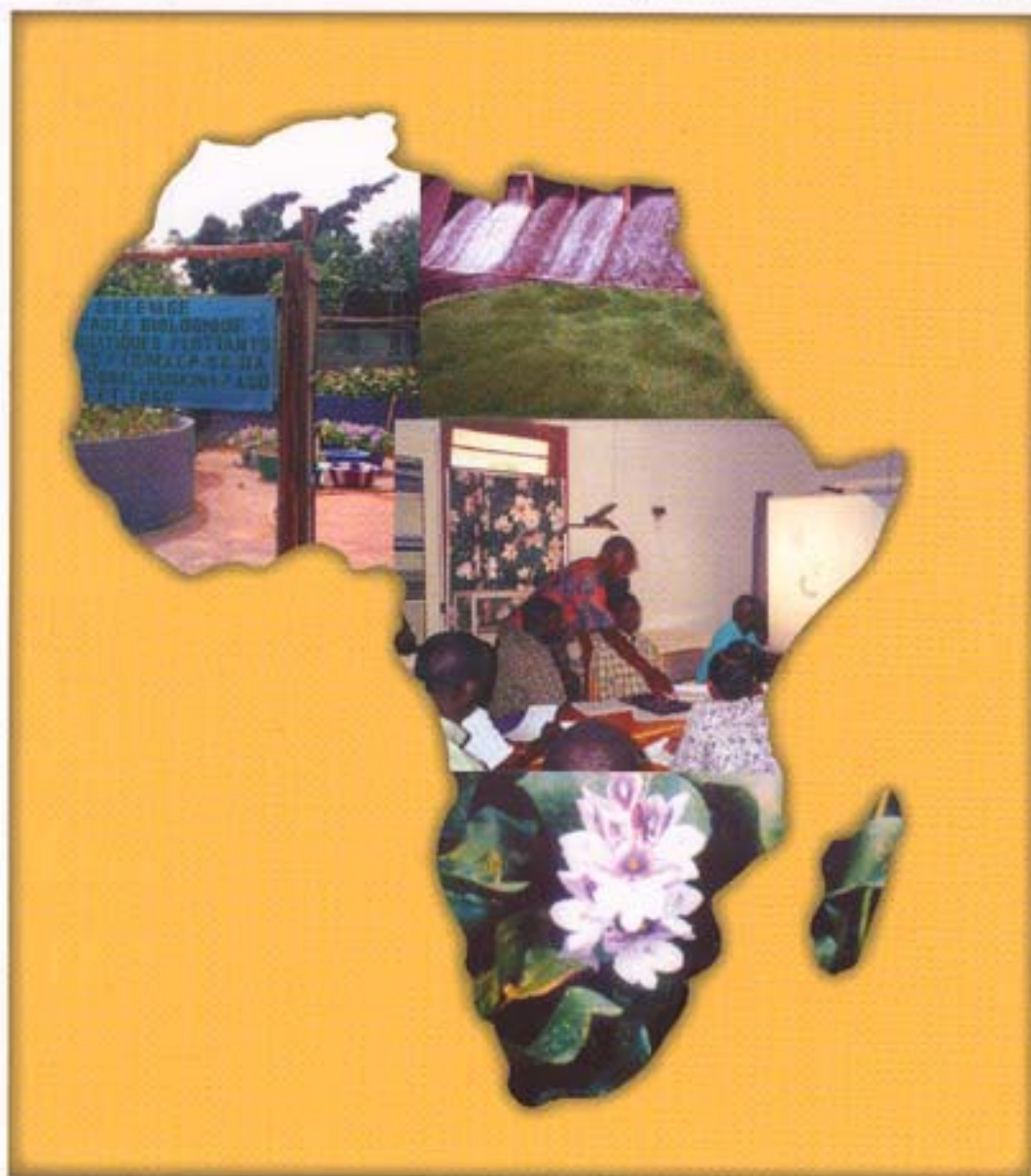


# MANAGEMENT OF PROBLEMATIC AQUATIC WEEDS IN AFRICA

FAO efforts and achievements during the period 1991–2001



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# **MANAGEMENT OF PROBLEMATIC AQUATIC WEEDS IN AFRICA**

***FAO EFFORTS AND ACHIEVEMENTS  
DURING THE PERIOD 1991 – 2001***

Prepared by

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and  
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Food and Agriculture Organization of The United Nations  
Rome, 2002

## PREFACE

Plants that are beneficial in their homeland, once they are introduced into other parts of the world – accidentally or intentionally - may become weed problems. This may happen when they find environmental conditions that are favourable for their growth and – most importantly – their populations are not limited by the natural enemies that are present in their original habitats. These natural enemies associated with the plants contribute to prevent the uncontrolled growth of their populations.

Exotic aquatic weeds, in the absence of their natural enemies, cause major problems in Africa. In this continent they rapidly invaded freshwater bodies and became widespread especially in tropical and warm-temperate regions. In particular the populations of some species, such as Water Hyacinth (*Eichhornia crassipes* (Martius) Solms-Laubach), Water Lettuce (*Pistia stratiotes* L.) and Water Fern (*Salvinia molesta* D.S. Mitchell) have increased dramatically during recent decades, becoming an agricultural, environmental and public health problem. They threaten freshwater bodies both in coastal areas and inland, where they (a) interfere with human activities, seriously affecting the national economy and social structure; (b) are deleterious for human health, since they offer a suitable habitat for vectors of many diseases; and (c) are a serious menace for the environment and biological diversity, including the displacement of native *flora* and *fauna*.

The control of these weeds in Africa is difficult and all sound options should be considered. When necessary, a combination of control measures may be used, depending on the nature of the local problem. Among the ways to control exotic weeds, environmentally friendly and sustainable methods should be adopted.

A sound option is the so-called classical biological control, which is the use of beneficial organisms – the natural enemies that effectively limit the populations of the host plant in its area of origin – to reduce the growth and population density of the weed in the area of introduction. The organisms used are host-specific and do not harm other desirable plants. Biological control is the preferred way to control aquatic weeds, since it is self-sustaining and its implementation relatively cheap and environmentally friendly. Also, the adoption of biological control instead of chemical control in water bodies, avoids pollution and any other

undesirable impact on water used for drinking or agriculture. Effective natural enemies of aquatic weeds have already been identified, studied and used successfully in parts of Africa, America, Asia and Australia.

The Food and Agriculture Organization of the United Nations (FAO) is strongly committed to contributing to the control aquatic weeds and to help to solve the serious problems caused by these plants. During the past ten years FAO has made numerous effort to control of aquatic weeds at various levels, from the institutional level to the field level, with the identification and implementation of effective strategies and through concerted and coordinated international actions. These efforts have also included the provision of advice and technical assistance, with the participation of relevant institutions. The aim is to conduct sound pest management, achieving sustainable, long-term control.

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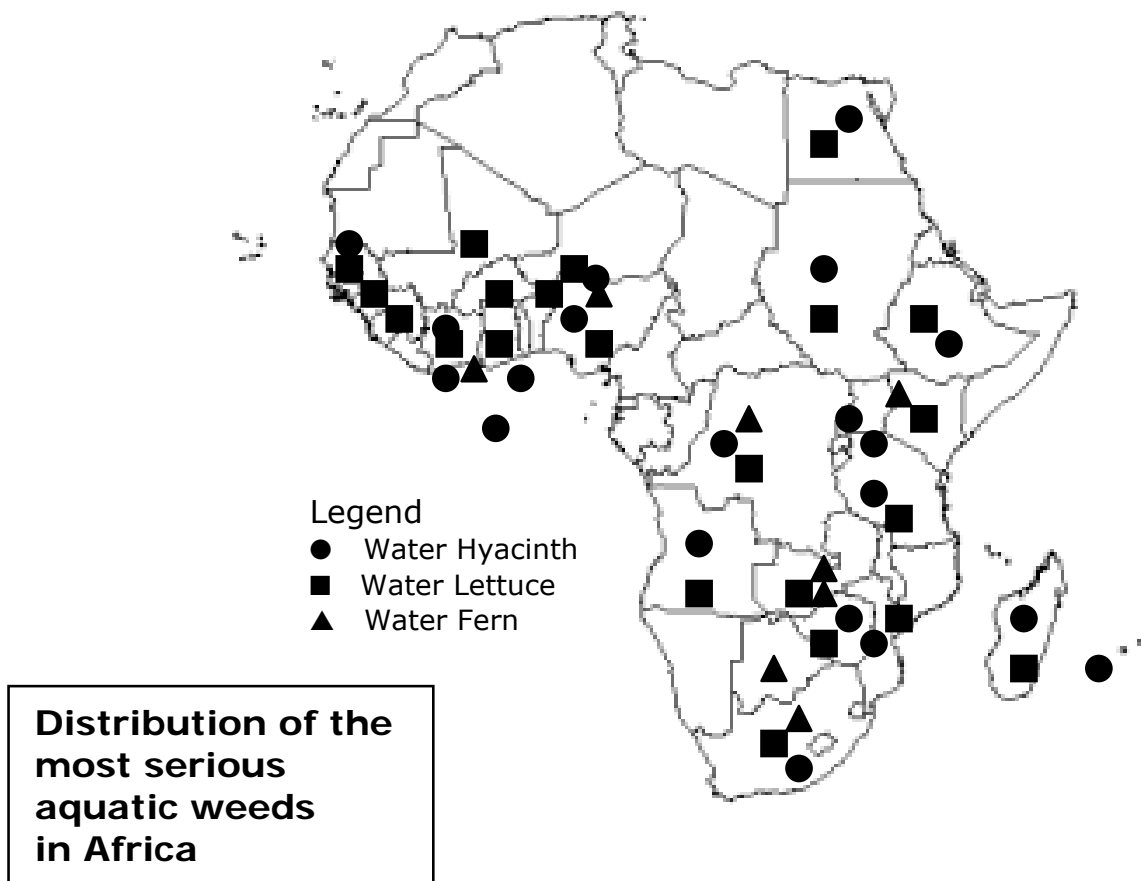
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## List of Acronyms

CABI	Commonwealth Agricultural Bureaux International
CSIRO	Commonwealth Scientific and Industrial Research Organization
ECOWAS	Economic Community of West African States
FAO	Food and Agriculture Organization of the United Nations
IIBC	International Biological Control Institute
IITA	International Institute of Tropical Agriculture
TCP	Technical Cooperation Programme (FAO)
UNDP	United Nations Development Programme
USDA	United States Department of Agriculture

# 1. MAIN AQUATIC WEED PROBLEMS IN AFRICA

Although exotic aquatic weeds have been reported to be present in Africa since the end of the nineteenth century (Tackholm and Drar, 1950), they started infesting massively African freshwater bodies during the early 1950s (Mitchell, Pieterse and Murphy, 1990) and rapidly spread in many countries. The growth of these weeds is extremely fast and this allows them to develop huge infestations in areas where they had not been reported only a few years earlier. These plants invaded lakes, ponds, rivers, canals and agricultural fields, becoming noxious weeds. The damage to the environment and the economy is enormous, having a disrupting impact on agriculture, fisheries, production of electricity, transportation, health, livelihood, living conditions and social structure. Water Hyacinth, Water Lettuce and Water Fern pose the most serious problems.



## 1.1. Water Hyacinth

**Origin and Distribution.** Water Hyacinth (*Eichhornia crassipes* (Martius) Solms-Laubach), which is native to the Amazon basin, Brazil (Penfound and Earle, 1948; DeLoach, 1976), became widespread throughout the world, also due to its attractive appearance. It is commercially available as an ornamental for ponds. Its spread started with its deliberate introduction into North America from Brazil, in the late nineteenth century, as an ornamental in ponds and subsequently escaped cultivation (DeLoach, 1976; Barrett and Forno, 1982). At present it occurs as a weed throughout tropical and subtropical regions of the world, including North and South America, Africa, Asia, Australia and New Zealand.



**Plant and flowers of  
Water Hyacinth**

**Morphology and Biology.** This perennial herbaceous plant is a floating freshwater hydrophyte. It belongs to the Family *Pontederiaceae* and all the species in the Genus *Eichhornia* are aquatic. Water Hyacinth shows considerable variation in both leaf and flower form and colour, also depending on the age of the plant. The flowers are bluish purple, large and self-fertile. The seeds are produced in large numbers and are contained in capsules, each capsule containing up to 300 seeds (Manson and Manson, 1958). The seeds can remain viable for 5-20 years (Matthews, Manson and Coffey, 1977). The plant can also reproduce vegetatively through the production of horizontal stolons.

**Weed problem.** The fast growth of Water Hyacinth allowed the plant to build huge populations in its ranges of introduction, developing dense mats on the surface of the water and becoming a major weed problem.



**Dense mat of plants  
of Water Hyacinth**

It is considered the worst aquatic weed in the world. The rapid increase and spread of the plant into new areas is due particularly to its vegetative reproduction, a single plant being able to develop very rapidly a significant infestation. Moving easily with water currents, winds or other accidental means, such as fishing nets and boats, the plant invaded rivers, canals, ponds, lakes, dams and other freshwater bodies. The main problems arising from the growth of Water Hyacinth in thick mats are (a) an enormous water loss through evapotranspiration, that alters the water balance of entire regions; (b) the impediment to water flow, that increases sedimentation, causing flooding and soil erosion; (c) the obstruction of navigation; (d) hampering fishing and dramatically reducing the catch and the source of food and income for local populations; (e) a drastic change in the physical and chemical properties of water and in the environment in the water bodies invaded, with detrimental effects on plants and animals; (f) the reduction of the activity of electrical power stations, jeopardizing the power supply of the country; and (g) a serious threaten to agricultural production, following the blockage of irrigation canals and drainage systems. The economy of the countries concerned was therefore seriously affected in many aspects. This weed represents an environmental problem as well and indirectly a public health problem, since it may create a microhabitat suitable for the breeding of many vectors of human diseases and for hosting poisonous snakes.

Water Hyacinth is the principal aquatic weed in Africa. It is a weed problem in many countries, especially in Egypt and East, West and South Africa. This plant appeared in Lake Kyoga in Uganda in the early 1980s and it also occurs in Lake Kwana and down the Kyoga Nile. In 1988 it was observed in Lake Naivasha in Kenya. However, the most disturbing development in the region during the 1990s was in Lake Victoria. In 1990 dense mats of this weed were found interfering with fishing on the Tanzanian shore and during the same year mats were recorded on the Ugandan shore and around the Sese Islands. In Zimbabwe the plant attained the status of noxious weed in the 1980s. It was first recorded in Lake Kariba in 1994 and by 1996 it infested over 200 ha. In the early 1990s Water Hyacinth was also found in the Pangani River in the United Republic of Tanzania and the lower reaches of the Kagera River in Rwanda. FAO has been conducting numerous projects for the control of this weed (see Chapter 3).

## 1.2. Water Lettuce

**Origin and Distribution.** The area of origin of Water Lettuce (*Pistia stratiotes* L.), is still speculative, being most probably South America (Cordo, Deloach and Ferrer, 1981). The plant spread widely and at present occurs in all continents, except Europe and Antarctica. Probably the initial spread took place through ballast water in ships from South America. At present it is also commercially available as an ornamental for ponds. It is one of the most widely distributed water plants. In Africa it is ubiquitous.



**Plants of  
Water Lettuce**

**Morphology and Biology.** This perennial freshwater hydrophyte is a herbaceous floating plant belonging to the Family *Araceae*. It consists of a rosette of pale green leaves, prominently veined and it resembles a small lettuce plant. Water Lettuce has velvety-hairy, erect leaf blades, a very short stem and long feathery roots suspended in water. The flowers are bisexual. The plant reproduces and spreads rapidly by means of stolons and seeds. The seeds are easily carried by water for long distances, since they float during the first two days after they reach maturity. The hairy cover of leaves traps air and is water repellent,

preventing the plant from being submerged by heavy rains. Both Water Lettuce and Water Hyacinth can bioaccumulate heavy metals (Sridahar, 1986).



**Dense mat of plants of Water Lettuce**

**Weed problem.** Water Lettuce is a major weed problem in the tropics, where its impact is similar to that of Water Hyacinth, both on the environment and on the economy of the countries concerned. However, it was not a weed problem in Africa until recently and its weed status appears to be due to the pollution of water bodies and the presence of organic wastes and residues of fertilizers. The plant develops dense mats and its noxious effects are similar to those caused by Water Hyacinth and include (a) causing an enormous water loss through evapotranspiration, with the consequent negative impact on the water balance in entire



**Infestation of Water Lettuce  
in a dam – Kumasi, Ghana**

regions; (b) clogging rivers and canals and related problems; (c) interfering with the activity of hydroelectric power stations; (d) hampering fishing; (e) hampering navigation; (f) negatively affecting water control and use for agricultural purposes; (g) displacing of native species, because of the modification of environmental conditions: mainly due to oxygen depletion in water and sediments, increased sedimentation – caused by the roots – and excessive shading – caused by the leaves; and (h) indirectly affecting human health, since it provides a suitable breeding habitat for pests and vectors of diseases. Water Lettuce occupies habitats similar to those where Water Hyacinth occurs and is generally displaced by the latter, but, inversely, the control of Water Hyacinth may be followed by increased numbers of plants of Water Lettuce where mixed populations occur. Water Lettuce invaded inland waters of various African countries in the early 1980s. The problems posed by this weed are particularly serious in West Africa, especially in Niger and Volta River basins, where FAO has been conducting numerous projects (see Chapter 3).

### 1.3. Water Fern

**Origin and Distribution.** Also Water Fern (*Salvinia molesta* D.S. Mitchell) is native of South America, in coastal and inland regions of south-eastern Brazil. The plant was introduced to Sri Lanka in the 1930s and has rapidly spread since then, now occurring in tropical and subtropical regions worldwide (Holm *et al.*, 1991). The species is commercially available for aquariums and ponds and this may likely have been the way it was initially introduced and may still contribute to its spread. In Africa it is a weed problem mainly in the inter-tropical zone.



Water Fern

**Morphology and Biology.** Water Fern is a free-floating fern belonging to the Family *Salvinaceae* that lives in freshwater systems. Stagnant or slowly moving waters are the habitats most favourable to its growth. It consists of a horizontal rhizome that floats just below the water surface and produces at each node three leaves, two of which, aerial, are light green, broadly elliptic, about 25 mm long, while the third leaf, submerged, is brownish, filamentous, feathery and root-like and about 25 cm long. The plant does not have roots. The submerged leaf, which serves as roots by absorbing water and nutrients, bears the sporocarp, oval in shape, which is the structure normally producing the spores.



**Infestation of Water Fern  
in Senegal River, Senegal**

Hairs growing orderly, in parallel rows, on the aerial leaves assure a water-repellent layer that allows the plant to float (Holm *et al.*, 1991). Individual plants are up to 30 cm long. Their growth is extremely fast, allowing the population to double within about one week (Mitchell and Tur, 1975). Mature plants press each other into tight chains, forming thick mats on the water surface and can withstand periods of stress, such as low temperatures, or periods of drought, regrowing from dormant buds. Water Fern readily reproduces vegetatively, by fragmentation of the rhizome, small fragments allowing the development of new infestations. The African plants are sterile and more vigorous than other accessions (Holm *et al.*, 1991).

**Weed problem.** Growing rapidly in dense mats, the plant invaded lakes and streams in its range of introduction, becoming a nuisance. Water Fern is also known as Kariba Weed, this common name originating from Lake Kariba on the Zambesi River in southern Africa, an area that was invaded by this weed. It has a heavy impact on the environment and the economy of the regions affected. It causes similar problems to those posed by Water Hyacinth and Water Lettuce, such as clogging canals, rivers and lakes; displacing native plants and animals; and interfering with the irrigation of many crops, navigation, fishing and the activity of electric power stations. In addition, it grows in rice paddies, where it poses serious problems. Water Fern invaded inland waters of various African countries in the early 1980s. The weed problem is particularly serious in West Africa, especially in Niger, Volta and Senegal River basins, where — also in this case — FAO has been conducting several projects (see Chapter 3).

## 2. THE APPROACH

FAO took action at different levels and funded initiatives to fight aquatic weeds in Africa, following the requests for assistance from countries concerned. It (a) provided guidance and organized expert consultations to identify the best methods and state-of-the-art strategies; (b) provided up-to-date information to governments and sensitised them in regard to the need for and importance of using appropriate means and methods to control aquatic weeds; (c) conducted surveys to assess the levels of infestation and the nature of the problem under local conditions; (d) provided technical assistance for the training of personnel on weed identification and control; (e) introduced biological control agents and established units for mass rearing of biological control agents for the above-mentioned and other weeds; and (f) conducted control schemes in the field, in association with national institutions, scientists and specialists. FAO has emphasized the importance of adopting a **regional approach** in addressing the control of aquatic weeds, since a cooperative effort is essential for this kind of transnational pest control problem.

The control of exotic aquatic weeds in Africa is very difficult, because of their aggressiveness, rapid growth and ease with which they spread. In this part of the world and in the absence of their natural enemies, these plants found ideal environmental conditions for their growth and at present it is impossible to eradicate them. However, these plants are not a nuisance in their homeland, where there is a balance with their natural enemies.

**Adults of  
*Neochetina  
bruchi* –  
natural  
enemy of  
Water  
Hyacinth**

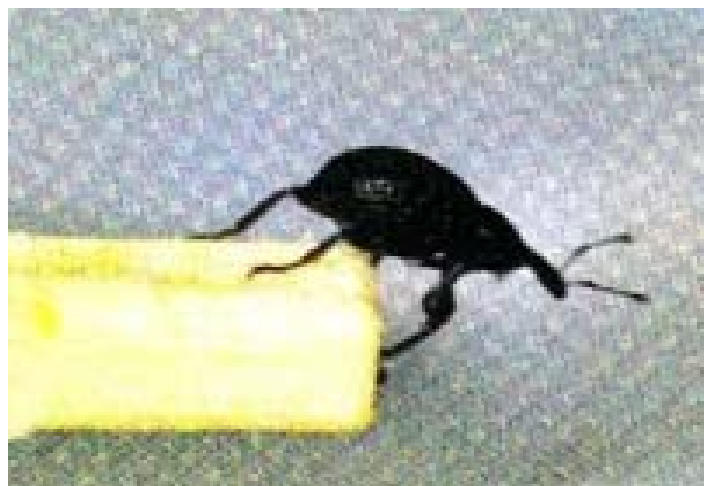


Photo G. Buckingham / Cornell University

**Biological control**, through the introduction of the natural enemies of each plant from its area of origin, is the preferred method of control, since it is effective and environmentally friendly, has a relatively low implementation cost and is the only sustainable way to control these aquatic weeds. Insect herbivores have been introduced and used successfully in Africa, allowing the control of the pests in areas where this method was implemented. Also, the aquatic environment is very sensitive and freshwater bodies must be protected, since the use of chemicals may be a pollution hazard for rivers and fish and for the utilization of water for irrigation, drinking, or other uses.

Nevertheless, the nature and the urgency of the problems posed by these weeds may require the use of a combination of the control methods available – an **Integrated Pest Management** – with the aim of obtaining a sound pest management. This means minimizing the impact on the environment and achieving sustainable, long-term control. Anyhow, biological control should be the main component in this approach. Therefore the control of these aquatic weeds needs to be adapted to local conditions and specific problems and may require a combination of biological, physical (mechanical, or manual) and – under particular circumstances with heavy infestations and for short-term results – chemical means. Also, due attention has to be paid to the important aspect of preventing the development of infestations through avoiding the environmental conditions, such as water pollution, that favour weed growth and demographic explosions.

**Adult of  
*salviniae*  
– natural  
enemy of  
Water  
*Cyrtobagous*  
Fern**



### **3. WEED PROBLEMS IN SPECIFIC AREAS, WORK CONDUCTED BY FAO AND ACHIEVEMENTS (IN PROGRESS)**

FAO has conducted numerous initiatives in Africa during the past ten years to control aquatic weeds. Projects have been conducted at regional and national level.

#### **3.1. International Expert Consultation**

FAO, in close collaboration with the University of Florida and the United States Department of Agriculture (USDA), convened an international expert consultation on Strategies for Water Hyacinth Control, in Fort Lauderdale, Florida, USA, in September 1995. The consultation had two main objectives. The first objective was to prepare suitable guidelines for Water Hyacinth control in developing countries of the tropical and subtropical regions, indicating the strategy for the implementation of the methods available. The second objective was to prepare an updated status report of biological control of Water Hyacinth — including the natural enemies and the methods for rearing and release — and give advice for its rapid and successful implementation in developing countries. The consultation provided a valuable contribution. Twenty-one prominent specialists attended and discussed specific problems and possible solutions for African countries and regions. The experts provided up-to-date information and prepared a strategy for integrated Water Hyacinth control. They noted that Water Hyacinth is still the major floating water weed in the world, despite the attempts made to date to control it. The experts concluded that to allow the identification of an appropriate strategy for the control of this weed, it is essential that the nature of the problem is clearly defined — e.g. new infestation, isolated infestation, or large-scale infestation. The options available are biological control by means of insects, physical control and chemical control. They recommended to make efforts to prevent new infestations and, when new infestations are detected, to take immediate action to control them. Also, the importance of public awareness was stressed and that priority should be given to biological control, while chemical control should only be used for emergencies and not for maintenance control. Physical control may also be used for specific needs and circumstances. Research on integrated control should be undertaken, with emphasis on providing applied answers to the many country- and site-specific needs.

## **3.2. Field Projects**

Following requests for assistance from the governments of countries where aquatic weeds have caused major problems, FAO has organized and conducted Technical Cooperation Projects in the following regions, or countries:

### **3.2.1. East Africa**

East African countries share an extensive and interconnected system of freshwater lakes, rivers and lagoons heavily utilized for navigation, fishing, irrigation and power generation. The interference of aquatic weeds with these waterways constitutes a particularly serious and difficult problem because of their capacity for regeneration and spread and because of the diverse and adverse effects on aquatic ecosystems. The main aquatic weed in East Africa is Water Hyacinth.



**Heavy infestations by Water Hyacinth  
make fishing very difficult or impossible**

The work conducted by FAO also included technical consultancies and provision of biological control agents (insects) through the Commonwealth Agricultural Bureaux International (CABI).

## **Uganda and East Africa (Kenya, Rwanda and the United Republic of Tanzania)**

In 1991 the Government of Uganda and FAO launched a short-term project under the Technical Cooperation Programme (TCP) of FAO to assess the extent of Water Hyacinth infestation in the Uganda sector of Lake Victoria and in Lake Kyoga. This project strongly recommended initiating immediate control measures with biological control agents – e.g. the weevils *Neochetina eichhorniae* and *N. bruchi* (*Coleoptera: Curculionidae*) – in combination with short-term control measures.

A regional project was conducted between 1993 and 1994 in **Kenya, Rwanda, the United Republic of Tanzania and Uganda**. During this project (a) a five-year project document was formulated to establish a technically sound system to control aquatic weeds in East Africa; (b) national policies were developed in Water Hyacinth control; (c) a biological control programme was started against Water Hyacinth in the subregion; (d) a regional training course was held on the control of aquatic weeds; (e) host specificity studies were carried out on *Neochetina* spp. in Uganda and Kenya; and (f) a regional technical consensus was developed on the biological control of Water Hyacinth in Lake Victoria. This regional project provided the basis for the implementation of biological control in the region.

Due to the existing heavy infestations of Water Hyacinth in Ugandan side of Lake Victoria, an emergency project under the Technical Cooperation Programme of FAO was also conducted during 1996 – 1997 in Uganda. This project allowed (a) the construction of rearing units and the provision of training in biological control techniques; (b) the training of 18 District Fisheries Officers on matters related to the use of integrated control of Water Hyacinth, for further sensitization of local communities at affected fish-landing sites; and (d) the creation of working teams trained to remove Water Hyacinth as planned by the community Water Hyacinth management groups. To date, over 60 percent of the Water Hyacinth infestation in Lake Victoria has been reduced by the release of biological control agents combined with regular mechanical removal of the weed.

### 3.2.2. West Africa

Floating aquatic weeds such as Water Hyacinth, Water Lettuce and Water Fern are a hazard to water bodies in West Africa, where they invaded inland waters of various countries in the early 1980s.

#### Ghana

A project funded by the European Commission was implemented by FAO, during the period 1994 – 1996, for the integrated control of aquatic weeds in Ghana. In particular, the objectives of this project were to (a) assess the aquatic weed problem; (b) strengthen national capabilities for aquatic weed management; (c) strengthen international collaboration; and (d) prepare a subregional project for the member countries of the Economic Community of West African States (ECOWAS) on integrated control of aquatic weeds. The project carried out surveys of some 36 water bodies (reservoirs, lagoons, rivers and lakes) countrywide, assessing the major weed species and their cover. In the course of the survey some species, new as weeds, were recorded, namely *Limnocharis flava* (*Butonaceae*) and *Vallisneria gigantea* (*Hydrocharitaceae*). Extensive countrywide public education using warning posters, video documentaries, print and electronic media and public *fora* was carried out as well. Also, the project successfully introduced and allowed for the establishment of three biological control agents for Water Hyacinth and a biological control agent each for Water Lettuce and Water Fern. These introductions were conducted with consultancies provided by the Commonwealth Scientific and Industrial Research Organization (CSIRO). Manual and chemical control (using Glyphosate) was carried out with varying degrees of success and cost. The experience gained with this project has benefited not only fishermen, extension workers and communities in general in Ghana, but also those in **Côte d'Ivoire, Burkina Faso, Mali and Senegal**.

Following this project, the regional project mentioned below was started in June 2000, in **Burkina Faso, Ghana and Togo** (in progress).

#### Aquatic weed control in Volta Basin

A regional project, under the Technical Cooperation Programme of FAO, was started in June 2000, in the Volta basin, involving **Burkina Faso, Ghana and Togo**. In these countries aquatic weeds are a menace to fisheries, aquaculture, navigation, drainage, irrigation, water supply

schemes and power generating schemes. The objective of this project, which followed a project of the European Commission on the integrated control of aquatic weeds in Ghana, is to assist the governments of these countries in preventing further spread of aquatic weeds and to coordinate aquatic weed management. In particular, a regional training course was carried out on the management of aquatic weeds and activities are being conducted to (a) establish surveillance systems of aquatic weeds in these countries; (b) introduce, rear and release biological control agents to use against Water Hyacinth, Water Lettuce and Water Fern; (c) establish a rearing unit in each country; (d) conduct awareness campaigns on aquatic weed problems and methods for their control among the rural population, involving rural communities in the release of selected biological control agents; (e) establish national committees on aquatic weed control; and (f) establish intercountry cooperation and exchange of information on matters related to aquatic weed control.

## **Côte d'Ivoire**

Since the early 1980s the water bodies of Côte d'Ivoire have been invaded by several species of aquatic weeds, including Water Hyacinth, Water Lettuce, Water Fern, *Nymphaea* (four species), Lotus (*Nelumbo nucifera*), *Polygonum* (five species), *Leersia* and others. The first three among the above-mentioned species were definitely the most noxious.

A Project funded by the United Nations Development Programme (UNDP) was conducted during the period 1994 – 1999, with a component addressing specifically (a) the control of Water Hyacinth, Water Lettuce and Water Fern using natural enemies; (b) the monitoring of population dynamics of target plants and biocontrol agents; (c) the strengthening of national capacities in term of integrated pest management and coordination with projects in other countries; and (d) the dissemination of the results in other countries having similar problems. During this project specialists were trained and four biological control agents were successfully imported, reared and released (the weevils *Neochetina bruchi* and *N. eichhorniae* against Water Hyacinth; the weevil *Neohydronomus affinis* against Water Lettuce; and the weevil *Cyrtobagous salviniae* against Water Fern). All of them established. Attempts to rear the moth *Niphograptia (Sameodes) albiguttalis* against Water Hyacinth failed. Some control of Water Hyacinth was obtained, but given the severe infestation, additional means of control would be



**Pools for rearing biological control agents:  
*Neochetina* spp. and *Cyrtobagous salviniae*  
La Me, Côte d'Ivoire**

desirable to achieve control in the short-term. Good control of Water Lettuce was achieved. This project was conducted with consultancies from CSIRO. The natural enemies were obtained from the International Institute of Tropical Agriculture (IITA).

## **Mali**

The high level of infestation of the Niger River by aquatic weeds has become a problem, especially with regard to its effects on navigation, irrigation in paddy fields, water flow in irrigation canals, fishing, human health and – particularly in Mali – hydroelectric power stations. The worst infestations in Mali are those of Water Hyacinth in the districts of Loulikoro and Bamako and Water Lettuce in Koulikoro, Bamako, Ségou and Mopti.

A project for the management of waterweeds was carried out in Mali in the period 1996 – 1997. During this project (a) training on the control of aquatic weeds was conducted; (b) the levels of infestation of floating aquatic weeds on the Niger River were assessed and an inventory of species was prepared; (c) a biological control programme for Water Hyacinth and Water Lettuce was started; (d) a strategy for integrated pest management was defined; and (e) a rearing facility for biological control agents was established.

This project was followed by the regional project mentioned below, involving **Benin, Mali, the Niger and Nigeria**, which was started in October 2000.



**Training conducted in Mali**

## **Aquatic weed control in the Niger basin**

A regional project involving **Benin, Mali, the Niger and Nigeria**, was started in October 2000, for (a) providing training in methods of floating weed surveillance and in the rearing of the weevils *Neochetina* spp. and other natural enemies of Water Hyacinth; (b) the introduction of biological control agents in the country and the establishment of units for their rearing; (c) the creation of a database on the levels of infestation of aquatic weeds in the basin of Niger River and on the establishment, population levels and impact of the natural enemies released; (d) the organization of a network for cooperation on the control of Water Hyacinth in the countries affected; and (e) the formulation of a draft long-term project for further submission to donors. A subregional training course on aquatic weed control for Niger basin took place and the other activities are in progress.

## **Control of Water Fern in Mauritania and Senegal**

Water Fern was officially recorded in the Senegal River in September 1999, near the villages Khor and Rosso, about 60 km from the Diama dam. This plant was originally introduced for cultivation in Khor for its use in integrating poultry feed. Unfortunately floods allowed the plant to escape cultivation and invade both sides of the Senegal River for a distance of about 70 km. Water Fern then also invaded the canals in the region and the Lampsar and Gorom Rivers. In 2000, Water Fern and *Typha australis* were estimated to infest altogether an area of 18 694 ha, 10 854 ha of which were on the Senegalese side and 7 840 ha on the Mauritanian side.

A regional project was started in February 2001 in **Mauritania and Senegal** to (a) build two units for the rearing of the weevil *Cyrtobagous salviniae* (one unit in each country); (b) release the weevil in the field; and (c) establish a surveillance system for the fern and the weevil. To date the following tasks have been accomplished: (a) The weevil has been introduced, the rearing is in place and the weevil has been released; (b) *Cyrtobagous salviniae* has been established at the release sites, where it is effectively controlling the weed; local authorities and rural communities (about 26 000 people in 23 villages in the area invaded) have been sensitized about the importance to control aquatic weeds. Following the excellent results obtained with biological control, parts of the Senegal River, where previously dense mats of Water Fern occurred, have been completely cleared.



**Infestation of Water Fern in Senegal River, BEFORE (Top) and AFTER (Bottom) release of *Cyrtobagous salviniae***



## **4. COLLABORATION WITH OTHER INSTITUTIONS**

Within the framework of assistance to developing countries, FAO plays an important role as a catalyst of scientific and institutional resources, in developing synergies among governments and institutions and in coordinating efforts for the effective implementation of projects on the management of weeds. This implementation takes place mainly through the collaboration of FAO with other institutions.

Collaboration with experienced institutions in the control of aquatic weeds — such as IIBC, CSIRO, IITA, the Plant Protection Research Institute of Pretoria, South Africa, the University of Florida and the United States Department of Agriculture (USDA) — is a key component in the implementation of FAO projects aiming at pest control and food security. This approach is also necessary (a) to take full advantage of the international, specific knowledge and expertise; (b) to make available and maximise the efficiency in the use of inputs — such as biological control agents — also sharing resources and facilities; (c) for the use of the state-of-the-art techniques; and (d) for a sound solution of problems. This important collaboration has taken place in the form of technical consultancies of specialists, the provision of biological control agents and the convening of meetings of experts on the control of specific weeds.

Another main activity of the collaborative work has been the capacity-building at national level and the training of local personnel before conducting the field work for the implementation of the control strategies developed.

## 5. PROSPECTS FOR THE FUTURE

One of the major problems and causes of difficulties in the control of invasive alien species is that often action is taken too late, only after the weed has spread extensively and the problem has attained huge proportions. It is therefore necessary to stress the importance of making all efforts and take the necessary steps for the **prevention** of the infestation and – if the alien species is already present – its **early detection**. This did not happen in the case of Water Hyacinth, Water Lettuce and Water Fern, but should be a lesson for the future.

Anyhow, among the means of control, classical biological control should be the key component of integrated management of water weeds in Africa. The results obtained are encouraging. For instance excellent results were obtained in a short time in the case of Water Lettuce and Water Fern, whose populations were significantly reduced within a few years by natural enemies introduced for this purpose. Water Fern was removed from heavily infested parts of the Senegal River within one year after the release of the biological control agents.

In the case of Water Hyacinth, significant biological control was observed five to six years after the release of *Neochetina* spp. For instance, following the major project on biological control of this weed in Lake Victoria, five years after the release of the *Neochetina* weevils the level of infestation was significantly reduced.

The experience gained to date and the positive results obtained confirm the importance of maintaining the regional approach established by FAO. This cooperative effort should be strengthened and further developed in the future. This approach also requires close international collaboration among institutions and governments. The transnational nature of the problem and the type of territory concerned, where water bodies are even shared among several neighbouring countries, require a global vision and concerted actions for control to be successful.

For this purpose, it is necessary to continue and further develop synergy among stakeholders to (a) maximize efficiency in implementation; (b) optimize the use of resources; (c) allow the sharing of knowledge and facilities; (d) allow the sharing information about levels of infestation,

problems and results; (e) prevent reinfestation given the interconnection

and the transnational nature of waterways and the fact that often the weed problem in a given country originates in neighbouring countries; and (f) assure continued, coordinated and sustained efforts.

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