.	One year's supply of fuel, oil filters and spare parts	59,640
v.	Miscellaneous costs	74,550
Total costs per year per rearing unit		**174,297.9**

Number of sites to host rearing units variable across countries; each rearing unit can produce several hundred thousand weevils per year but actual figures are unavailable.

2.3.6 The effectiveness of national and Regional efforts in surveillance, monitoring and control of water hyacinth and other invasive weeds

Various methods have been employed by countries of the Lake Victoria Basin for surveillance, monitoring and control of water hyacinth and associated invasive weeds in the region. The purpose of this objective is analysis of the effectiveness of those methods at national and regional level. The information used in the analysis was collected through review of relevant literature on the previous water hyacinth management effort; and through consultations with key stakeholders at country and regional level. Stakeholders consulted are presented in the consultative Country Reports. Summary of strengths and weakness of option used to control water hyacinth in Lake Victoria Basin are summarised in table 3.

Table 3: Analysis of the different methods used for the control of water hyacinth

	Biological control with *Neochetina* spp	**Manual removal**	**Mechanical removal**	**Herbicide application**
Strengths	1. Effective on lakes and other water bodies where water is not fast flowing 2.Offers long-term control	Results immediate especially on small infestations	Offers immediate relief and thus suitable for areas where weed must be removed quickly	Effective and results immediate
Weakness	1. Not very effective in riverine environments, OR in highly eutrophic waters OR where most of the plants are rooted (R. Molo, *pers.comm.)* 2- Control by weevil manifest 2-4 years after release and thus not suitable for situations where weed must be removed quickly	1. Very laborious 2.Offers only temporary relief 3.Unsuitable for large infestations or where weed occurs on expansive masses of water 4.third most expensive	1. Most expensive method 2.Limited to selected sites 3.Must be done continuously if weed not checked by other means	1. May contribute to eutrophication of water from the sinking biomass of dying weed into the water 2.May affect quality of drinking water 3.Expensive and must be repeatedly applied 4.May interfere with biological control when larvae and pupae sink with the dying/dead plants
Relative costs	Least inexpensive compared to other methods	Very expensive, more so than biological control and herbicides per unit of area/volume	Very expensive, more so than biological control and herbicides per unit of area/volume	Second least inexpensive method per unit of area/volume, after biological control
*Cost-	0.091	0.116	0.016	0.183

	Biological control with *Neochetina* spp	Manual removal	Mechanical removal	Herbicide application
effectiveness ratio of method (Lwasa and Mwanje, 2002)				

**The lower the cost-effectiveness ratio the cheaper (amount removed/time) the method; values arrived at with the assumption that environmental effects of the methods are unknown, and that only one method is used at any one time. The values change when two or more methods are used concurrently for control.*

2.4 Synthesis

2.4.1 Overview

The information presented in the preceding sections 2.1, 2.2 and 2.3 are the basic situational analysis of the historical and current status of water hyacinth surveillance, monitoring and control in each of the partner states of the East African Community provides a basis for a situational analysis of the historical and current status of water hyacinth surveillance, monitoring and control in each Partner State of the East African Community. In this section, a situational analysis of both external environment and internal dynamics that could impact on the implementation of the strategy is considered.

2.4.2 External factors that could influence the success of the strategy for the surveillance, monitoring and control of water hyacinth

From the information presented in the previous sections 2.2 and 2.3), it is apparent that a robust strategy for the surveillance, monitoring and control of water hyacinth for the Lake Victoria Basin must take care of both biophysical and socio-economic factors that enhance proliferation of the weed and hinders its sustainable control. For example, it is of interest to take note of the fact that

availability of water nutrients (mostly due to point and non-point source pollutants), waterfalls (that enhance water hyacinth 'seed' in Rwanda, Tanzania and Uganda), wind velocity, heavy rains, floods, and bays shaded from strong winds and waves all contribute to the proliferation of water hyacinth in the Lake Victoria Basin (LVB).

While the strategy for the surveillance, monitoring and control of water hyacinth must remain focused on surveillance, monitoring and control, efforts to create synergies with other organizations (regional, national and local levels) concerned with the management of aquatic resources in the Lake Victoria Basin will be required. This is particularly so given the fact that an effective and efficient system for the surveillance, monitoring and control of water hyacinth will naturally require effective integration of some critical information whose gathering is not the mandate of the units responsible for the surveillance, monitoring and control of the weed. An example of where synergies are required in implementing the strategy for the surveillance, monitoring and control of water hyacinth is a scenario like the updating of existing factors (in form of maps and statistical information) that show the geographic distribution of pollutants that enhance proliferation of water hyacinth. Knowing the seasonally and long-term dynamism of such pollutants will enable the efficient and effective deployment of financial, human and time resources in the surveillance, monitoring and control of water hyacinth. Yet, the mandate to collect, analyse and interpret data on pollution types and levels of the water bodies, within the Lake Victoria Basin, is vested in other institutions (at regional and national levels) within each Partner State.

Another critical external factor that may enhance the success of the strategy will be both basic and applied research on various aspects of water hyacinth and other aquatic weeds. Research has yielded valuable information that is useful for understanding the proliferation of water hyacinth and its surveillance, monitoring and control. For example, research on the

mechanisms and dynamics of ecological succession a common phenomenon that involves water hyacinth and several native aquatic plants (e.g. hippo grass) in LVB is very important in the understanding of natural weed control mechanisms in the management of water hyacinth. Continued research is required to generate new knowledge and filling gaps in existing knowledge regarding the proliferation, surveillance, control, and impacts (both positive and negative) of water hyacinth for effectiveness of the proposed strategy.

2.4.3 Need for the strategy for the surveillance, monitoring and control of water hyacinth

The noxious weed has various impacts on the socio-economic and bio-physical functioning of the water bodies (and associated ecosystems) within the LVB. These negative economic impacts include interference with water transportation, blocking of fish landing sites, increase in transportation costs, reduced fish catches, difficulties in electricity generation and water extraction, fewer tourists, and blockage of irrigation canals. Social impacts include lack of clean water, increase in vector-borne diseases, migration of communities, social conflict and difficulty in accessing water points, increase in the population of dangerous snakes. Environmental impacts include decline in water quality, water loss through evapo-transpiration, siltation, increased potential for flooding, spread of other aquatic weeds and a decline in the diversity of aquatic life. On the positive side, some enterprising members of the riparian communities are deriving livelihoods by harvesting water hyacinth for various economic uses such as livestock feed and production of furniture and handicrafts (see LVBC a, 2011).

On the other hand, there is a growing school of thought that water hyacinth can be managed as a resource (asset) especially in the production of commercial goods (e.g. furniture, crafts, animal feeds, bio-energy) and the

provision of breeding grounds for some fish species. On the other hand, it goes against the law of some Partner States. While the debate is bound to continue, it must be realized that the direction the Partner States adopt whether to accept water hyacinth as an economic resource will greatly influence the implementation of the strategy. This strategy considers water hyacinth as a noxious weed that must be eliminated in Partner States using all the available control measures. However, it is also envisaged that this stand may change in respect of accepting that some level of water hyacinth infestation is both ecologically and economically desirable.

2.4.4 Internal factors that could influence the success of the strategy for the surveillance, monitoring and control of water hyacinth

If the various elements of the information presented in Chapters 1-3 are pieced together, it becomes clear that there are internal factors that pertain to institutional capacities and arrangements that may impact on the proposed strategy implementation by the Partner States. For any strategy to be developed and implemented successfully, emphasis should be placed on doing the 'right things' (effectiveness) and doing 'things right' (efficiency) with the available financial, human and time resources. The strategy, developed based on the analysis of the informational elements preceding sections in Chapters 1-2, is meant to effectively and efficiently align scarce resources to control water hyacinth as a way of making a contribution to the vision of the LVBS i.e. *'A prosperous population living in a healthy and sustainably managed environment providing equitable opportunities and benefits'*, and the mission is *'to promote, facilitate and coordinate activities of different actors towards sustainable development and poverty eradication of the lake Victoria Basin'*. In the next paragraphs, the strengths and weaknesses of existing institutional capacities and arrangements to align scarce resources for the implementation of the strategy are discussed.

It is common knowledge that for any organization, situational analysis not only shapes formulated strategy, but also the implementation mechanism. In this respect, it is important to point out that one of the strengths of the Partner States in the implementation of the strategy is that each Partner State already has national arrangements for controlling water hyacinth. These arrangements range from on-going projects to institutionalised arrangements in all the five Partner States. Such existing arrangements are critical in future alignment of scarce resources in implementing the proposed strategy by the Partner States. The existing institutions, while they need strengthening, are also critical in creating synergies at regional and national levels. Creation of synergies will be critical for deploying scarce resources effectively in implementing the strategy. For example, synergies can be created in leveraging how to use existing knowledge, practices and techniques for the effective and efficient surveillance, monitoring and control of water hyacinth (and other aquatic weeds) using scarce resources

A critical issue is the enactment of regional laws (which take precedence over national laws), for the control, surveillance and monitoring of water hyacinth and other aquatic weeds. The process of enacting new laws, or reviewing exiting ones, is another opportunity that should be taken advantage of during the implementation of the proposed strategy. The LVBC is well positioned to coordinate activities as a way of maximising the synergies among the different Partner State for the enactment of such laws as well as the surveillance, monitoring and control of water hyacinth within the LVB.

However, besides the above strengths and opportunities, there are also weaknesses in existing efforts to conduct effective and efficient surveillance, monitoring and control of water hyacinth in the LVB. For example, the existence of two separate national units, one responsible for the surveillance/monitoring and the other unit responsible for the control of water hyacinth might be a weakness unless the two separate units are under the same decisional-making command. Additional threats include insufficient

funding arrangements for aquatic weed management. The immense size of the LVB also poses a threat as to whether each Partner State has sufficient resources to keep the water hyacinth and other aquatic weeds effectively detected, monitored and controlled.

At the operational level, there are still weaknesses in the techniques used to estimate the coverage of water hyacinth in all the Partner States. Such weaknesses have led to discrepancies in the extent of water hyacinth in all Partner States. For example, Landsat TM Imagery has provided higher estimates of water hyacinth cover than ground methods. The discrepancies are expected because ground estimates for geographic areas is always poor since it is subjective. On the other hand use of imagery would give the most accurate data on coverage but this also depends on whether imagery of the right resolution is used. Using Landsat TM (recommended for mapping objects whose smallest size should be at least 1 ha) could have also introduced errors in the estimations but perhaps more accurate than ground estimations. Aerial surveys or use of high resolution imagery (IKONOS) would be the most accurate way of estimating water hyacinth coverage. It is recommended that aerial surveys/high resolution satellite imagery should be used, periodically, to determine the exact extent of water hyacinth coverage in hotspot areas. Use of aerial sampling, in hotspot areas, will be the most cost-effective way of generating accurate water hyacinth coverage provided the sampling interval is established through research (e.g. MSc level). The consultant recommends at least two Master of Science (MSc) research project (one for open water bodies and the other for river/dam water systems in establishing the sampling interval (intensity) for the Lake Victoria Basin.

Lastly, another weakness regarding information on the occurrence and distribution of water hyacinth is the lack of a standardised way of collecting data across the five Partner States. Standardisation of data variables, on water hyacinth and other aquatic weeds, needs to be undertaken. In addition, GPS units should be used when they are set to decimal degrees (e.g. 31.345 but not

E 31˚32’ 15”) in order to generate data readily usable in GIS software. The coordinate system (UTM or Degrees) and datum to be used for mapping activities also need to be agreed upon for all the Partner States.

CHAPTER 3

THE STRATEGY FOR WATER HYACINTH SURVEILLANCE, MONITORING AND CONTROL

3.1 Need for the Strategy

It is a well understood concept and is generally accepted that all organizations need some direction (or strategy) in deploying available resources for the realization of organizational goals. For this reason, the Lake Victoria Basin Commission (LVBC) has developed a strategy to ensure an effective and efficient surveillance, monitoring and control of water hyacinth for the period 2012 – 2030. A Strategy, according to Cole (1997) typifies the determination of basic long term goals and objectives of an organization and the adoption of courses of action necessary for realising the goals. The LVBC has developed this strategy to assist the Partner States to use a fairly common mechanism to conduct surveillance, monitoring, and control of the water hyacinth (and other aquatic weeds) in the Lake Victoria Basin in order to ensure the attainment of a higher goal of an environment free of invasive weeds as a way of enabling the unimpeded use of water resources for various economic processes and operations that in turn improve the wellbeing of the communities within the Riparian Partner States.

3.2 Purpose of the strategy

The purpose of the water hyacinth surveillance, monitoring and control strategy is to maintain the current low levels of water hyacinth in those parts of the basin where this is so; and further reduce the levels of water hyacinth to both ecological and economic acceptable levels in those areas of the basin where the weed is still, seasonally or permanently, an economic burden. By

implementing the proposed strategy (as explained in Chapter 4), LVBC will ensure that the riparian communities, in the Partner States, carry out their economic activities with minimum hindrances from water hyacinth. The maintainance of water hyacinth, at ecologically and socio-economic acceptable levels, will be achieved through instituting a well coordinated surveillance and monitoring system that allows rapid identification and removal of economically important weeds over the short-, medium- and long-terms.

3.3 Strategic Goal

In this document, a goal has been defined as a focused statement of intent directed to operations (Cole, 1997); in light of this, the goal of the LVBC Strategy for water hyacinth surveillance and control is ***"to run a well-coordinated system"*** **in each of the Partner states of Burundi, Kenya, Rwanda, Tanzania and Uganda for the surveillance, monitoring, and control of water hyacinth coverage/infestations to acceptable ecological and economic levels.**

This goal is a critical factor for LVBC to achieve success in maintaining of water hyacinth at insignificant levels in the Lake Victoria Basin.

3.4 Strategic Objectives

The selected strategic objectives for this strategy are aimed at aligning organizational resources in order to maintain water hyacinth levels at ecologically acceptable levels within the short-, medium- and long-terms. Five (5) strategic objectives have been selected to achieve this goal and these include:

3.4.1. Strategic Objective1: Management of water hyacinth infestations in hotspots and other areas to the acceptable ecological and economical levels as and when infestation occurs;

Strategically the water hyacinth mapped in 36 (13 in Uganda, 7 in Kenya and 16 in Tanzania) hotspots need to be removed by using above recommended methods. The involvement of key stakeholders in the hotspots is very important and sustainable. Since LVEMP 1 managed to remove water hyacinth by 80% by 2005; and with this level of water hyacinth economical activities were not affected; then this strategy is aiming at removing the water hyacinth by the same level.

Communities' involvement- removing and destroying water hyacinth-Kenya 2011-Photo by Dr. Mngodo

Outcome: 80% Reduction in area covered by water hyacinth in identified hotspots

Key Performance Indicators

i. % reduction in area covered by water hyacinth in identified hotspots;
ii. Capacity built on the key stakeholders (fishermen/lady (BMUs); water suppliers, villagers; district authorities, and other main users of the hotspots); and
iii. Key stakeholders willingly manage water hyacinth at ecological and economical levels.

3.4.2. Strategic Objective2: Establishment of a cost-effective water hyacinth surveillance, control and monitoring system;

Cost-effective National and Regional water hyacinth surveillance control and monitoring system will enable national and regional water hyacinth units to be able to understand the position and movement of water hyacinth; and hence communicate with responsible key stakeholders to control it. The strategy is proposing to establish a special national water hyacinth surveillance, control and monitoring system unit. The Unit will be responsible for coordinating, mobilising and ensure effective water hyacinth monitoring and control at national level.

Outcome: Key stakeholders routinely contributing to the rapid generation of accurate spatial information on the occurrence of water hyacinth/other aquatic weeds; and remove within Partner States

Key Performance Indicators

i. National water hyacinth surveillance, control and monitoring system unit established and operationalised;

ii. a coordinated cost-effective water hyacinth surveillance, control and monitoring system established in each country; and
iii. collected data is informing hyacinth surveillance and control.

3.4.3. Strategic Objective3: Prevention and control of the water hyacinth as rapidly as it is identified by the established water surveillance and monitoring system

The effective and efficient regional and national units will have responsibility of maintain water hyacinth at acceptable economical and ecological levels. These units are given responsibility therefore to ensure key stakeholders and responsible institutions develop a culture of preventing and controlling water hyacinth as rapidly as possible. This to happen it needs well established water surveillance and monitoring system in place.

Outcome: Water hyacinth (and other aquatic weeds) maintained at an economical and ecological levels considered by the Partner States to be insignificant in disrupting economic processes within the Lake Victoria Basin

Key Performance Indicators

i. Regional Water surveillance and monitoring system established and operational at all levels; and
ii. LVBC and Partner States able to effectively and efficiently coordinate at the regional and national levels respectively the surveillance, monitoring and control of water hyacinth in LVB.

3.4.4. Strategic Objective 4: Establishment of a mechanism for sustainable financial resources/ mobilization for the implementation of this strategy;

From the analysis, water hyacinth surveillance and control is taken as project oriented intervention. This is why just after LVEMP I project water hyacinth came again in a very high speed. In order to ensure water hyacinth is controlled at economical and ecological levels; countries and LVBC Secretariat need to monitor and control continuously. This is only possible if sustainable financing mechanism is put in place to support not only the incoming water hyacinth surveillance, control units or offices, but also key stakeholders who will be used to monitor and remove water hyacinth.

Outcome: LVBC and Partner States have sustainable, stable and secure mechanisms in place for funding the implementation of the strategy for surveillance, monitoring and control of water hyacinth in LVB.

Key Performance Indicators

i. National water hyacinth monitoring and control sustainable financing sources established and operationalised; and
ii. Increased annual financial support to government institutions and key stakeholders to monitor and control water hyacinth.

3.4.5. Strategic Objective 5: Establishment of effective and efficient water hyacinth communication framework;

Water hyacinth monitoring and control requires effective and efficient communication at all levels. National Water hyacinth monitoring and control institutions and key stakeholders must communicate on the location, amount, Direction and any other information that is required to control water

hyacinth. This strategy is proposing to establish effective and efficient communication at all levels.

Outcome: An effective and efficient Water hyacinth monitoring and control communication framework at all levels established and operational in each country and at LVBC Secretariat.

Key Performance Indicators

i. effective and efficient National Water hyacinth monitoring and control communication framework established and operationalised; and
ii. Water hyacinth monitoring and control information flows and access of information (documentations, media and sharing of experiences) at all levels.

(a) 3.4.6. Strategic Objective 6: Establishment and operationalization of regional and national coordination mechanisms ensuring synchronization of water hyacinth surveillance, monitoring and control system.

The role of LVBC Secretariat is to coordinate and promote the National Water hyacinth monitoring and control initiatives. In order to effectively implement this, strategy is proposing to establish a special water hyacinth monitoring and control unit. The role of this unit is to regionally mobilise resources, coordinate national units and ensure effective monitoring and control of water hyacinth.

The water Hyacinth research need to be supported and encouraged to ensure the water hyacinth surveillance, monitoring and control system is informed by research findings.

Outcome: An effective and efficient regional coordination of Water hyacinth monitoring and control in Lake Victoria Basin.

Key Performance Indicators

i. effective and efficient regional Water hyacinth monitoring and control unit established and operationalised;
ii. regional water hyacinth monitoring and control financial resources mobilised and efficiently utilised according to plan; and
iii. capacity building of Research stations in the Lake Victoria Basin enhanced and research findings shared and adopted.

3.5 Strategic interventions

For each strategic objective presented in Section 3.4, the required strategic interventions have been identified and are depicted in Table 4. To conform to conventional norms recommended by Lewis (2008) that 'those who will do the work must design the operational plans', tasks and work packages (for each identified intervention listed in Table 4) will be identified and planned for (review the suggested) in details by the implementers of the strategy for the surveillance, monitoring and control of water hyacinth in each of the five Partner States. By implication, this means that the strategy has only identified strategic interventions which will be translated into various projects and/or routine organizational workflows needed to implement the proposed strategy for the surveillance, monitoring and control of water hyacinth in each of the five Partner States.

Table 4 : Activities (and associated tasks) for each strategic choice

Strategic objective	Expected outcome	Strategic Intervention
1. Control of existing water hyacinth infestations in hotspots and other areas to the acceptable ecological and economical levels as and when infestation occurs;	i. 80% reduction in area covered by water hyacinth in identified hotspots; ii. Capacity built on the key stakeholders (fishermen/lady (BMUs); water suppliers, villagers; district authorities, and other main users of the hotspots); and iii. Key stakeholders willingly manage water hyacinth at ecological and economical levels; need of removing water hyacinth and other associated aquatic weeds in the hotspots as and when infestation occurs;	i. To build capacity of key stakeholders in each hotspot to understand the water hyacinth dynamics and control methods; ii. To support, involve and mobilise key stakeholders (fishermen/lady (BMUs); water suppliers, villagers; district authorities, and other main users of the hotspots) in each hotspot to use the recommended methods to remove water hyacinth at the acceptable level in each hotspot; iii. To create incentives to the key stakeholders to value and see the need of removing water hyacinth and other associated aquatic weeds in the hotspots as and when infestation occurs; iv. To hire machines in the areas where machines can be economically used, to remove water hyacinth easily and quickly; and v. To use biological methods as means to ensure sustainability of intercepting the water hyacinth cycle/ life.
2. Establishment of a cost-effective water hyacinth surveillance and monitoring system	Key stakeholders routinely contributing to the rapid generation of accurate spatial information on the occurrence of water hyacinth/other aquatic weeds; and remove within Partner States	iv. Capacity building of the technical staff of mandated agencies for the surveillance and monitoring of water hyacinth and other aquatic weeds v. Development of standardised field data collection tools vi. Capacity building of community members in the surveillance and monitoring of water hyacinth and other aquatic weeds in each Partner State vii. Establishment of a regional and national baseline databases for the water hyacinth surveillance and monitoring system viii. Execution of routine or/and project-based periodic activities for the surveillance and monitoring of water hyacinth and other aquatic weeds in each

Strategic objective	Expected outcome	Strategic Intervention
		Partner State
3. Prevention and control of the water hyacinth as rapidly as it is identified by the established water surveillance and monitoring system	Water hyacinth (and other aquatic weeds) maintained at an ecological level considered by the Partner States to be insignificant in disrupting economic processes within the Lake Victoria Basin	i. Using data generated in 1(e) above, establish periodic infestations of water hyacinth in terms of coverage (ha) and using categories such as s ('insignificant', 'light', 'significant' or 'very heavy') ii. Establish (or enhance if existing) a manual control system for critical economic areas (water abstraction points/sources, power generation plants, fish landing beaches, ports and piers, irrigation canals) that will have low to moderate weed infestation iii. Implement a biological control scheme (with *Neochetina spp*) in lake environments and dams that get heavily infested with water hyacinth
4. Establish a mechanism for sustainable financial resources mobilisation to finance the strategy	LVBC and Partner States have sustainable, stable and secure mechanisms in place for funding the implementation of the strategy for surveillance, monitoring and control of water hyacinth in LVB.	i. Identify all the possible different sources of funding for implementing the strategy ii. Secure funds for implementing the strategy iii. Mainstream the strategy implementation in the financial plans of the partner states iv. Establish effective and efficient financial administration for strategy implementation
5. Establishment of a communication framework	An effective and efficient Water hyacinth monitoring and control communication framework at all levels established and operational in each country and at LVBC Secretariat.	i. Build capacity of journalists from Partner States to effectively communicate water hyacinth and other aquatic weeds issues to a varied audience within Partner States and beyond ii. Carry out awareness and sensitisation programmes among riparian communities in the LVB iii. Promote the integration of invasive weeds information and management issues in school curriculum iv. Procure communication and information gathering equipment
6. Setup coordination mechanisms for ensuring synchronization of water hyacinth surveillance, monitoring and control systems	LVBC and Partner States able to effectively and efficiently coordinate at the regional and national levels respectively the surveillance, monitoring and control of water hyacinth in LVB. Capacity building of Research stations in the Lake Victoria Basin enhanced and research findings shared and adopted.	i. Strengthen the LVBC Regional unit for effective coordination of the activities of the control and surveillance of water hyacinth and other aquatic weeds ii. Improve the effectiveness of key national institutions for control and surveillance of water hyacinth and other aquatic weeds iii. Strengthen existing Institutions' capacity to improve the cooperative management of water hyacinth iv. Develop improved policy and

Strategic objective	Expected outcome	Strategic Intervention
		regulatory framework for the control and surveillance of water hyacinth and other aquatic weeds in LVB v. Assist research institutional development for establishment of database and database management (see 1(a)-(c) above) vi. Develop and implement quality assurance mechanism to track implementation of the strategy

3.6 Coordination

Sustainable aquatic weed management plan requires carefully constituted national and regional institutional frameworks with appropriately mandated institutions and adequate enabling policy and legal arrangements. Such institutions must have the infrastructural and human resource base to build upon for the management of aquatic weeds. In the Lake Victoria Basin (LVB), weeds are targeted for control according to the regional and national legal instruments for the protection of water resources and prevention of the proliferation of weeds. Clear mandates, roles and responsibilities should exist at all levels for the weed control (see Tables 4 and 5).

To ensure effectiveness, there should be in place national and regional coordination arrangements given the multiplicity of stakeholders at different levels. Needless to say that, the overall success will depend on the extent of participation and active involvement of stakeholders. For effective coordination, it is essential that there is an elaborate communication system for raising awareness among stakeholders on aquatic weeds, surveillance and control methods and for keeping them updated about the progress, successes and challenges.

To effectively deter illegal movement of these noxious weeds to areas that are weed free, each Partner State implements the relevant legislation of weed control and those that have need to enact legislation for water hyacinth and other invasive weeds control as well. This should be followed by harmonization of these laws and regulations for effective implementation of transboundary aquatic weeds control.

However, the best option for the needed compliance in the areas specified above, is the enactment of a regional legislation to cover all those areas and specifically for the control of water hyacinth and other aquatic weeds that would be implemented in each Partner State considering the transboundary nature of the problem. This proposal is also premised on the fact that regional laws take precedence over national laws (EAC Treaty, 2000).

3.7 Early Warning Detection and Timely Action

During the implementation of aquatic weed control programmes, it is important to promptly identify the sources of infestation. It is also important to identify activities that are potential transfer routes (vectors) of the weeds and promptly address them. Upon identification, new or small infestations must be contained to avoid invasion of other areas that are clear of weeds. Well coordinated manual harvesting and destruction at community level can adequately deal with such levels of infestation.

Early detection of aquatic weeds provides opportunity for rapid responses that are the most strategic and cost effective form of invasive weed management. Early detection increases the likelihood of successful containment or eradication and is less costly because the incursion is handled when small, not widely distributed and not well established. Failure to detect aquatic weeds early limits the ability to implement effective control measures. Timing of control and choice of control method is very important for the success of aquatic weed control programme. Seasonal events, growth rates and size of infestation affect control methods and can best be handled as explained below:

i. Manual removal is best for small infestations that can rapidly be contained and the removed weeds destroyed without disposal problems

ii. Biological control agents are best released as early as possible during the growth phase of the water hyacinth

iii. Mechanical removal is most suitable in extensive infestations. Best used in deeper water with limited obstacles (surface or sub-surface)

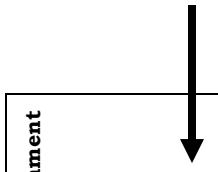
Lastly, good hygiene need to compliment the control treatments to prevent the spread of aquatic weeds through machinery, equipment, boats and trucks used

to remove the weeds. All equipment should be thoroughly cleaned before leaving the weed control treatment site.

3.8 Prioritisation of weed control areas

For best results in aquatic weed control, it is important to assess the highest priority areas. Several prioritization methods as illustrated in Figure 22 may be used depending on the anthropogenic and environmental factors. The prioritized areas should then be closely observed. Surveillance and mapping to record changes should be done. The level of infestation should be mapped regularly (e.g. quarterly or annually) as funding and resources allow in order to gain information on the successes and challenges of the control methods being implemented.

During the monitoring of the effectiveness of treatment/ control methods, GPS reference points and photographic evidence and if possible satellite imagery should be used to help record conditions of the infestation before and after implementation of particular control method(s). Clear records of these together with the dates and locations are important to help understand what gains are being made.



Increasing risk of establishment	Characteristic of the water body	Increasing risk of infestation Community interaction with the water body →		
		Limited community access to the water body	Moderate community access (bridge, parks, boats) and use of the water body	High community access and use of the water body (bridge, parks, boats, pumps for water works & irrigation, recreation, fishing)
	Fast flowing, no ponds or sheltered zones- rivers. Strong currents exposed zones- Lakes	**Low Priority**	**Low Priority**	**Medium Priority**
	Slow moving and ponded- rivers. Sheltered bays- Lakes Moderately degraded	**Low Priority**	**Medium Priority**	**High Priority**
	Highly degraded streams. High nutrient loads. Slow moving and ponded -rivers. Nutrient/eutrophic rich sheltered bays	**Medium Priority**	**High Priority**	**High Priority**

Figure 22: Matrix for prioritising aquatic weed control (Source: *MRPMG 2009 with modifications*)

3.9 Catchment Management

Nutrients originating from water catchment exhibits significant influence on water quality that may lead to eutrophication. Nutrient rich water supports water hyacinth proliferations. It is therefore important that the nutrient sources are identified for appropriate mitigation measures to be implemented. Nutrient releases to water can occur from sources such as: Wastewater treatment plant effluents; Industrial effluents; Industrial wastes; Urban storm-water drains; Urban wastes; Runoff from degraded land, soil erosion; Effluents from intensive livestock handling areas and feed lots ; Cropping and agriculture and Abattoir effluents. The nutrient pollution arising from these sources

should primarily be controlled through appropriate national laws and regulations.

There are areas that are of high risks of introduction and invasion by aquatic weeds because of interaction with activities in the surrounding areas of the water body. Such high risk areas should be identified so that early detection (early warning) surveys can be done. It is important to implement such surveys so that new invasions coming into the area can be eradicated as soon as possible. Examples of high risk areas are:

Bays especially those directly receiving high nutrient loads from the surrounding: (e.g. sewage works, industry, municipality, agriculture); (ii) Ponded or slow flowing water bodies; (iii) Water bodies near residential areas; (iv)Areas of high human activities (e.g. fish landing sites, camp sites, boat piers, bridges).

The high risk areas should be monitored during the different seasons and in case of unforeseen climatic events. The community should be strongly integrated in the early warning system. Overall, the message here is that water weeds thrive on nutrients that are generated by activities within the watershed. A well planned watershed management done in an integrated manner that looks at (targets) interaction between the various operating sectors will create a sustainable system that effectively controls the impact activities. Through the effective management of the watershed, polluting sources are identified and dealt with at source to minimise or eliminate impacts, thus cutting down the nutrient loads into water bodies.

3.10 Research and Development

Control of aquatic weeds must be informed by research and more so because the ecology of the weeds is governed by physico-chemical status, physical

status (morphology, open vs. sheltered, wave movements), climate/weather conditions (rainfall, wind, temperature), that significantly influence resurgence, proliferation and succession characteristics. Research to understand the weed ecology, weed impacts and the impacts of the management process should be done. Impact on habitats quality and species within the LVB system should also be assessed before and after the implementation of control measures. Data obtained should be examined in relation to meteorological data and weather events (rains, winds, dry spells, floods, temperature).

Research should also be done to quantify the levels of damage already done by water hyacinth in the LVB and the costs of control, loss of livelihood, economic loss to the partner states, diseases, and disruption of normal operations caused by water hyacinth.

3.11Aquatic weed control- options and approach

An integrated approach is vital to achieve successful aquatic weeds management, because it puts the most stress on the weeds. Integrated approach is a combination of different weed control methods that are carefully selected to form a mix with the most effective outcome. The chosen methods must complement one another and not counter-act the effect of each method. Control options are usually selected based on the characteristics of the water body, effectiveness and costs of the control method, water uses and national regulations and priorities. During weed control, site prioritization should be done carefully (Fig.22).

3.12 Education and Awareness

Raising awareness among the riparian communities is one of the most effective actions that can be undertaken to control and prevent the spread of water weeds. It allows people to be aware and understand the significance of aquatic weeds and not to engage in behaviours that contribute to the spread of the weeds. A community that is aware will willingly participate in activities to control aquatic weeds. There are a number of options available for raising awareness among stakeholders. First crucial step for effective aquatic weed control is to ensure that the community can correctly identify and recognise an aquatic weed.

3.13 Effective Communication

Paramount to the fight against the water hyacinth has been the appreciation of the key stakeholders, particularly the communities on whose behalf the water hyacinth is being cleared from the waters. Therefore it has been noted that communication plays an important role and that the absence of well organized information flow can easily deal a fatal blow to even the most noble of intentions. For the fight against the water hyacinth to be successful, it is necessary to enhance awareness among stakeholders of the social, economic and environmental consequences of water hyacinth infestation. Riparian communities of water hyacinth infested bodies should be involved in control initiatives, with emphasis on community mobilization, coordination of community-based activities and access to information.

For successful water hyacinth control information must be easily accessible to: Key decision makers; Policy makers; Researchers and; Representatives of, and eventually, the affected communities. The information can be about: the actual water hyacinth problem and the type and magnitude of its socio-economic and

environmental costs; the available alternatives for control of the water hyacinth, their effectiveness and costs, and what to expect from their adoption and; the experiences within the region and the rest of the world of the effective handling of the weed problem.

The Lake Victoria Basin Commission has formulated a regional communication strategy to enable public participation and communication within LVEMP II. The strategy comprises three broad categories of internal communication, national and regional outreach and community awareness and participation. All the Partner States have also initiated the formulation of their own communication strategies that will lock into the regional communication strategy..

The key stakeholders or audiences that shall play a critical role in the surveillance and control of aquatic weeds are shown in Box 4:

Box 4: Key audiences/stakeholders for the effective implementation of the strategy

i.	East African Legislative Assembly	xi.	Business community, including local and foreign investors
ii.	National Parliaments of Burundi, Kenya, Rwanda, Tanzania and Uganda	xii.	Development partners/donors
		xiii.	Farmers
		xiv.	Fishermen
iii.	Government line Ministries in the five countries	xv.	Beach management units
		xvi.	Regional and National secretariats of LVEMP 11
iv.	Local politicians		
v.	Civil society organizations (NGOs and CBOs)	xvii.	Car washers facilities
		xviii.	National water authorities and projects
vi.	Policy makers		
vii.	Law enforcement agencies	xix.	Institutions of learning
viii.	Cultural and religious leaders	xx.	The mass media
ix.	Professional Associations	xxi.	The general public
x.	Local Government Authorities		

To ensure linguistic harmony in the region, the messages will have to be produced in various languages, including English, French, Kiswahili and some major local dialects to cater for all audiences.

The following are channels of communication that can be applied during surveillance and control of aquatic weeds. The choice of each will depend on the message target stakeholder group (See Box 5).

Box 5: Channels of communication during surveillance and control of water hyacinth

i.	Radio stations, including community radios	vi.	Summits, conferences, meetings and workshops
ii.	Urban and national Newspapers and magazines	vii.	Email
		viii.	Website information
iii.	Billboards	ix.	Signposts, fliers and posters
iv.	Cell phones	x.	Cartoons
v.	Social networks	xi.	Music, dance and drama

3.13.1 Feedback mechanisms

It will be important to ensure that there is regular and comprehensive feedback for the implementers of the strategy to track the reaction of key actors and stakeholders. Feedback would, *inter alia*, help in the following ways: assurance that the messages have been received; knowing that the messages elicited a response from the receivers and gauging whether the receiver assigned the same meaning to the message as intended by the sender. The following are proposed as suitable means of actualising feedback mechanism (See Box 6)

Box 6: Feedback mechanisms during the strategy implementation

i. Suggestion boxes in regional offices ii. Call-ins during radio and TV programmes iii. Question and answer sessions during meetings iv. Internet chats v. Toll free telephone lines	vi. Drama groups and exhibition vii. Beach-based festivals for fishermen, farmers and car washers viii. Homilies/sermons/announcements for churches/mosques ix. Registry book for generated information and queries

CHAPTER 4

IMPLEMENTATION MECHANISM FOR THE STRATEGY

Effective implementation of the water Hyacinth surveillance, Monitoring and control strategy (WHSMCS) will depend on how best the planned activities in the Partner States are coordinated and harmonised. Lake Victoria basin Commission Secretariat (LVBCS) is the primary coordinating agency that will ensure that the national activities are well coordinated and synchronised to avoid unnecessary duplications and conflicts that may arise. The National Focal Point Ministries will coordinate the activities of the water hyacinth units with those of other technical agencies within the Partner States. The implementation mechanisms of the WHSMCS at the regional and national levels are outlined in the following sections.

4.1 Regional Institutions

Under the EAC Treaty, the EAC Partner States have agreed to cooperate in the management and sustainable development of shared natural resources (the Protocol for Sustainable Development of Lake Victoria Basin and the Protocol on Environment and Natural Resources Management). The Lake Victoria Basin Commission was established to implement the Protocol for Sustainable Development of the LVB, and is responsible for coordinating the actions of national and local organizations and stakeholders. As such, the LVBC will be the primary regional body responsible for guiding the implementation of the Water Hyacinth Surveillance, Monitoring and Control Strategy (WHSMCS). The responsibilities of LVBC include i.e. mobilising resources for the implementation of the WHSMCS, coordinating the activities of various actors

on the ground, and conducting monitoring and evaluation of the implemented activities.

4.2 National Institutions

The technical sector Ministries and Departments involved in the implementation of the WHSMCS will include Agriculture, Water Development, Fisheries, Transport, Tourism, Industry, and regional cooperation. They will be responsible for determining which activities of the WHSMCS fall within their mandates and for incorporating these activities into their policies and programs in collaboration with other stakeholders.

In Burundi, the Focal Point Ministry for the EAC, the Ministry of the Water, Environment, Land Management and Town planning is proposed to be in charge of coordinating the implementation of the WHSMCS with technically relevant sector ministries. In Kenya, Ministry of Agriculture is proposed to be in charge of coordinating the implementation of the WHSMCS with technically relevant sector ministries and agencies. In Rwanda, Institut de Sciences Agronomique due Rwanda is proposed to be in charge of coordinating the implementation of the WHSMCS with technically relevant sector ministries. In Tanzania, Ministry of Agriculture, Food Security and Cooperatives is proposed to be in charge of coordinating the implementation of the WHSMCS with technically relevant sector ministries. In Uganda, Ministry of Agriculture Animal Industry and Fisheries is proposed to be for the implementation of the WHSMCS with technically relevant sector ministries.

National focal points have been developed in all the Partner States but the water hyacinth units have yet to be established in Rwanda and Burundi. The operating water hyacinth units in the Partner States shall involve representatives from all stakeholder groups in the LVB in the implementation of the WHSMCS. These units will be responsible for educating stakeholders in

the Partner States about the WHSMCS and for promoting integration of recommendations and activities of the WHSMCS into ongoing management plans in the LVB.

4.3 Local institutions

The Ministries responsible for Local Government in the Partner States will be in charge of implementation of the WHSMCS based on their mandates. The Ministries will work with Lower Local government structures that will be the primary implementing agents and will be the focal points on the ground for incorporating activities into their District work plans, for guiding implementation activities (such as site selection, community involvement and monitoring and evaluation), and for ensuring follow-up on data collecting and reporting.

At the grassroots level, Beach Management Units and Water Users Associations/Committees have a mandate to participate in management of water resources in the basin. They will work closely with the District Environment and Water Offices to ensure WHSMCS implementation according to recommended activities. They will also be responsible for monitoring and reporting on the status of water hyacinth monitoring and control including weed incidences and coverage in their locality.

Other important partners will be the Research Institutions both within the region and from other countries that will be needed to conduct the necessary research for effective implementation of the strategy and also to train local authorities in technical skills to promote the long-term sustainability of the interventions.

4.4 Regional and International Conservation Agencies

LVEMP, NBI-NELSAP and other regional or international conservation partners on the ground and those not on the ground but with interest in conservation in the LVB, will be critical to the success of the strategy implementation. Their experience in water hyacinth and other aquatic weeds management links to potential financiers or financing capability will be very important for the implementation of the strategy.

4.5 NGOs and CBOs

International organizations including NGOs and CBOs will be involved primarily as sources of funding and technical expertise. The participation of local NGOs such as OSIENLA, Lakes Link Uganda, Suswatch, ECOVIC, LAVRLAC, etc, is critical in the implementation of strategy. A comprehensive list of NGOs/CBOs operating in the LVB is found in annex 2

4.6 Financing of the strategy

The acquisition of adequate resources is a prerequisite for the successful implementation of this strategy (WHSMCS). LVBC who is the primary coordinating institution responsible for the implementation of the WHSMCS should be the vehicle for the mobilization of the necessary resources. These resources shall be mobilized from national sectoral budgets, bilateral and multilateral donors and the private sector. Support from organizations such as IDA, GEF and SIDA and others with a long history of support in the conservation and sustainable development projects in the LVB, will be critical

in providing the funding to implement the strategy. Possible financing sources: LVEMPII, Donors, Private Sector, LVBC (Environment Trust Fund).

4.7 Monitoring, evaluation and reporting

Implementation of the strategy will require regular monitoring and evaluation of the progress of the different planned activities, which will be based on appropriate performance indicators for the Monitoring and Evaluation (M&E) system. Initial steps in setting up the M&E system requires that the stakeholders are involved early enough to participate to enable clear understanding of the planning and implementation of the M&E system. LVBC together with the responsible actors should develop detailed work plan for each priority activity for the implementation of the M&E, and these work plans will include detailed measurable performance indicators in terms of quantity, quality and timeframe. The implementing actors will be responsible for conducting on-the-ground monitoring, evaluation and reporting of activities and indicators to LVBC, as the overall coordinating body. Table 5 provides the roles and responsibilities of the key stakeholders in the surveillance, monitoring and control of water hyacinth in the LVB.

Table 5: The roles and responsibilities of different stakeholders in the surveillance, monitoring and control of water hyacinth and associated invasive weeds

Institution	Institutional mandates	Roles
Lake Victoria Basin Commission	To have within the Lake Victoria Basin and East African Community at large a prosperous population living in a healthy and sustainably managed environment providing equitable opportunities and benefits through the promotion, facilitation and coordination of activities of different actors towards sustainable development and poverty eradication.	i. Coordinate and oversee Water hyacinth surveillance & control programmes ii. Quality control of data acquisition, treatment, storage and management iii. Mobilize and coordinate all stakeholders with interest in participating in the control programs

		iv. Build capacity of the region to control the aquatic weeds v. Mobilize resources
EACJ	Ensuring adherence to the Law, Interpretation and application of the Treaty for the Establishment of the East Africa Community the Treaty	To hear and determine disputes on the interpretation of the Treaty and in this case with regard to sections related to the waterweed control and arbitration
LVFO	1. Fisheries management in the region 2. Maintenance of vibrant fisheries industry in the region	Research Capacity building
National Legislative Assembly	National interest in environmental management and the control of water weeds	i. National policies on aquatic weeds ii. Enacting laws and regulations on aquatic weeds iii. M & E framework

4.7.1 Analysis of stakeholder roles and responsibilities in surveillance and monitoring

The overall objective of surveillance is to track the occurrence, spatial distribution and cover abundance of water hyacinth and other invasive weeds over time. Monitoring is often used together with surveillance to reflect the latter's sub objective namely to identify temporal changes in spatial distribution and cover abundance. Monitoring is also used independently to (i) track changes in plant well-being, mat condition and cover abundance of water hyacinth and other invasive weeds in relation to impacts of control measures; and (ii) track shifts in environmental and or ecological impacts as well as socio-economic constraints due to weed infestation so as to inform weed control processes with respect to "effective control levels". Analysis of the roles and responsibilities of key stakeholders in surveillance and control of water hyacinth in Lake Victoria Basin are outlined in Table 6.

Table 6: Analysis of Stakeholder roles and responsibilities in surveillance and monitoring

Task	Overall objective	Stakeholders* (These should be institution based)	Roles and responsibilities
Surveillance of water hyacinth and associated invasive weeds	To track occurrence, spatial distribution and cover abundance of water hyacinth and associated invasive weeds over time	Community level informants	Report localised weed occurrence and size of weed infestation and distribution
		Trained field surveillance technicians	Locate weed infestations and determine distribution and cover abundance;
		GIS and remote sensing experts	Collate and analyse available surveillance information including spatial remote sensed imagery; produce periodic reports on occurrence, spatial distribution and. cover abundance
Monitoring changes in plant well-being, mat condition and cover abundance	Keep track of changes in plant well-being, mat condition and cover abundance in relation to impacts of control measures;	Biological control specialist teams and community experts	Determine changes in plant well-being, mat condition and cover abundance in relation to impacts of control measures
		Trained field surveillance technicians	Determine associated changes in weed cover abundance
Monitoring shifts in environmental and socio-economic impacts due to weed infestation"	Keep track of shifts in environmental/ ecological as well as socio-economic impacts due to weed infestation so as to inform the control process with respect to "effective weed control levels"	Aquatic ecology study team	Determine and report associated shifts in environmental/ecological impacts due to weed infestation;
		Socio-economic study team	Determine and report associated shifts in socio-economic impacts due to weed infestation. This should include risks and health effects to the community

** In all cases gender balance is emphasised in involvement*

4.7.2 Analysis of stakeholder roles and responsibilities in the control process

Past weed management experience in Lake Victoria promoted integration of two or three methods in the control of water hyacinth and associated invasive weeds. Kenya and Uganda integrated manual, mechanical and biological control methods. Tanzania instituted manual removal and biological control. Rwanda had the two methods of manual and biological but at low scale. Burundi had no active program over that time. The overall objective of water hyacinth control was to bring weed biomass down to levels with insignificant environmental and socio-economic impacts. Analysis of stakeholder roles and responsibilities of the components of the water hyacinth control processes are outlined in Table 7.

Table 7: Stakeholder roles and responsibilities in the control processes

Activity	**Control method**	**Stakeholders***	**Roles and responsibilities**
Integrated control of water hyacinth and associated invasive weeds	Manual weed removal	Local communities; youth/women groups (e.g. for Rwanda); NGOs /hired labour	Use hand tools and protective gear especially gloves and gumboots to control small to medium sized weed influxes especially at landing beaches and small water bodies;
	Mechanical weed extraction	1. Trained technicians and operators for weed harvesters and loading equipment; 2. Drivers 3. Record keepers and 4. Various support staff	i. Operation and maintenance of weed harvesters, conveyor loaders ii. Driving weed disposal trucks and other vehicles iii. Record keeping and iv. Casual labour
	Biological control	1. Biological control specialist 2. Trained technicians	i. Plan and oversee biological control activities ii. Supervise rearing field releases and monitoring of biological control weevils

		3. Trained caretakers	iii. Rearing and supervised field release of biological control weevils

** In all cases gender balance is emphasised in involvement*

4.8 Roles and Responsibilities of the different Stakeholders

Surveillance monitoring and control of water hyacinth and associated invasive weeds will involve a large pool of stakeholders with wide-ranging professional diversity. The roles and responsibilities are analyzed in Table 8 below are proposed.

Table 8: Roles and responsibilities of stakeholders in the strategy implementation

Stakeholder	Responsibilities	Roles
East African Community Secretariat	To promote the widening and deepening of economic, political, social and cultural integration in order to improve the quality of life of the people of East Africa through increased competitiveness, valued added production, trade and investment; through control/removal of water hyacinth and other invasive weeds from all the fresh waters of the region	i. Guiding the EAC Policy framework on Environment and Natural Resources with specific reference to aquatic weeds surveillance & control in Lake Victoria Basin (LVB) ii. Periodic Briefing of the EAC Council of Ministers and Summit on progress made in aquatic weed control iii. Resource mobilization from partners for use in the control programs
East African Legislative Assembly	Legislation, oversight and representation	i. Legislate & enact laws on control of water weeds ii. Approve funding iii. Audit review iv. Formation of a specialized committee to follow up on the activities related to control of aquatic weeds
Lake Victoria Basin Commission	To have within the Lake Victoria Basin and East African Community at large a prosperous population living in a healthy and sustainably managed environment providing equitable opportunities and benefits through the	i. Coordinate and oversee Water hyacinth surveillance & control programmes ii. Quality control of data acquisition, treatment, storage and management iii. Mobilize and coordinate all

Stakeholder	Responsibilities	Roles
	promotion, facilitation and coordination of activities of different actors towards sustainable development and poverty eradication.	stakeholders with interest in participating in the control programs iv. Build capacity of the region to control the aquatic weeds v. Mobilize resources
EACJ	Ensuring adherence to the Law, Interpretation and application of the Treaty for the Establishment of the East Africa Community the Treaty	To hear and determine disputes on the interpretation of the Treaty and in this case with regard to sections related to the waterweed control and arbitration
LVFO	1. Fisheries management in the region 2. Maintenance of vibrant fisheries industry in the region	Research Training
National Legislative Assembly	National interest in environmental management and the control of water weeds	i. National policies on aquatic weeds ii. Enacting laws and regulations on aquatic weeds
Line Ministries e.g. Water and Environment	1. National in the following areas: 2. Environmental management 3. Water resources management 4. Fisheries and fisher folks welfare 5. Management of weeds 6. Food security 7. Health	i. Initiate & Implement policies ii. Mainstream aquatic weeds surveillance & control in policies, laws and strategies iii. Supervise government programmes for water weeds iv. Develop capacity for surveillance & control
National Environmental Management Authorities: NEMA,NEMC, REMA	1. National Environmental management 2. National Population welfare	i. Coordination ii. Enforcement
Local Authorities	Welfare of the local community	i. Mobilisation ii. Ordinances/byelaws iii. Sensitization iv. Implementation of surveillance & control activities
Community	Welfare of the community	i. Implementation of surveillance & control activities ii. Gathering and transmitting iii. information on water hyacinth & associated water weeds
NGOs &CBOs	Community focused projects	i. Link national and regional institutions to the community ii. Fundraising & funding iii. Training of community iv. Help monitor and demand accountability
The media	Information dissemination	Reporting issues of public interest

Stakeholder	Responsibilities	Roles
Development partners	Assistance to regional and national institutions	Assistance in the development and implementation of the surveillance & control process

4.9 Activities for addressing institutional, coordination and capacity needs at national and regional levels

With many stakeholders that are critical for the prevention and control of water hyacinth and other invasive weeds, institutional, coordination and capacity issues and need of the different stakeholders have to be addressed in designing a realistic and sustainable surveillance and monitoring system.

On institutional needs, identifying key government institutions with a national or regional mandate is essential as a strategy for leveraging sustained government funding as well as integration into national planning processes. Assigning the water hyacinth control role and responsibilities to these institutions is in addition essential to keep the agenda of water hyacinth control high in the political arenas of the countries at all levels of government - executive, legislative and judicial. The research aspect can also be promoted within the Universities and other research institutions and agencies of government.

Capacity needs assessment of the key institutions for the strategy implementation, should be carried out by LVBC. This will enable resources to be properly directed towards capacity building for sustainable strategy implementation.

The strategy proposed here is to have coordination centred at both regional and national levels. The East African Community Secretariat is the most suitable home for coordinating water weeds control in all other water bodies of EAC other than Lake Victoria where the Lake Victoria Basin Commission is the best suited regional coordination centre. At country levels and basing on reviews of

the mandates of the different government institutions, the coordination strategy should be to have the Ministry responsible for environmental affairs/water management take the lead role in this activity. The recommendation is arrived at recognizing that the water hyacinth negative impacts are not specific to any sector but impact across several sectors that in each country are best catered for under the environmental legislation.

The role and functions of the national and international Civil Society Organizations (CSO) and Private Sector Organizations (PSO) in the control of these weeds was well captured and defined in the reviews done. It is proposed that as strategic partners, the CSO and PSO become an integral part of the National processes in the water weed control so as to tap into their vast knowledge and expertise in the control processes. Moreover, these organizations may be able to leverage their own funding that can support the government resources. The proposed institutional and coordination mechanisms described above is illustrated below (Fig.23).

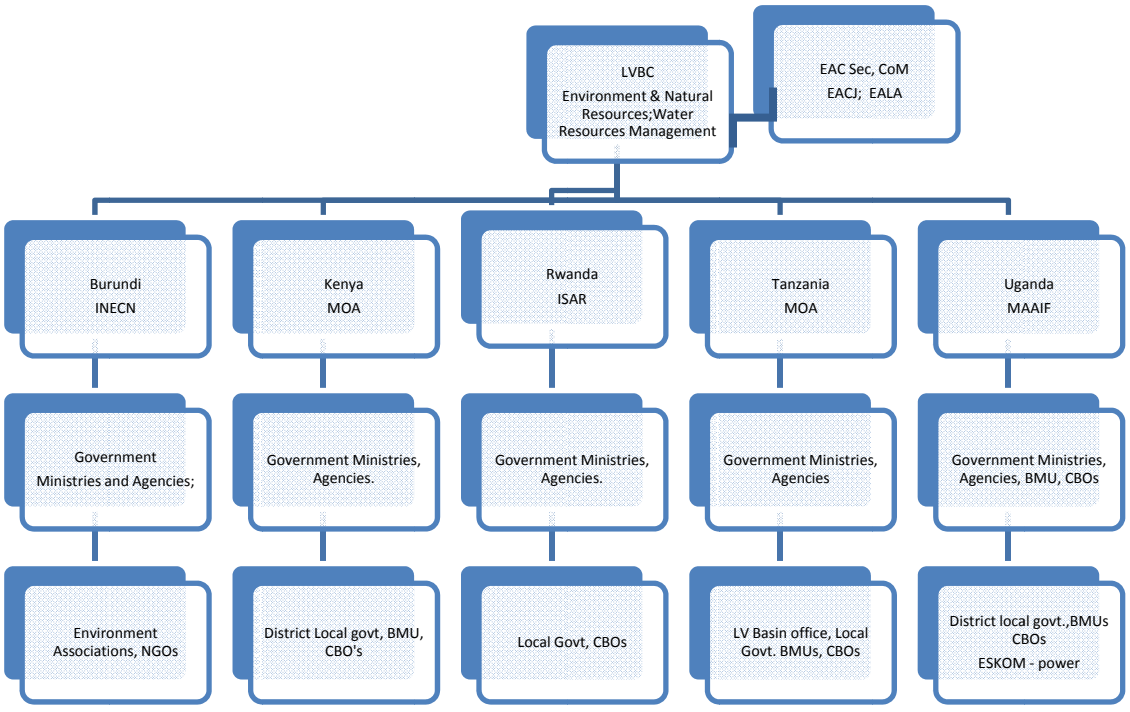


Figure 23: The proposed Organogram for institutional and coordination mechanisms

It was evident that there are capacity gaps that needed to be continuously built and sustained if the weed menace is to be controlled effectively. The personnel who had been trained in the various aspects of water hyacinths control Uganda, Kenya and Tanzania especially at government ministries in the 1990's had dwindled for various reasons including natural attrition. Hence, the strategy proposed in this regard is to continuously train individuals within all the responsible government Ministries and agencies as well as from the CSO and PSO. In the Beach Management Units, because of the high mobility of the inhabitants, more structured training programmes should be designed and applied. As part of the capacity enhancement strategy, it is proposed that trainees are exposed through experiential learning approaches to situations and different methodologies applied in water hyacinths control in different EAC countries and districts. This is the function and role that will be coordinated by the Lake Victoria Basin Commission Secretariat and the National Coordinating ministries.

4.10 Proposed Activities to be undertaken under different strategic objectives

The summary of proposed Action Plan for surveillance and control of water hyacinth is illustrated in Table 9. The Action plan is premised on overall objective of the Strategy namely: to develop an effective surveillance and management system for water hyacinth and other aquatic weeds. The system can be considered in two: identifying and monitoring aquatic weed infestation in the Lake Victoria basin and prioritising areas for strategic control of the weeds within Lake Victoria Basin.

4.11 Budget Estimates

The budget estimate for the implementation of this strategy based on the strategic activities is presented in Table 10. Financing the implementation of the strategy is expected to come from the Partner States, EAC, NGOs and donor agencies.

Table 9: Action Plan for the implementation of the water hyacinth surveillance, monitoring and control Strategy

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
1. Establishment of a cost-effective water hyacinth surveillance and monitoring system	1.1.1 Configuration of GPSes for use in collecting spatial attributes for use across the 5 Partner States	▬			LVBC	GPses configured	High
	1.1.2 GIS/image analysis training on integrating GPS-collected and existing GIS maps using Open Source GIS/Image Processing systems (e.g. Quantum GIS and GRASS). Includes expenses for the trainer consultant	▪▪▪▪▪▪▪▪▪			LVBC	Number of GIS,/image analysis training completed	High
	1.2.1 Design of standard data collection tool	▬			LVBC		High
	1.2.2 Field pre-testing of the standardized data collection tool	▬			Partner States		Moderate
	1.2.3 Establishment of aerial/space sampling grids for hotspot areas	▬			LVBC/ Partner States		Moderate

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
	1.3.1 Mobilization of community members (through use of local governance structures) to participate in the surveillance of water hyacinth and other aquatic weeds	▪▪▪▪▪▪▪▪▪▪▪▪			Partner States /NGOs/CBOs	Number of community mobilisation meetings per country	Moderate
	1.3.2 Training of selected community members in how to use hand-GPS's and recording water hyacinth/other aquatic weeds attributes	▬▬			Partner States	Number of trained community members per partner state Training Reports	Moderate
	2.3.3 Field supervision of community members practicing how to collect and record spatial data on water hyacinth/other aquatic weeds attributes	▪▪▪▪▪▪▪▪▪▪▪▪			Partner States /NGOs/CBOs	Field supervision reports	Moderate
	1.4 Establishment of a baseline database for the Water Surveillance and Monitoring System 1.4.1 Procurement of hardware (for each unit: 2 PCs, 1 A3 printer, 20 hand-held GPS, 2 Camcorders)	▬▬ ▬▬			LVBC LVBC	hardware in place	Moderate High
	1.4.2 Procurement of Open Source	▪▪▪▪▪▪▪▪▪▪▪▪			LVBC	procured software	High

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
	Software (including GIS, Image processing, statistical)						
	1.4.3 Procurement of existing digital spatial map layers (including DEMs, rivers, water bodies, roads, land cover/use) for each country				LVBC Partner States		Moderate
	1.4.4 Procurement of high-resolution imagery for hotspot areas				LVBC	Number of images procures	High
	1.4.5 Preparation of base maps (from procured existing GIS maps) for each hotspot in each Partner State				LVBC Partner States	Number of base maps prepared	High
	1.5.1 Periodic (monthly) field surveillance of water hyacinth and other aquatic weeds in the Lake Victoria basin: 20 selected communities per partner state each expensing $100 per month for 12 months for 10 years				BMU/Communities	Number of surveillance reports from communities	Moderate

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
	1.5.2 Monthly trend analysis (monitoring) of water hyacinth/other aquatic weeds distribution by the Water Surveillance and Monitoring Units per partner state	▪▪▪▪▪▪▪▪▪▪▪▪			Partner States	Trend analysis reports	High
	1.5.3 On demand aerial surveys for hotspot areas with reported extensive water hyacinth/other aquatic weeds estimated every 5 years for 10 hot spot areas with an estimated 300 square km per hotspot area		▪▪▪▪▪▪▪▪▪▪▪▪		LVBC	Number of aerial surveys done	Low
	1.5.4 Procurement and analysis of medium resolution imagery for hotspot areas with reported extensive water hyacinth/other aquatic weeds estimated once every 10 years for 10 hot spot areas		▪▪▪▪▪▪▪▪▪▪▪▪		LVBC	Images procured	Moderate
2a. Prevention and control of the water hyacinth as rapidly as it is identified by the established water surveillance and monitoring system	2.1.1 Surveillance to categorise the degree of infestation ('none', 'light', 'significant', 'heavy'). Early warning system		▪▪▪▪▪▪▪▪▪▪▪▪		Partner States	Surveillance Reports	Moderate
	3.1.2 Establishing seasonal/temporal occurrence of infestation and WH movement patterns into or out of the location		▪▪▪▪▪▪▪▪▪▪▪▪		Partner States	Infestation Reports	High

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
	2.2 Establish a manual control system for critical areas (water abstraction points/sources, power generation plants, fish landing beaches, ports and piers, irrigation canals) that have low to moderate weed infestation	▪▪▪▪▪▪▪▪▪▪▪▪▪▪					
	2.2.1 Procuring hand-tools, boats and protective wear	▪▪▪▪▪▪▪▪▪▪▪▪▪▪			Partner States	Tools, boats and protective gears in place	High
	2.2.2Assembling and, training teams of personnel to be involved with removal operations	▪▪▪▪▪▪▪▪▪▪▪▪			LVBC/ Partner States	Trained personnel and Training Reports	Moderate
	2.2.3 Instituting public awareness activities to inform and secure public cooperation	▪▪▪▪▪▪▪▪▪			Partner States	Number of workshops Workshop Reports	High
	3.3 Implement biological control – with *Neochetin*a spp – in lake environments and dams, that are heavily infested with WH						
	2.3.1 Establishing weevil release points and numbers for the weevils required	▬▬▬			Partner States	Weevil released points established	High

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
	2.3.2 Training workshops on methods of rearing, release and impact assessment	▪▪▪▪▪			LVBC/ Partner States	Workshop Reports	Moderate
	2.3.3 Releasing the weevils to control the weeds and monitor the impact	▪▪▪▪▪▪▪▪▪▪▪▪▪			LVBC/ Partner States	Weevils weeds control Reports Weed infestation under control	High
2b. Control of existing water hyacinth infestations in hotspots and other areas to the acceptable ecological and economical levels as and when infestation occurs;	1. Training of key stakeholders in each hotspot to understand the water hyacinth dynamics and control methods; 2. To mobilise key stakeholders (fishermen/lady (BMUs); water suppliers, villagers; district authorities, and other main users of the hotspots) in each hotspot to physically to remove water hyacinth at the acceptable level in each hotspot; 3. To provide incentives package (e.g application for Payment for Ecosystem Services -PES) to the key stakeholders removing removing water hyacinth and other associated aquatic weeds in	▪▪▪▪			LVBC/ Partner States	% Reduction in area covered by water hyacinth in identified hotspots	High

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
	the hotspots; 4. To hire machines in the areas where machines can be economically used, to remove water hyacinth easily and quickly; and 5. To use biological methods as means to ensure sustainability of intercepting the water hyacinth cycle/ life.						
3 Establishment of a communication framework	3.1 Establishment of effective and efficient communication mechanisms				LVBC/ Partner States	Communication committee in place Communication protocol in place	
	3.2 Carrying out one regional training programme of the Media from the partner states				LVBC/international Partners	Media of the partner States knowledgeable and participating fully in disseminating water hyacinth/water weeds issues	
	3.3 Preparing information/awareness materials (posters, information sheets, flyers)				LVBC/ Partner States	Information and awareness materials in place and being used	
	3.4 Production of documentary and educational videos, radio programmes, live and recorded interviews				LVBC/ Partner States	Films and videos in place and being used	

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
						Ongoing Radio and TV programmes	
	3.5 Launching of water hyacinth magazines, newspaper supplements, billboards	▪▪▪▪▪▪▪▪	▪▪▪▪▪▪▪▪		LVBC/ Partner States	Magazines, newspaper articles/supplements, billboards in place	
	3.6 Reviewing school curricula to incorporate invasive water weeds issues	▪▪▪▪▪▪▪▪	▪▪▪▪▪▪▪▪		Partner States	Water hyacinth issues included in School curricula	
	3.4.1 Purchase of cameras (static & videos), mobile phones	▪▪▪▪▪▪	▪▪▪▪▪▪		LVBC/ Partner States	Information gathering and transmission equipment in place Functioning information network with strong community feedback	
	3.4.2 Purchase of film vans		▬		LVBC/Partner States/international partners	Film vans in place Aware community and active in water hyacinth/aquatic weeds surveillance, monitoring and control	
4. Setup coordination mechanisms for ensuring synchronization of water hyacinth surveillance, monitoring and control	4.1 Strengthen the LVBC Regional unit for effective coordination of the activities of the control and surveillance of water hyacinth and other aquatic weeds					Fully functional effective and efficient unit for the coordination of the implementation of the strategy	

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
systems	4.1.1Financing the incremental operating/administrative costs of the LVBC coordination unit	———	———	———	EAC and International Partners	Adequate funding secured for short and medium term operation of the strategy implementation coordination unit	High
	4.1.2 Supporting coordination of implementation of the strategy	- - - -	- - - -	- - - -	EAC and International Partners	Effective and efficient coordination unit Annual monitoring and Evaluation Reports	High
	4.2 Improve the effectiveness of key national institutions for control and surveillance of water hyacinth and other aquatic weeds				LVBC and Partner States	Effective and efficient national institution per partner States	High
	4.2.1 Financing the incremental operating costs of the national water hyacinth units responsible for the implementation of the water hyacinth control and surveillance strategy	- - - -	- - - -	- - - -	Partner States and International Partners	Adequate funding secured for short and medium term operation of the strategy implementation by national units	High
	4.2.2 Assisting national institutions to prepare and implement water weeds M&S projects that can attract financing	- - - -	- - - -	- - - -	LVBC	Successful Project proposals Implemented projects	Moderate
	4.3 Strengthen existing Institutions capacity to improve the cooperative management of water hyacinth	- - - -	- - - -	- - - -	LVBC and International Partners	Operating networking between the partner State lead agency and key stakeholders in the	High

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
						implementation of the strategy	
	4.3.1 Capacity needs assessments for institutions involved in the strategy implementation	▬					High
	4.3.2 Capacity building programs: short and long-term training, technical assistance, equipment , outreach	▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪▪			LVBC and International Partners	Training accomplished Training Reports Number of outreach programmes accomplished	
	4.4 Develop improved policy and regulatory framework for the control and surveillance of water hyacinth and other aquatic weeds in LVB	▪▪▪▪▪▪▪▪▪▪▪▪			Partner States	Policy and regulations reviewed to mainstream aquatic weeds management	
	4.4.1 Harmonization of national policies, legislation, and standards for aquatic weeds control and surveillance	▪▪▪▪▪▪▪▪▪▪▪▪			Partner States	Policies , Regulations and Standards harmonised within and among partner states for sustainable implementation of the strategy	

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
	4.5 Assist in institutional development for establishment of database and database management mechanisms	▪▪▪▪▪▪▪▪▪▪▪▪▪▪			LVBC and International Partners	Trained officers from the partner states in database management	
	4.5.1 Developing standard monitoring and surveillance protocols for water hyacinth and other aquatic weeds	▪▪▪▪			LVBC	Monitoring and surveillance Protocol in place	
	4.5.2 Establishing a regional data base containing information on the distribution of water hyacinth and other aquatic weeds, the methods of their control and their environmental and socio-economic impact.	▪▪▪▪▪▪▪▪▪▪▪▪▪▪			EAC/LVBC	Fully functional database operating effectively and efficiently	
	4.6 Develop and implement quality assurance mechanism to track implementation of the strategy				LVBC	Quality assurance mechanisms in place	High
	4.6.1 Developing a monitoring and evaluation (M&E) protocol to track the implementation of the water weeds M&S strategy.	▬▬			LVBC	M&E Protocol in place	High
	4.6.2 Carrying out monitoring and evaluation by LVBC of the strategy implementation activities for quality assurance	▪▪▪▪▪▪▪▪▪▪▪▪▪▪			LVBC	Monitoring and Evaluation Reports	High

Strategic objective	Tasks	Timing			Responsibility	Outcome indicators	Priority
		2012-2014	2015-2020	2020-2030*			
	4.6.3 Collection, analyses, storage, and dissemination of data and information on the strategy implementation performance, outcomes, and impact, based on agreed indicators	......	......	......	LVBC/ Partner States	M&E Indicators in place Strategy implementation progress reports	High
Establish a mechanism for sustainable financial resources mobilisation to finance the strategy	6.1 identifying different sources of funding for implementing the strategy	......			LVBC and Partner States	Diverse, stable and secure funding mechanisms for strategy implementation	High
	6.1.1 Securing funds for implementing the strategy	......	......				
	6.2 Mainstreaming the strategy implementation in the financial plans of the partner states	......	......		Partner States	Stable funding source for the strategy implementation	High
	6.2.1 Establishment of effective and efficient financial administration for strategy implementation	......	......			Effective and efficient disbursement of funds for the strategy implementation	High

** Only activities apply for long term*

Table 10: Cost estimates for the implementation of the water hyacinth surveillance, monitoring and control strategy

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
1. ESTABLISHMENT OF A COST-EFFECTIVE WATER HYACINTH SURVEILLANCE AND MONITORING SYSTEM					
Capacity building of the technical staff of mandated agencies and other stakeholders for the surveillance and monitoring of water hyacinth and other aquatic weeds	Development/updating of common manuals for short GPS/GIS/remote sensing new/refresher courses for national/district technical staff (Consultant professional fees at US $ 200/day X 22 days X 1 person); delivery of short new/refresher courses for national/district technical staff (drawn from the national surveillance/monitoring units) on how to use hand-held GPS, GIS, and image interpretation for mapping the occurrence of water hyacinth and other aquatic weeds in the Lake Victoria Basin (Participants' per diem of US $ 75/day X 7 days X 5 participants/country X 5 countries); delivery of the new/refresher short course on how to use hand-held GPS, GIS, and image interpretation for mapping the occurrence of water hyacinth and other aquatic weeds in the Lake Victoria Basin (Consultant professional fees at US $ 200/day X 7 days X 1 person/country X 5 counties; per diem for training consultant at US $ 100/day X 1 consultant X 7 days X 5 countries); and GPS training of strategic partners (fishers, water transporters, and water/wetland extension staff) on the use of hand-held GPS to collect spatial data on the occurrence of water hyacinth and other aquatic weeds (Participants' per diem of US $ 20/day X 2 days X an average of 30 participants/country X 5 countries, Per diem for	34,150	37,565	82,643	154,358

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
	technical staff at US $ 75/day X 15 days X 1 person/country X 5 counties)				
Development of standardised data collection protocols/tools	Design of new and periodic updating of a standardised data collection tool for capturing different attributes of water hyacinth and other aquatic weeds (Professional fees for a regional consultant at US $ 200/day X 20 days X 1 person); and Establishment/reviewing of aerial/space sampling grids for acquiring imagery, if needed, in water hyacinth hotspot areas in the Lake Victoria Basin (Professional fees for a regional consultant at US $ 400/day X 20 days X 1 person)	12,000	13,200	14,520	39,720
Establishment of national and regional baseline databases for the Water Surveillance and Monitoring System	Procurement of hardware (US $ 1,000/PC X 2 PCs X 5 countries; US $ 2,000/printer X 5 printers; US $ 300/GPS X 30 GPSes/country X 5 Countries); Acquisition of existing digital spatial map layers (including DEMs, rivers, water bodies, roads, land cover/use and high-resolution imagery) at cartographic scales of 1:50,000 – 100,000 for the Lake Victoria Basin in each country (An average of US $ 75,000/country X 5 counties); Installation of Open Source spatial Software (including GIS, Image processing, statistical)(Professional fees for a regional consultant at US $ 200/day X 2 days/country X 5 countries X 1 person); and Preparation/updating of base maps (from procured existing GIS maps) for each hotspot area/country in each Partner State (Professional fees for a regional consultant at US $ 200/day X 30 days/country X 5	472,000	519,200	571,120	1,562,320

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
	countries X 1 person)				
Execution of routine or/and project-based periodic activities for the surveillance and monitoring of water hyacinth and other aquatic weeds in each Partner State	Periodic (monthly) field surveillance of water hyacinth and other aquatic weeds in the Lake Victoria Basin (an average of US $ 1000/month X 12 months X 3 years X 30 communities/country X 5 countries); Monthly trend analysis (monitoring) of water hyacinth/other aquatic weeds distribution by the Water Surveillance and Monitoring Units (An average of US $ 1,500/month X 12 months X 3 years X 5 countries); One time aerial surveys (during the short- medium and long-terms) for hotspot areas with reported extensive water hyacinth/other aquatic weeds (An average of US $ 15/sq. km X 3,000 sq. km/country X 5 countries); and Packaging of information (on water hyacinth surveillance, monitoring and control) for dissemination to stakeholders at regional level (an average of US $ 10,000/year X 3 years X 5 countries.	969,000	1,731,900	2,317,090	5,017,990
Subtotal for the surveillance and monitoring component		1,487,150	2,301,865	2,985,373	6,774,388
PREVENTION AND CONTROL OF WATER HYACINTH AS RAPIDLY AS IT IS IDENTIFIED AND, MAINTAINING INFESTATIONS AT ECOLOGICALLY INSIGNIFICANT LEVELS					

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
Implementation of short new/refresher courses for national/district technical staff on water hyacinth control methods, rearing and release of *Neochetina* spp. weevils and, monitoring of their establishment and impact	Consultant professional fees at US $ 200/day X 2 persons X 10 days + participants' per diem of US$ 50.day X 2 days X 16 persons X 5 countries + logistical preparations estimated at US$ 1,000 X 5 countries	17,000	34,000		51,000
One-day workshop for teams selected to implement manual and mechanical control on personal safety during operations, operation and deployment of machinery (harvesters, boats, booms, etc) used to remove water hyacinth and other aquatic weeds in the Lake Victoria Basin	Participants' per diem of US $ 50/day X 1 day X 15 participants/team X 10 teams X 5 countries + facilitator allowances @ US$200/day X 10 days + logistical costs estimated @ US$1,000 X 10 days	49,500			99,000
Procuring hand tools, boats and protective wear to be used by institutional staff hired to remove continuously individual plants drifting from other areas into the critical area, wages for staff involved and, disposal of weed	hand tools and protective wear estimated at an average of US $ 2,000/month X 12 months X 10 areas /country X 5 countries + hire of motorised boats @ US$3,000/month X 12 months X 10 areas /country X 5 countries	120,000	90,000	120,000	330,000
Purchase of aquatic vegetation cutter, mechanical weed harvester, a shore conveyor, a conveyor trailer, a workboat,	At US$ 8000,00 per set x 3 for Lake Victoria and training on operation by the suppliers	2,400,000	800,000	80,000,	3,200,000

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
and floating trash booms. Installation of containment booms/barriers to contain weed in one location	A set of booms for the rivers at US$ 800,000				
Contract firms to remove weed infestations that are moderately heavy and those confined by the containment booms	An average of US $ 10,000/month X 3 months X 3 years X 5 countries	600,000	400,000	200,000	1,200,000
Conduct public awareness activities to inform public and secure its cooperation/support; these would include sensitisation meetings of local/opinion leaders, radio and TV spots, newspaper advertisements	US$ 10,000 X 5 countries	50,000	-	-	50,000
Identify target lakes and dams and, establish rearing and release points and numbers for the weevils	Consultant professional fees at US $ 200/day X 7 days X 2 person/country X 5 counties	14,000			14,000
Establish and maintain rearing units	An average of US $ 15,000/country X 5sites X 5 countries + maintenance at an average of US$ 1,500/month X 12 months X 4 years X 8 sites X 5 countries	1,953,000		1,302,000	3,255,000
Release weevils and conduct periodic monitoring of impact	20,000 per country				100,000

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
Institute mechanical removal with harvesters and/or manual removal at sites identified at periodic intervals	Consultancy for mechanical removal estimated at US$500,000 X 5 sites ,	12,500,000	12,500,000		2,500,000
Acquire dump sites for harvested WH	0.5 acre piece of land estimated at US$ 3,000 X 8 sites X 5 countries	120,000			120,000
At locations with heavy resident populations of WH, apply approved herbicide to weaken (reduce its vigour) weed mass then subsequently remove weed mass by mechanical or manual means before it sinks into water column	Consultancy for herbicide application estimated at US$300,000 X 5 sites	7,500,000			1,500,000
Enforce proper waste disposal practices – domestic and industrial – including treatment of effluents	Consultancy to implement proper waste disposal and its enforcement in the LVB		150,000		150,000
Re-establish fringing wetlands at lake edges and enforce observation of buffer zones round water bodies	Consultancy for establishment and rehabilitation of fringing wetlands and enforcement of buffer zones round water bodies		150,000		150,000

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
Encourage best practices in agronomy and infrastructural development (roads, buildings, etc) to reduce erosion of soils into water bodies.	Consultancy for implementation of practices to reduce soil erosion in the LVB		150,000		150,000
Develop and/or harmonize transboundary legislation and policies on waste management in the L. Victoria catchment	5 five-day regional workshops of 10 persons each estimated at US$20,000	20,000			20,000
Subtotal for the control component					12,899,000
Establishment of a communication framework					
Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
Preparing training manual and other training materials	Hiring consultant to produce training materials	70,000			70,000
Preparing awareness materials (posters, information sheets, flyers)	Hiring consultant to produce training materials	50,000			50,000
Production of awareness and educational materials: documentary and educational videos, radio programmes, live and recorded interviews	Hiring consultant for each task	250,000	150,000	100,000	500,000
Carrying out one regional training programme of the media from partner states in environmental journalism	Participants 'fees 1,500 x 10 participants x 5 countries for 3 weeks, training by one national university	75,000			75,000
Carrying out awareness and training for communities and schools programmes using materials in3.1.1 & 3.2.1	Consultants fees Per diem for technical staff from the 5 counties	120,000	200,000	130,000	450,000
Reviewing school curricula to incorporate invasive water weeds issues	Consultants fees at 15,00 0 per country x 5 Adoption Workshop	75,000			75,000
Purchase of cameras (static & videos),	Procurement of equipment for data collection and information	30,250			30,250

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
mobile phones,	exchange				
Establishing communication network among stakeholders	Procurement of hardware and software	250,000	150,000		400,000
Purchase of film van	One van based at LVBC at 80,000 US$ each x5				400,000
Subtotal for communication					2,050,000
Setup coordination units for ensuring synchronization of water hyacinth surveillance, monitoring and control system					
Financing the incremental operating/administrative costs of the LVBC coordination unit	Budget support operation/administrative cost of the regional coordination	700,000	500,000	150,00	1,350,000
Financing the incremental operating costs of the national water hyacinth units responsible for the implementation of the water hyacinth control and surveillance	Coordination and supervision activities of partner states by LVBC and	500,000	800,00	1,200,000	2,500,000

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
strategy	Workshops to assess progress of strategy implementation				
Assisting national institutions to prepare and implement water weeds M&S projects that can attract financing	Hiring consultant for training at US$50,00 and training national teams in proposal preparation (US$200)	250,000			250,000
Carry out capacity needs assessment for the institutions involved in the strategy implementation	Hiring consultants to carry out institutional capacity needs assessment	200,000			200,000
Capacity building programs: short and long-term training, technical assistance, equipment , outreach	Participants' per diem of US $ 75/day X 7 days X 5 participants/country X 5 countries	13,125	14,437.5	15,881.25	43,444
	Technical assistance/consultant (Expert 120,00 US$ annually)	360,000	720,000		1,080,000
	Equipment (80,000US$ x5)	400,000			400,000

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
Harmonization of national policies, legislation, and standards for aquatic weeds control and surveillance	Consultants fees Per diem for technical staff from the 5 counties	120,000	200,000	135,000	455,000
Developing standard monitoring and surveillance protocols for water hyacinth and other aquatic weeds	Consultants fees Adoption Workshop	155,000 49,500			155,000 49,500
Establishing a regional data base containing information on the distribution of water hyacinth and other aquatic weeds, the methods of their control and their environmental and socio-economic impact. Effectively operating the database for 10 yrs	Procurement of hardware and soft ware (computers, data software, statistical packages) Maintenance and Management cost	1,300,00	20,000	30,000	1,350,000
Developing a monitoring and evaluation (M&E) protocol to track the implementation of the water weeds M&S strategy.	Consultants fees Adoption Workshop	120,000 49,500			120,000 49,500
Carrying out monitoring and evaluation by LVBC of the strategy implementation activities for quality assurance	Supervision visits by LVBC to Partner states Regional Evaluation workshops	22,500	15,000	35,000	72,500

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
		99,000	99,000		198,000
Collection, analyses, storage, and dissemination of data and information on the strategy implementation performance, outcomes, and impact, based on agreed indicators	Professional fees for a regional consultant at US $ 400/day X 20 days X 1 person x5 Regional workshop	40,000 49,500	80000 99,000	400,000 198,000	520,000 346,500
Subtotal for coordination of strategy implementation					9,139,444
Establish a mechanism for sustainable financial resources mobilisation to finance the strategy					
Mainstreaming the strategy implementation in the financial plans of the partner states	Consultants fees	120,000			120,000
Establishment of effective and efficient financial administration for strategy	Consultants to set an effective and efficient financial	120,000	120,000		240,000

Item	Budget notes	Implementation period			Total Amount (US $)
		Short Term 2012-2014	Medium Term 2015-2020	Long Term 2021-2030	
		Total (US $)	Total (US $)	Total (US $)	
implementation	administration system Hardware and software (30,00 per country/year)	150,000	150,00		300,000
Subtotal for financial resource mobilisation					660,000
Grand Total for the Strategy Implementation					31,522,832

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ANNEXES:

Annex 1: Water Hyacinth Coverage and Hotspots

Annex1.1: Water hyacinth coverage of the Kenyan side of Lake Victoria

Year	Infestation (ha)	Remarks
1994	8500	Data extracted from Report of water hyacinth control component of LVEMP I (Kari Kibos)
1998	17200	
2000	400	
2003	384	
2007	4005	
2010	9600	Data from LVEMP II Baseline survey

Annex 1.2: Water hyacinth infestation of the Kenyan side of Lake Victoria

Location/Site	Infestation (ha)	Infestation status*
Sango Rota	1000	3
Kunya	800	3
Luanda Kutieno	0.06	1
Homa bay Pier	750	3
Kananga Beach	750	3
Ngegu Beach	25	3
Kuwour Pier	0.15	3
Doho Beach	60	2
Kendu Bay Pier	0.4	3
Obaria Beach	1	3
Asembo Bay	4400	3
Kaloka Beach	20	3
Asat Beach	510	3
Ogal Beach	1	1
Nduru Beach	0.4	3
Kicinjo	600	3

Location/Site	Infestation (ha)	Infestation status*
Dunga	0.5	2
Luanda Kanyango	0.0025	2
Muhuru Pier	0.0025	1
Sio River Mouth	0.001	1
Nzoia River Mouth	2	2
Bulwani	3	2
Goye (Yala River mouth)	0.002	1
Usenge	0.06	1
Misori	0.0025	1
Lambwe River mouth	10	2
Yala River at Dominion Farm (Water Intake Point)	0.01	1
Rakwaro	900	3
Kwang (River Migorin Mid mouth)	0.01	1
Uyawi	0.0005	0
Karungu Bay	0.0008	1
Sindo Beach	0.0002	1
Ogwedhi (Kamnoka)	0.06	1
Lunda	0	0

** 0=no water hyacinth or negligible*

1= low infestation, can easily be removed by hand

2=moderate infestation, fishing boats can land

3= heavy infestation, no fishing, no landing

Annex 1.3 Water hyacinth distribution trends by region/district in Tanzanian waters of Lake Victoria.

Location		Water hyacinth Infestation (ha)			
Region	**District**	**Hot spot**	**2003**	**2007**	**2010**
Mwanza	Nyamagana/Missungwi	Mwanza gulf	77.4	102.5	41.7
	Magu	Simiyu	2.7	17.6	15.5
	Sengerema	Katunguru	0.0	1.1	18.7
Mara	Musoma Urban	Samara Bay	34.8	167.2	149.2
	Rorya	Kinesi	0.5	8.0	6.5
		Sota	0.0	0.0	0.0
	Bunda	Kisorya	0.0	34	2.9
		Mugara/Issanju	7.1	9.6	34.6
	Musoma rural	Suguti/Chitare	0.9	4.5	22.4
Kagera	Bukoba rural	Rubafu	4.8	209	226.4
	Chato	Nyamirembe/Buzirayombo	0.2	67.6	22.4
			128.9	621.1	540.3

Annex 1.4: Changes in cover abundance (ha) of mobile water hyacinth in 'production' and 'storage' bays in northern Lake Victoria, Uganda.

Location (Bays)	Initial Infestation				Resurgence Trends					
	1994	**1997**	**1998 May**	**1998 Oct.**	**1999**	**2001**	**2002 March**	**2003**	**2004**	**2005**
Murchison⊕	877	490	100	0	2.0	10.0	9.0	10.0	12.0	15.0
Waiya*	3	80	140	20.0	1.0	0.5	1.0	0.5	0.3	0.5*
Thruston*	108	790	800	30.0	1.0	1.0	1.0	1.0	1.0	0.8*
Hannington*	96	304	750	300.0	1.0	1.0	1.0	0.8	1.0	1.5*
Macdonald	13	4	2.0	2.0	1.0	1.0	1.0	2.0	3.0	5.0
Pringle	15	5	1.0	1.0	1.0	1.0	1.5	1.0	0.5	0.3*
Napoleon Gulf	NS	NS	NS	NS	1.0	2.0	2.0	3.0	2.5	4.0
Bunjako	NS	NS	NS	NS	NS	2.0	8.0	8.0	9.0	9.0*
Total	1,112	1673	1, 793	353	8	18	25	26.3	29.0	36.1

Annex 2: List of NGOs/CBOs involved in water hyacinth issues in the Lake Victoria Basin

Annex 2.1: Water Hyacinth stakeholders (NGOs n& CBOs) in Tanzania

Category	Stakeholder
Government Departments/Ministries	Ministry of Agriculture Food Security and Cooperatives Vice President office (National Environment Management Council) Ministry of Water Ministry of Livestock and Fisheries Development Prime Minister's Office – Regional administration and Local Government
Research Institutions	Sokoine University of Agriculture Tanzania Fisheries Research Institute Veterinary Investigation Centre
Government Institutions	Directorate of crop development Directorate of Water Resources Management Directorate of Water laboratory Directorate of fisheries research
Non Governmental Organizations	Tanzania agricultural Modernization Association (TAMA, Major Alliance Education Centre (M.A.E.C), ZAM ZAM Youth Friendly Centre (ISHI), HIFADHI MAZINGIRA KAGERA (HIMAKA), Bishonga Community Dev Organization (BICODEO),
Local Authorities	District Executive directors of Nyamagana, Misungwi, Sengerena, Geita, Chato, Bukoba, Karagwe, Misenyi, Magu, Bunda, Musoma and Rorya and Ukerewe
Transporters	Ferry Services Individuals boat owners
Community	Beach Management Units (BMU), Community Based Organizations, Fisher folks, local community

Annex 2.2: Water Hyacinth Stakeholders in Kenya

Category	Stakeholder
Government Departments/Ministries	Ministry of Environment and Mineral Resources Ministry of Agriculture Ministry of Transport Ministry of Water and Irrigation Ministry of Fisheries Development Kenya Forestry Service
Research Institutions	Kenya Agricultural Research Institute Kenya Marine and Fisheries Research Institute Maseno University Moi University
Government Institutions	Water Resources Management Authority Lake Basin Development Authority Kenya Plant Health Inspectorate Service Kisumu Port
Non Governmental Organizations	OSENALA (Friends of Lake Victoria) BOFICO (Bondo) UHAI (Kisumu town) VIRED International (Kisumu) WIFIP (Kisumu)
Water Services Companies	Kisumu Water and Sanitation Company South Nyanza Water Services Company Lake Victoria South Water Services Board
Local Authorities	Town Clerk Kisumu Homabay, Bondo, Busia
Transporters	Kisumu Port Suba Ferry Services Individuals boat owners
Community	Beach Management Units (BMU), Community Based Organizations 9CB)s), local community

NB: These are the stakeholders whose activities or services are affected by water hyacinth or whose activities lead to proliferation of water hyacinth, or are involved in water hyacinth utilization, research etc.

Annex 2. 3: Water Hyacinth Stakeholders in Uganda

Category	Stakeholder
Government Departments/Ministries	Ministry of Water and Environment Ministry of Agriculture Animal Industry and Fisheries Ministry of Transport and Communications Ministry of Gender Labour and Social Development Ministry of Local Government Ministry of Energy and Mineral Development Ministry of Health Ministry of Education
Research Institutions	National Agricultural Research Organisation National Fisheries Research Institute Makerere University Kyambogo University
Government Institutions	Directorate of Water Resources Management Directorate of Water Development National Water and Sewerage corporation Uganda Railways Corporation
Non Governmental Organizations	Uganda Water and sanitation Network Lakes Link Uganda Uganda Association of Impact Assessment Environment Alert
Local Authorities	Town Clerk Kampala, Jinja, Entebbe, Masaka
Transporters	Ferry Services Individuals boat owners
Community	Beach Management Units (BMU), Community Based Organizations, Fisher folks, local community