# Effects of Agricultural Activities in Kagera Riverine Wetlands on Water Hyacinth Control

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**Abstract:** During September 2000, a survey was conducted on the river Kagera basin to assess the impact of biological control of water hyacinth (Eichhornia crassipes Martius, Solms-Laubatch) and effects of agricultural activities in the Kagera riverine wetlands water hyacinth control. The results revealed insignificant weevil impact on the water hyacinth plants. Weevil feeding marks were rare and plant size varied significantly from one site to another. It was apparent that intensive agricultural activities mainly vegetable crops were carried out in the Kagera riverine wetlands. Most of the fields were so close to the riverbanks with only mean distance of 0.8m. This had two main effects, first it caused severe land degradation due to soil erosion both at riverbanks and the riverine wetlands and second it led to nutrient loading into the river. Most of the riverbanks were infested with rooted water hyacinth plants that were very healthy to warrant conceited control efforts. Thus, there is a pressing need to train farmers on wise use of riverine wetlands without causing environmental degradation.

## INTRODUCTION

River Kagera, which originates from Rwanda and enters lake Victoria at Lukunyu village in Uganda just above the Tanzania/Uganda border, forms the national boundary between Tanzania and Rwanda (Fig 1). The river flows through very extensive flood plains, estimated at some 35,000 ha and runs about 150 km in Tanzanian territory before it enters the lake Victoria. The river has been and continues to be a major source of water hyacinth infestation in the lake Victoria.

### Water hyacinth Weed

Water hyacinth, Eichhornia crassipes (Martius) Solms – Laubach, is a perennial, herbaceous, aquatic plant of the family Pontederiaceae. The genus Eichhornia contains a number of other species all of which are aquatic, but only E. crassipes has become a serious weed. Water hyacinth originates from Latin America Amazonia Brazil with natural spread through Brazil and other Central and South American countries (Penfound and Earle 1948, Sculthorpe 1967; Little 1968). The spread of water hyacinth into new areas commenced in the 1880s with its deliberate introduction into the USA as an attractive pond ornamental. The weed was recorded in Egypt, Australia and Southern Asia by 1890s (Gopal and Sharma 1981).

Its presence in Tanzania was reported to occur in Tanga region (river Sigi 1955 and Pangani in 1959). It was reported to occur in Lake Victoria in 1980s. It is believed that the Source of water hyacinth in Lake Victoria is river Kagera, which brings huge floating mats into the Lake from Lagoons, ponds and flood plains in Rwanda.

Into Rwanda water hyacinth was brought by European lady who kept this weed as an ornamental plant at her home. During rains the water hyacinth escaped from her control and entered into river Kagera where it proliferated heavily. A series of Surveys show that 0.2 – 0.8ha of water hyacinth enter into Lake Victoria daily (Mjema et al. 2001). Within its introduced range, water hyacinth has enormous social economic and environmental impacts, earning this plant the title "world's worst aquatic weed".

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**Fig 1. Lake Victoria basin and its river system**

**Weevils**

Biological control agents released against water hyacinth in Lake Victoria are arthropods, Neochetina Weevils i.e. N. bruchi and N. eichhorniae. Neochetina species are nocturnal, insects belonging to the order Coleoptera, family Curculionidae. The two Neochetina species are unable to survive on any plant other than water hyacinth. The host – specificity of these insects has been demonstrated during extensive host testing and confirmed by observations after their release.

For the first time Water hyacinth weevils were imported from Benin into Tanzania in 1995. They were received reared and maintained at Kibaha National Biological Control Centre. In August 1996, about 9,000 weevils were produced at Kibaha and released in rivers Pangani and Sigi in Tanga region.

In 1997 Neochetina weevils were harvested from Tanga and Kibaha and released in Lake Victoria. Subsequent releases in the Lake Victoria and other water bodies in its catchment followed this release. Approximately 80 million weevils have been harvested and released at different infested areas. Currently it is estimated that there are several billions of weevils attacking water hyacinth in the Lake Victoria and its catchment.

Biological control is one of the methods among several used to control the water hyacinth. Neochetina weevils (locally known as mbawa kavu) are widely used as biological control in Tanzania. Since the introduction of Lake Victoria Environmental Management Project (LVEMP), the weevil has proved a very high success in controlling the water hyacinth (Water hyacinth annual component report, 2001). It was then decide to release the weevils in several places along the river Kagera, as it is a major source of the water hyacinth. Neochetina weevils harvested from two rearing units at Kyaka and Kyakairabwa in Bukoba district were released to the river Kagera to control the weed. However, the impact of the released weevils to the weed was not established. This raised some concern to some scientists particularly those in the water

hyacinth control component. Thus, a joint study was conducted between water hyacinth control component and wetland management component to assess both, the impact of the released weevils to the weed along the Kagera river and impact of agricultural activities taking place in the Kagera riverine wetlands to the water hyacinth.

## METHODOLOGY

Interviews to farmers using guide questions and field visits to do some physical observations and measurements of several parameters were the major methods used. To assess the impact of the released weevils to the water hyacinth several parameters were measured from the weed, these parameters were;

- Plant population /0.5m$^2$
- Petiole length (cm)
- Lamina width (cm)
- Root length (cm)
- Weed coverage
- Number of ramets/plant
- Number of weevil feeding scars on the second youngest plant leaf
- Number of adult weevils/plant
- Health status of the water hyacinth plants.

To assess the impact of agricultural activities along the Kagera riverine wetlands to water hyacinth several parameters were collected by either interviewing farmers or field visits to make physical observations. Eight sites were visited (Kyaka Lubale, Kayemba, Kitengule prison, Murongo, Shamshaija, Lwabukagate, Ibanda and Kamalwa). The interviews were conducted in order to get;

- Type of crops grown
- Distance between river banks and the fields
- Type of fertilizers used
- Type of pesticides used
- Presence of fields in the visited sites

## RESULTS

### Weevil impact assessment

Despite regular release of Neochetina weevils in the river Kagera, there was no significant impact on water hyacinth. The weed (water hyacinth) at seven sites out of the eight visited had no feeding scars, indicating absence of the weevils.

Most plants looked healthy with petiole and root length averaged at 22.3 and 19.7cm respectively (Table 1). Size of water hyacinth varied from one site to another depending on the distance between fields and the riverbanks. Petiole and root length were highest at the river mouth than those at the upper course. For example, petiole length up to 41cm was recorded at river mouth while at Shamshaija had only 3.9cm. Similarly the root length at the river mouth was up to 47cm but most sites visited had only up to 19.7cm.

**Table 1. Weevil impact assessment on water hyacinth**

| Plant parameter | Mean value |
|---|---|
| Plant populatin/0.5m2 | 5.75 |
| Leaf length (cm) | 22.3 |
| Root length (cm) | 19.7 |
| Number of leaves/plant | 6.0 |
| Lamina width (cm) | 8.5 |
| Ramets/plant | 1.8 |
| Coverage (m) | 5.0 |
| Feeding scars/plant | 0.56 |

**Impact of agricultural activities.**
It was noted that intensive agricultural activities mainly horticultural crops (71%) were carried out in the Kagera riverine wetlands. Maize, sweet potatoes, onions, Chinese cabbage, beans, tomatoes, banana, and carrots were common crops grown.

Most of the fields were less than a meter from the riverbanks, average of only 0.8m (Table 2).

**Table 2. Crop cultivation and fertilizer application in Kagera riverine wetlands.**

| Site | Mean distance between fields and riverbanks (m) | Fertilizer application YES/NO | Types of fertilizer applied | Crop type cultivated |
|---|---|---|---|---|
| Kyaka-Lubale | 0.3 | Yes | FYM | Chinese cabbage, onions, maize |
| Kayemba | 0.5 | Yes | FYM | Beans, maize, sweet potatoes, |
| Kitengule prison | 0.5 | Yes | FYM | Maize, onions, tomatoes, |
| Murongo | 0.7 | Yes | FYM | Onions, tomato, sweet potatoes |
| Shamshaija | 2.25 | No | | Sweet potatoes, maize, cabbages |
| Lwabukagate | 0.75 | No | | Carrots, banana, Sweet potatoes |
| Ibanda | - | - | - | - |

## DISCUSSION

Kagera riverine wetlands is like any other wetlands in the lake Victoria basin in that they are very fertile and hence attracts many users. These users include, farmers, livestock keepers, fishermen, weavers, etc. The agricultural activities seen at Kagera riverine wetlands also take place in most fringing wetlands of lake Victoria basin and in other riverine wetlands like that of Rubana and Mara riverine wetlands in Mara region, Simiyu in Mwanza region to mention a few.

Due to placement of fields very close to the riverbanks and sometimes close to the lake edges as seen in wetland management component studies, soil erosion is pronounced, which means that both rotten crop debris and remaining fertilizers washes into the river or lake hence supplying nutrients to water hyacinth that's why the weeds were very healthy particularly those at the river mouth as more nutrients are concentrated here. Not only the water hyacinth plants were flourishing well but also the weevil were not functioning due to presence of these chemicals hence giving a good chance for water hyacinth to establish and cause more problems to the lake and the river. Studies from water hyacinth control component LVEMP noted that in presence of toxic chemicals or in areas with plenty of nutrients, Neochetina weevils do not function. This accounts for the reason why there were no effects on water hyacinth in Kagera river although several releases of weevils were made into the river.

## RECOMMENDATIONS

River Kagera remains a major source of water hyacinth to lake Victoria and since the impact of the released weevils to water hyacinth so far is insignificant, efforts should be made to release more weevils at higher frequency and in as many places as possible in the river. Since crop cultivation in the riverine wetlands of Kagera is invetable, there is a pressing need to carry out farmers training especially those who use the riverine wetland on sustainable agriculture that will ensure increased production per unit area at same time the riverbanks are conserved and hence the water hyacinth managed. Assessment of the impact of the weevils on the weed should be carried out repeatedly so that the status of the weed can be compared between the time before and after interventions.

## CONCLUSION

Wetland degradation due crop cultivation caused increased soil erosion and this affected very much the riverbanks. Creation of pockets in the riverbanks due to erosion favored the weed to settle instead of passing. In addition continuous soil erosion in the riverbanks brought in rotten plant debris and left over fertilizers to the pockets. This gave food to the wed and discouraged the weevils from fighting the weed.

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