Ministry of Environment and Science, Ghana

CAB International

IUCN The World Conservation Union

GISP
Global Invasive Species Programme

United States Government

Prevention and Management of Invasive Alien Species: Forging Cooperation throughout West Africa

Proceedings of a Regional Workshop

9 - 11 March 2004
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This workshop was co-hosted by the Government of Ghana, CAB International and the Government of the United States of America. Sponsorship was provided by the U.S. Department of State, with additional support from the Global Invasive Species Programme (GISP).

The workshop steering committee comprised Professor Emmanuel Owusu-Bennoah (Council for Scientific & Industrial Research, Ghana), Dr Marcel Nwalozie (CORAF, Senegal), Dr Greg Sherley (Global Invasive Species Programme, South Africa), Mr Kweku Amoako Atta de Graft-Johnson (Water Research Institute, Ghana), Dr Geoffrey Howard (IUCN East Africa, Kenya), Dr Manuele Tamo (International Institute of Tropical Agriculture, Benin), Dr Jeffrey Fisher (U.S. Department of State, USA), Ms Sara Woodring (U.S. Embassy, Ghana), Mr Richard Orr (National Invasive Species Council, USA), Dr Sarah Simons (CAB International, Kenya).

The organisers wish to thank all the participants (Appendix 1) for their contributions. The views expressed in this document are those of the participants, and do not necessarily reflect the position of the sponsors, the organisers, or of any government or other body represented at the meeting.

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Contact: CAB International, P.O. Box 633-00621, Nairobi, Kenya. Tel: +254 20 524450/62. Fax: +254 20 522150.
E-mail: cabi-arc@cabi.org.

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Acronyms

CABI	CAB International
CAC	Codex Alimentarius Commission
CBD	Convention on Biological Diversity
CILSS	Permanent Interstate Committee for Drought Control in the Sahel
CORAF	West and Central African Council for Agricultural Research and Development
CSIR	Council for Scientific and Industrial Research, Ghana
ECOWAS	Economic Community of West African States
GEF	Global Environment Facility
GISP	Global Invasive Species Programme
IAPSC	Inter-African Phyto-Sanitary Council
IAS	Invasive Alien Species
ICAO	International Civil Aviation Organisation
IITA	International Institute of Tropical Agriculture
IMO	International Maritime Organisation
IPPC	International Plant Protection Convention
IUCN	World Conservation Union
MES	Ministry of Environment and Science, Ghana
MOFA	Ministry of Food and Agriculture, Ghana
NEPAD	New Partnership for Africa's Development
NISC	National Invasive Species Council, USA
OIE	World Organisation for Animal Health
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
WSSD	World Summit on Sustainable Development
WTO	World Trade Organisation

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Recommendations

We, the delegates[1] to the Regional Workshop on *Prevention and Management of Invasive Alien Species: Forging Cooperation throughout West Africa*, held in Accra Ghana, 9-11 May 2004, co-hosted by the Ministry of Environment and Science (Ghana), the World Conservation Union (IUCN) and CAB International (CABI), and funded by U.S. Department of State and the Global Invasive Species Programme (GISP);

Recognising that invasive alien species (IAS) are a major threat to biodiversity in the region and a serious constraint to regional economic development;

Considering that expanding trade, transport and tourism are increasing the frequency of invasions;

Reaffirming that an effective response to the problem of invasive alien species requires action at community, national, regional and international levels;

Acknowledging that the countries of West Africa are Parties to the Convention on Biological Diversity and other international instruments that seek to minimize the threats posed by IAS;

Recognising that IAS cause impacts in many sectors and must therefore be tackled using a multisectoral approach;

Having discussed and considered how the problem of IAS can be addressed more effectively in West Africa through regional cooperation and collaboration;

Recommend:

1. Establishment of national steering committees and focal points

The committees should be formed immediately ensuring representation from relevant existing committees and all relevant ministries and stakeholder groups. The national focal point should coordinate the steering committee, and could serve as liaison to a regional body formed to address IAS in West Africa.

2. Establishment of a regional coordinating mechanism

A regional co-ordinating mechanism should be established under existing regional bodies. CAB International is requested to facilitate the process and provide interim regional co-ordination.

3. Development of a regional strategy and action plan

A draft regional document should be prepared by a technical team taking into account national strategies and action plans, for subsequent validation and adoption. The strategy should include links, where appropriate, with relevant international and regional instruments, bodies and organizations.

4. Promotion of awareness at national and regional levels

Policy makers and other stakeholders should be made aware of the threat posed by IAS, and of the associated economic and environmental impacts. Media and languages appropriate to the different stakeholder groups should be utilized.

5. Building/strengthening of national and regional capacity

Particular needs include: training and technology transfer; exchange of IAS experts in the sub-region; strengthening research capacity; and setting up centers of excellence based on existing capacity.

[1] Representing Benin, Burkina Faso, Cameroon, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo

6. Development of a regional legal framework

The framework should promote regional harmonization of policy, legislation and regulations on IAS, taking into account existing legal frameworks. The framework should create an enabling environment for the application and enforcement of regulations, and for building consensus on IAS management issues.

7. Improvement of the knowledge base

Biological, ecological and socio-economic research should be undertaken on prevention and management of IAS. Emphasis should be given to baseline studies and IAS inventories, risk assessment, use of indigenous technical knowledge, and assessment of the impact of IAS and management strategies.

8. Enhancement of regional communication and information dissemination

The regional co-ordination mechanism should serve as a clearing house for information and expertise on IAS, to promote regional communication and collaboration. Emphasis should be given to early warning systems and promotion of community participation.

9. Mobilisation of increased financial resources

In response to the growing threat posed by IAS, increased funding for prevention and management is requested from governments, the private sector and development partners.

SECTION A - WORKSHOP PROCEEDINGS

1. Background

1.1 Context

Article 8(h) of the Convention on Biological Diversity (CBD) calls on parties to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species", as far as is possible and appropriate. Decisions V/8 and VI/23 of the Conference of the Parties to the CBD expand on how Article 8(h) should be addressed at a national and international level, including the development and implementation of IAS strategies and action plans. Decision VI/23 reaffirmed the importance of both national and regional strategies and plans for addressing IAS, and for collaboration between neighbouring countries and trading partners, both regionally and internationally. The importance of raising awareness of threats posed by IAS and of the means to address the threats has also been emphasized in the decisions.

As a means of raising awareness and fostering regional collaboration in addressing IAS issues, the U.S. Department of State had previously funded five workshops in different regions of the world, that were convened by the Global Invasive Species Programme. The World Conservation Union (IUCN) funded and organised a sixth workshop in the Meso-America region. This seventh and final workshop of the overall series, focused on IAS issues in the West Africa region. Again, this was funded by the US Department of State, but was co-hosted and organised by CAB International and the Ministry of Environment and Science, Ghana.

1.2 Objectives

There were four objectives of the workshop:

a. Raise awareness of the economic and environmental problems caused by IAS.
b. Promote linkages and cooperation between the different sectors and stakeholders.
c. Foster regional cooperation between the countries of West Africa.
d. Develop an outline regional strategy for addressing IAS.

1.3 Participants

The workshop was attended by 57 delegates and observers (Appendix 1). Sixteen countries from West Africa were represented, including: Benin, Burkina Faso, Cameroon, Cote d' Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone and Togo (Figure 1). National representatives were mainly senior level government officials from the agriculture and environment sectors, but university researchers and administrators, and non-governmental organizations were also represented. There were also representatives of the U.S. Department of State, U.S. National Invasive Species Council, U.S. Agency for International Development, the Global Invasive Species Programme (GISP), the International Institute of Tropical Agriculture (IITA), the World Conservation Union (IUCN) and CAB International (CABI).

1.4 Workshop Methods

The methodology used during the workshop aimed to promote information sharing and active participation. Exchange of information was central to the objective of raising awareness, while effective participation was essential for forging linkages and planning collaborative and cooperative action.

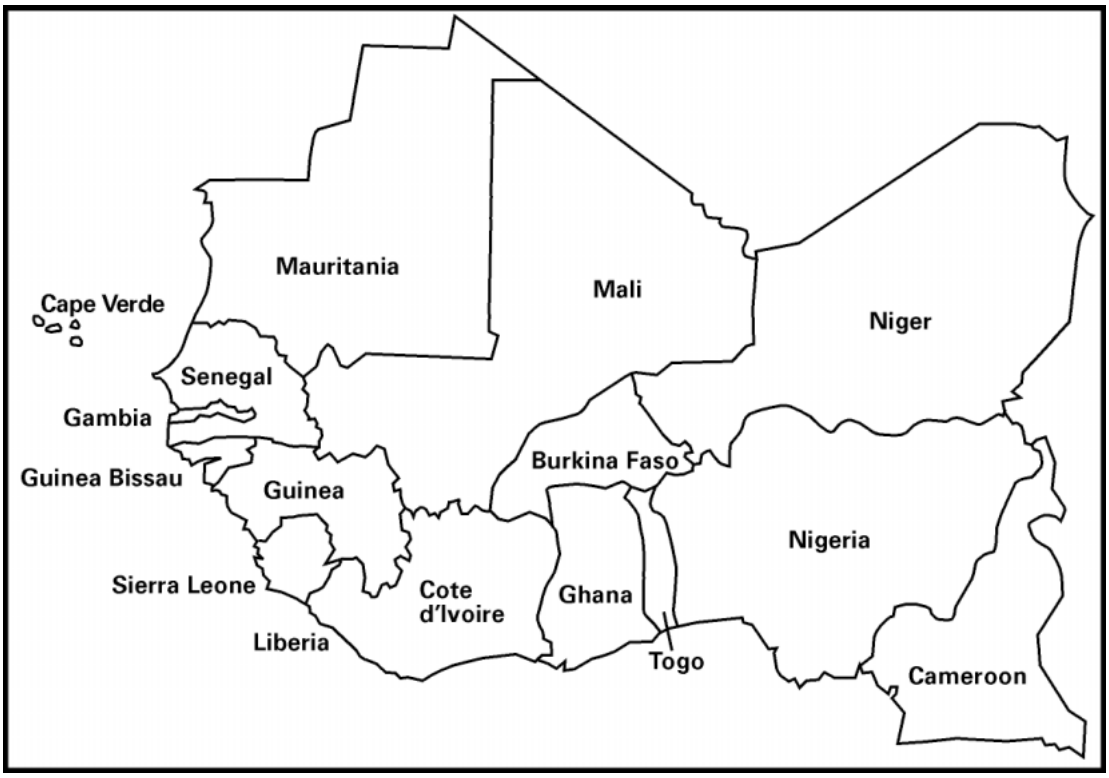

Figure 1. West Africa (All countries shown except Cape Verde were represented at the workshop).

The workshop was organised around presentations, facilitated plenary sessions and working group sessions that focused on identifying shared challenges and forging cooperative strategies to address the IAS problem in the West Africa region (see Appendix 2 for the workshop programme).

- Presentations provided global, regional and national perspectives, and are summarised in section 3.
- Facilitated plenary sessions were conducted, providing the opportunity for every participant to present their views through writing on workshop cards which were then displayed. Results of these sessions are provided below. Other plenary sessions were more typical chaired discussions.
- Two working groups were formed for parallel discussion of selected issues. These were chaired and reported by group members: Group 1 Chairman, David Arodokoun, Rapporteur, Ousseynou Diop; Group 2 Chairman, Ben Donnie, Rapporteur, Sankare Yacoub. Working group findings were reported back in plenary.

In all the sessions, including the parallel working groups, simultaneous French/English and English/French translation was provided. Although many of the participants had some bilingual skills, simultaneous translation was essential for consistency with the objective of promoting regional collaboration, and was appreciated by the participants.

2. Opening Ceremony

The opening ceremony was chaired by Prof. Alfred Oteng-Yeboah, Chair of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the Convention on Biological Diversity (CBD). The workshop was opened by the Honourable Mary Yates, U.S. Ambassador to Ghana, and Dr. Matthew Antwi, Deputy Minister, Ministry of Environment and Science (MES), Ghana.

Professor Owusu-Bennoah, Acting Director General of the Council for Scientific and Industrial Research, Ghana, welcomed participants to the workshop. He noted that usually when delegates from different nations gather to discuss economic issues they are considering positive impacts. In contrast, this meeting concerned negative economic impacts, specifically those caused by Invasive Alien Species (IAS). IAS impact negatively on efforts to achieve two of the Millennium Development Goals, namely poverty reduction and protection of the environment. The World Summit on Sustainable Development (WSSD) recommended strengthening of national, regional and global efforts to control IAS, as they endanger the national resource base of economic and social development. Thus IAS issues must be addressed in the broad context of sustainable development.

Mr. Dennis Rangi, Director for International Development, CAB International (CABI) also welcomed participants, and thanked everyone for the considerable effort they had made to attend the workshop. He noted that there were a number of CABI member countries represented at the meeting, including Cote d' Ivoire, who had joined two weeks previously. He highlighted the importance of trade in development, but noted that trade also provides many pathways through which alien species can invade. This emphasizes the need for collaboration and cooperation in addressing the problem of IAS and accordingly CABI has identified IAS as one of its six strategic themes for Africa. He acknowledged the U.S. State Department and thanked them for their interest and financial support for the workshop. He also thanked GISP for their support.

The Honourable Clement Ellede, Deputy Minister in the Ministry of Food and Agriculture (MOFA), Ghana, highlighted the importance of IAS in relation to food security. He noted that many alien species (such as cocoa in Ghana) can be highly beneficial. But some invasive species, such as witch weeds (S*triga* spp.) cause major yield losses. In Ghana and Nigeria an estimated 35% of cereal yields are lost to witch weeds, and St. Paul's wilt of coconut has devastated smallholders in Ghana. Thus strategies for addressing the problems caused by IAS need to be balanced with the benefits of alien species (See Appendix 3).

The Honourable Mary Yates, U.S. Ambassador to Ghana said that she was pleased the workshop was promoting international collaboration, and that through the State Department, the U.S. is supporting a number of initiatives on IAS. This was the 7th and last of a series of workshops they had supported, but U.S. anticipates providing long-term support in the area of IAS. Dealing with IAS is complex, as the problems are transboundary and cross-sectoral. Trade carries risk in relation to IAS, but management of the threats posed by IAS is about balancing the risks and benefits. In the U.S., IAS are estimated to cost $138 billion per year, so the message relayed was that prevention is far better than control or eradication (See Appendix 4).

The workshop was formally opened by Dr. Matthew Antwi, Deputy Minister, Ministry of Environment and Science (MES), Ghana, who reminded participants that IAS threaten food security, health, and the environment, and as a major cause of biodiversity loss, are addressed in Article 8(h) of the Convention on Biological Diversity. An example of the damage caused in Africa is the water hyacinth, which costs $20-50 million a year in just seven countries. IAS include all types of organisms, and they invade all sorts of ecosystems, though actual or ecological islands are particularly susceptible. In Ghana, a number of invasions have been the subject of control efforts in recent years, including *Striga*, *Bemisia*, *Chromolaena*, Cape St. Paul's wilt of coconut, larger grain borer and aquatic weeds. Dr. Antwi thanked the U.S. State Department for sponsoring the meeting, and congratulated the organizers, noting the importance of the theme. Regional cooperation is required in surveillance, border controls, legal frameworks, research on management and uses of IAS, and in the early detection and rapid response to invasions (See Appendix 5).

3. Presentations

Two papers were presented at the beginning of the workshop to provide background information and to highlight some of the key issues for consideration.

Prof. Emmanuel Owusu-Bennoah, Acting Director General of the Council for Scientific and Industrial Research (CSIR) in Ghana, presented a paper on "Invasive Alien Species in West Africa: Environmental and Economic Impact" (Appendix 6). *Broussonetia papyrifera*, the paper mulberry, was cited as an example of a species that was introduced intentionally, but which has since become invasive. The species was originally introduced as a potential source of raw material for paper production, but the project was unsuccessful. Now the tree is a serious problem in the Afram Headwaters Forest Reserve in Ghana. Further examples of IAS with environmental and economic impact in West Africa include *Striga* spp., *Chromolaena odorata* and *Eichhornia crassipes*. Tools for preventing invasions include public awareness, early warning systems, the use of risk assessment, national and international regulations, and quarantine measures and treatments for imported commodities. Mitigation measures for species that have already invaded include eradication, containment and suppression. The importance of appropriate legal frameworks at national and international level was emphasized.

Dr. Geoffrey Howard of the World Conservation Union (IUCN) made a presentation on "Invasive Alien Species: Definitions, Concepts and Issues" (Appendix 7). An invasive alien species can be defined as "a species new to an area, introduced intentionally or unintentionally, which spreads at the expense of native species, and causes damage to biodiversity, development and livelihoods". Thus a species may be alien to a habitat, but be naturally present in another habitat in the same country.

The process by which an alien species becomes invasive consists of four steps:

(i) Introduction, which may be intentional or unintentional, and by different sectors along various pathways;
(ii) Establishment, when the introduced species survives and reproduces;
(iii) Naturalization, leading to the species becoming part of the flora/fauna in its new habitat;
(iv) Invasion, in which the species multiplies and/or spreads with impacts on species, ecosystems, people and development. There may be a long time lag between (iii) and (iv).

It was noted that while all invasive alien plants could be considered as weeds, not all weeds are invasive. If the likelihood of each of steps (ii) to (iv) is 1-10%, then the chance of an introduced species becoming invasive is only 0.0001-0.1%.

While several invasive plants are well known in Africa, examples of other invasive species include Nile tilapia, Louisiana crayfish, rats and mice, Indian house crow, the house sparrow, and many insects. IAS also include pathogens and parasites of plants and animals, and there are many aquatic and terrestrial micro-organisms that are IAS, but are rarely seen or simply not known yet to science. Prevention of IAS is the most cost-effective approach, followed by eradication, and if all else fails, control is the last resort.

Presentations were made by participants at different points during the workshop illustrating ongoing activities against IAS in West Africa, including:

- Espéces exotiques envahissant les milieux aquatiques, by S. Yacouba and N. Ya Nestor (Côte d' Ivoire)
- Espéces etrangeres nuisibles envahissantes identifies au Senegal, by O. Diop
- Prevention and management of invasive alien species: Forging cooperation through West Africa. A case for the Gambia, by M. Bojang
- Situation de la jacinthe d'eau au Benin, by C. Hounkpe
- Problem of water hyacinth or *Eichhornia crassipes* control in sahelian countries by L. Ouedraogo & R. Dabire (Burkina Faso).
- Incidence de l'attaque de *Bemisia argentifolii* sur la croissance et la production du soja, by M. Ndiaye (Senegal).
- Impact of *Chromolaena odorata* on forest communities and grasslands in South Benin, by P. Agbani, A. Aboh, R. Holou and B. Sinsin.
- Prospects for the biological control of *Chromolaena odorata* in Ghana, by J. Timbilla.

Dr. Richard Orr made a presentation on the United States of America National Invasive Species Council (NISC, www.invasivespecies.gov) (see Appendix 8), as an example of national coordination of IAS issues. Their first IAS action plan identifies 57 specific actions in 9 key areas. Copies of the management plan were provided to participants.

Ms. K. Brand gave a presentation on the Global Invasive Species Programme (GISP, www.gisp.org) (see Appendix 9). GISP is a partnership between IUCN, CABI and the Nature Conservancy, and has forged strong links with CBD. A small secretariat has just been established in South Africa. Ms Brand also gave a short presentation on the possible elements of a communication and dissemination strategy.

4. Current National Situation

4.1 Written Country Reports

Prior to the meeting, national delegates were requested to provide a short report on the current situation in their countries, covering the following topics:

- Preliminary list of IAS, including any information on their ecological and economic impacts
- Summary of existing IAS activities (management efforts or awareness campaigns)
- List of organizations that could be involved in IAS activities
- Any identified priorities for future work particularly in relation to management and policy
- List of experts working in the field of biological invasions
- Key references on biological invasions in the country
- Current needs for managing IAS

Thirteen countries provided reports, and these are attached in Appendices 10 to 22. To bring all participants to the same starting point, participatory plenary sessions were undertaken to characterize the current situation in West African countries in relation to IAS and their management

4.2 Current Invasive Species in Participating Countries

Participants were invited to list the invasive species present in their countries. Table 1 shows the species listed by each country, and the top three priorities.

A number of observations were made on the list:

- The list is certainly not comprehensive, and should be taken as a broad-brush overview.
- Invasive plants featured prominently. Midway through the session participants were specifically asked for IAS other than plants, as up to that point only plants had been listed.
- Very few aquatic organisms are listed (apart from floating weeds), and very few microbial IAS.
- Most of the invasive species identified as priorities were either agricultural pests, or aquatic weeds.

Table 1. Preliminary list of IAS in West African countries. Shaded boxes denote priority species.

Country	Benin	Burkina Faso	Cameroon	Cote d'Ivoire	Gambia	Ghana	Guinee	Guinee Bissau	Liberia	Mali	Mauritanie	Niger	Nigeria	Senegal	Sierra Leone	Togo
Achatina spp. (giant land snails)	X	X		X	X	X	X		X	X		X	X		X	X
Aleurodicus dispersus (spiralling whitefly)	X		X	X		X		X	X				X			X
Anopheles spp. (mosquitoes)		X			X			X		X	X	X	X	X		
Azadirachta indica (neem)						X	X			X		X		X		
Azolla filiculoides (red water fern)							X	X								
Bemisia argentifolii (silverleaf whitefly)				X												
Broussonetia papyrifera (paper mulberry)					X		X									
Cape St Paul's Wilt	X		X	X	X			X		X	X	X		X		X
Charles Taylor ant						X										
Chromolaena odorata (siam weed)	X						X					X				X
Cyperus spp. (sedges)													X			
Eichhornia crassipes (water hyacinth)					X							X				
Hyptis suaveolens (desert lavender)						X										
Imperata cylindrica (lalang grass)						X								X		
Lantana camara (lantana)										X				X		
Leucaena leucocephala (leucaena)	X											X				
Limicolaria flammea (land snail)		X														
Mimosa pigra (giant sensitive plant)					X											
Mononychellus tanajoa (cassava green mite)						X										
Mus musculus (house mouse)						X										
Nypa fruticans (nipa palm)		X				X					X		X	X	X	
Oedaleus sp. (grasshopper)												X		X		
Oreochromus sp. (tilapia)						X										
Orseolia oryzivora (African rice gall midge)						X										
Oryza barthi (wild rice)							X									
Pennisetum (grass)					X											
Phenacoccus manihoti (cassava mealy bug)						X										
Phtorimaea operculella (potato tuber moth)						X										
Pistia stratiotes (water lettuce)						X			X							
Plutella xylostella (diamond back moth)				X								X				
Prostephanus truncatus (larger grain borer)					X											
Quelea quelea (red-billed weaver)														X		
Rastrococcus invadens (mango mealy bug)														X		
Rodents															X	
Salvinia molesta (water fern)															X	
Schistocerca gregaria (desert locust)															X	
Sida corymbosa															X	
Striga hermonthica (witchweed)															X	
Typha spp. (bullrush, cattail)															X	

4.3 Current National Responsibility

Participants listed the organisation(s) with current responsibility for IAS issues in their countries (Table 2).

- In most countries the responsibility falls under the environment and/or agriculture ministries.
- In several countries more than one agency is listed.

Table 2. National Responsibilities for IAS in West Africa

Country	Responsible for IAS
Benin	Ministry of Agriculture, Livestock and Fisheries
Burkina Faso	Ministry of Environment, Higher Education and Scientific Research
Cameroon	No existing programme to date
Cote d'Ivoire	Ministry of the Environment Ministry of animal resources and fisheries production
Gambia	National Environment Agency (Agriculture and Natural Resources Working Group)
Ghana	Ministry of Environment and Science
Guinea	Ministry of Agriculture and Livestock
Guinea-Bissau	Secretariat of State of Natural Resources, Energy and Industry
Liberia	Forestry Development Authority Environmental Protection Agency Bureau of Fisheries
Mali	Ministry of Agriculture, Livestock and Fisheries Institute of Rural Economy
Mauritania	Ministry of Rural Development and the Environment
Niger	Ministry of Water and the Environment
Nigeria	Federal Ministry of Environment
Senegal	Ministry of Agriculture and Hydrology, Ministry of Environment
Sierra Leone	National Agricultural Research Co-ordinating Council
Togo	Ministry of Agriculture Ministry of the Environment University of Lome

4.4 Cross-Sectoral Coordination

Participants were invited to suggest what an appropriate body would be for ensuring effective cross sectoral coordination of IAS issues at the national level (Table 3).

Table 3. Potential national body for cross-sectoral coordination of IAS issues

Country	Potential Coordination Body
Benin	National workshop on IAS; national committee for monitoring and control of IAS
Burkina Faso	Inter-sectoral committee for control of IAS
Cameroon	Joint working group between IRAD, Ministry of Agriculture and Ministry of Environment and Forestry
Cote d'Ivoire	Inter-sectoral / inter-ministerial committee
Gambia	Agriculture and Natural Resources Working Group/Committee
Ghana	Inter-sectoral Commission/Committee/Working Group on IAS
Guinea	National IAS Unit
Guinea-Bissau	Inter-sectoral committee
Liberia	Formation of inter-agency national committee
Mali	Stakeholders committee
Mauritania	Coordinating committee
Niger	National committee for IAS control
Nigeria	Cross Sectoral Working Committee
Senegal	Inter-ministerial Committee on IAS
Sierra Leone	Inter-sectoral commission/committee/working group, with national research organisation as focal point
Togo	Inter-ministerial Committee (Agriculture and Environment)

If such a coordination mechanism was to be established, someone would have to organize the process for its establishment, and participants gave suggestions as to who this might be (Table 4).

Table 4. Potential convenor/organiser of a national body for cross-sectoral coordination of IAS issues

Country	Potential Convenor
Benin	National Institute of Agricultural Research
Burkina Faso	Prime minister
Cameroon	Institute of Agricultural Research for Development (IRAD)
Cote d'Ivoire	Ministry of Environment, National Agency for Environment
Gambia	Ministry of Agriculture/National Environmental Agency
Ghana	Ministry of Environment and Science, Environmental Protection Agency
Guinea	Ministry of Agriculture and Livestock
Guinea -Bissau	Prime Minister
Liberia	Environmental Protection Agency
Mali	Ministry of Agriculture, Institute of Rural Economy
Mauritania	Ministry of Rural Development and Environment
Niger	Ministry of Water and the Environment
Nigeria	Federal Ministry of Environment
Senegal	Ministry of Agriculture
Sierra Leone	National Agricultural Research Co-ordinating Council
Togo	Ministry of Agriculture

Participants were then invited to suggest which sectors and stakeholders should be involved in national IAS issues, given an ideal situation in which a cross-sectoral coordination mechanism had been established (Table 5).

Table 5. Sectors and stakeholders who should be involved in IAS issues

Country	Sectors, stakeholders
Benin	University, INRAB, IITA, Directorate of Agriculture Plant protection service, Govt and NGO extension, IUCN, Directorate of Fisheries, Directorate of the Environment, INRAB
Burkina Faso	Institute of Environment and Agriculture Research (INERA), Transport, Horticultural imports
Cameroon	Institute of Agricultural Research for Development (IRAD), Ministry of Agriculture, Ministry of Environment and Forests,
Cote d'Ivoire	Ministry of Scientific Research (Centre for Ocean Research), Ministry of Environment (Anti-pollution centre), Ministry of Transport, Ministry of Tourism
Gambia	Agriculture, Natural Resources and Environment, Ministry of Trade and Industries, Ministry of Tourism, Private Sector, Ministry of Works and Communication, Ministry of Finance,
Ghana	Ministries of: Roads and Transport; Education; Mines and Energy; Food and Agriculture; Environment and Science, Local Government and Rural Development; Lands and Forestry; Works and Housing. Beneficiaries, Associations, Universities, NGOs, Private Sector, Research Institutions, Environmental Protection Agency, Tourism, Water
Guinea	Agriculture, Water and Forests, Hydrology, Environment,
Guinea-Bissau	Ministry of Agriculture
Liberia	Environmental Protection Agency, Ministry of Finance (Customs), Ministry of Agriculture, Forestry Development Authority, Air and Sea Ports
Mali	Environment, Agriculture, Energy, Hydrology, Regulatory Services, Research (Institute of Economic Research),
Mauritania	University, Ministries
Niger	Ministry of Environment, University, National Research Institutes, Directorates of Animal Production, Fisheries, Plant Protection
Nigeria	Environment, Science, Civil Society, Private Sector,
Senegal	Fisheries, Livestock, Finance,
Sierra Leone	Ministries covering transport, education, tourism, water, mines and energy, agriculture, environment, science, local government, lands, forestry, University, NGOs, private sector, research organizations, ports of entry (land, sea, air)
Togo	Ministry of Agriculture,

Some observations were made on the results of the exercise.

- There are potentially many sectors involved in IAS issues, including some that the agriculture/environment sectors do not normally interact with.

- The wide range of sectors means that an appropriate coordination mechanism is essential, and most delegates envisaged some sort of inter-ministerial coordination body.

4.5 National Challenges

In a plenary brainstorming session, participants identified and discussed the challenges that they face at a country level in addressing IAS issues. These were clustered into the following categories (see Appendix 23 for full list). Potential solutions were also discussed.

Institutions. Establishing workable institutional arrangements to ensure effective coordination of IAS activities was seen as a major challenge. Components of institutional arrangements posing particular challenges are; developing strategic action plans, establishing communication and reporting channels, information exchange, and sharing national competencies. Government bureaucracy is a potential constraint in some countries.

Awareness. An important challenge is awareness amongst policy makers, particularly on the impact of IAS. Public awareness is also generally low.

Technical Information. There is lack of technical information at present, which presents a challenge in promoting awareness of IAS. There are no good inventories of the IAS already present, and of their biological and economic impacts. Taxonomic identification of potentially invasive species was noted as a specific challenge, for which there is a very limited capacity in the region.

Policy. Policies relating to IAS are fragmented, and this makes raising awareness more challenging. The policy and legislative framework for dealing with IAS issues needs harmonizing. Specific issues to be covered could be early detection, resolution of conflicts of interest, and taking into account the interests of different stakeholder groups (for example one group might see an IAS as a resource they wish to use, while to another it may be a threat to their livelihood).

Resources. A shortage of resources, particularly financial was seen as a major challenge, arising in part from the lack of good information on the costs of IAS. Increased funding is required for prevention, surveillance, control and research.

Capacity. There was a broad perception that capacity is inadequate at almost all levels in regard to IAS prevention and management.

5. Forging Regional Cooperation

Two working groups addressed a series of questions concerning regional cooperation in IAS prevention and management. The two groups recorded the points discussed (Appendix 24). Here a synthesis of the two groups' findings is presented for each question.

5.1 Perceived needs and opportunities for collaboration throughout West Africa

The need for collaboration in West Africa was seen to be clear, as IAS 'know no boundaries' and several IAS are already present in most of the countries. A high level of connectivity of water systems promotes the spread of IAS, heightening the need for collaboration. There is a need for good networking, with effective communication and information exchange in the region, provided for under regional/sub-regional legal frameworks, strategies and action plans. These should be developed taking account of previous failings.

There are opportunities to work through existing national centres and regional agencies and bodies. Regional bodies that could be involved include ECOWAS, CORAF, CILSS, and at the continental level, NEPAD and IAPSC. Where it is not already, IAS needs to be brought onto the agenda of these organizations.

5.2 What do we want the region to achieve collectively?

Through regional collaboration, more effective prevention, eradication or control of IAS could be achieved. This should include ecosystem restoration following eradication or control. A cooperation mechanism for regional collaboration is required, and common approaches to management and control of IAS can be forged, including harmonized regulatory frameworks, holistic and sustainable control and cross border controls.

5.3 What are the challenges to achieving regional cooperation?

The national challenges identified in the earlier session were generally applicable across the region. It was emphasized that regional cooperation is difficult if national systems are not functioning. Thus a key initial step in developing regional cooperation is that national strategies must be developed. Different countries are at different stages of this process. Challenges that relate particularly to the regional level include achieving a cross-border regional vision, taking account of different interests and priorities. Commitment of political leaders to regional collaboration is required. Language barriers, regional conflicts and bureaucracy all present challenges to achieving regional cooperation.

5.4 What are the necessary elements for a strategy to achieve regional cooperation?

The importance of being organized at national level was again highlighted; regional coordination is envisaged via national focal points or coordinators. A key element would be some sort of regional coordination mechanism such as a secretariat, with an associated regional strategy. This would include a mechanism for regional consultation and meetings, a clearing house mechanism for exchange of information, and cooperative programmes for research. The involvement of, and linkages to, existing networks and organizations was also seen as an important element.

5.5 How can we promote collaboration and cooperation within existing frameworks?

Existing frameworks occur at national, regional and international levels. In all cases collaboration and cooperation can be promoted through increased awareness, and this is addressed below. National frameworks have been considered above. At the regional level, the Economic Community of West African States (ECOWAS) provides a framework, through its agriculture and environment unit. However, there was some debate over what role ECOWAS might take, and no consensus was reached. Of the countries present, Mauritania and Cameroon are not ECOWAS members. Other regional and continental frameworks for cooperation are provided by the Permanent Interstate Committee for Drought Control in the Sahel (CILSS), the West and Central African Council for Agricultural Research and Development (CORAF), the Inter-African Phyto-Sanitary Council (IAPSC) and New Partnership for Africa's Development (NEPAD).

At the international level, the Convention on Biological Diversity (CBD), the International Plant Protection Convention (IPPC) and GISP were cited as existing mechanisms within which collaboration could be promoted. As a thematic focal point under the CBD, GISP is promoting access to global IAS databases, and the West Africa region could both contribute to and utilize the databases. Table 6 shows membership of some international bodies which include provision for addressing IAS issues.

5.6 What are the existing resources that can be utilised?

Existing resources identified include individuals, communities, national organizations, and regional and international bodies. Although capacity is felt to be lacking, at the same time it was noted that there are experts, technicians and specialists in the region, particularly in the area of integrated pest management and biological control. All countries have community groups, NGOs, and national research institutions and universities that can be mobilized for IAS prevention and management. Indigenous knowledge (and associated networks such as CAMES) was also cited as a resource. At the regional and international levels ECOWAS, African Development Bank and GEF were identified as existing sources of expertise and finance.

Table 6. Membership of international bodies and conventions by the 16 participating countries

Country	CBD	WTO	IPPC	OIE	CAC	IMO	ICAO
Benin	✓	✓		✓	✓	✓	✓
Burkina Faso	✓	✓	✓	✓	✓		✓
Cameroon	✓	✓		✓	✓	✓	✓
Cote d'Ivoire	✓	✓		✓	✓	✓	✓
Gambia	✓	✓		✓	✓	✓	✓
Ghana	✓	✓	✓	✓	✓	✓	✓
Guinea	✓	✓	✓	✓	✓	✓	✓
Guinea-Bissau	✓	✓		✓	✓	✓	✓
Liberia	✓		✓		✓	✓	✓
Mali	✓	✓	✓	✓	✓		✓
Mauritania	✓	✓	✓	✓	✓	✓	✓
Niger	✓	✓	✓	✓	✓		✓
Nigeria	✓	✓	✓	✓	✓	✓	✓
Senegal	✓	✓	✓	✓	✓	✓	✓
Sierra Leone	✓	✓	✓	✓	✓	✓	✓
Togo	✓	✓	✓	✓	✓	✓	✓

CBD *Convention on Biological Diversity*
WTO *World Trade Organisation*
IPPC *International Plant Protection Convention*
OIE *World Organisation for Animal Health*
CAC *Codex Alimentarius Commission*
IMO *International Maritime Organisation*
ICAO *International Civil Aviation Organisation*

5.7 What additional resources are needed?

Additional financial and material resources are required to build on the existing capacity, to fill gaps, and to facilitate regional cooperation. Particular areas identified as requiring resources included; communications systems, pre- and post-entry quarantine facilities, research on biological and socioeconomic impacts of IAS, and training in specialist skills such as taxonomy. It was suggested that governments should earmark more funds for IAS work, but additional external financial support is required along with backstopping from international organizations.

6. The Way Forward

6.1 Recommendations

The working group presentations were used as the basis for developing a set of recommendations. The steps in this process were as follows:

- In plenary, key issues arising from the working groups were identified, and consolidated to produce a consensus list.

- In plenary, participants made suggestions for specific recommendations under each of the key headings. A communication and dissemination strategy was identified as a key component of the regional IAS strategy for West Africa, and more detailed discussions were held to identify stakeholders, what information needs to be communicated, and what the other components of the communication strategy should cover. Figure 2 gives the details of all the recommendations suggested, and Appendix 25 gives the additional details on the communication strategy.
- A drafting team, comprising the chair and rapporteur of the working groups plus the organizers, prepared a summarized version of the recommendations.
- The draft recommendations were discussed in plenary, and changes agreed.
- The drafting team revised the recommendations accordingly, and prepared both French and English versions.
- French and English versions of the Final Recommendations were distributed in the final session of the workshop and unanimously adopted.

The final recommendations are presented at the beginning of this report (preceding Section 1). It was agreed they could be used as an awareness-raising tool, providing a succinct summary of the outcome of the workshop suitable for policy and decision makers. Figure 2 (below) gives the details of all the recommendations suggested, and Appendix 25 gives the additional details on the communication strategy.

6.2 Next Steps

While the recommendations summarise the broad issues that need to be addressed for effective, regional cooperation, participants also identified a number of steps that could be taken immediately following the workshop by themselves and their colleagues. These included:

- Presenting the workshop recommendations and the workshop proceedings to the relevant national authorities. (All participants received electronic copes of the final recommendations on CD before departure).
- Establishing a national committee on IAS, and where one already exists, strengthen it based on the discussions at the workshop.
- Establishing/appointing a national focal point for IAS issues, and communicating the contacts to CAB International, Nairobi.
- Informing relevant stakeholders of this workshop and its recommendations, and create awareness among different stakeholder groups including the public.
- Beginning the process of formulating IAS national strategies and action plans. Where these exist, they should be reviewed in the light of the current workshop.
- Linking with other relevant national programmes, and begin sourcing funding as well as with programmes in neighbouring countries.
- Beginning the processes of setting up nationwide rapid response local level task forces for dealing with IAS.
- Establishing a national IAS clearing house on IAS information.
- Distributing the workshop proceedings - CABI will send workshop reports to the country focal points / representatives.
- Individual countries writing to CABI and formally requesting CABI to act as interim coordinator for a regional West Africa initiative on IAS.

7. Conclusion

In closing, a number of speakers noted that the workshop had been highly successful, and had achieved its objectives. Awareness of the problems caused by IAS had been raised, and linkages promoted between different sectors and stakeholders. This was the first time that the countries of West Africa had come together as a region to discuss invasive alien species, so it was an important first step in fostering regional cooperation. Much information was exchanged in discussions, presentations and written reports (see Appendix 26 for abstracts of technical papers). An outline for a regional strategy was developed, including identification of immediate and future actions, and a workshop communiqué with recommendations was agreed by participants.

Details of Suggested Workshop Recommendations

1. Establishment of national committees and focal points

- Forma national stakeholders steering committee (taking into account existing committees)
- Committees should be set up immediately
- Establish/appoint national focal points
- Focal point to coordinate steering committee

2. Establishment of a regional coordinating mechanism

- appoint an interim facilitator (CABI) whilst the sub-region studies where the coordination should be

3. Development of a regional strategy and action plan

- adequate funding to be provided by all countries
- inventory of IAS in all countries
- appoint technical team to draft action plan taking into account national plans
- regional workshop to validate action plan
- ratification of regional action plans by all countries
- ratification of IPPC by all countries
- regional training center/plans
- establish links with international and regional bodies e.g. IPPC, GISP, ECOWAS, WTO

4. Promotion of awareness at national and regional levels

- publicise danger posed by IAS
- CABI/GISP to assist other agencies
- publicity by drama, video, films, sports using print and electronic media
- all publicity in English/French/Portuguese
- target policy makers first then general public
- identify regional/national institutions to be targeted to help promote IAS management
- identify media appropriate to messages
- sensitization of regional bodies
- sensitize policy makers through special fora
- send workshop communiqué to policy makers
- socioeconomic/health impact studies to be used to sensitize policy makers
- community participation

5. Building/strengthening of national and regional capacity

- Capacity building of IAS stakeholder institutions
- Set up centers of excellence in IAS (in existing research centers)
- Training needs assessment of IAS institutions (training of trainers)
- Continued strengthening of IAS institutions capacity (human and financial resources
- Harmonization of regional training in IAS
- Establishment of databases (IAS organisms)
- Use/exchange IAS experts in the sub region

6. Development of a regional legal framework

- phytosanitary regulations
- build from existing legal frameworks (FAO/IPPC, CILSS)
- adopt international framework where not already done
- harmonize existing regulations
- ensure all states have legal framework
- harmonize national policies
- application and enforcement of regulations
- conflict of interest resolution
- establish links with international and regional bodies e.g. IPPC, GISP

7. Improvement of the knowledge base

- Research
- Collect indigenous knowledge on IAS
- Impact assessment studies (socioeconomic, biological)
- risk assessment studies
- IAS inventories/baseline data collection

8. Enhancement of regional communication and information dissemination

- (see also Appendix 25)
- technical team to be appointed to draft regional communication and dissemination strategy for validation
- prepare video/films on success stories in IAS management
- regional bulletins/newsletters on IAS
- train specialized communicators in IAS
- association of IAS journalists
- set up network for dissemination/broadcasting
- promote use of local languages to communicate at national level (radio/films/print media)
- Early warning
- Community participation

9. Establishment of a regional clearing house mechanism

- set up database on IAS (national/regional)
- set up regional and national websites on IAS
- clearing house mechanism to be set up (details to be worked out later) to facilitate activities in clearing house

10. Mobilization of increased financial resources

- all countries should provide adequate funds for IAS management
- funds to be committed to IAS management by nations/regional/international organizations
- enhance private sector funding
- CABI should source funding through linkages with multilateral/international organisations
- NEPAD to fund IAS management

SECTION B - APPENDICES

APPENDIX 1: List of workshop participants

Dr. Y. David Arodokoun
Director General
INRAB
B.P. 884
Cotonou, Benin
E-mail: dginrab@yahoo.fr
Tel: 229-30-0723/360391
Fax: 229-30-0326

Mr. Onodje Pierre Agbani
Universite d' Abomey-Calavi
Faculte des Science Agronomiques
Laboratoire d'Ecologie Appliquee
01 BP 526
Cotonou, Benin
E-mail: pagbani@yahoo.fr
Tel: 229 30 3084/60 8987
Fax: 229 30 3084

Dr. Louis R. Quedraogo
Head of Programme
INERA/CNRST
BP. 10 Koudougou Province
Burkina Faso
E-mail: orllouis@hotmail.com or
crsaria@fasonet.bf
Tel: 226-44-6509/10
Fax: 226 44 6508

Dr. Sankare Yacouba
Responsable du Department de l'Information
Scientifique et Technique Centre de Recherche
Oceanologiques
B.P.V. 18, Abidjan
Cote d' Ivoire
E-mail: sankare04@hotmail.com
Tel: 225-2135 5014/5880
Fax: 225-21-351155

Mr. Ebou Sarr
Government Dept. of State Fisheries
Natural Resources & the Environment
P.O. Box 577
Banjul, Gambia
E-mail: wildlife@gamTel:gm
Tel: 220-375-888/376973/903479
Fax: 220-392179/228998

Prof. Hamidou Boly
Director
INERA/CNRST
BP. 8645 Ouagadougou 04
Burkina Faso
E-mail: inera.direction@fasonet.bf
Tel: 226-340271
Fax: 226-34-0271

Ms. Catherine H.K. Hounkpe
Direction des Peches
Ministere de I' Agriculture de I'Elevage et de la
Peche
01 BP 383
Cotonou, Benin
E-mail: maepdp@intnet.bj
Tel: 229 33 1551/1831
Fax: 229 33 5996

Dr. Musa Bojang
Director General
National Agricultural Research Institute (NARI)
P.M.B 526
Serekunda, Gambia
E-mail: nari@ganet.gm
Tel: 220-4484 925/9941 920
Fax: 220-4484 921

Dr. Salomon Nyasse
Scientific Coordinator for Perennial Crops
Institut de Recherche Agricole pour le
Développement (IRAD)
P.O. Box 2123
Yaounde, Cameroun
E-mail: nyasse@iccnet.cm
Tel: 237 223 3538
Fax: 237 223 3538

Dr. Almamy Camara
Park & Wildlife Management
Abuko Nature Reserve
Gambia
E-mail: wildlife@gamtelgm or
almamoc@hotmail.com
Tel: 220 4484 453/2376972/3
Fax: 220 2392179

Prof. Emmanuel Owusu-Bennoah
Acting Director General
Council for Scientific and Industrial Research (CSIR)
P.O. Box M. 32
Accra, Ghana
E-mail: eobennoah@ucomgh.com
Tel: 233-21-760166/777651-4
Fax: 233-21-779809

Prof. Alfred Oteng-Yeboah
Deputy Director General
Council for Scientific and Industrial Research (CSIR)
Accra, Ghana
E-mail: aaoyeboah@yahoo.com

Dr. Joseph Cobbinah
Technical Specialist, MRM, AFFS
Council for Scientific and Industrial Research (CSIR)
Accra, Ghana
E-mail: jcobbinah@hotmail.com

Mr. Gyanpah Amoako-Gyedu
Deputy Director Natural Resources Management
Conservation International (CI)
P.O. Box KA 30426
Accra, Ghana
E-mail: cioaa@ghana.com
Tel: 233-21-773893/780906
Fax: 233 21 762009

Mr. James Timbilla
Scientist
CSIR-Crops Research Institute
P.O. Box 3785
Kumasi, Ghana
E-mail: jtimbilla@yahoo.com
Tel: 233-24 643673
Fax: 233-51-60142

Dr. David Wilson
Lecturer
University of Ghana
Accra, Ghana
E-mail: wilsondd@ug.edu.gh
Tel: 233-21-500381 ext 3267/3277
Fax: 233-21-500305

Mr. Moses Duku
Deputy Director
Ministry of Environment and Science (MES)
P.O. Box M232
Accra, Ghana
E-mail: mosesduku@yahoo.com
Tel: 233 24 449691
Fax: 233 21 666 828

Mr. Kweku Amoako Atta de Graft Johnson
National IAS Project Coordinator
CSIR-Water Research Institute
Accra, Ghana
E-mail: kaadigi@hotmail.com

Mr. Michael K. Dade
Scientist
Volta River Authority
Akosombo, Ghana
E-mail: dade@akosombo.vra.com
Tel: 233-251-20321
Fax: 233-21-776005

Dr. Anthony Cudjoe
Deputy Director
Plant Protection and Regulatory Service Directorate
P.O. Box M. 37
Accra,Ghana
E-mail: icpcc@ghana.com or
tonycudjoe@yahoo.co.uk
Tel: 233 24 256293/27 740313

Mr. Carl Fiati
Senior Programme Officer
Environmental Protection Agency
P.O. Box M. 326
Accra,Ghana
E-mail: cfiati@epaghana.org
Tel: 233-21-664697/8
Fax: 233-21-662690

Dr. Bourema Dembele
Scientific Director
Institut d' Economie Rurale
BP. 258, Mali
E-mail: bourema.dembele@ier.ml
Tel: 223 223 1905/222 2606
Fax: 223 222 3775/223 644 0714

Prof. Kwame Afreh Nuamah
National IPM Co-ordinator
University of Ghana
Tel: 233-21-500381
Fax: 233-21-500184

Prof. Essie T. Blay
Crop Science Department
University of Ghana
Ghana

Mr Ernesto Pereira
Directorr
Secrétariat des Ressources Naturelles, Energie et de l'Industrie
Guinea Bissau
E-mail: pereiraernesto@yahoo.fr
Tel: 245 203264

Dr. Sekou Cisse
Director General
IRAG
B.P. 1523
Conakry, Guinea
E-mail: iragdg@irag.org.gn
Tel: 224 11 26 9131

Robert Clausen
Regional Environmental Advisor
United States Agency for International Development
P.O. Box 1630
Accra,Ghana
E-mail: rclausen@usaid.gov
Tel: 233-21-228440
Fax: 233-21-231937

Mr Ben Turtur Donnie
Biodiversity consultant
National Environmental Commission of Liberia
P.O. Box 4024
Monrovia, Liberia
E-mail: benturturdonnie@yahoo.com
Tel: 231 226211/37747511387
Fax: 231 226210/31 205407127

Mrs. Ama Kudom Agyemang
Environmental Journalist
GBC Radio News
P.O. Box 1633
Accra, Ghana
E-mail: kudomagyemang@yahoo.com
Tel: 233 24 567888
Fax: 233 24 410572

Mr. Ibrahim Malik Inahoro
Senior Conservation Manager
Nigeria Conservation Foundation
P.O. Box 74638
Victoria Islands
Nigeria
E-mail: ncf@hyperia.com
Tel: 234 1 26424898/4718693
Fax: 234 1 2642497

Mr Mbaye Ndiaye
Head, Phytopharmacy Laboratory
Direction de la Protection des Végétaux
BP 20054
Thiaroye, Senegal
E-mail: mbaye@hotmail.com
Tel: 221 834 0397
Fax: 221 834 2854

Mr. Ousseynou Diop
Direction Protection des Végétaux
BP. 20054
Thiaroye, Senegal
E-mail: diopousseynou@hotmail.com
Tel: 221 834 0397/221 647 2733
Fax: 221 834 2854

M. Kotchikpa Okoumassou
Direction Faune Et Chasse
B.P. 355
Lomé, Togo
E-mail: okoumdfc@hotmail.com
Tel: 228 912 5405
Fax: 228 221 4029

Dr. Rogers A. D. Jones
Chief Executive
National Agric. Research Coordinating Council (NARCC)
P.M.B. 1313
Freetown, Sierra Leone
E-mail: cenarcc@sierratel.sl
Tel: 232-2222-4708/222179
Fax: 232-2222-4439

Dr. Sarah Simons
Deputy Director
CAB International - Africa Regional Centre (CABI-ARC)
P.O. Box 633-00621
Nairobi, Kenya
E-mail: s.simons@cabi.org
Tel: 254-20-524450/524462
Fax: 254-20-522150

Dr. Richard Orr
Assistant Director
National Invasive Species Council (NISC), USA
1849 C. Street.
Washington DC 20240
USA
E-mail: richard_orr@ios.gov
Tel: 202 354 1882
Fax: 202 371 1751

Dr. Mamadou Balde
Entomologist
ISRA/CNRA
BP. 53
Bambey, Senegal
E-mail: ousndoye@refer.sn or
adndiaye@syfed.refer.sn or
tunkanbalde@yahoo.fr

Dr Geoffrey Howard
Regional Programme Coordinator
World Conservation Union (IUCN)
P.O. Box 68200
Nairobi, Kenya
E-mail: gwh@iucnearo.org
Tel: 254-20-890605/12
Fax: 254-20-890615

Mr Morris Akiri
Administrator
CAB International - Africa Regional Centre (CABI-ARC)
P.O. Box 633-00621
Nairobi, Kenya
E-mail: m.akiri@cabi.org
Tel: 254-20-524450/524462
Fax: 254-20-522150

Ms Kobie Brand
Communications Officer
Global Invasive Species Programme (GISP)
Private Bag X7
Claremont 7735
Cape Town, South Africa
E-mail: brandt@nbi.ca.za
Tel: 27 21 7998839
Fax: 27 21 7971561

Mr. Pocanam Yentchabre
ITRA
B.P. 1163
Lome, Togo
E-mail: itra@cafe.tg or
yenpoca@yahoo.fr
Tel: 228-225-2148/3096/1559
Fax: 228-225-1559

Manuele Tamo
International Institute of Tropical Agriculture (IITA)
08 BP 0932 Tri Postal
Cotonou, Benin
E-mail: m.tamo@cgiar.org
Tel: 229 350188
Fax: 229 350556

Dr Jeffrey Fisher
Ecology & Conversation Officer
Department of State (USA)
2201 C. Street
Washington DC 20520
USA
E-mail: fisherjp@state.gov
Tel: 202 647 0199
Fax: 202 647 5247

Dr Roger Day
Rapporteur
CAB International - Africa Regional Centre (CABI-ARC)
P.O. Box 633-00621
Nairobi, Kenya
E-mail: r.day@cabi.org
Tel: 254-20-524450/524462
Fax: 254-20-522150

Mr Martin Kimani
Facilitator
CAB International - Africa Regional Centre (CABI-ARC)
P.O. Box 633-00621
Nairobi, Kenya
E-mail: m.kimani@cabi.org
Tel: 254-20-524450/524462
Fax: 254-20-522150

Mr Dennis Rangi
CAB International - Africa Regional Centre (CABI-ARC)
P.O. Box 633-00621
Nairobi, Kenya
E-mail: d.rangi@cabi.org
Tel: 254-20-524450/524462
Fax: 254-20-522150

Dr Madiodio Niasse
UICN-West Africa Regional Office (BRAO)
01 BP 1618 Ouagadougou 01
Burkina Faso
E-mail: Madiodio.niasse@iucn.org
Tel: 226 3070 47
Fax: 226 307561

Mary Carlin Yates
United States Ambassador to Ghana
Dr. Mattew Antwi
Deputy Minister
Ministry of Environment and Science (MES), Ghana
E-mail: mattewantwi@hotmail.com

Mr Kweku Owusu Baah
Chief Director: Ministry of Food and Agriculture (MOFA)
Ghana
E-mail: kobaah@hotmail.com
Tel: 233-21-666567

Ms Sara Woodring
Economic Assistant
United States Embassy (Ghana)
P.O. Box 194
Accra, Ghana
E-mail: WoodringSE@state.gov
Tel: 233-21-775348
Fax: 233-21-776008

Ms Vivien Asafu-Ajaye
Ministry of Environment and Science
P.O. Box M232
Accra, Ghana
Email vivicay001@yahoo.com
Tel: 233-21-660005
Fax: 233-21-666828

Mr E.O. Nsenkyire
Chief Director
Ministry of Environment and Science (MES)
P.O. Box M. 232
Accra, Ghana
E-mail: mest@africaonline.com.gh
Tel: 233-21-666828

Hon. Clement Ellede
Deputy Minister (in charge of crops)
Ministry of Food and Agriculture (MOFA)
Ghana
E-mail:minister@mofa.gov.gh

APPENDIX 2: Workshop Programme

The Prevention and Management of Invasive Alien Species: Forging Cooperation throughout West Africa

Accra, Ghana, 9th - 11th March 2004

Tuesday 9 March 2004: *Morning*
Defining the issue on the global and regional scale (Chair: Professor Alfred Oteng-Yeboah)

09h00 Welcome, Introductions and Opening Ceremony
09h10 Statement by Hon. Major (Rtd) Courage E.K. Quasigah, Minister, Food and Agriculture
09h20 Statement by Hon. Professor Dominic Fobih, Minister, Lands and Forestry
09h30 Statement by Her Excellency, the US Ambassador to Ghana, Hon. Mary Yates
09h40 Keynote Address by Hon. Professor Kasim Kasanga, Minister, Environment and Science
09h50 Invasive Alien Species in West Africa: environmental & economic impact
Professor Emmanuel Owusu-Bennoah, Acting Director General, CSIR
10h10 Invasive species issues globally – problem definition, causes, and consequences
Dr Geoffrey Howard, IUCN, East Africa

10h30 Coffee Break

Current status of invasive alien species in West Africa (Chair: Mr Dennis Rangi)

10h50 Overview of the workshop objectives
11h00 Participatory Session on Current Status of Invasive Alien Species
by the National Delegates of:
Bénin, Burkina Faso, Cameroon, Cap Vert, Cote d'Ivoire, Gambia, Ghana, Guinée, Guinee Bissau, Liberia, Mali, Mauritanie, Niger, Nigeria, Sénégal, Sierra Leone, Togo
12h00 Summary of Country Reports on Invasive Alien Species
12h15 Discussion

12h30 Lunch

Tuesday 9 March 2004: *Afternoon*
Exploring approaches to achieving success throughout the region (Chair: Dr Salomon Nyasse)

14h00 Experiences of Invasive Alien Species in countries in West Africa (country representatives)
15h00 NISC: A mechanism for managing Invasive Alien Species within the USA (Mr Richard Orr)
15h20 Overview of Directives for Working Groups

15h30 Coffee Break
16h00 Working Groups on Regional Cooperation
Questions to be addressed by a representative of each country:
1. Main challenges and mechanisms for addressing the problem within each country
2. Perceived needs and opportunities for cooperation throughout West Africa
3. What do we want the region to achieve collectively?
4. What are the challenges to achieving regional cooperation?

17h30 End of Day 1

18h30 *Cocktail Reception hosted by the Minister for Environment and Science*

Wednesday 10 March 2004: *Morning*

Exploring approaches to achieving success throughout the region (Chair: Prof. Hamidou Boly)

09h00 Presentations by Working Groups
09h40 Discussion
10h00 Overview of the Global Invasive Species Programme (GISP) and the Global Strategy on Invasive Alien Species
10h20 Overview of Directives for Working Groups

10h30 Coffee Break (in working groups)

11h00 Working Groups on Regional Cooperation
To address the following questions:
1. What are the necessary elements for a strategy to facilitate regional cooperation?
2. How can we promote collaboration & cooperation within existing frameworks?
3. What are the existing resources that can be utilized to achieve regional cooperation?
4. What additional resources are needed?

12h30 Lunch

Wednesday 10 March 2004: *Afternoon*

Exploring approaches to achieving success throughout the region (Chair: Dr Bourema Dembele)

14h00 Working Groups on Regional Cooperation
To address the following questions:
1. Who needs to be involved? When and where?
2. What are the steps to establish regional collaboration and promote action?
3. What are the steps that can be taken immediately and who should take them?

15h30 Coffee Break

16h00 Presentation of Working Group Summaries
16h30 General Discussion and Recommendations
17h30 End of Day 2

Thursday 11 March 2004: *Morning*

Regional Communication and Dissemination Strategy (Chair: Dr Martin Odei)

09h00 Presentation on the Communication Strategy of the Global Invasive Species Programme (Ms Kobie Brandt)
09h20 Participatory Session on Key Components of a Communication & Dissemination Strategy
To address the following questions:
1. Who are the stakeholders?
2. What needs to be communicated, by whom and to whom?
3. What are the key components of a communication & dissemination strategy?

10h20 Overview of Directives for Working Groups

10h30 Coffee Break

11h00 Working Groups on Communication & Dissemination Strategy
To address the following questions for each component:
1. What information needs to be communicated?
2. What existing mechanisms can be utilized?
3. What new systems need to be designed and established?

12h30 Lunch

Thursday 11 March 2004: *Afternoon*
The Road Ahead (Chair: Dr Madiodio Niasse)

14h00 Presentation of working group summaries
14h30 General Discussion and Recommendations for a regional strategy on IAS

15h30 Coffee Break

16h00 "The road ahead – where we go from here"

16h30 Closing remarks

17h00 **End of workshop**

APPENDIX 3: Statement by the Honorable Clement Ellede - Deputy Minister, Ministry of Food and Agriculture, Ghana

Mr. Chairman, Hon. Minister of Environment and Science, Research Scientists assembled here, Farmers, Participants, Invited Guests, Ladies and Gentlemen

It is indeed a great honour to be with you today to make a statement on the opening of the International Workshop on Prevention and Management of Invasive Alien Species with the theme: Forging Cooperation throughout West Africa. My statement this morning would centre around Invasive Species and Food Security.

Mr. Chairman, globalization has made the introduction of alien species into native ecosystems much easier. Many societies now benefit or depend on large number of alien species as food, medicine or raw materials for industry. This rather enhanced easy access to a wide range of the world's biodiversity has invariably contributed, in many instances, to the enrichment of many lives worldwide but has also created a number of problems in some parts of the world.

It is clear from the above, that the introduction of alien species into new ecosystems could have beneficial as well as detrimental effects. It is, therefore, for this reason that I am pleased to know that the Global Invasive Species Programme (GISP), in part, seeks to address biological species (plants and animals) that are introduced into new habitats ostensibly to improve the welfare of peoples but end up impacting negatively on them and on the environment.

Mr. Chairman, I have been reliably informed that the majority of our food and cash crops in this sub-region are introduced alien species. It is common knowledge that coca (*Theobroma cacao*), which is the number one foreign exchange earner for both Ghana and Cote d'Ivoire has its origins in the New World (South America). Thanks to Tetteh Quarshie for its introduction. Similarly, maize (*Zea mays*), cassava (*Manihot esculenta*) and yam (*Dioscorea* sp.*)* originated from the same location whilst rice (*Oryza sativa)* came for East Asia and Coffee (*Coffea arabica)* from the Mid East.

Mr. Chairman, some alien species are creating serious problems in the sub region. Notable amongst these are the witch weed (*Striga* spp.), the Siam or Acheampong weed (*Chromolaena odorata*), the water hyacinth (*Eichhornia crassipes)* and the Cape St. Paul's wilt.

May I at this juncture give brief highlights on the problems these noxious alien species pose to food security in the sub-region.

The witch weeds *Striga hermonthica* and *S. gesnerioides* compete with cereals (sorghum, millet and maize) and legumes (cowpea) respectively for nutrients. In most cases these weeds destroy these crops leading to very high yield losses. In Ghana and Nigeria, estimated yield losses attributable to the witch weed were 35% (0.17 million tonnes) and 25% (3.75 million tonnes) respectively.

Mr. Chairman, another good example of an alien species that threatens our environment and the comfort of our people is the water hyacinth. This water weed can lead to depletion of water bodies. Furthermore, it obstructs boat movement, destroys propellers and fishing gears and can retard or even prevent fishing activities and thus increases the woes of our already protein impoverished populations and the rural poor.

Mr. Chairman, I could continue with many more examples but since time is not on our side, I would end up with another major alien pest, the Cape St. Paul's Wilt. This pest has virtually halted the further development or totally destroyed the coconut plantations especially in the Volta, Greater Accra, Central and Western regions leaving the rural poor, who depend solely on this crop, poorer than before.

Mr. Chairman, the relevance of alien species on food security needs of any nation cannot be ignored. It is most important to have a balance between the negatives and positives of alien species in order to achieve food security. Once we have an assembly of policy makers and expert scientists here today, it is my hope that the issue of alien species and food security would be discussed thoroughly.

My Ministry is waiting patiently for the recommendations from this workshop to support the course we are already pursuing to attain food security for this nation.

I wish you all fruitful deliberations at this workshop.

Thank you and may God Bless You.

APPENDIX 4: Opening Address by Ambassador Mary Yates, United States of America Ambassador to Ghana

Mr Chairperson, Honourable Ministers of State, Colleagues from the Departments of State and Interior, Distinguished Ladies and Gentlemen

Akwaaba. Bonjour. Good morning to you all

I am very pleased to be here today to help open this workshop aimed at developing international cooperation in the fight against invasive alien species in West Africa.

The US State Department has demonstrated a long commitment to combating the spread of invasive alien species through our funding of pilot projects to address the impacts of invasive species on trade and the environment. Specifically, we have helped CAB International, the organizer of this current workshop, develop databases that provide for information sharing on invasive species. These efforts are critical to the development of integrated national plans and management strategies.

The State Department has also funded a series of workshops around the globe to increase awareness of the problems associated with invasive species, and to promote intergovernmental cooperation in controlling their spread. Although this is the seventh and last workshop in that series, I can assure you that the US government support for and involvement in efforts to address invasive species issues will be long-term.

I have to say honestly that this is a new topic for me, but I've quickly become a convert to the importance of managing invasive species. A primary goal of this conference is to sound a wake-up call and we hope you too will take this message away with you.

From the recent education I've received on the topic, I've discovered that not all alien species become invasive and harmful. However, those that do are widely recognised as one of the greatest biological threats to our planet's environment, and economic well-being.

Invasive species are a primary menace to endangered and threatened species. Just a few weeks ago, the U.S. Fish and Wildlife Service reported the extinction of two bird species as a result of the predatory invasive brown tree snake in Guam. In Ghana, the Water Hyacinth is an aquatic invasive which not only blocks waterways and interferes with fishing, but I'm told it prevents sunlight and oxygen from reaching submerged plants and fish, dramatically reducing the diversity of species in the aquatic ecosystem.

Furthermore, the cost to the agricultural and forestry sectors, through control measures and production losses, are enormous. The estimate of the global cost of invasive species is $250 billion per year for control and eradication.

In the US, we are struggling against invasive species as well. There are an estimated 50,000 non-native species that cost the US more than $138 billion dollars per year.

Globalisation has brought tremendous benefits to so many people, and it holds a lot of promise for the economies of both West Africa and the US. But it is important to be aware that the increasing trade, travel, and transport of goods across borders can also facilitate the introduction of alien species.

As I mentioned, not all newly introduced species become invasiveindeed, where would we be here in Africa without the 'alien' foods such as maize, rice, and potatoes, which are now staples. Nevertheless, some people suggest countries should fend off any opportunity for invasive species to become established. This approach, I believe, might be an oversimplified and impractical management strategy. Effective management is about balancing the different needs and risks. And invasive species are introduced in ways that are often unintentional and unexpected.

There are also examples of deliberate introductions of species that were not intended to be harmful. Here in Ghana, I understand that the Paper Mulberry Tree was introduced to develop a 'pulping' industry for

producing paper. The project failed, and Ghana was left with a highly invasive tree species that is extremely difficult and costly to eradicate.

Clearly the issues surrounding invasive species are complex and I'm no expert. But I do know that invasive species do not respect political boundaries, and no single country alone has all the solutions. The cross-sectoral nature of invasive species makes responding to the problem a big challenge. Successful management will require co-operation and action by governments, economic actors and individuals, who need to keep in mind that prevention is usually easier than eradication.

The first step is to raise awareness about the threat posed by invasive species. Ghana, with its leadership in ECOWAS, is the right place to start the discussion of a regional strategy to fight this problem of invasive species.

Mr. and Madam Chairpersons, Honourable Ministers, distinguished ladies and gentlemen, I wish you a productive and successful workshop, and on behalf of the US Government, I am pleased to be part of this important initiative.

Thank you.

APPENDIX 5: Keynote Address by the Hon. Dr Matthew K. Antwi - Deputy Minister, Ministry of Environment and Science, Ghana

Mr. Chairman, Hon. Ministers of State, Members of the Diplomatic Corps, Distinguished Workshop Participants, Ladies and Gentlemen.

It is my pleasure and honour to share my thoughts with you at this workshop whose theme is: ***The Prevention and Management of Invasive Alien Species: Forging Cooperation throughout West Africa.***

Ladies and Gentlemen, the negative impacts of Invasive Alien Species (IAS) on the environment, socio-economic development and human health have engaged the attention of policy makers, scientists and natural resource managers throughout the globe for a long time.

Global Invasive Alien Species Issues

In the convention on Biological Diversity (CBD), Article 8(h) calls on member governments to "as far as is appropriate, prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species". Invasions by non-native species are a threat to biodiversity and threaten food security, health and economic development. In addition, IAS are also now recognized as one of the greatest biological threats to our planet's environmental and economic well-being.

Many nations continue to grapple with the complex and expensive IAS problems. For example, the cost of water hyacinth problems in African countries amounts to US$20 – 50 million annually. Worldwide, the problem of IAS became significant only with the advent of agriculture. The economic impact of Invasive Alien Species on Agriculture is astronomical.

In 1992, estimated annual crop losses due to IAS in America were between US$2 to 3 billion and its control, using herbicides, was estimated between US$1.5 to 2.3 billion. The total cost of non-indigenous weeds was approximately US$5.5 to 7.7 billion in 2000.

Again, in Australia, the Federal Government provided two million Australian Dollars in 1991 to mechanically and chemically control the alien sensitive plant, *Mimosa pigra*, to halt its spread. However, national, sub-regional and international responses to the IAS problem have so far been insufficient to counter their increasing toll on natural resources and society.

IAS issues in the West African Sub-region

Here in West Africa, the ECOWAS sub-regional treaty will eventually not only allow our economies to be full integrated but also encourage the movement of our peoples, goods and services. These frequent cross border interactions along with the share water bodies and farmlands will invariably increase the possibility of IAS infestations. The need for serious deliberation on this issue should therefore be the concern of all of us gathered here.

Mr. Chairman, the scope of IAS invasions is global and the cost is enormous in both ecological and economic terms. IAS are found in all taxonomic groups. They include viruses, fungi, algae, mosses, fern, higher plants, invertebrates, fish, amphibians, reptiles, birds and mammals. They have invaded and affected native biota in virtually every ecosystem type on earth.

Many hundreds of extinctions have been caused by IAS especially under "Island" conditions either on real Islands or in ecological Islands, such as aquatic ecosystems. IAS, thus, can transform the structure and species composition of ecosystems by suppressing or excluding native species either directly by out-competing them for resources or indirectly by changing the way nutrients are cycles through the system.

A recent assessment of some IAS in Ghana shows that wherever the leguminous plant, *Leucaena leucocephala*, and Teak *Tectona grandis*, have been introduced and become invasive, the species diversity in the area was found to be less than 10% of the original composition.

Collaboration in ECOWAS

We, in the West African sub-region, have in the past decade or more had a good collaboration on the management of IAS invasions with some assistance from the donor community and international organizations. These have included the following:

- PAN AFRICAN *Striga* Network;
- Biological control of the silver leaf white fly, *Bemisia tabaci,* which almost devastated our annual crop yields of mangoes, citrus, cassava, etc.;
- Integrated management of the Siam weed, *Chromolaena odorata*, also know as "Akyeampong" in Ghana, including the use of its bio-control agent *Pareuchaetes pseudoinsulata*;
- The Cape St. Paul's Wilt disease which continues to devastate our coconut palm plantations;
- The larger grain borer on cereals; and last but not the least,
- The integrated control of aquatic weeds.

These collaborative efforts have to a large extent proven quite successful and have in some cases completely freed our water bodies, food and cash crops and fishery resources from the scourge of these IAS invasion and thus from socio-economic decline, ill-health, unemployment and poverty.

It is within this context of collaboration in the sub-region where our peoples are linked through ethnicity, culture, water bodies, grazing lands and a shared future that I wish to congratulate the organizers and sponsors of this workshop. I also wish to congratulate you on the choice of the theme "The Prevention and Management of Invasive Alien Species: Forging Cooperation throughout West Africa".

In conclusion, Mr. Chairman, the countries of the sub region need to pull all available resources together and unite to fight IAS. This could be enhanced through strict border (land and water) and in-country surveillance and checks for the introduction of IAS, joint research into IAS management, adequate government and sub-regional financial and logistic support. The search for possible uses for IAS should also be considered as part of their management.

Finally, I would like to add my voice to the call by the Global Invasive Species Programme workshop publication 2002 which says that the West African sub-region and for that matter ECOWAS, Cameroon and Chad, in the main:

1. Need to establish a comprehensive IAS surveillance programme to enable early detection and rapid response to be made;
2. Undertake further assessment of IAS pathways and impacts and disseminate results widely to resource managers and policy makers;
3. Implement legal frameworks to minimize the risk of biological invasions.

I again welcome all of you, distinguished ladies and gentlemen, to this forum and to Ghana. I wish you all very fruitful deliberations in the coming days and may your untiring efforts continue to bring hope, good health, peace and prosperity to our peoples.

APPENDIX 6: Presentation on Invasive Alien species in West Africa - Environmental and Economic impact

Please download the Powerpoint presentation at
http://www.gisp.org/downloadpubs/wa_appendix6.zip

APPENDIX 7: Presentation on Invasive Species Issues Globally - Problem, Definition, Causes and Consequences

Please download the Powerpoint presentation at
http://www.gisp.org/downloadpubs/wa_appendix7.zip

APPENDIX 8: Presentation on the National Invasive Species Council, USA

Please download the Powerpoint presentation at
http://www.gisp.org/downloadpubs/wa_appendix8.zip

APPENDIX 9: Presentation on the Global Invasive Species Programme

Please download the Powerpoint presentation at
http://www.gisp.org/downloadpubs/wa_appendix9.zip

APPENDIX 10: Country Report on Invasive Alien Species in Benin

Dr. David Arodokoun, Director General of the National Institute of Agricultural Research
Mme Catherine K Hounkpé, Biologist with the Department of Fisheries (*Direction des Pêches*)
Mr. Pierre O. Agbani, Botanist and Ethnobotanist, Assistant Researcher at the University d'Abomey, Calavi.

With a surface area of 112 600 km², Benin is located in West Africa. It shares borders with Nigeria, Togo, Niger and Burkina-Faso, has a population of around 6 500 000 inhabitants and is divided into 12 departments. It has a large water network consisting of rivers, lakes and lagoons, the largest of which are the Ouémé, the Couffo and the Mono Rivers in the south basin, and the Niger and its tributaries, the Mékrou, the Alibori and the Sota, in the north basin. Benin's lakes are the Nokoué and the Ahémé and its lagoons are the Porto-Novo and those along the coast. The population's main activities are farming, animal breeding, fishing, handicrafts, trade and tourism.

Several production activities such as farming, animal breeding and fishing are threatened by the invasion of harmful species, the most important of which are as follows:

- *Phaerococus sp* and green mites on manioc;
- *Rastrococus invadens*, on mango trees;
- White flies on various plant species;
- *Striga hermonthica, Striga gesneroides* on grains (maize, sorghum, niébé etc)
- *Chromolaena, odorata* in fallow land, protected areas and grazing lands
- *Eichhornia crassipes*, and *Pistia stratiotes* on water surfaces and areas that can be flooded
- *Hyptis suaveolens* in grazing lands
- *Ramphicarpa fistulosa* in deep rice fields
- Rodents and scale insects in crops and fields.

The most problematic cases currently involve the *Chromolaena odorata* and the *Eichhornia crassipes*

Case of *Eichhornia crassipes*

The water hyacinth (*Eichhornia crassipes*) was introduced into Benin and then rediscovered 1977 on the Sô River. Ten years later, it became the most threatening aquatic plant. The population calls it 'Togble' which can be translated as "the country is being destroyed".
It reproduces in a vegetative manner with stolons by forming large blankets that are easily spread by the water current, the wind and boatmen. It produces large quantities of seeds with a germinating power of up to 15 years. The significant infestation of most of Benin's water bodies on account of an excessive nitrogen and phosphate content in the water, favours the proliferation of the water hyacinth. The water's salt content of at least 5% contributes to its destruction.

Water hyacinth invasion causes socio-economic, environmental and health problems.

Socio-economic problems

Death of water hyacinth on Lake Nokoué (brackish water body in dry season)

- Decreased yields in fish-breeding enclosures of fish called 'Acadja'
- Halt in fishing activities (the use of fishing boats becomes difficult)
- Invasion of food crops and vegetable gardens in the Ouémé valley and their destruction;

- Destruction of houses on piles as a result of the coiling and decomposi-tion of the water hyacinth in these piles.
- Decreased fishing production on infested bodies of water;
- Halt in irrigation activities in rice fields

Environmental problems

- The covering of water surfaces by water hyacinth causes a decrease in photosynthesis.
  The result of this is:
  - the drop in the primary productivity of the water bodies concerned
  - the consumption of large quantities of oxygen during the decomposition of dead hyacinth plants
  - the obstruction of water routes, and
  - an accelerated filling up of water bodies on account of the sedimentation of the water hyacinth.

Health problems

The water hyacinth is a breeding ground for mosquitos that transmit malaria. It is also the home of poisonous reptiles.

Actions taken to control hyacinth invasion

- Biological control by the *Institut International Tropical Agricole* (IITA) and the *Direction des Pêches* with the release of biological agents (*Neochetina eichhorniae, Neochetina bruchi, Niphograpta albiguttalis, Eccritotarsus catarinensis)*
- The construction of hyacinth enclosures for the releases;
- The setting up of invasion management committees and their supply with boats by the Beninese government within the framework of manual control
- The training of three (03) fishing technicians in March 2001 in techniques towards the biological control of the water hyacinth in Mali.

At the end of this training period, the tasks allocated to the participants were performed, namely:

- the assessment of sites infested with water hyacinth.
- the setting up of a biological agent breeding unit consisting of six (06) circular tanks provided by the FAO.
- the running of the biological agent (weevils) breeding unit in Porto -Norvo.
- the release of beetles into the bodies of water concerned

- the raising of awareness among river-side populations regarding the significance of biological control operations in their communities.
- the monitoring of infested sites.

Future priority actions

- Continuing the management of floating plant life;
- Biological control: the release of new beetles (*Orthogalumna terebrantis* or *Bellura densa* or *Xubida infussella)*;
- Manual control (the setting up of physical barriers)
- Enhancement of the water hyacinth (handicrafts, agriculture, etc.);
- Skills reinforcement (training, information, education and communication);
- Monitoring of socio-economic and environmental impacts.

2. Case of *Chromolaena odorata*

The impact of *Chromolaena, odorata* on the regeneration of dense semi-deciduous forests in Guinean and Sudano-Guinean grazing lands

With the increase in grazing land, their colonisation by *Chromolaena, odorata* favoured the increase in the diversity of invasive species. However, in dense forest, this species diversity decreased significantly.

Chromolaena, odorata has a negative influence on the abundance of edible species in grazing grounds, and reduces the regeneration density of forest species by half in fallow lands as well as in dense forest areas.

3. Case of *Striga* spp.

They live as a parasite on niébé and cereals (maize, sorghum and millet).

Damage is great and results in the abandonment of entire pieces of land.

They are the subject of conventional agronomic research and their biology has been studied. Among the control measures recommended are mechanical breakdown, the fructification of parasitic plants, suicidal germination, crop rotation and the use of resistant varieties. These measures remain insufficient.

4. Other species of invasive alien plants in Benin

These are:
Hyptis suaveolens found in all kinds of grazing land.
Ramphicarpa fistulosa in rice fields.
Neither has yet been the object of control.

A comprehensive inventory will make it possible to bring to light a reliable data base and to adopt the appropriate management according to the species and their ecological specificity.

CONCLUSION

- The water hyacinth has caused poverty in continental fishing communities through its negative impacts.
- Despite the efforts made to control this invasive plant, its cyclic proliferation continues.
- Its spread over divided water bodies makes it more complicated to manage effectively. The Central Core of the classified forest of the Lama in south Benin constitutes the last great semi- deciduous forest for the conservation of biological diversity in south Benin. With its dense and suffocating blanket, *Chromolaena, odorata* is hindering forest regeneration and together with other invasive species, is accelerating the loss of biological diversity in Guinean and Sudano-Guinean grazing lands as well as the reduction in quantitative and qualitative grazing values.

A local and regional participatory approach will make it possible for the propagation and control of invasion alien species to be managed effectively in the West African sub-region.

APPENDIX 11: Country Report on Invasive Alien Species in Burkina Faso

Dr Louis Ouedraogo, Head of Programme, INERA/CNRST P.O. Box. 10 Koudougou Province, Burkina Faso.
Professor Hamidou Boly, Director INERA/CNRST, P.O. Box 8645 Ouagadougou, Burkina Faso.

Introduction

Historically speaking, the continental part of West Africa experienced frequent invasions by desert locusts which were at the root of many disasters affecting plant production. Famine, for instance, often occurred in this part of Africa. As far as anyone can remember, the end of the terrible years of drought between 1969/73 in the Sahelian area with its disastrous consequences on all levels (ecological, human), experienced an invasion of rats that took human lives in certain regions of West Africa. Apart from these isolated cases, biological invasions were few and far between.

During the past few years, the situation has seen a new development in West Africa, which is probably in relation with a general global tendency. In fact, current invasions of exotic species seem to constitute one of the main threats to natural ecosystems, biodiversity, human activity and sometimes, to man's physical integrity.

The most spectacular invasions observed these past few years are those caused by *Eichhornia crassipes* or water hyacinth, *Pistia stratiotes* or Araceae, *Salvinia molesta* or water fern and *Typha australis, Phragmites australis*.

1. Invasive Alien Species in Burkina Faso

Burkina Faso has not been spared by biological invasions, despite its continentality, as reflected in the numerous and insidious paths borrowed by invasive exotic or emerging indigenous species to spread across the world. Frontiers between countries and continents have indeed been blurred and biological organisms travel rapidly using many routes.

The awareness of problems caused by the invasion of prolific species has resulted in ecological research (Ouedraogo, 1994), and more particularly, in a sub-regional workshop organised on the subject by Nigeria on the theme 'The water hyacinth, threat and resource'. During the course of this workshop, it became clear that this plant was present in many CEDAO countries (CEDAO Report, 1994) and already constituted a serious development problem for some of them. When the situation was examined, it appeared that the water hyacinth was not the only invasive alien of fresh water rivers and bodies. Three species were emphasised, namely:

- *Eichhornia crassipes (Mart.) Solm Laub.*
- *Pistia stratiotes L.*
- *Salvinia molesta.*

The workshop emphasised the complexity of the situation. In fact, harmful invasive plants know no boundary or country and what's more, trans-border rivers are at the root of the contamination of several countries. This is the case of Niger and Nigeria which are probably constantly reinfected by the waters of the Niger River flowing from Mali.

It also turned out that several methods in the control of floating plants, particularly the water hyacinth, should be combined. **The Lagos workshop therefore saw the necessity of adopting an integrated approach** in the management of these floating plants: integrating countries as well as methods in the control of these plants.

All the countries within the organisation were thus called to assess the situation of floating plants. The investigations conducted in the 16 countries concerned clearly showed that they were all affected by the problem of invasive alien aquatic plants, but in varying degrees.

1.1 Overview of the situation of invasive alien plants in Burkina Faso

The whole country and a sample of one hundred and fifteen (115) rivers and water bodies scattered across the country were screened in 1995 (Ouedraogo, 2002). Since then, these investigations were updated and contain the following information:

1.1.1 Aquatic ecosystems

The analysis of the samples taken from the bodies of water makes it possible to classify them into two groups, from the point of view of their colonisation by macro-phytocenosis:

i. bodies of water exempt from macrophyte vegetation or very slightly colonised;
ii. bodies of water significantly colonised by the vegetation. These can be subdivided into three sub-groups:

- Colonisation by forage grass species, Cyperacea, legumes and various Nymphaeaceae;
- Colonisation by prolific species, particularly *Ceratophyllum demersum, Trapa natans, Potamogeton octandrus, Najas* sp., *Oxycaryum cubense, Leersia hexandra, Pycreus mundtii, Pistia stratiotes, Azolla africana, Typha australis, Polygomum* spp., *etc;*
- Colonisation by *Eichhornia crassipes, Typha australis, Azolla africana*, concerns the rivers and bodies of water explored (7%).
- **These cases of colonisation cause harm in the face of which fishing populations it attacks appear to be defenceless.**

The development and evolution of the above species create plant material that slowly restricts water surfaces in the form of a floating aquatic prairie.

Table 1: Harmful colonisation of certain bodies of water by plants other than the water hyacinth (Ouedraogo, 1995, 2000)

Body of water	Blanket of harmful vegetation	Taxons concerned: *Trapa natans (1), Ceratophyllum demersum (2), Potamogeton . (3), Oxycaryum cubense (4), Leersia hexandra (5), Najas* sp. *(6), Typha australis (7), Azolla africano (8), Paspalum* sp. *(9), Pycereus mundtii (10), Polygonum* sp. *(11), Typha australis (15 a)*
Lake Tengrela	20 ha	1 ; 2 ; 3 ; 4 ; 5 ; 6 ; 8 ; 10
Hippo marsh	40 ha	1 ; 2 ; 3 ; 4 ; 5 ; 8 ; 10 ; 15 a
Boudierie	30 ha	11
Tapoa	25 ha	1 ; 2 ; 3 ; 6 ; 11
Banzon	20 ha	2 ; 4 ; 5 ; 8 ; 9 ; 10 ; 11
Kou Valley	10 ha	1 ; 2 ; 4 ; 5 ; 6 ; 7 ; 8 ; 9 ; 10 ; 11
Sourou Valley	15 ha	15 b
Bangré		15 b
Takaledougou		15 b
Lemouroudougou	15 ha	15 b, 2, 5
Total	165 ha	

Out of all the bodies of water studied, eight, or 7% of the sample present with problems of infestation, mainly by *Pistia stratiotes* and *Eichhornia crassipes, Typha australis* and *Azollaa africana*. These species affect the following bodies of water: Nagbangré, Koubri 1, Koubri 2, Boulbi, Ouaga 2 Dam, Ouaga 3 and FCBO, the Son (Mou) tributary of the Bougouriba, which is, in turn, a tributary of the Mouhoun (ex. Volta Noire). Significant colonies covered the eutrophic waters of the Ouagadougou area. Approximately 14 hectares of surfaces were covered, corresponding to swampy areas (Ouedraogo, 2000).

There are between 17 000 and 21 000 tons of accumulated green biomass. Ethnobotanical surveys have estimated the loss suffered by fishing activities, arboriculture and vegetable gardening at 20 million CFA francs annually, or at between 35 000 and $US 40 000. Losses recorded in terms of health (malaria, bilharzia) are not included in these estimates. Furthermore, the affected areas are plagued with an increased activity of serpents, particularly pythons, which attack small ruminants.

The water hyacinth is at present invading the largest water reserves in Burkina Faso, namely the Kompienga (20 000 ha) located in the basin of the Niger and Bagré (25 000 ha) and the Bougoriba which belong to the Volta Basin (Ouedraogo 2001).

1.1.2 Prolific terrestrial plant species

Relatively recent inventories indicate the presence of a certain number of prolific species.

Table 2: Terrestrial infesting plants

Taxons	Biological type	Origin	Distribution
Chromolena odorata	**Np**	Introduced	Recent introduction but spreading rapidly
Hyptis suaveolens	**Th**	Indigenous?	Wide-spread
Cassia obtusifolia	**Th**	Indigenous?	Wide-spread on poor soil
Cassia occidentalis	**Th**	Indigenous?	Wide-spread on poor soil
Ipomoea asarifolia	**Ch vines**	Indigenous?	Not wide-spread but difficult to eliminate
			Wide-spread in depleted areas
Sida acuta	**Th**	Indigenous?	
Striga spp.	**Th**	Indigenous?	

1.1.3 Invasive animal species

There are few species recognised as prolific and invasive in the animal world, the most commonly mentioned being locusts and grasshoppers. *Quelea quelea,* of which there have been large populations these past few years, should be added to these arthropod insects. The proliferation of this species is often associated with the development of *Typha australis* which provides them with an ideal medium for protection and reproduction (Ouedraogo, 2003).

2. Existing programme at national level on invasive alien species

After botanical and ecological inventories revealed the water hyacinth phenomenon in Burkina Faso in the 1990's (Ouedraogo, 1994, 1996, 1998, 1999), many studies were done on the dangers of this species. Following these preliminary awareness activities directed at policy-makers, a *Comité National de Lutte Contre les Végétaux Aquatiques Envahissants* (CNLCVAE) [a national committee for the struggle against invasive aquatic plants] was created under the sponsorship of the *Ministère de l'Environnement* [department of the environment. This committee consists of the main departments involved in the utilisation and management of bodies of water, in particular, *la Recherche scientifique* (INERA) [scientific research], *la Société Nationale Burkinabè d'Electricité* (SONABEL) [national Burkinabè electricity company], *l'Office*

National de l'Eau et de l'Assainissement (ONEA) [national water and sanitation department], *l'Association des Pêcheurs* [fishing association], *l'Association des Pépiniéristes* (Hortculturists*),* Green-Cross, Global

Village, Ouagadougou city hall, the *Ministère de l'Agriculture* [department of agriculture], the *Ministère de Défense nationale* [ministry of national defence] (Military Engineers) and the *Ministère de l'Administration* Territoriale [department of administration].

A strategy was drawn up to manage these plants, consisting of physical control and tests for all the other existing kinds of control, particularly, biological and chemical. These activities were implemented thanks to the assistance of the *Institut de l'Environnement et Recherches Agricoles* (INERA) [environmental and agricultural research institute] which organised a pilot research project, the results of which have been satisfactory. The institute has, since then, continued its activities together with the *Ministère de l'Environnement et du Cadre de Vie* [department of the environment and life environment] and populations in infested areas to find solutions but the lack of consistent financing is preventing the growth of this programme whose intervention possibilities are restricted.

3. Government Agencies and NGOs

Those involved are, in part, the same ones as those already mentioned. These are the *Ministère des l'Enseignements Secondaire Supérieur et la Recherche Scientifique* (MESSRS) [department of higher secondary education and scientific research], the department of energy, the department of agriculture and water and fishing resources, *l'Association des Pêcheurs* [the fishing association], the *Association des Pépiniéristes* (Horticulturists), Green-cross, Global Village, Ouagadougou city hall, the department of the environment and of life environment, the ministry of defence (Military Engineers), the ministry of administration, the Burkinabè association for environmental conservation, the department of culture and tourism, the department of communication, etc.

4. Priorities and Strategies at National Level

It is urgent that we implement a National Programme on invasive species based on a complete assessment of the situation that encompasses all invasive species, regardless of whether or not they are exotic, both vegetal and animal, through consistent financing.

A network needs to be created, incorporating all the countries of the sub-region around the problem of invasive species;

Consistent financial means need to be sought through NEPAD or by means of any other channel towards organising research activities and adapting control technologies for each species targeted, with the involvement of those populations that would benefit from the results.

An effective mechanism for the promotion of the exchange of experiences and for the implementation of development activies relating to the control and eradication of invasive species needs to be set up.

5. Lists of experts working in the field of biological invasion

Table 3: List of experts working in the areas of plant infestation

Surname And Given Names	Speciality	Address
Dr Ouedraogo R. Louis	Phyto-Ecologist	INERA/CNRST CRREA CENTRE Saria P.O. Box 10 Koudougou Burkina Faso

APPENDIX 12: Country Report on Invasive Alien Species in Cameroon

Dr Salomon Nyassé, Ambassa-Kiki Louis Raphäel, Onana Jean Michel, Achoundong and Cheek Martin
Institut de Recherche Agricole pour le Développement (IRAD), P.O. Box 2123 Yaoundé, Cameroon.

1. Invasive alien species of Cameroon

Chromolaena odorata (L.) R.M. King and H. Robinson.	Introduced into West Africa in 1960s and now a major agricultural weed. In Cameroon, it is called Bokassa grass (formerly called *Eupatorium*).
Schwenkia americana L. (Solanaceae) and *Browallia americana* L. (Solanaceae)	Both originally from South America. Only recorded as reaching Cameroon in recent decades. They are roadside weeds and occasional weeds of cultivation.
Nipa fruticans	Originally from South-East Asia. Introduced to Calabar about a century ago. Now slowly spreading into Cameroon mangrove swamp from West to East.
Clerodendrum chinense	Originally from South-East Asia. Introduced to Africa as ornamental. Now a minor weed of lowland areas, e.g. at Mount Cameroon.
Cecropia peltata	Originally from South America. Introduced to Limbe Botanic Garden about a century ago. Now spreading slowly out from Limbe and competing in the same niche as *Musanga cecropioides*.
Cuphea carthegenensis (Jacq.) MaGride (Lythr.)	Originally from South America. Introduced in recent decades in Cameroon and spreading fast. Known from South-West Province and North-West Province lowland-submangrove areas, especially roadsides.
Buddleja davidii (Logan.)	Originally from China ? Widespread as ornamental in Europe, introduced to Mount Oku as an ornamental. Spreading slowly in the wild.
Eichhornia crassipes **and** ***Pistia stratiotes*** (Araceae)	Aquatic weeds originally from South America (Water hyacinth).

2. Existing programmes on invasive species in Cameroon

As only *Chromolaena odorata* is considered as major weed, there is not yet a programme for the management of invasive species.

3. Organisations that may be involved with the management of invasive alien species

The Scientific Co-ordination for Forest and Environment of the Institute of Agricultural Research for Development (IRAD); the National Herbarium of IRAD may be involved with the identifications and collection of ecological data;
The Scientific Co-ordination for Animal Production and Fisheries of IRAD;
The Ministry of Agriculture (Quarantine Service);
The Ministry of Environment and Forests (collaboration with IRAD);
The Ministry of Husbandry, Fisheries and Animal Industries (collaboration with IRAD).

4. Priorities for Cameroon

To set a programme for monitoring the situation (major and minor invasive alien species).

5. List of experts

Dr. FOAHOM Bernard: IRAD, Scientific Co-ordinator for Forest and Environment, P.O. Box 2123 Yaoundé, Cameroon, Email address: foasipowa@yahoo.fr, Tel: +237 992 61 05 (Mobile phone).

Dr. AHOUNDONG: IRAD: Head, National Herbarium, P.O. Box 2067 Yaoundé, Cameroon, Email address: gachoundong@yahoo.fr, Tel: +237 231 44 16 (Office) / +237 223 88 27 (Home).

Dr. ONANA Jean Michel: IRAD, National Herbarium, P.O. Box 2067 Yaoundé, Cameroon, Email address: jmonana@yahoo.fr, Tel: +237 231 44 16.

Dr. CHEEK Martin: Royal Botanic Garden, Kew, Richmond, Surrey, TW9 3AB (Works with the National Herbarium of Cameroon).

Dr. EKUE NDOMO Fabian: IRAD, Scientific Co-ordinator for Animal Production and Fisheries, P.O. Box 2123 Yaoundé, Cameroon, Email address: ekuefabian@yahoo.com, Tel: +237 961 68 35 (Mobile phone).

6. References

Hepper, F.N. and Keay, R.W.J. (1954–1972). Flora of West Tropical Africa. E2, London.
Various editors, currently Achoundong. (1963). Flore du Cameroun. National Herbarium, Cameroon – IRAD – MINREST.

7. Current needs for managing invasive species

Especially for *Chromolaena odorata*, our needs concern:
Best way of managing Chromolaena odorata;
Warning from neighbouring countries;
Creation of a laboratory in Africa working on Chromolaena odorata.

The case of *Chromolaena odorata*

In Cameroon as in any country in the humid tropics, more than a hundred weed species have been already described. Among them, the major one considered as alien is Chromolaena odorata (Chromolaena). Chromolaena was found for the first time in Cameroon in the late seventies to early eighties. Since then, due to its vivacity, the relative longevity and good germinating power of its achenes, and its capability to establish rapidly and overgrow the vegetation in place, its has spread all over the country, except in the zone north of the 8th parallel probably because of the dry climate.

Although some farmers in Cameroon claim that this weed species is useful since - according to them - groundnut grown in Chromolaena fallow gives higher yield as compared with newly cleared forested land, most of them consider it as a noxious species and designate it as "*invading fallow*".
Its nuisance is based mainly on the following factors:

- High competition for water and nutrients;
- Fire hazards in dry seasons;
- Infestation by rodents; and above all,
- Exuberance that causes stifling of seedlings.

In spite of the well-known negative importance of this weed, information available on studies conducted on it is scanty. Due to that and to the difficulty in proposing acceptable research activities with an IRAD umbrella, the scientists of the Scientific Co-ordination for Forest and Environment (Soil, Water and Atmosphere research Programme; National Herbarium) decided, during their monthly co-ordination meetings in 2002, to write a project that could be proposed for international funding.

Title of the project: *Chromolaena odorata* monograph in Cameroon

Outline

1. Literature review (concerning only works carried out in Cameroon)
2. Survey in rural areas of the country throughout
3. Extension of Chromolaena in Cameroon and its consequences
4. Field work on:
   - Chromolaena fallow for land rehabilitation
   - Control of Chromolaena odorata

Unfortunately, for many reasons, the project was never written as such, but the idea remained. The opportunity given by IRAD participation in the above mentioned workshop might be the occasion for resuming the write-up.

APPENDIX 13: Country Report on Invasive Alien Species in Cote d'Ivoire

Dr Sankaré Yacouba, Head of Programme, *Centre de Recherches Océanologiques* [Centre for Oceanological Research] BPV 18 Abidjan, Côte d'Ivoire.
N'Goran Ya Nestor, *Centre de Recherches Océanologiques*, BPV 18 Abidjan, Côte d'Ivoire.

1. General points on the Cote d'Ivoire

Location. The Cote d'Ivoire (4°30' and 10°30' N and 2°30' and 8°30'W) is located in the intratropical zone and in the centre of the Gulf of Guinea, in West Africa. It has a surface area of 322 465 km² and is bordered in the south by the Atlantic Ocean, in the south-east by Liberia, in the north-west by Guinea, in the north by Burkina Faso and in the east, by Ghana.

Length: The Ivorian coast runs along the Gulf of Guinea over more than 540 km between Liberia and Ghana.

Climate: The country is influenced by the monsoon (humid equatorial mass) and the harmattan (dry tropical mass). These two air masses are separated by the intertropical front which directly influences the local climate. The northern climate is of Sudanese type and is characterised in its northern and centre section by a two-season climate: a dry season between October and March and a rainy season between April and September. In its southern and intermediate half, the climate is tropical and humid and is characterised by a four-season climate: two dry seasons from November to March and from July to August and two rainy seasons, from April to June and from September to October, corresponding to the rise of the intertropical front and during which two thirds of the total annual rainfall have been recorded. The country crosses a climatic transition zone and experiences a relatively long harmattan period (5 to 6 months) in the northern region and 1 to 2 months in the southern region.

Types of habitat: One of the most characteristic elements of Ivorian ecosystems is its vegetation which gives the country its most concrete expression. Most of those who have studied the Ivorian ecosystem have subdivided it into areas and sections mainly based on the major plant formations in their landscape, as follows:

- the Guinean area consisting of, from south to north: i) the coastal section; ii) the woodlands section; iii) the mesophilic section; iv) and the mountainous section;

- the Sudanese area, consisting of, from south to north: i) the Sub-Sudanese section; ii) and the Sudanese section.

Dense Ivorian forests occupy the southern half of the country. In fact, they belong to a much larger area, covering Liberia, Cote d'Ivoire and western Ghana.

Among the ecological factors making it possible to distinguish the different types of forests, the climatic variables should first be considered, particularly rainfall, and then, soil quality, mainly in terms of their water retention capacity. This ecological factor mainly makes it possible to subdivide dense forests into sub-types. There are two major types of dense forest in the Guinean area: moss forests more towards the south, and mesophilic forests which form borders with the Sudanese area.

Coastal savannas are open and humid plant formations, and are of a specific type. They are located south of the lagoons, on the coastal ridge between Port-Bouet and Grand-Bassam. These savannas are found on quaternary sands characterised by deep water-logging and form wide grassy prairies generally near Guinean savannas. They are quite dense but not diversified from a taxonomic point of view.

Pre-lagoon savannas are located north of the lagoons, on Neogene (or Continental Terminal) sands, in the forest region of lower Cote d'Ivoire. It is this specific location that gives these plant formations their name of "savanna included" in the forest.

A close-up view shows that the Cote d'Ivoire consists of different types or sub-types of habitats, the main ones being as follows:

i. marginal-coastal environments (five lagoon complexes: 17 km² Fresco lagoon, 190 km² Grand-Lahou lagoon; 525 km² Ebrié lagoon, 424 km² Aby lagoon and numerous small closed lagoons). All the lagoons, except for the small closed lagoons, connect with the sea. The largest of these lagoons (Grand Lahou, Ebrié et Aby) were initially separated but are now linked together through the construction of canals (the Azagny canal links the Grand Lahou lagoon to the Ebrié logoon and the Assinie canal links the Ebrié lagoon to the Aby lagoon) which facilitiates the movement of small boats over an area of approximately 300 km.

ii. In addition to these open lagoon complexes, many closed lagoons are found along the coast.

iii. The mouths of the country's main rivers: Comoé, Bandama, Sassandra and Cavally, and coastal rivers such as Agneby, La mé, Boubgo.

iv. Along the coast are also swamps, marshes and mangrove forests consisting mainly of two plant species: *Rhizophora racemosa* (Rhizophaceae) and *Avicennia Africana* (Avicenniaceae).

v. Finally, populations have also settled along the coast, as reflected by the houses and facilities constructed.

The Ivorian continental shelf has a surface area of 12 000 km^2 and consists of two kinds of beds: in the east, a soft (sandy) bed suitable for the use of trawl nets, an area that makes up almost 2/3 of the surface area [industrial trawler fishing]; a hard (rocky) bed in the west where trawling is more difficult and even impossible. In this area, fixed gear (longlines, handlines and gill nets) is used [traditional fishing].
The continental shelf is extremely narrow. Its width varies from between 9 and 18 miles with an average of 13 miles, and it dips from between 120 and 130 metres. At the Grand-Bassam transect, the pre-continent extends over 12 miles, narrowing at Jacqueville (10 miles) and Grand-Lahou (9 miles) and widening at Fresco (14,5 miles) and Sassandra (16 miles). According to Le Loeuf and Intès (1968 and 1969), the slope is mostly regular, being between 0.5 and 0.9%. The break of the shelf is sometimes characterised by rock outcroppings (sandstone) where deep coral masses are found.

Nature and rate of utilisation: Different kinds of activities are conducted in the region concerned, particularly agriculture [industrial crops of oil palms, coconut palms, rubber seed oil, pineapples, banana trees (sweet bananas), food crops of manioc, banana trees, etc.], energy operation (thermal electric plant in Azito), wood logging, sand extraction and filling, industry [oil and gas refinery, food, leather tannery, etc.]. There are also large facilities, such as the Port Authority of Abidjan and of San Pedro, the "coastal" road as it is called in Cote d'Ivoire, which crosses the entire country from east to west, oil and gas development structures on the continental shelf, bridges (Félix Houphouet Boigny bridge and Général de Gaule bridge, etc.) and especially where major cities are found, such as Abidjan, the economic capital of Cote d'Ivoire and cities such as San-Pedro (port city), Grand-Lahou, Sassandra, Grand-Bassam (second largest capital of the country during colonial times) and finally, fishing activies are also conducted.

The Ivorian coast is indeed sought after for the conducting of all the above-mentioned activities, and mainly for future activities. The country's coast offers significant mining opportunity and for this reason, many projects are in the pipeline, for instance, a third bridge and the extension of the Port of Abidjan.

2. Extent of information on the biological diversity of the coastal and marginal-coastal areas in Cote d'Ivoire.

Table 1 features the number of plant and animal species found in the coastal and marginal-coastal areas of Cote d'Ivoire.

Table 1. Biological diversity of the coastal and marginal-coastal areas in Cote d'Ivoire

Taxons	Number		Observations
	In the world (*)	Cote d'Ivoire	
Microphytes	7000	1241	Some work
Macrophytes	Unspecified	327	Some work
Bacteria	10 000	140	Some work
Zooplankton	Unspecified	Many species indicated	Some work
Cnidaria (Polyp and jellyfish)	3100 of which 200 are hydrozoans	Some species indicated	No work
Ctenophores (Sea cucumbers)	90	Some species indicated	No work
Platyhelminthes	15 000	Some species indicated	No work
Nemerteans	900	Some species indicated	No work
Gnathostomulide	80	Not indicated	No work
Gastrotricha	400	Not indicated	No work
Rotifera	2000 dont 50 marins	Some species indicated	No work
Kinorhynche	150	Not indicated	No work
Loricifers	10	Not indicated	No work
Acanthocephala	600	Not indicated	No work
Entoprocta	150	Not indicated	No work
Nematoda	80 000	Some species indicated	No work
Nematophores	240	Not indicated	No work
Ectoprocts	5000 of which 50 are marine	Not indicated	No work
Brachiopods	335	Some species indicated	Scattered work
Molluscs Gastropods Clamshells Cephalopods	110 000	581 246 186 110	Work available Some work Some work Some work
Siphoncules	300	Not indicated	No work
Echiurians	140	Not indicated	No work
Annelids Oligochaete Hirudineans Polychaetes	 3100 300 5400	 99 99 434	 Scattered work No work Available work
Arthropods Crustaceans Aquatic insects	Unspecified 350 000 Unspecified	 302 Unspecified	 Scattered work
Paganophores	100	Not indicated	No work
Echinodermes	6000	Some species indicated	No work
Chaetognaths	100	Some species indicated	Scattered work
Fish (bony)	25 000		Work available
Amphibians	2000	Some species indicated	Scattered work
Reptiles	5000	Some species indicated	Scattered work
Birds	9000	Some species indicated	Scattered work
Mammals	45 000	Some species indicated	Scattered work

[(*) Margulis and Schwartz, 1988)] Remark: Introduced species should be added to these figures.

The table reveals that significant work remains to be done in order to determine the biological diversity of the coastal and marginal-coastal areas in Cote d'Ivoire.

3. Extent of information on the biological diversity of exotic and invasive aquatic plant species

3.1 General points and inventory of species

The floating plants found in African waters include almost all the families in the fresh water of Gulf of Guinea countries, especially eleven plant species (Table 2): *R. fluitans, A. africana, S. nymphellula, S. molesta, C. cornuta, P. Striatiotes, E. crassipes, Lemna* sp., *Spirodela* sp., *Wolfia* sp., and *Wolffiella* sp.

Two families of fern, Azollaceae and Salviniaceae, and one family of flowering plants, the lemnaceae, consist of species that are specifically plants that float freely on the surface of aquatic environments, although the lemnaceae includes species that also live under water.

Apart from these families, there are very few plant species that float freely on the water surface because most species generally belong to other life forms in the aquatic environment. *Eicchornia crassipes*, for instance, is the only species of the family of pontederiaceae that floats freely on the water.

The main freely floating invasive alien aquatic plants are *Pistia stratiotes* (Araceae), *Salvinia molesta* (Salviniaceae) and *Eichhornia crassipes* (Pontederiaceae).

Table 3 features the overview of the invasion of certain aquatic environments in Gulf of Guinea countries by *Pistia stratiotes, Salvinia molesta* and *Eicchornia crassipes*. These plants seem to shift from east to west. In Cote d'Ivoire, CRO (1992) made the assumption that floating plants, particularly *Salvinia molesta,* were introduced by horticulturists into the Bassam region during the 1980's. This species experienced a boom in 1984 and then were progressively replaced and displaced by the water hyacinth *Eicchornia crassipes* between 1985 and 1986. This species then progressively invaded all the county's aquatic ecosystems.

Table 2. The main floating plants found in African waters *(Mitchell, 1985)*

Floating plants	Distribution in Africa
Bryophytes	
Ricciaceae	
Riccia fluitans L.	Throughout Africa
Ricciocarpus natans (L.) Corda	Tropical and subtropical Africa
Pterydophytes	
Azollaceae	
Azolla pinnata R. Br. Var. africana (Desv) Bak.	Throughout Africa
Azolla nilotica Decne ex Mett. (e)*	Subtropical and tropical east Africa
Azolla filiculoides Lam. (a)**	South Africa
Salviniaceae	
Salvinia nymphellula Desv. (e)*	Tropical west Africa
Salvinia hastata Desv (e) *	Subtropical and tropical east
Salvinia molesta D.S. Mitchell (a)**	Tropical and subtropical Africa
Parkeriaceae	
Ceratopteris cornuta (Beauv.) Lepr.	Tropical and subtropical Africa
Ceratopteris thalictroides (L.) Brongn.	Mauritius
Ceratopteris richardi Brongn.	Tropical and subtropical Africa
Anthophyta	
Araceae	
Pistia striatiotes L.	Tropical and subtropical Africa
Pontederiaceae	
Eicchornia crassipes (Mart.) Solms-Laub. (a)**	Tropical and subtropical Africa
Lemnaceae	
Lemna spp.	Throughout Africa
Spirodela spp.	Throughout Africa
Wolfia spp.	Throughout Africa
Wolffiella spp.	Throughout Africa

***e = endemic to Africa **a = introducted plants**

Table 3. The detection of *P. stratiotes, E. crassipes* and *S.* in certain waters of Gulf of Guinea countries and in Africa.

Country	Aquatic environments	Years	Authors
Pistia stratiotes			
Cote d'Ivoire	Agneby	1933	Portère 1950 and 1951
Cote d'Ivoire	Ayamé	1970	Sankaré et al. 1986
Cote d'Ivoire	Kossou	1972	Mullighan 1972
Cote d'Ivoire	Comoé	1983	Guiral et al. 1992
Salvinia molesta			
Zimbabwe		1959	Mitchell, 1972
Kenya		1976	Gaudet, 1976
Congo		1965	Little, 1965
Ghana	Lake Volta	1980	Okera, Com. Pers.
Cote d'Ivoire	Ono Lagoon	1983	Guiral et al., 1992
Eicchornia crassipes		1950	Tackhom and Drar, 1950
Egypt		1955	Dubois, 1955 and Robyns, 1956
Zaïre		1956	Wild (1956)
Zimbabwe		1958	Mendonca, 1958
Mozambique		1958	Mendonca, 1958
Angola		1965	Little
Senegal		1976	Robson, 1976
Mauritius		1959-1979	Jacot, 1979 and Scott et al. 1979
South Africa		1985	Oso, 1988
Benin		1985	Oso, 1988
Nigeria		1985	Okera, com. Pers
Ghana	Ono Lagoon	1986	CRO, 1992
Cote d'Ivoire			

4. Extent of information on the biological diversity of exotic and invasive alien aquatic animal species

Introductions of aquatic animal species were often encouraged in Africa, particularly in Gulf of Guinea countries, mainly for the purposes of improving production and of contributing towards satisfying the population's increasing demand for animal protein.
These introductions are the subject of controversy between developers/policy-makers/business leaders and scientists. In the opinion of the first group, nature and populations have to be assisted and the introduction of species to improve production is justified. But according to the scientists, all introductions are, in principle, liable to cause irreversible damage to flora and fauna, and to local aquatic ecosystems.

Introductions of species are either voluntary or involuntary (accidental). In the first case, introduction is based on specific aims and mainly concern three levels of intervention:

- the transplantation or the transfer of species from one point to another within the same ecosystem;
- the introduction of species foreign to the ecosystem but from the same biogeographical area;
- and finally, the introduction of species from biogeographically different areas, and even from different continents.

Involuntary introduction, which involves the same levels as above and is characterised by the absence of a specific aim, consists of several methods or means of introduction, the main ones being associated with, for instance, the wind, surface water, animals (birds) and modern means of transport (boats and cars).

The aims of **voluntary introductions** of aquatic species into Gulf of Guinea countries are diverse and can be summarised as follows, in order of their importance:

- Aquaculture;
- Productivity improvement;
- Biological control;
- Crops and unknown aims.
-

4.1 Invasive alien local fauna attached to roots of aquatic macrophytes

The development and proliferation of freely floating macrophytes in almost all the aquatic networks in Gulf of Guinea countries are accompanied by a new form of introduction and transfer of aquatic species: the introduction of animals attached to roots of plants. Also, interest in this fauna has been renewed because the existence of exotic animals is suspected, the proliferation of which may be negative for local populations.

*** Gastropod molluscs**

Gastropod molluscs are characterised by a sinistral shell. There are 7 species of bulinus in West Africa, namely: *Bulinus globosus* (Morelet), *Bulinus Jousseamei* (Dautzenberg), *Bulinus truncatus* Rohlfsi (Clessin), *Bulinus guernei* (Dautzenberg), *Bulinus umbilicatus* (Mandahl-Barth), *Bulinus forskalii* (Ehrenberg) and *Bulinus senegalensis* (Müller). The species *B. dyboski* and *B trigonus* were made synonymous with *Bulinus truncatus*. Finally, the bulinus species, whose role in the transmission of *Schistosoma haematobium* has been confirmed in West Africa are *B. globosus*, *B. truncatus*, *B. guerni*, *B jousseaumei*, *B. senegalensis* and *B. umbilicatus*.

Two species of *Biomphalaria* (Planorbidae): *Biomphalaria pfeifferi* (Krauss) and *Biomphalaria sudanica* (Martens) and one species of *Physa* (*Physa marmorata*) are also found in West Africa and are involved in the transmission of *Schistosoma mansoni.* The population of these gastropod molluscs increases in the presence of floating plants and dominate numercially in almost all the biotopes.

*** Bloodsucking diptera insects**

Many bloodsucking diptera insects, particularly mosquitos or culicidae (3 genera *Anopheles – Aedes – Culex* and 25 species), the Culicoides (2 genera and 2 species including *Bezzia pistiae*), Tabanids (3 sub-families, 8 genera and 46 species) also proliferate in the presence of free floating aquatic macrophytes.

*** Skimmers**

During the course of a recent study we conducted, we noted an increase in skimmer populations in Ivorian aquatic environments. This increase is reflected at the numerical and specific level, thus, 7 families, 46 genera, and 99 species were able to be collected. The species found are often detected for the first time in the sites examined.

4.2 Invasive alien fauna

*** Involuntarily introduced invasive alien exotic fauna**

To date, the inventory has revealed three taxonomic groups that were introduced involuntarily: Gastropod mollusc (*Bulinus camerunensis and Potamopyrgus cilliatus, Physa acuta, Lymnae columella and Helisoma sp*), Diptera (two Lepidoptera pyralidae not yet linked to the species), Amphipod crustaceans (*Gammarus* sp, Gammaridae not yet linked to the species). These species were detected for the first time in Ivorian waters and were found attached to the roots of floating plants.

*** Voluntarily introduced invasive alien exotic fauna**

For the purposes of biologically controlling floating plants, the Ivorian government authorised the introduction of phytophagus insects. These insects specifically attack floating plants and were introduced into Ivorian waters during the 1990's:

Cyrtobagous salviniae (beetle);
Neochetina bruchi (beetle);
Neochetina eicchorniae (beetle);
Neochetina affinis (beetle);

All these insects are originally from South America and most of them were obtained from Benin and South Africa. They were quarantined, mass reproduced and introduced into the country's water bodies in order to biologically control floating plants.

4.3. The specific case of introduced and invasive alien prawns and fish

*** The specific case of the *Penaeus monodon* prawn**

Introduced and invasive alien aquatic invertebrates have not often been the focus of attention of scientists. However, the giant prawn has recently been introduced.

The giant prawn *Penaeus monodon*, Fabricius (Crustacea, Peneidae) originally comes from the western regions of the Pacific and was introduced into the Ivorian waters (Grand-Lahou) during the 1990's. The aim of the introduction of the giant prawn, organised by a private local structure, was to develop shrimp farming and to sell individuals on the interntional market. Work was interrupted due to problems of reproduction and water quality, but certain specimens were found in natural environments and are regularly caught by populations living along river banks.

*** The specific case of fish**

Improvement of productivity

In order to satisfy the different needs of the population, many barrier lakes were created. For instance, there were more than 500 barrier lakes created in Cote d'Ivoire between 1958 and 2000. These reservoirs consist of hydroelectric barrier lakes, mixed farming lakes, tourist lakes and service reservoirs (consumption, etc.) River species that prefer stream water are not often able to develop in these environments. Thus, the absence of animals occupying these new ecological recesses or their under-development by local species present, justified the introduction of numerous species. It is for this reason that, for instance, species such as *Heterotis niloticus* and *Oreochromis niloticus* were introduced into lake Kossou in Cote d'Ivoire, with the aim of promoting the lake's colonisation by fish that were more suitable to lacustral conditions and mainly, of increasing the volume of catches.

Tilapias (*Oreochromis* sp. and *Sarotherodon* sp.) are very good colonising species on account of their biological characteristics (species displaying parental care), of their high physiological tolerance and of their ability to feed off algae and detritus, which are resources that are often badly exploited in many barrier lakes. In Gulf of Guinea countries, they were introduced into many small mixed farming reservoirs. These fish currently make up from about 40 % to 80 % of traditional fishing in inland waters.

Biological control

The creation of numerous barrier lakes contributed towards modifying the hydro-dynamics of many bodies of water in Gulf of Guinea countries. These modifications certainly caused the proliferation of aquatic plants, numerous harmful aquatic invertebrates and also the multiplication of many undesirable fish. In the latter case, undesirable cultured fish should also be added. Certain fish species were then introduced into the aquatic environments of Gulf of Guinea countries in order to biologically control these nuisances. Species such as *Gambusia affinis* or *Poecilia reticulata* were used in different Gulf of Guinea regions to try and control malaria-carrying mosquitos. For the same reason, it was also recommended that Cichlidae malacophage *Astatoreochromis alluaudi*, from East Africa, be used to control bilharzia carriers and particularly, Gastropod Molluscs *Bulinus* sp and *Biomphalaria* sp. Finally, fish such as *Ctenopharyngodon idella* and *Tilapia rendalli*, which were introduced mainly for purposes of aquaculture, were also used to control certain invasive alien aquatic plants. Finally, in order to control the production of fish-farming (case of Tilapias) the predatory species *Lates niloticus* and *Clarias lazera* were introduced into certain environments in Gulf of Guinea countries.

Culture

For trivial reasons, for instance, the nostalgia for certain populations to reintroduce fauna into their immediate environment, species were transferred and even introduced into certain Gulf of Guinea countries. This is the case of cat fish *Hetrobranchus longifilis* from certain sacred waters and the plant *Cyperus alopecuroides* which were introduced, for example, into the Bouaké region by Burkinabé peasants. These peasants grow vegetables on the banks of reservoirs and the plant is very abundant on the lakes of Burkina Faso.

In addition, for purposes of food and traditional medicine, certain coastal populations contribute to the transfer of aquatic species. Finally, aquatic species are introduced and transferred for experimentation purposes.

First according to Welcomme (1988), and then to Satia and Bartley (1997), approximately 430 introductions and transferts of aquatic species were made during the course of the last 150 years worldwide. Only 139 species belonging to 87 genera and 46 families of fish were introduced into the aquatic ecosystems of 42 African countries between 1920 and 1970.

In reality, according to Lévèque (1999), only slightly more than 20 species of fish from other continents were introduced into Africa, particularly into North Africa, South Africa and Madagascar. In Gulf of Guinea countries, only about twenty introduced or transferred species were recorded.

Table 4a: Species of fish introduced voluntarily into the aquatic environments (brackish and fresh) of Gulf of Guinea countries.

Species	Countries of destination	Origin	Year	Aims	Sources
Same continent and same geographic area					
Heterotis niloticus	Cote d'Ivoire	Cameroon	1958	Aquaculture, traditional fishing	Moreau et al., 1988
Heterotis niloticus	Cameroon	Gabon	1955	Aquaculture	Moreau et al., 1988
Heterotis niloticus	Congo	Zaïre	1966	Aquaculture	Moreau et al., 1988
Oreochromis macrochir	Cote d'Ivoire	Cameroon	1957	Aquaculture	Lazard, 1990
Oreochromis macrochir	Ghana	Kenya	1962	Aquaculture	Welcomme, 1988
Oreochromis mossambicus	Benin	Cote d'Ivoire	1984	Lagoon aquaculture	Lazard, 1990
Oreochromis niloticus	Cote d'Ivoire	Burkina	1957	Aquaculture and traditional fishing	Welcomme, 1988 Lazard, 1990
Oreochromis niloticus	Cote d'Ivoire	Egypt	1988	Aquaculture and traditional fishing	Welcomme, 1988 Lazard, 1990
Oreochromis niloticus	Sierra Leone	Ghana (Volta)	1978	Aquaculture	Welcomme, 1988
Oreochromis niloticus	Benin	Cote d'Ivoire	1979	Aquaculture	Lazard, 1990
Oreochromis mosambicus	Benin	Cote d'Ivoire	1979	Aquaculture	Lazard, 1990
Oreochromis spirulus	Benin	Kenya	1986	Aquaculture	Lazard, 1990

Table 4b: Species of fish introduced voluntarily into the aquatic environments (brackish and fresh) of Gulf of Guinea countries.

Same continent and different geographical area					
Oreochromis mossambicus	Cote d'Ivoire	Mozambique	1982	Lagoon aquaculture	Lazard, 1990
Oreochromis niloticus	Cote d'Ivoire	Ouganda	1968	Aquaculture and traditional fishing	Welcomme, 1988 Lazard, 1990
Astatorechromis alluaudi	Cote d'Ivoire	Uganda	1973	Mollusc control	Lazard, 1990
Clarias lazera	Cote d'Ivoire	Central African Republic	1973	Experimentation	Moreau et al., 1988
Clarias gariepinus	Cote d'Ivoire	Central African Republic	1973	Aquaculture	Welcomme, 1988
Clarias lazera	Cameroon	Central African Republic	1972	Biological control	Moreau et al., 1988
Tilapia rendali	Cote d'Ivoire	Zaïre	1957	Aquaculture	Lazard, 1990
Tilapia rendali	Liberia	Zaïre	1960	Aquaculture, fishing	Lazard, 1990
Lates niloticus	Mali	Morocco	1954	Traditional fishing	Moreau et al., 1988
Tilapia zilii	Cote d'Ivoire	Congo	1957	Aquaculture	Welcomme, 1988
Different geographical area					
Ctenopharyngodon idella	Cote d'Ivoire	Austria	1979	Plant control, small dams	Welcomme, 1988
Cyprinus carpio	Cote d'Ivoire	Austria	1976	Aquaculture	Welcomme, 1988
Cyprinus carpio	Ghana	Unspecified	1962	Unspecified	Moreau et al., 1988
Cyprinus carpio	Nigeria	Austria/Israel	1954-1976	Aquaculture	Welcomme, 1988
Cyprinus carpio	Nigeria	Israel and USA	1954 and 1976	Experimentation	Moreau et al., 1988

Table 4c: Species of fish introduced voluntarily into the aquatic environments (brackish and fresh) of Gulf of Guinea countries.

Different geographical area (continuation and end)					
Cyprinus carpio	Togo	Israel	1965-71	Aquaculture	Moreau et al., 1988
Gambusia affinis	Cote d'Ivoire			Mosquito control	
Gambusia affinis	Ghana			Mosquito control	
Gambusia affinis	Nigeria	England	1972	Aquaculture	Moreau et al., 1988
Ictalurus punctatus	Nigeria	USA	1970-1976	Aquaculture	Welcomme, 1988
Oreochromis aureus	Cote d'Ivoire	Israel-Egypt	1981-1988	Lagoon aquaculture	Lazard, 1990
O. urolepis hornorum	Cote d'Ivoire	Malasia USA	1967-1982	Aquaculture	Welcomme, 1988 Lazard, 1990
O. urolepis hornorum	Benin	Brazil	1972	Aquaculture	Lazard, 1990
Osphonemus goramy	Cote d'Ivoire	Singapore	1957	Aquaculture	Welcomme, 1988
Micropterus salmoides	Cameroon	France	1956	Experimentation	Moreau et al., 1988
Micropterus salmoides	Nigeria	USA	1976	Biological control	Moreau et al., 1988

Potentially invasive alien introduced species

All species that are introduced or transferred are potentially invasive. However, many voluntary introduction activities were interrupted through lack of experience because they were unplanned and were not based on ecological principles. As a result, certain introduced fish or invertebrate populations were reduced until the species became extinct. This is certainly the cases of *Cyprinus carpio* and *Gambusia affinis* in Cote d'Ivoire, etc.

Invasive alien introduced species

Invasive alien introduced species are characterised according to Holcik (1991) by good naturalisation and are found outside of their point of introduction. According to this definition, invasive alien species are summarised in Table 5.

Inventory of activity programmes on invasive alien species: Management and awareness.

Large marine ecosystems in Gulf of Guinea countries

The aims of the project are (1) to determine and manage the ecosystem pollution in Gulf of Guinea countries; (2) to protect human health (3) to provide living resources on a lasting basis; (4) to rediscover biological diversity; (5) to acquire fishing ressources for human nutrition; (6) to promote the regionalisation of data collection and of the exchange of marine information; (7) to develop marine environment management skills; (8) to establish socio-economic bases for development purposes.

Six countries (Cote d'Ivoire, Ghana, Togo, Benin, Nigeria and Cameroon) are involved in the project which is financed by UNDP/GEF (6 million US dollars) and is run by UNIDO. The project runs for four years and its Regional Centre is based in Abidjan at the *Centre de Recherches Océanologiques*.

Table 5. Inventory of invasive alien introduced specieses.

Species	Distribution		
	Area of origin	Area of introduction	Area of invasion
1. Astatorechromis alluaudi	Uganda	Small artificial lakes, bodies of water and lagoons	Humid areas (fresh and brackish water)
2. Clarias lazera	?		
3. Clarias gariepinus	?		
4. Ctenapharyngodon idella	China -Siberia		
5. Cyprinus carpio	Japan– China-Asia		
6. Gambusia affinis	USA-Mexico		
7. Heterotis niloticus	Senegal-Niger		
8. Oreochromis aureus	Nile-Niger		
9. Oreochromis macrochir	Zambezi		
10. Oreochromis mossambicus	Zambezi		
11. Oreochromis niloticus	Nile Israel		
12. Oreochromis spilurus	Kenya-Somalia		
13. O. urolepis hornorum	Tanzania		
14. *Ictalurus punctatus*	USA		
15. *Lates niloticus*	Nile-Niger		
16. *Micropterus salmoides*	USA-Mexico		
17. Osphonemus goramy	?		
18. Tilapia zillii,	West and Central Africa		
19. *Tilapia rendali*	West and Central Africa Asia		

Ecological and economic impacts are to be added

Invasive alien floating plants project

Bodies of water have been invaded since the 1980's by free floating macrophytes: *Eicchornia crassipes*, *Salvinia molesta* and *Pistia stratiotes*, which cause many problems (eutrophication, fish mortality, loss of biological diversity, illness, reduced purchase power of coastal populations, etc). In order to remedy this situation, a project to control these plants was initiated and financed by UNDP/GEF, and carried out by the *Centre Ivoirien Anti-Pollution* (CIAPOL) [Ivorian anti-pollution centre]. It consists of several themes of activity, the main ones being biological control through the use of exotic insects which specifically graze on these plants, biological diversity through the monitoring of key benthic and ichthyological species, socio-economic aspects associated with the presence of floating plants and finally, the integrated management of catchment areas.

Centre de Recherches Océanologiques [oceanological research centre] research programmes

The *Département des Ressources Aquatiques Vivantes* (DRAV) [living aquatic resource department], is conducting several research programmes on living resources. These programmes consist of the monitoring of biological diversity, which include invasive species. These are:

- The non-consumptive utilisation of tuna resources
- The non-consumptive utilisation of coastal marine resources
- The non-consumptive utilisation of lagoon resources

In addition to these ongoing programmes, there are sometimes others that run for a specific time according to outside demand, in order to resolve problems that may arise. It is within this framework that IRD and the CRO have just run two programmes of mutual interest which they created and implemented. These are, for example, the *Programme de Production Induite en Zone de Convergence par les Ondes Longues Océaniques* (PICOLO).

The aim of the PICOLO project is to understand and to model the physical and biological processes that would explain seasonal concentrations of tuna in a region located outside the known large oceanic enrichment systems. In fact, there have been significant seasonal catches of different tuna species - listao (*Katsuwonus pelamis*), albacore (*Thunnus albacares*) and patudo (*Thunnus obesus*) – by means of seines for the last fifteen years in this area of the equatorial Atlantic. But this type of fishing remains unexplained from the point of view of primary productivity in an area that has been seen as biologically deficient up to now.

Similarly, the department of the environment is conducting research programmes to understand how aquatic systems function. In this context, a study was developed, based on the knowledge of the functioning of lagoon ecosystems and on the extent to which pollution and invasive alien plants disrupt these environments. A programme called “Pollutions lagunaire et marine” [lagoon and marine pollution] is thus currently being run.

In turn, the department of aquaculture is conducting genetic studies that make it possible to specify the systematics and the distribution of aquaculturally significant species. Finally, other national structures, such as universities, are also conducting work in aquatic environments towards drawing up an inventory of fresh water species and characterising them.

List of governmental structures, non-governmental organisations and agencies involved or that could be involved in the management of invasive alien exotic species.

	Characteristics of the institutions		
Scientific institution	**Type**	**Collection**	**Observations**
Centre de Recherches Océanologiques	Scientific research in oceanology, brackish and fresh water	-Fish -Benthos (collection kept by the IRD) and – aquatic entomofauna	Former collection and set up of a new collection
Université de Cocody	Scientific research on fresh water	Fish and crustaceans	**New collection**
Université d’Abobo-Adjamé	Scientific research on fresh water	Poissons	New collection

Table to be completed with the other structures

Priority action and strategies towards identifying management priorities and recommendations

In this chapter, we will summarise Cote d’Ivoire’s "environmental philosophy" as far as possible in terms of needs, projects, etc. in the global areas of the environment and in particular, in terms of invasive alien species.

Problems

With its steady growth since 1994, Cote d’Ivoire is faced with the significant challenge of consolidating its economic recovery while integrating it closely with environmental issues.

Indeed, in order to be lasting and qualitative, the promotion of a strong growth policy, based on the accelerated development of industry, on mining mineral and energy development and on the increase in farming production, requires the appropriate and effective handling of the environmental problems faced by Ivorian populations.

These problems are identified in the *Livre Blanc de l'Environnement* (white paper), and concern:

- The rapid loss of wetlands, which results in the loss of biodiversity (out of the 232 species of mammals recorded in Cote d'Ivoire, 25 are classified as rare or threatened);
- The degradation in the quality of water and its overexploitation, associated with the absence of an integrated management of available resources;
- The degradation of the urban enviroment (air pollution, liquid and solid waste);
- Industrial pollution mainly in Abidjan, where pollutant waste is esimated at 100 000 tons of industrial waste per year, of which 7 000 tons is dangerous waste (paint, varnish, glue, manufacture of agro-pharmaceutical products, surface treatment, petroleum refining, manufacture of electric batteries, acetylene, textile, metal recovery);
- Coastal erosion (which is reflected in certain parts of the coast by retreats of 3 metres annually;
- The pollution of sea and lagoon water by industrial waste water and organic matter, and the invasion of bodies of water by floating aquatic plants;

These environmental problems are accompanied by the following restrictions:

- Poor management skills in urban as well as in rural areas where poverty, the lack of training and insufficent basic services accentuate pressure on the environment;
- The considerable gap between the rate at which natural resources are used up and the rate of their replenishment, which is associated with rapid demographic growth (300 000 ha/year of deforestation occurs as opposed to only 5 000 ha/year of forestation;
- The exclusion of the environment of wetlands in teaching programmes, training and research and its insufficient consideration in teaching programmes and training;
- The absence of an environmental - wetlands section in development programmes and projects.

At the institutional and legal level, certain regulations remain outdated and are thus unsuitable. Similarly, certain sectors are supplied with legal provisions and others are not.

Large-scale initiatives of environmental policy

In order to deal with the environmental problems associated with wetlands and with identified restrictions, the government has set out three **main objectives**.

a. to promote the lasting development of natual resources and to manage them rationally;
b. to protect the heritage of biodiversity;
c. and to improve the life environment of coastal and riverside populations.

These three main goals can only be reached if the obstacles preventing the setting up of a true mechanism of lasting development are lifted. This implies:

a. the improvement of the institutional, legal and regulatory framework;
b. the development of human resources and research;
c. and the setting up of a national environment information and monitoring system for the wetlands;

The strategy of intervention will consist of both a participatory and a regional approach:

a. participatory approach: the environmental action will be based on joint decisions. It will take the recommendations of target groups into consideration and if possible, involve them in the action, which will best guarantee their subscribing to the objective and their acceptance of methods. This approach will reinforce the role of participants in the different areas of the environment: women, children, farmers, scientific organisations, NGO's, religious communities and traditional chiefdoms, which are just as essential to the action of public authorities (government or local government).

b. regional approach: this aims at bringing about responses that take regional specificities into consideration. It assumes that the institutional framework is suitable for a decentralised action, by giving local participants the power they need to intiative the action.

The implementation of the Plan of Action, approved by the cabinet on 13 December 1995, is based on a coherent set of priority actions to be undertaken.

The main programmes concerning aquatic environments are:

The management of human settlements: actions specified by the government towards improving the quality of life in the urban areas neighbouring the wetlands involve the strengthening of efforts undertaken by community leaders to clean up unsanitary areas. This goal will be reached mainly by reducing production, improving refuse collection, beautifying the landscape and improving housing.

The main objective in rural areas is to improve the living environment by promoting the involvement of populations in environment management. In order to accomplish this objective, the government will strenghthen its local managerial know-how by improving the coordination and financing of basic services that are responsible for developing resources in terms of water, energy, rural trails, health, housing and education.

The management of coastal space. This is a rich ecosystem but is exposed to serious environmental problems. This area will receive significant treatment including the management of coastal erosion, the control of hydrocarbon pollution, development work consisting of the clean-up of beaches, the protection of tourist sites and the improvement of the living conditions of coastal populations.

The control of pollution and industrial nuisances will be conducted by strengthening and coordinating actions towards a more effective policy. These actions will involve limiting industrial and home industry nuisances, controlling the atmospheric pollution generated by vehicles in the urban area of Abidjan, preventing pollution associated with the use of phytosanitary products, and managing medical and biomedical waste.

Integrated water management: The aim of this programme is to make a coordinated management of water possible on the national as well as on the transnational level through the rational and planned use of water resources and through the control of pollution sources.

The improvement of energy resource management: these programmes aim to satisfy energy needs but without harming the environment, particularly by accelerating the transition between methods of power consumption, improving the management of firewood and developing new and renewable energy.

Research, education, training and awareness towards preserving the environment and the lasting management of natural resources will constitute a central axis of government policy. Eight actions will form the foundation of this programme: the creation of research structures and the prioritisation of thematic programmes; the strengthening of institutions responsible for training environmental trainers and managers; the creation of branches for the training of environmental technicians and officers; the strengthening of training and facilitating structures directed at women and children; the strengthening of the capacities of NGOs in order to allow them to effectively train and support populations; the development of information and awareness campaigns in the various administrative regions through the appropriate use of local languages, cultures, religions and media reports; the training of environmentalists in classified facilities

towards a better understanding of environmental problems within companies; the setting up of a national committee for the integration of the environmental dimension in school programmes, from pre-school to university education.

Environmental information will be managed in an integrated manner through the setting up of a coordinated environmental information system.

Finally, **the improvement of institutional, legal and regulatory frameworks**: the government expressed its wish to remove the obstacle constituted by the inadequacy and shortage of regulatory and legal documents as well as institutional deficiencies observed in terms of government policy coordination.

Inventory and details of Ivorian experts working in the area of invasive alien species

Human resources

Surnames and given names	Area of specialisation	Structure	Address
Ama Antoinette Adingra	Bacteria	Centre de Recherches Océanologiques [oceanological research centre]	BPV 18 Abidjan
Amon Kothias Jean Baptiste	Fish	Centre de Recherches Océanologiques	BPV 18 Abidjan
Atse Boua Celestin	Aquaculture	Centre de Recherches Océanologiques	BPV 18 Abidjan
Jean-Baptiste Louis François	Aquaculture	Centre National de Recherche Agronomique [national agricultural research centre]	Bouaké 633
Doumini Bouberi	Fish	Centre de Recherches Océanologiques	BPV 18 Abidjan
Da Costa Sebastino	Fish	Centre National de Recherche Agronomique	Bouaké 633
Da Kouete Philippe	Algae	Université de Cocody	Abidjan
Etien N'DA	Environmentalist	Agence National de L'Environnement [national environment agency]	Abidjan
Egnankou Wadja	Mangroves and aquatic plants	Université de Cocody	Abidjan
Goore BI	Crustaceans	Université de Cocody	Abidjan
Gourène K.	Fish	Université d'Abobo Adjamé	Abidjan
Hie Daré Jean-Pierre	Fish	Centre de Recherches Océanologiques	BPV 18 Abidjan
Konan Amoin Annabelle	Phytobenthos	Centre de Recherches Océanologiques	BPV 18 Abidjan
Kouassi Aka Marcel	Bacteria	Centre de Recherches Océanologiques	BPV 18 Abidjan
N'Goran Ya Nestor	Biology of fish	Centre de Recherches Océanologiques	BPV 18 Abidjan
N'Douba Valentin	Zooplankton	Université de Cocody	Abidjan
Otémé Ziriga	Aquaculture	Centre National de Recherche Agronomique	Bouaké 633
Tidou Abiba	Zooplankton	Université Abob-Adjamé RCI	Abidjan
Traoré Kassoum	Fish	Centre Nationale de Recherche Agronomique	1740 Abidjan 01
Traoré Dossahoua	Aquatic macrophytes	Université de Cocody	Abidjan
Sankaré Yacouba	Benthos and aquatic entomofauna	Centre de Recherches Océanologiques	BPV 18 Abidjan

Surnames and given names	Area of specialisation	Structure	Address
Zabi S. Guillaume	Benthos	Centre de Recherches Océanologiques	BPV 18 Abidjan
Wongbe Yte	Zooplankton	Centre National de Recherche Agronomique	Man 440
Abouo Béatrice Adepo	Fish	Université Abobo-Adjamé RCI	Abidjan

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Current needs for the management of invasive alien species

Priorities (in terms of needs) of the environmental policy for invasive alien species during the next few years were specified and divided into two spheres of activity:

The problematic areas requiring research or training work are summarised in the table below:

Projects	**Players**
National action underway and anticipation of outside financial support	
a. **Invasive alien aquatic plants**. The project involves the CI	UNDP/GE, carried out by the CIAPOL
b. **Scientific bulletin**. edited by the Centre de Recherches Océanologiques (Ivorian journal of oceanology and limnology) and coordination and extension bulletin..	Ivorian budget, carried out by the CRO
c. **Inventory of sea, lagoon and fresh water organisms**	Ivorian budget, carried out by the CRO
d. **Monitoring of certain aquatic organisms** found in lagoon waters	Ivorian budget, carried out by the CRO
e. **Monitoring of certain aquatic organisms found in fresh water**.	Ivorian or Belgian budget, carried out by the Université de Cocody (UC) and the Université d'Abobo-Adjamé
f. **Promotion and enhancement** of certain aquatic organisms through aquaculture	Ivorian budget, carried out by the CRO, the CNRA and the Université de Cocody
g. **Creation of an information and data management centre**.	Ivorian budget, carried out by the CRO
h. **Strengthening of the intervention capabilities of institutions**.	Ivorian and other budgets
i. **Taining**	Ivorian or Belgian budget, carried out by the Université de Cocody (UC) and the Université d'Abobo-Adjamé.

Projects	**Players**
New national action	
a. **Creation of a permanent department for the monitoring and coordination of activities on invasive alien species**.	Ivorian budget, carried out by the CRO
b. **Raising of awareness among the people and educating them**.	Ivorian budget, carried out by the CRO
c. **Setting up of an inter- and intra- monitoring network and an information management system for invasive alien species**.	Ivorian budget, carried out by the CRO
d. **Support measures for legislation and regulation**.	Ivorian budget, carried out by the CRO

APPENDIX 14: Country Report on Invasive Alien Species in Gambia

Dr Musa Bojang, Director General, National Agricultural Research Institute, P.M.B. 526 Serekunda, Gambia.

The Gambia is a narrow strip of land of about 440km in length and 50km wide at its end on the Atlantic Ocean. It is surrounded by the republic of Senegal on all sides except the short seaboard bordering on the Atlantic Ocean. The country has a total surface area of about 11,147km² and a human population of about 1.5 million inhabitants. With rapid demographic growth, driven by declining mortality and more recently by immigration influx, total population increased from about 400,000 persons in 1965 to about 1,5 million inhabitants by 2003. The population growth rate is estimated at 4.2% per annum. The population density increased six-fold since the 1950s to its current level of 96 persons per km² which is among the highest in the region.

The country lies within the Sahelian Zone and experiences a climate which is predominantly sub-tropical with a long dry season (November – June). Since the inception of the major Sahelian drought in the early 1970s, the annual average rainfall declined from 1100mm to less than 800 mm resulting partly in the poor performance of the agricultural sector and the degradation of native vegetation resulting to changes in species composition of ecosystems. Although The Gambia is a very small country, it has a wealth of biological diversity. It has different types of ecosystems, including close woodlands, open woodland, tree and shrub Savannah, wetland ecosystems, marine and coastal ecosystems and agricultural (crop land and rangeland ecosystems). The Country has several protected areas, which promote in-situ conservation. These include six national parks and nature reserves covering a total land area of about 39,772 ha i.e. about 3.7% of The Gambia's land area and there are plans to extend this to at least 5% including representative samples of all major habitats that need to be protected. There are sixty-six forest parks with a total area of 32,000 ha.

Most of the invasive species in The Gambia are weeds mainly from the Cyperaceae Compositae and Gramineae families as follows:

Common Name	**Scientific Name**	**Family**
Spiny amaranth	*Amaranthus spinous*	Amaranthaceae
Day flower	*Cammelina benghalenisis*	Commelinaceae
Bristle starbur	*Acanthospermum hispidum*	Compositae
Billy-goat weed	*Agerantum conyzoides*	Compositae
Siani weed	*Chromolaena odorata*	Compositae
Siani weed	*Eupatorium odorata*	Compositae
Tridax	*Tridax procumbeus*	Compositae
Swamp morning glory	*Ipomoea aquatica*	Convulvulaceae
Flate sedge	*Cyperus difformis* linn	Convolvulaceae
Flat sedge	*Cyperus distans linn-f*	Cyperaceae
Punple nut sedge	*Cyperus rotundus* linn	Cyperceae
Nut grass	*Cyperus tuberosus rottb*	Cyperaceae
Umbrella flat sedge	*Mariscus alternifolius* vahl	Cyperaceae
Copper-leaf plant	*Acalypha ciliata forsk*	Euphorbiaceae
Spurge weed	*Euphorba heterophylla linn*	Euphorbiaceae
Signal grass	*Brachiaria delexa* robyus	Gramineae
Signal grass	*Brachiaria lata* C.E hubbard	Gramineae
Finger grass (Crab grass)	*Digitaria horizontalis* wild	Gramineae
Jungle grass	*Echinochloa colona* (L) link	Gramineae
Goose grass	*Eleusine indica* Gaertn	Gramineae
Spear grass	*Imperata cylindrica* (linn) beau	Gramneae
Wildrice	*Oryza longistaminata* chev.roehr	Gramineae
Guinea grass	*Penicum maximum* Jacq	Gramineae
Rice grass (ditch millet)	*Paspalum orbiculare* forst	Gramineae
Fox tail	*Setaria longiseta* Beaux	Gramineae
Cat's tail	*Sporobolus pyramidalis*	Gramineae
Pig weed	*Portulaca alaracea* linn	Portulacaceae
Witch weed	*Striga hermonthica*	

Source – Department of Agricultural Services (Crop Protection Unit)

The two most invasive of the exotic plant species to be found in The Gambia are the neem tree (*Azadirachta indica*) and Lantana (*Lantana camara*). The neem tree spreads through suckering and has formed xtensive thickets in many parts of the country. It's control is hampered by the ability of the roots to sprout and its spread is threatening many habitat types from coastal scrub-woodland to riverine forest in the fresh water stretches of The River Gambia. The water hyancinth (*Eichhornia crassipes*) has also become established in the upper reaches of the Allahein rever and requires elimination to prevent/reduce its spread.
Three species of animals have colonized The Gambia. Two of these, the brown rat (*Rattus norvegicus*) and the house mouse (*Mus musculus*), are pests of stored food and goods. The third species, the house sparrow (*Passer domesticus*) poses no foreseable threat at the moment.

There is an urgent need for a comprehensive research and monitoring programme to determine and implement an appropriate control technique.

Institutional Mandate: NARI-The National Agricultural Research Institute and the crop protection Unit of the Department of Agricultural Services are responsible for the control of alien invasive species that threaten agricultural crops. As regards alien invasive plants and animals the management responsibility lies with the Departments of forestry, wildlife and livestock services respectively. The national environment agency, the Department of Customs and Excise, Gambia Ports Authority and the Ministry of Trade and Industry are also involved with either the management or control of alien invasives as it relates to their areas of responsibility.

In the Gambian context, the capacity to assess and monitor alien invasives and legislative measures to control them are either lucking or extremely weak. National control programmes: there is no coordinated national programme for the control of alien invasive species. However, various sectoral and piecemeal control programmes do exist which aims at distinguishing the harmful from the harmless alien species and identify the impacts of the former on native biodiversity. Four major options have been identified for dealing with alien invasive species;

a. Prevention (interception, treatment of suspected material. Prohibition, etc.)
b. Early detection – to determine possibility of eradication or containment
c. Eradication
d. Control – to reduce the density and keep below an acceptable threshold.

Priorities for the management of invasive alien species in the Gambia

Gaps/issues/ Threat	Strategy	Action	Capacity needs		
			Individual	**Institutional**	**Systemic**
Poor understanding and information on status of invasive alien species and their impact on biodiversity as well as the methods to eradicate them	Raise level of general understanding about alien invasives and the methods to combat them	Conduct public awareness activities on alien invasive species, Assess and determine the status as well as the impact of alien invasives in the country. Put in place appropriate and feasible methods of combating alien invasive species. Promote information exchange within and between institutions, regions, countries etc.	Train personnel in relevant discipline. Train personnel in techniques of prevention, early detection and control of alien invasives. Ensure cross-border cooperation and information exchange. Train personnel in legislative and policy review. Train personnel in policy and legislative formulation on alien invasives. Train law enforcement officers. Initiate projects on alien invasives to acquire hands on training and experience in control methods.	Improve existing sectors/sub-sectors through re-structuring and provision of adequate and necessary resources (material, equipment infrastructure) etc to better handle issues pertaining to alien invasives.	Put in place a comprehensive legislation and policy governing the handling, movement, use, trade etc of alien invasive species.
Lack of a comprehensive legal and Legislative framework on invasive alien species including non-enforcement of existing sectoral laws.	Develop a comprehensive legal, policy and legislative and administrative framework to regulate alien invasives.	Review existing sectoral legislations and policy as they relate to invasive aliens, Update or develop as appropriate a national policy and legislation on invasive alien species, Enforce existing sectoral/sub-sectoral laws on alien invasives. Set up national committee/body to be responsible of all matters relating to alien invasives. Ensure inter sectoral Coordination at national level.	As above	As above	As above

APPENDIX 15: Country Report on Invasive Alien Species in Ghana

Professor Emmanuel Owusu-Bennoah, Council for Scientific and Industrial Research, P.O. Box M32, Accra, Ghana.
Mr Carl Fiati, Senior Programme Officer, Environmental Protection Agency, P.O. Box M 326, Accra, Ghana.

1. List of alien species in Ghana

Over 250 species of exotic plant species have become naturalized in Ghana, and over 20 of these can be categorized as invasive. The water weeds *Eichhornia crassipes, Salvinia molesta, Pistia stratiotes and Azollo filiculoides* are all invasive, the first being particularly damaging and the target of a classical biological control project. Water weeds pose threats to the Tano River and associated lagoons, the River Volta and parts of the Lake. Major terrestrial invasive include *Chromolaena odorata, Broussonetia papyrifera* and *Leucaena leucocephala. Chromolaena and Leucaena* colonise disturbed forests and savanna woodlands, where they prevent regeneration and displace indigenous species, posing a threat to the biodiversity and to sustainable utilization of the forests. The River Afram Headwaters Forest Reserve is threatened by the invasion of Broussonetia *as well as* Chromolaena.

A preliminary list of 30 invasive alien species include:
*Azolla filiculoides (*Red Water Fern)
Broussonetia papyrifera (Pulp Mulberry/Yorke)
Chromolaena odorata (Siam Weed/Acheampong/Busia)
*Commelina spp.**
*Cyperus imperata** (Atadwe)
Cyperus papyrus (Papyrus)
Eichhornia crassipes (Water hyacinth)
*Leucaena leucocaphalla (*Leucaena)
Gliricidia sepium (Gliricidia)
Salvinia molesta
*Striga hermonthica**
Striga gesnerioides
*Cercropia peltata (*French Odwuma*)*
*Vossia cuspidata** (Hippo Grass)
Lantana camara
Mimosa pigra
Nelumbo lutea
Mellingtonia sp,
Azadiracta indica Neem/Abode)
Mucuna pruriens
*Enteromorpha flexuousa**
*Polygonum senegalense**
Pistia statiotes
Limnocharis flava
Rottboelia cochinchinensis
Vallisneria spiraligigantea
*Ceratophyllum demersum**
Tectona grandis (Teak)
*Typha domingensis** (Cattail)
Mistletoe
***denotes that species is indigenous**

2. Summary list of existing programs

a. Biocontrol of *Chromolaena odorata* (Implemented by Crops Research Institute, Kumasi. Funded by Government of Ghana).
b. Integrated Mycoherbicide Programme for Water Hyacinth Control in Africa (IMPECCA) (Implemented by CAB International; Funded by DANIDA)
c. Waterweed management in West Africa Ghana Water Bodies Implemented by Environmental Protection Agency and FAO in Ghana.
d. Integrated management of the Volta River Basin (Implemented by Environmental Protection Agency, Funded by GEF).

3. List of agencies involved in invasive alien species

Governmental

- Ministry of Environment and Science (MES)
- Ministry of Food and Agriculture (MOFA)
- Ministry of Lands and Forestry (MLF)
- Ministry of Mines and Energy (MME)
- Ministry of Local Government (MLG)
- Ministry of Works and Housing (MWH)
- Ministry of Road and Transport (MRT)
- Ministry of Railway and Ports (MRP)
- Council for Scientific and Industrial Research (CSIR in MES) – Water Research Institute (WRI), Crops Research Institute (CRI), Soil Research Institute (SRI), Forestry Research Institute of Ghana (FORIG), Savanna Agricultural Research Institute (SARI).
- Environmental Protection Agency (EPA in MES)
- Plant Protection and Regulatory Services Directorate (PPRSD in MOFA)
- Ghana Irrigation Development Authority (GIDA in MOFA)
- Forestry Commission (FC in MLF) – Wildlife Division, Forest Services Division
- Volta River Authority (VRA in MME)
- District Assemblies (DA's in MLG)
- Water Resources Commission (WRC in MWH)
- University of Ghana
- University of Cape Coast
- University of Education Winneba
- University of Development Studies, Tamale
- Kwame Nkrumah University of Science and Technology (KNUST) – Institute of Renewable Natural Resources (IRNR).

Non-Governmental Organisations

- Wildlife Society
- Friends of the Earth
- CARE
- Green Earth
- Conservation International

Associations

- Wildlife Exporters Association\Ghana Institute of Professional Foresters
- National Canoe Fishermen Association
- Ghana Timber Association
- Tree Growers Association
- Inland Boat Owners Association

Private Sector

- Timber Companies
- Volta Lake Transport

Beneficiaries

- Farmers
- Fishermen

4. What priorities have been identified

i. *Eichhornia crassipes*
ii. *Chromolaena odorata*
iii. *Salvinia molesta*
iv. *Broussonetia papyrifera*
v. *Leucaena leucocephala*

5. List of experts

	NAME OF ORGANIZATION	REPRESENTATIVE	ADDRESS	TELEPHONE	FAX	E-MAIL
	University of Ghana	Dr. David D. Wilson	Department of Zoology University of Ghana Legon, Accra	021 500381 Ext.3267/3277 020 813331	021 500305	Wilsondd@ug.edu.gh
	Forestry Commission	Komla Obed Kass-Yerenchi	Resource Management Support Centre Forest Services Division P.O. Box 1917 Kumasi	021 780909 021 762009		cioaa@ghana.com
	Conservation International Ghana	David Kpelle	P.O. Box KA 30426 Accra	021 780906 021 762009		cioaa@ghana.com
	Plan Protection and Regulatory Service Directorate	Dr. Anthony Richmond Cudjoe	PPRSD (MOFA) P.O. Box M.37 Accra	024 256239 027 7402313 021 302638		icpcc@ghana.com
	National Science & Technology	Dr. Martin A. Odei	NASTEF PO Box M.32 Accra	021 765237		Ma-odei@yahoo.com
	Environmental Protection Agency	Carl Fiati	P.O. Box M326 Ministry Post Office Accra	021 664697/8	021 662690	Cfiati@epa.Ghana.org
	Council for Scientific and Industrial Research (CSIR)	Prof. Alfred A. Oteng-Yeboah	P.O. Box M32 Accra	021 777651-4 021 774380 027 554931	021 777655 021 779809	aayeboah@yahoo.co.uk affscir@ucomgh.com
	CSIR – Savanna Agricultural Research Institute (CSIR-SARI)	Dr. Victor Attuquaye Clottey	P.O. Box 52 Tamale	071 22411 071 25251	07123197	catuq@yahoo.com
	University of Ghana	Dr. (Mrs.) Essie T. Blay	Department of Crop Science, University of Ghana, Legon, Accra	021 513592		Essie-blay@hormail,com

	NAME OF ORGANIZATION	REPRESENTATIVE	ADDRESS	TELEPHONE	FAX	E-MAIL
	Ministry of Environment and Science	Moses Hensley Duku	PPME P.O. Box M.32 Accra	021 666049 021 662264	021 666828	mosesduku@yahoo.com
	Council for Scientific and Industrial Research (CSIR)	Prof. Emmanuel Owusu-Bennoah	Ag. Director-General (CSIR), P.O. Box M.32 Accra	021 760166 021 777651-4	021 779809 021 777655	eobennoah@ucomgh.com affscsir@ucomgh.com
	Ministry of Environment and Science	Mr. Edward Osei Nsenkyire	Chief Director Ministry of Environment and Science P.O. Box M.232	210 666049 021 662264 021 673336	021 666828	mest@africaonline.com.gh
	CSIR – Water Research Institute (CSIR-WRI)	Kweku Amoako Atta De-Graft-Johnson	Water Research Institute CSIR, P.O. Box 38 Achimota or P.O. Box M.32, Accra	021 775354 021 779512-4	021 761030	wri@ghana.com
	Council for Scientific and Industrial Research (CSIR)	Dr. Joseph Cobbina	CSIR-AFFS P.O. Box M.32 Accra	021 777951-4 021 267631	021 779809 021 77655	JCobbina@hormail,com
	Council for Scientific and Industrial Research (CSIR)	Dr. Felix O. Anno-Nyako	CSIR-AFFS P.O. Box M.32 Accra	021 777651-4 0277 888625	021 779809 021 777655	foanyako@yahoo.com.uk
	Volta River Authority	Michael K. Dade	Health Services Dept. Volta River Authority Akosombo	0251 20321	021 776005	mdade@akosombo.vra.com
	University of Ghana	Prof. Afreh-Nuamah	University of Ghana Legon	027-522007 020-8135959 024-893568		
	CSIR-Forestry Research Institute of Ghana (CSIR-FORIG)	Mr. Bright Obeng Kamkam	FORIG , Kumasi	024-579480		
	University of Ghana	Dr. Gabriel Ameka	Botany Department University of Ghana Legon	024-524395		
	CSIR-Water Research Institute	Mr. Felix Akpabey	WRI-CSIR Accra	024--683748		ffelix39@yahoo.co.uk

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7. Identify current needs (requiring external support) for managing invasive species

Policy formulation; Surveillance, Legislation and Implementation of Control Programmes.
Training;
Equipment; Mechanical and Chemical Control of *Eichhornia* and other water weeds, *Broussonetia, Chromolaena, Striga*

APPENDIX 16: Country Report on Invasive Alien Species in Liberia

Mr Ben Turtur Donnie, Biodiversity Consultant, National Environmental Commission of Liberia, P.O. Box 4024, Monrovia, Liberia.

Background

The Republic of Liberia is situated on the southwest corner of the West Coast of Africa between longitude $7^0$30' and $11^0$30' west and latitude $4^0$18' and $8^0$30' north. It covers a surface of about 111,370 km^2 (about 43,506 square miles). The dry land extent is 96,160 sq. km or 37,570 sq. miles. Liberia is limited on the west by Sierra Leone, on the north by Guinea, on the east by Côte d'Ivoire and on the south by the Atlantic Ocean. Total land boundaries extend to 1,585 kilometers (990 miles)- Guinea, 563 kilometers (352 miles), Cote d'Ivoire, 716 kilometers (446 miles), Sierra Leone, 306 kilometers (191 miles).

There are four topographical regions with each having its own distinct physical features and height above sea level. Along the Sea Coast is the Coastal Plain of 350 miles (560 km), an almost unbroken sand strip, which starts from the lowest elevation up to 30 meters above sea level. Next to the Coastal Plain is the Belt of inundated plateaux followed by the Belt of high lands and rolling hills in the north and northwest. The highest elevation is the northern highlands, which includes mount wutivi (1350 meter), the maximum elevation in Liberia.

Topographical Regions of Liberia

Despite the small size of Liberia, it supports significant biodiversity. There are over 2000 flowering plants (225 timber species), 600 bird species, 150 mammals and 75 reptiles. By the end of the 2nd millennium Liberia contained 42% of the Upper Guinea Forest of West Africa; the largest portion possessed by a single country in the region as Guinea has 8%, Cote d'Ivoire 28%, Ghana 16%, Sierra Leone 5% and Togo 1%. Of the over 2000 flowering plants there is some knowledge on the 225 timber species, but no studies has been done on the rest of the plants. Consequently, the need for taxonomy studies exists.

The equatorial position and the distribution of high and low pressure belts over the African continent and the Atlantic Ocean influence the climate of Liberia. Rainy and dry seasons with a transitional period can be distinguished. The months of heaviest rainfall are June, July and September. Notwithstanding, the rainy season lasts from late April to October. The dry season begins in November and ends early April.

It does not rain continuously during the rainy season. It is common to have sunny days during the months when the rain is heaviest. This is also true for the dry season; there are some rainy days during the dry season. The rainfall ranges from 2000 to 4000 mm/year with an average of 2,372mm.

The internally produced renewable water resource is estimated at 200km^3. This amount of water is drained into the Atlantic Ocean by two-river systems. The major basins drain the territory in a general northeast – southwest direction. There are six major rivers, which drain the country with north-south pattern: Mano, St. Paul, Lofa, St. John, Cestos and Cavalla. They drain 66% of the country. The short coastal watercourses drain about 3% of the country and include by not limited to the Po, Du, the Timbo, the Farmington, and Sinoe rivers.

Demography

The population by 2002 estimates is 2.7 million with 6.7% fertility rate and annual growth rate at 2.4%. Human mortality per annum is caused mainly by Malaria 16.5%, Anemia 12.6%, Respiratory Infection 12.5%, Diarrhea 5.6%, Hypertension 4.6%, and Malnutrition 4.4% and other causes.

Since 1970 the population of Liberia has been growing at an average annual rate of 3%. Liberia's population in 1974 was at 1.55 million; that is a density of 41 persons per square mile. It rose to 2.15 million in 1984, which equals the density of 57 persons per square mile. In 2002 Liberia's population reached 2.70 million with a density of 71. That density remains lower than those of neighboring states on the West African Coast.

According to the 1974 census, 29.1% of the population lived in urban areas and 70.9% were rural dwellers. By 1984 more people lived in urban communities (1981 it was 37.1%). Migration from the rural areas to the capital city and other large urban centers is a characteristic of Liberia's population dynamics especially throughout the civil strife. Most of the urban people are found in cities along the Atlantic coastline. Monrovia is the largest city with a pre-war population of about 250,000 of people. Due to increasing insecurity in many parts of the country, exodus of people into Monrovia has swelled the population to more than one million people.

The population of Liberia is young. In 1984, it was estimated that 44% of the population compose of people below 15 years of age. The female population is higher than the male counterpart, but there are more literate males than females.

Economy of the Country

Liberia's economy is largely dependent on extractive industries primarily rubber, timber, gold, diamond and agricultural crops. About two decades ago, the economy was comparable to other high income earning countries when world market prices of the commodities were considerably high. Besides, there was a flurry of industries, which contributed to the strength of the economy. That situation has changed dramatically due to world recession, and the civil war.

Political Subdivisions

Liberia is divided into 15 political sub-divisions, called counties.
The fifteen counties are: Lofa, Bong, Gbarpolu, Grand Cape mount, Montserrado, Nimba, Grand Gedeh, River Gee, Maryland, Sinoe, Grand Kru, Bomi, Grand Bassa, Margibi, Rivercess

Status of biodiversity in Liberia

There are two components of biodiversity. The terrestrial biodiversity includes the forest ecosystem, and the mountain ecosystem. The aquatic biodiversity comprise the wetland and mangroves, freshwater, and coastal and marine ecosystems. These natural systems, even though have great potential for human and industrial development, are under continual threats of destruction as a result of neglect and mismanagement

Forest Cover

It is believed that Liberia is the only country in West Africa that once was covered entirely with rain forest. The forest of Liberia is being reduced at the rate of 1-2% per annum. More than 50% of the forests have been destroyed over the years. The two remaining dense forest areas are now found in the northwest and southeast of the country separated and isolated from each other by a break extending from Monrovia to Nimba County. These two forest blocks are further fragmented and dissected by the advances of shifting cultivation along existing roads and by the construction of logging roads.

By the end of the second millennium Liberia contained 42% of the Upper Guinea Forest of West Africa, the largest portion possessed by a single country in the region; Guinea has 8%, Cote d'Ivoire 28%; Ghana, 16%; Sierra Leone 5%; and Togo, 1%.

Establishment of plantations has not kept pace with land rehabilitation with deforestation. It is estimated that 2% (480,000 acres) of the land area of Liberia (24.000,000 acres) is lost to deforestation annually, whereas, reforestation has achieved the replanting of about 27,000 acres since the inception of the programme in 1971 with scattered plantations in Grand Cape Mount, Grand Gedeh, Nimba, Bomi, Bong and Rivercess Counties. Additionally, plantation development by Forestry Development Authority (FDA) has largely made use of exotic tree species as opposed to indigenous species. Very little is known about the exotic species.

Wetlands and Mangroves

Wetlands are areas that are permanent or temporary, with water that is static or flowing, fresh, brackish including areas of marine water the depth of which at low tide does not exceed six (6) meters. They are transitional zones between terrestrial systems and open water systems, and are highly productive areas rich in flora and fauna. Their economic and ecological functions attract human activities that eventually impact on biodiversity. Liberia has a few wetlands that provide both subsistence and economic benefits to its many inhabitants. Like wetlands all over the world, they have become stressed by human induced activities. There are four (4) wetland types: Inland Riverine, Inland Swamp, Coastal and Coastal Lacustrine. Presently only eight (8) wetlands have been identified, three (3) of which have been proposed for conservation status.

Mangroves characterize the wetlands of Liberia and cover a small area along the coast, from Cape Mesurado to Cape Palmas, at the edges of lagoons, riverbanks, and river estuaries and in widespread areas of swamps. According to Gatter (1988), mangroves cover 0.5% of the land surface of Liberia, which is equivalent to a 500 km-wide belt extending along the total length of the coastline.

Mangroves of the Mesurado Wetlands near Monrovia

The most common mangrove species is Rhizophora racemosa, but six (6) other species occur in the country. Mature mangroves, reaching heights up to 30m were found along the lower Sehnkwehn and some neighboring rivers, where species such as Rhizophora harrisonii, Rhizophora mangle and Avicennia Africana occur together with impressive tracts of Pandanus. Except for few places in the central part of the country, primary mangrove forest has been replaced by secondary ones. Much of the mangrove destruction appears to be concentrated along the edges of creeks, and particularly more widespread around the larger towns and cities, such as Monrovia, Buchanan, Greenville, and Harper. Mangroves are degraded due to urban expansion, collection of firewood and construction of makeshift structures.

Wetlands with Water Hyacinth along Benson River near Buchanan City

Coastline and Maritime Claims

The Liberian coast is pounded by powerful surf, which has produced a relatively straight coastline with many lagoons. The coastline is 350 miles long (560 km), characterized by an unbroken sand strip. The width of the coastal plain varies from 16-40 km and most of its land mass has an elevation of 9-30m. Most rivers flow slowly over the plain in large meanders and then widen near their estuaries. The territorial water is about 159,200 sq. km. (70,000 Sq. miles), larger than the land area of the country.

Relief and Soils

Several physiographical zones that roughly run parallel to the coastline characterize the relief of Liberia, which gains altitude gradually north away from the coast. These are respectively: the coastal plains, the rolling hills; the plateaux and mountain ranges and the northern highlands.

The coastal plain is characterized by a relatively straight coastline with sand bars and long beaches (with a nearly unbroken sand strip), salt and fresh water lagoons and a few promontories like Cape Mount, Cape Mesurado and Cape Palmas. These promontories and beaches together with Lake Piso and Lake Shepherd are points of high attraction and could play an important role in future tourist promotion program of the country. The belt of rolling hills parallel to the coastal zone has elevation in the order of 90m. There are numerous hills, valleys and watercourses in this zone. It is forest covered in Grand Cape Mount County and in the eastern part of the country. Most of the private agricultural concessions are located in this belt where both agriculture and forestry are favored by the prevailing topographical and climatic conditions.

The plateaux and mountain ranges are behind the rolling hills. The plateaux reach heights up to 300m and the mountain ranges up to 600m. Important ranges are the Mano River Mountain, the Bea, Bong, Gibi, Kpo, Putu and Tienpo ranges. The greatest width of this zone is about130km between the Lofa and St. Paul Rivers. Within this area farming dominates the different forms of causes for biodiversity loss. Logging is but slightly hindered by relief in the eastern part of the country. Exploitation of forest is more difficult in central and Upper Lofa County, however, because of topographic conditions. The northern highland zone is situated in Upper Lofa and Nimba Counties and comprises Wologisi range with a height of 1,350m and Nimba range with an elevation of 1,385 meters on the Liberian side, as the mountain is shared by Cote d'Ivoire, Guinea and Liberia.

Invasive Alien Species

There are many floral and faunal species that invaded Liberia over the last several decades. Invasion here means accidental and unplanned introduction of plant and animal species. Some of the plant species are: the water hyacinth, the Nile salad, *Leucenea leucocephalus* and the *Chromoleana odorata.*

Leucenea has some positive sides as nitrogen fixing plant and animal feed. There has been no thought as to the development of the positive effects. It was brought in for reforestation, and we later discovered its characteristic invasiveness and colonization of large areas.

Chromolaena odorota, a perennial shrub is a typical pioneer species of secondary forest succession with a strong heliophilic character and vigorous vegetative development. Initially *C. odorata* spreads through seed dispersion, but after establishment it may also reproduce vegetatively from lateral branches; regrowth occurs after slash and burn cultivation. It was introduced in West Africa around 1937 through contaminated seed lots of *Gmelina arborea*, a tree species imported into Nigeria from Sri Lanka for reforestation purposes. The first observation of *C. odorata* was made in early 1940s from Enugu in central part of Nigeria. The primary mechanism by which *C. odorata* spreads is through human activities. Such activities include road construction and maintenance of dirt roads and railways, which are of major importance in Liberia.

The major problem with *C. odorata* is that it provides shelter and breeding spaces for harmful insects such as the variegated grasshopper, *Zonocerus variegates*, which moves from *C. odorata* variegatus to cassava fields and feeds on the leaves causing important yield losses. Due to its abundant vegetation development *C. odorata* may over grow the young tree and hence leads to poor crop establishment. During the dry season, it constitutes a real fire hazard. Roadsides and open places around human settlements are often overgrown by dense bush of *C. odorata*, making it a nuisance to the settlement and traffic.


Chromolaena odorata near Ganta, Nimba County

In addition to the problem of *C. odorata;*

a. There has not been any inventory done on the alien and invasive species
b. There are no techniques developed to control the spread of these species
c. The quarantine service of the Ministry of Agriculture, which is responsible to regulate the entry of alien species, is weak and incapacitated.

There are many alien species, considering exotic food and ornamental plants introduced in Liberia over the years. A good example is our staple, rice, which is an exotic. The most industrious crop, *Hevea brasiliensis* (rubber tree, a native of Brazil) was introduced, and so are many species developed in forestry plantations. Few of the alien species are known to be invasive, but the most offensive are the water hyacinth and *Chromoleana odorata*. Water hyacinth covers the entire surfaces of some water bodies near towns and villages. *Chromoleana odorata* was first seen in Nimba County in the early 1980s, but it has spread to many parts of the country, getting close to Monrovia and other urban centers.

There is no policy on the prevention and control of Alien Invasive Species, and hence no legislature has been enacted. There is also no institutional arrangement for the prevention and control of alien invasive species. However, the focal point for the Convention on Biological Diversity is at the Environmental Protection Agency, and is responsible to institute programmes for the purpose. Also, the National Biodiversity Frameworks project is developing a policy for the prevention and control of genetically modified organisms and alien invasive species.

APPENDIX 17: Country Report on Invasive Alien Species in Mali

Dr Bourema Dembele, Scientific Director, Institute of Rural Economy, BP. 258, Mali.

General points on Mali

Mali is an inland country, located in the centre of West Africa. It has a surface area of 1 241 238 km² and in 2000, had a population of 10 226 012 inhabitants. The shortest distance to the Atlantic coast is 400 km across the Guinea mountains. Mali shares a common border with Senegal, Mauritania, Guinea, Cote d'Ivoire, Niger, Burkina Faso and Algeria.

Geographical context

Climate

Like all the countries belonging to the *Comité Inter Etats de Lutte contre la Sécheresse au Sahel* (CILSS), Mali is characterised by a tropical, semi-arid climate with a very long dry season (6 to 9 months) dominated by the harmattan, a dry wind from the Sahara, and a rainy season of three to six months, during which blows the monsoon, a wet wind from the Gulf of Guinea. The total rainfall as well as the length of the rainy season decreases from south to north, dividing the country into four climatic zones in the following order:

- the Sudanian zone, with annual rainfall of more than 1200 mm,
- the Sudano-Sahelian zone, with rainfall of between 1200 and 700 mm,
- the Sahelian zone with rainfall of between 700 and 200 mm. This zone occupies almost 25% of Mali's total surface area,
- the sub-Saharan or desert zone with annual rainfall of less than 200 mm. This zone occupies more than half of Mali's surface area.

Landform

Mali's landform is, in general, quite regular. Its North-East region is dominated by gentle slopes of between 400 and 300 m, making up a peneplain. The most significant ground irregularities are:

- the Mandingue plateau that forms the continental divide with the basin of the Senegal river in the west,
- the Fouta Djalon and the Manding mountains that form the border with Guinea,
- the two mountain chains in the East: Bandiagara plateau and the Hombori mountains.

The North-East of the country is dominated by the Adrar des Iforas, an eroded sandstone plateau, which forms part of the Hoggar mountains in Algeria.

The central part of the country is occupied by the major bed of the Niger delta, which extends over a surface area of more than 100 000 km^2.

Rivers

Mali is crossed by the Niger and Senegal rivers and their tributaries: the Baoulé, the Bani and the Bafing.

The Niger River

The Niger is 4200 km long, both one of the longest rivers in Africa and the longest river in West Africa. The theoretical surface of the catchment area is 2 million km². The Niger crosses the country from South-West (border with Guinea) to North-East (border with Niger) over 1700 km. It is subdivided into three parts in Mali:

- the Upper-Niger extending from the Guinean border to Markala. (The tributaries in Mali over this area are the Fié and the Sankarani),
- the Inner Delta of the Niger extending from Markala to Koryoumé,
- the Middle-Niger extending from Koryoumé to the Nigerian border.

The flow of the Niger in Mali is significantly dominated by rainfalls of the upper basins located in Guinea. It is characterised by a distinct seasonal variation of flows of the river between minimum flow and flooding.

Flooding begins towards the end of June. The maximum is reached at the end of September or at the beginning of October, in other words, a slight difference in relation to the maximum of rains. More than 80 % of the volume of the flood flows between August and November with a maximum recorded in October and the minimum, in May.

From Markala, the river forms a large flooded area (Inner Delta or lacustran basin) with an average river bed slope of less than 2 cm/km. The river water is transported to operating zones in a controlled manner through canals of the Office du Niger [Niger agency].

Beyond Mopti, the river divides into two canals, the Bara Issa and the Issa Ber that extend to form two shallow and seasonal lakes. At Diré, the two canals merge and travel eastwards towards Kabara, before making a large detour in a south-east direction towards Bourem. There are also a large number of shallow seasonal lakes in the Niger delta. These are the Débo, Fati, Teli, Korientzé, Tanda, Niangaye, Do, Garou, Faguibine and Aougoundou which form, along with others, a vast flood plain.

The Bani, the Niger's main tributery in Mali, is formed at the Dioïla through the merging of the Bagoé and of the Baoulé, all coming from the North of Cote d'Ivoire. It flows into the Niger at Mopti after a stretch of 500 km. Mopti has a catchment area of 130.000 km^2. The average annual flow at Douna is 423 m^3/s or a volume of 13 billion m^3 per year.

The Senegal River

It is formed at Bafoulabé through the merging of the Bafing and of the Bakoye which have their source in Guinea in the Fouta Djallon moutains. It extends over almost 800 km in Mali (plus the Bafing). The Senegal's basin in Mali is approximately 170.000 km^2. The river's average flow at Kayes is around 469 m^3/s or an annual volume of 15 billion m^3.

Resevoirs and dams

The Sélingué dam:

This multiple purpose dam has a hydro-electric plant with four turbines, each having a capacity of 11.9 MW and an intake with a capacity of 3 m^3/s for the irrigation of a 1000 ha area located immediately downstream from the structure on the right bank.

The Sélingué dam creates an artificial reservoir of 2 billion m^3 at the maximum refilling level. The flows of the river vary between 6 and 12 billion, or a module of between 200 and 400 m^3/s, according to the hydraulicity of the year. The dam supports the minimum flow of the Niger as soon as the flows of water from the Sankarani are lower than the flows required for electric power (towards end November).

The Markala dam:

The irrigation dam of Markala has been in operation since 1947. It consists of an 1813 m earth dam and of a dam with collapsible shutters of 816 m in length, which completely retracts in high waters.

The exact topography of the reservoir is unknown. However, the stored volume has been estimated at around 90 million m^3. The "useful" volume is around 60 million m^3.

The construction of the Markala dam made possible complete water control, rice growing by the *Office du Niger* (50 000 ha) and by the *Office Riz Ségou* (5 000 ha), and sugar cane production by the Sukala company (5.000 ha); or a total of around 60 000 ha.

The Sotuba dam:

The Sotuba dam is located 7 km downstream from Bamako on the right bank of the Niger. It was created in 1966 for hydro-electric and farming purposes.

It consists of a diversion dam (Aigrettes dam) which crosses the river, a canal with a maximum capacity of 10 m^3/s and a plant with an annual production of 35 GWH.
The raising of the water level by the Aigrettes dam makes it possible to divert part of the water from the river towards the hydro-electric plant, then the Baguineda zone located 30 km downstream. The total surface irrigated is estimated at 3 000 ha.

The Manantali dam:

The reservoir dam of Manantali is located 80 km from Bafoulabé, on the Bafing (tributary of the Senegal River). The major structures are the hydro-electric regulating dam of Manantali, the Diama anti-salt dam, the river-sea port of Saint-Louis and the river port of Kayes. With a total reservoir of 11.27 billion m^3, it makes the following possible:

- the development of 255 000 ha along the valley,
- an additional 1000 m^3/s for navigation,
- an annual production of 800 GWH.

Economic context

The Malian economy is mainly based on farming occupying 80 % of the population, provides 75 % of export revenue and contributes more than 40 % to the GDP. Farming is mainly rain-fed and is dominated by millet, sorghum, rice, maize and cotton. It is practiced over 3.9 million hectares (FAO, 2000) out of a total of 43.7 million hectares that can be used for animal breeding and farming, or 9%, distributed between crops of millet, sorghum, peanuts, maize, rice, cotton fonio, niébé and some tubers. Cereals (millet, sorghum, rice, maize) constitute the staple diet.

Cereal production experienced a signficant increase during the course of recent years, from 2.4 million tons in 1991/92 to 2.89 million tons 1998/99, or an average annual rate of increase of 2.5%. For the same period, rice production showed a spectacular 7.5% increase from 454 349 to 727 140 tons. In the case of industrial crops, cotton production rose from 276 023 tons in 1991/92 to 518 414 tons in 1998/99, or an average annual rate of increase of 12.5% on account of the increase in surface areas and of the number of operators. As far as stock production is concerned, the OMBEVI estimated its potential in 1999 at 6.427 million heads of cattle, 15,986 million sheep and goats, 467.000 camels, 845.000 horses and donkeys, and 65 000 pigs. The offtake rate for cattle is 14% and that of sheep and goats, 34.5%.

Status of invasive introduced species

Introduction

The introduction of alien species into an environment can cause disruptions in the functioning of ecosystems and interfer with production, farming, forestry-pasture or fishing objectives. When they find favourable ecological and biotic conditions, introduced species (plants, animals or micro-organisms) can quickly pass from normal plant status to invasive plant status through rapid proliferation and spatial colonisation.

In Mali, there are no legal acts classifying or providing a list of invasive alien species. The species listed in the document are those that cause problems to farming, forestry-pastrual or fishing production.

1. List of invasive alien plant species

The invasive introduced plant species that cause the most problems in Mali are mainly found among aquatic plants. There are those seen as harmful and those that are used as factors of production.

The most harmful species are the water hyacinth *Eichhornia crassipes* and the water fern Sa*lvinia molesta*. Other underwater species such as C*erathophyllum demersum* or *Myriophyllum sp, Azolla Africana, Typha sp,* etc. were also found locally and sometimes in dense infestation.

Species	Families	Locations
Eichhornia crassipes	Pontederiaceae	Niger and Bani rivers
Salvinia molesta	Salviniaceae	Niger river
Typha australis	Typhaceae	ON [Niger agency] rice growing areas, and Manatali and Kalana dams
Cerathophyllum demersum		ON and OPIB [Baguinéda irrigated area agency] irrigation canal
Azolla Africana	Azollaceae	ON area
Myriophyllum sp	Haloragaceae	ON and OPIB irrigation canals
Striga hermonthica	Scrofulaiaceae	Areas where crops of millet, sorghum and maize are grown, throughout the country
Striga gesnerioides	Scrofulaiaceae	Areas where niébé is grown throughout the country

Species of Striga and especially *Striga hermonthica* and *Striga gesnerioides* have spread so much that they are found in 82% of fields of millet, sorghum, maize and niébé.

1.1 Characterisation of species, distribution and damage

The presence in Mali of the water hyacinth goes back to 1990 around the town of Bamako. From here, it continued to invade the course of the river Niger. It is a threat to the other water bodies in the country, the rice fields of the *Office du Périmètre Irrigué de Baguinéda* [Baguinéda irrigated area agency] and of the *Office du Niger* [Niger agency]. Fishing and water traffic are threatened on the banks and branches of the river at Bamako and at Koulikoro, in the lakes of Sassila, Farako, and Sékoro and also between the COMATEX at Ségou and the Markala dam. The water hyacinth causes damage to energy production at Sotuba. It also causes health problems and thus results in harmful socio-economic consequences.

The giant fern, *salvinia molesta* (Salviniaceae) was observed in 2000 on the right bank of the Niger River at Bamako. Infestation spread into the OPIB irrigation canals, on to the banks of the Niger River at Ségou, upstream from the Markala dam, the Riz Ségou agency irrigation canal, the Thio navigation canal and the Niger agency water supply canal. It is beginning to seriously threaten fish, water traffic and the use of river banks by women at Thio.

Animal invasive alien species

Among animal species, the excessive proliferation of insects (Bemisia, Helioquelus, Helicoverpa, crickets and grasshoppers) and birds, such as the quelea quelea, can cause damage.

2. Programmes under way for the management of invasive alien plant species in Mali

There are no national management programmes in Mali. Invasive alien plant species in Mali are controled area by area by service departments, populations or by NGO's faced with the problem. Research activities on integrated management based on biological control are conducted at the IER. Control is mainly manual, for which the ON and the PRB are jointly responsible, towards the preservation of rice growing areas. *L'Energie du Mali* also conducts manual cleaning operations towards preventing the obstruction of grates that protect turbines. NGOs and fishing associations have been removing water hyacinths manually in their operating areas along the Niger River.
The factory PROFEBA uses the water hyacinth in the manufacture of its compound fertiliser.

3. List of departments involved in the management of invasive alien species.

L'institut d'Economie Rurale [institute of rural economy]
Agence du bassin du fleuve Niger (ABFN) [Niger River basin agency]
Direction nationale de la pollution et du contrôle des nuisances (DNACPN) [national pollution and nuisance control department]
Direction nationale de la conservation de la Nature (DNCN) [national nature conservation department]
Direction nationale de l'aménagement et de l'équipement rural (DNAER) [national development and rural support systems department]
Direction Nationale de l'Hydraulique et de l'Energie (DNHE) [national hydraulics and energy department]

Direction Générale de la réglementation et du contrôle (DGRC) [general regulations and control department]
Direction nationale de l'appui au monde rural (DNAMR) [national rural areas support measures department]
Energie du Mali (EDM) [Mali power company]
Office du Périmètre Irrigué de Baguineda (OPIB) [Baguineda irrigated area agency]
Office du Niger [Niger agency]
Office riz Ségou [Ségous rice agency]
Sukala
Office Malien du Tourisme (OMATO) [Malian tourism office]
Association Malienne pour la sauvegarde de l'environnement (AMASE) [Malian environment conservation association]
Guamina NGO
GEFAR consulting engineers

4. Priorities, strategies and management policy

There is no national strategy for the management of invasive alien species in general, and of invasive alien aquatic plants. A training workshop was organised from 8 to 11 April 1997 at the conference centre in Bamako on the theme of: "the integrated management of the water hyacinth and other aquatic plants". The aim was to inform those involved about the biology and methods of controlling the water hyacinth, to define integrated management strategies and to draw up a management plan to be undertaken. Twenty participants were involved, whose activities were in keeping with invasive alien aquatic plants and who were responsible for implementing the strategies defined during the workshop at the level of their departments. The workshop adopted an integrated management approach with the following recommendations:

a. To adopt an integrated management approach with biological control as a major component.
b. To raise awareness among populations and to provide them with training with the view to involving them in the implemention of activities.
c. To use herbicides under special conditions and through specialised structures as a last resort.
d. To actually involve all the departments

5. List of experts

Dr Bourema Dembele	Weed scientist IER
Dr Amadou Diarra	Weed scientists INSAH
DR Lassine Diarra	Ecologist IER
Cheickna Diarra	Consultant GEFAR
Lassana Diarra	Entomologist IER /CRRA Niono
Mountaga Kayentao	Agrologist IER /CRRA Sotuba

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7. Requirements for the control of invasive introduced species

Support measures for:

- the drawing up of a national strategy,
- the specification and inventory of invasive introduced species,
- the setting up of a legislative framework,
- the setting up of a framework of understanding for the control of invasive introduced species,
- the strengthening of capacities
- the collaboration with international sub-regional institutions.

APPENDIX 18: Country Report on Invasive Alien Species in Mauritania

Dr. Idrissa Diarra, Researcher, *Centre Nationale d'elevage et de recherches veterinaires* (CNERV) [national animal breeding and veterinary research centre], P.O. Box 167, Nouakchott, Mauritania.

1. Introduction

Mauritania is a Saharo-Sahelian country of 1 030 700Km² located in West Africa, with a population of around 3 000 000 inhabitants. The country is bordered in the north by the Western Sahara, Morocco and Algeria, in the East, by Mali, in the south, by Mali and Senegal, and in the west, by the Atlantic Ocean. 2/3 of its northern section is desert land.
The south, with an average annual rainfall of around 300 mm, displays more favourable conditions for the development of invasive alien species, mainly through the presence of more or less permanent bodies of water (the Senegal River and its tributaries, lakes, ponds, etc.).
Farming is also practiced in this area, particuarly farming irrigated along the river.

2. Organisations involved

According to the type of IAS and its area of development, different organisations are involved in the management of the plague.
It should be pointed out immediately that in Mauritania, a single department, the *ministère du développement rural et de l'environnement* (MDRE) [department of rural development and of the environment], deals with farming (agriculture and animal breeding) and environmental issues.
This department is responsible for the prevention and the management of IAS through the drawing up of suitable legislation and through the action of its specialised agencies.

Agencies of the MDRE [department of rural development and of the environment]

a. DEA: *Direction de l'élevage et de l'agriculture* [animal breeding and farming office]. This office has a specialised plant protection division. It also has a specialised structure for managing the desert locust (see below).
   DEAR: *Direction de l'environnement et de l'aménagement rural* [environment and rural development office]. This office deals with environmental matters (ecological modifications, agreements, fauna, flora, surface water) and forestry.
b. CNRADA: *Centre National de Recherche agronomique et de développement agricol.* [national agricultural and agricultural development centre]. It deals mainly with species that invade crops and areas suitable for cultivation.
c. CNERV: *Centre National d'élevage et de recherches vétérinaires* [national animal breeding and veterinary research centre]. As its name indicates, the CNERV deals with animal breeding, particularly animal feeding and reproduction as well as emerging animal diseases (especially water diseases)
   SONADER: *Société nationale de développement rural*. [national rural development company]
   It is specifically responsible for irrigated farming issues, thus problems concerning irrigated areas (irrigation canals invaded by cattails, for instance]
   PND: *Parc national du Dawling* [Dawling national park]
   This park is located on the right bank of the Senegal River, not far from the mouth. It deals with issues concerning invasive species within the protected area.
d. CLAA: *Centre de lutte anti-accridien* [grasshopper management centre]. The centre specialises in managing the desert locust (*schistocerca grégaria*)

In this sector, there are also once-off projects and programmes as well as NGOs which act in this domain.
In addition, other structures (departments or agencies) can be involved in the prevention and management of invasive species in an ancillary way.

Other structures:

- Department of tourism: when spaces earmarked for this activity are affected (especially camp sites).

- Department of fishing and maritime economy (*Institut mauritanien de la recherche océanographique et des pêches*: IMROP) [Mauritanian institute of oceanographical research and fishing]: This department is also responsible for inland fishing. It becomes involved when lakes and large ponds connected with this activity are attacked by invasive species.

- Nouakchott university: The university is involved within the framework of its training and research programmes as well as in partnership with the above-mentioned institutions.

3. Locations of invasive exotic species:

a. In Mauritania, the main invasive species causing problems currently is the cattail typha (*Typha australis*). In fact, in the lower valley of the river, all the fishing areas in the river bed as well as the water supply channels of surrounding areas and villages have been invaded by a large continuous blanket of cattail extending over several dozens and even hundreds of kilometres. In places, cattail is associated with another species called *phragmitès australis*. Actions undertaken to date to manage invasion have remained disproportionate to the extent of damage caused. Management has mainly been mechanical:
   - Use of a mower to clear water supply pipes and to facilitate water travel.
   - Attempt to develop the plant for cattle feed (national TCP). The cut plant is chopped up and mixed with molasses before being given to animals.

b. Salvinia (*Salvinia m.):* This species was eradicated within the context of a regional management programme (regional TCP).

c. Striga: Actions are taken with growers to manage the plant's spread.

d. Quelea Quelea: Annual campaigns are organised to control the bird population and thus save harvests.

Other programmes are conducted by the above-mentioned structures.
This is the case of the desert locust (that reappeared in 2004) the control of which is organised by the CLAA, of *oedalus s.*, organised by the decentralised structures of the MDRE and the control of the date palm mealy bug organised by a specific project.

4. Conclusion

Following close behind countries of the sub-region, exotic species are causing significant damage in Mauritania.

It is urgently up to the different structures liable to be involved to hold discussions towards:

- defining a framework of dialogue and coordination at national level.
- drawing up a national plan of action and clear cut rules of intervention.
- updating regulations in force and seeing to their enforcement.

APPENDIX 19: Country Report on Invasive Alien Species in Nigeria

Mr Ibrahim Inahoro, Senior Conservation Manager, Nigeria Conservation foundation, P.O. Box 74638, Victoria Islands, Nigeria.

1. List of alien species:

- **Water hyacinth *Eichhornia crassipes*:** This invasive weed is suspected to have invaded Nigerian water from the Republic of Benin about 1984. It has taken over more than 2000km of fresh water, rivers and creeks cutting ofF villages and rendering local fishermen jobless. The weed menace currently hampers normal economic activities in the riverine areas where the weed has established. They impede free river communication in waterways and above all, the spread of the weed obstruct fisheries activities and degrade water quality.

- **Typha grass *Typha dominguenesi*** The grass is suspected to have invaded Nigerian inland wetlands from East Africa. This aquatic has become a problem in the last 15 years in the Hadejia-Nguru wetlands and the water resources of the Komadugu-Yobe Basin. The weed has spread throughout the wetlands blocking water channels, hindering navigation, diverting water-flow, occupying farmland, and reducing extent of fishing ground and providing roosting sites for bird pest such as *Quelea*. One other economic impact of typha grass is the reduction of tourism potential of wetlands.

- **Nipa Palm *Nypa fructicans:*** Nipa was first introduced into Nigeria from Singapore Botanic Garden to the upper cross River estuary at Calabar in 1906 as an erosion control agent by the Colonial administration. Six years later in 1912 this alien macrophyte was also introduced to Oron, which is located down stream of Calabar. It has now spread westwards along the coast down to latitude 4^0E. By the early 1990s Nipa had been recognized as a serious invasive "weed" that needs to be addressed. Nipa impacts negatively on fish catch and shellfish collection. It also impacts negatively on rural navigation in coastal waters, it threatens Nigeria's extensive mangrove vegetation by displacing the mangrove stands and establishing itself in a mono-specific manner, and it reduces the potential for natural mechanisms for control of coastal soil erosion. Nipa causes general habitat conversion and biodiversity loss with attendant reduction in biological production potential of the ecosystem. Local folks depend, often disproportionately on biodiversity for their life support. Loss of biodiversity due to the invasion of plants such as nipa and water hyacinth forces migrations and the search for new livelihoods thereby distorting the social structure of the communities.

2. Summary List of existing Programme on invasive species

The Federal Government policy is the total elimination of the water hyacinth and Nipa palm and other invasive plant species in Nigerian waters. The proposed strategy includes:

- Inventory the spread of water hyacinth and other invasive weed in all water system
- Develop an infestation index map to determine control option
- Adopt an appropriate integrated control option to ensure that the weeds are no longer a menace
- Encourage sub-regional cooperation

The government plan is yet to materialise but the Nigerian Conservation Foundation, an NGO, has been involved in Nipa palm control since 1997. The strategy adopted by the NGO is to utilize various structural parts of Nipa for the production of materials that are useful to man, and to raise awareness through a campaign for native mangrove restoration.

3. List of government agencies, ministries and NGOs involved in invasive species management include;

- Nigerian conservation Foundation (NCF)-an NGIO
- Kainji Lake Fisheries Research Institute, New Bussa
- Federal Ministry of Environment, Abuja
- Nigerian Institute of Oceanography and Marine Research, (NIOMR

4. List of experts working on invasive plants in Nigeria.

These include:

- Prof. Emmanuel Obot, Nigerian Conservation Foundation, Lagos
- Mr. MPO Dore, Federal Ministry of Environment, Garki Abuja
- Ako Amadi, Nigerian Institute of Oceanography and Marine Research (NIOMR) Lagos.

5. The current needs requiring external support for managing Invasive species include;

- Extensive demonstration programmes of nipa palm utilization and restoration of native mangrove.
- Capacity building and skill acquisition for the utilization of invasive species
- Potential of Biogas and fertilizer production from water hyacinth
- Nipa palm based cottage-industry development for the production of industrial vinegar and sugar.

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APPENDIX 20: Country Report on Invasive Alien Species in Senegal

Mr. Ousseynou DIOP, *Direction Protection des Végétaux* [plant protection department], P. O. Box 20054, Thiaroye, Sénégal.

Contents

1. Invasive harmful alien species identified in Senegal

Different programmes were initiated by the *Direction de la Protection des Végétaux*: [plant protection department],

- Manioc mealybug *Phenacoccus manihoti* (1990-1994)
- Water salad *Pistia stratiotes* (1994-1995)
- Mango tree mealybug *Rastrococcus invadens* (1996)
- Manioc green mite *Mononychellus tanajoa* (1991-1995)
- White fly *Aleurodicus dispersus* (1995-1996)
- Water fern *Salvinia molesta* (2000 – 2002)
- Reed (***Typha australis***) (date of introduction unknown)

The first invasive alien species is the **manioc mealybug** (***Phenacoccus manihoti***), identified in 1976 by the DPV/Senegal in the mid-southern region of Sine Saloum (today known as Kaolack) bordering with Gambia.

The second IAS is the **manioc green mite** (***Mononychellus tanajoa***). It was identified in 1991 and has remained limited to the Ziguinchor wetlands.

The third IAS identified is the **water salad** (***Pistia stratiotes***) that had invaded the bodies of water in the Djoudj national bird park in the north and Lake Guiers en 1993. The filling up of the Diama anti-salt dam favoured the spectacular invasion of this plant.

The fourth IAS concerns the **mango tree mealybug** (***Rastrococcus invadens***) that appeared in 1996 in the immediate vicinity of Dakar airport. It invaded the entire capital and the Thiès and Ziguinchor regions.

The fifth IAS is the **white fly** (***Aleurodicus dispersus***) that appeared in 1995 in the Dakar region on ornamental plants in homes. It then invaded vegetable gardens in the Niayes (costal area between Dakar and St. Louis) and the cotton fields of the south-western regions.

The sixth IAS is the **water fern** (***Salvinia molesta***) which, in 2000, invaded all the bodies of water of the Senegal River from Rosso to St. Louis as well as its distributaries on the axes of the Taouey (Richard Toll), Gorom Lamsar and the bodies of water of the Djoudj national bird park.

The seventh is the **reed** (***Typha australis***) whose presence in Senegal goes back several decades. Here, it is considered as indigenous but it is, in fact, alien. Its environmental impact increased when the Diama anti-salt dam was filled on the Senegal River. Thousands of hectares have been invaded along the two banks of the Senegal River. Similarly, Lake Guiers is threatened by this plant. The Senegalese government has just set up a project called *Programme de Lutte contre les Végétaux Aquatiques Envahissants dans le Delta du Fleuve Sénégal* [programme for the management of invasive aquatic plants in the delta of the Senegal River] in which it has injected 4 billion F CFA (8 million $US).

This 1-year programme concerns the areas of the Senegal River (axes Gorom-Lamsar, Taouey-Lac de Guiers) over an area estimated at 1 267 000 m^2 (126.7 ha). Mechanical management has been organised here by a private Mauritanian company. It consists in the use of a mower with an amfibious shovel made in Canada which cleared an area of 16 ha by 13 February 2004.

All these invasive alien species, with the exception of *Typha australis*, have been controlled thanks to classical biological control consisting in the introduction of their specific natural enemy.
The **water hyacinth** (***Eichhornia crassipes***) is indeed found as an ornamental plant in gardens and houses. It has not yet been observed in the country's water bodies. This fearsome aquatic plant needs to be monitored on an ongoing basis.

The **desert locust** (***Schistocerca gregaria***) is a fearsome trans-border pest. Invasions of the species in Senegal are cyclical (1986-1988, 1993 and 2003). In 1988 and in 1993, significant economic damage was recorded.

2. Programmes underway

A 1-year invasive aquatic plant management programme in the Delta of the Senegal River has been set up by the *Ministère de l'Environnement et de l'Assainissement* [ministry of the environment and sanitation] and financed by the Senegalese government (4 billion F CFA (8 million $US) which mechanically controls the **reed** (***Typha australis***) in areas surrounding the Senegal River (Gorom-Lamsar, Taouey-Lac de Guiers axes) over a total area estimated at 1 267 000 m^2 (126.7 ha). Mechanical management has been organised here by a private Mauritanian company. It consists in the use of a mower with an amfibious shovel made in Canada which cleared an area of 16 ha by 13 February 2004. The coordinator of the invasive aquatic plant programme in the Delta of the Senegal River is:

Mr. Abdou DIA
Tel: 221 961 20 17 / 961 15 33 mobile: 221. 565 05 90
E-mail: cododia@yahoo.fr
P. O. Box 74 St. Louis/Senegal

- The monitoring and raising of awareness regarding invasive aquatic plants. Predator detection operations in the country by the *Division Avertissements Agricoles* [agricultural warning division] and *Défense des Cultures* [crop control] /*Direction de la Protection des Végétaux* [plant protection department]/ *Ministère de l'Agriculture et de l'Hydraulique* [department of agriculture and hydraulics]. Manager:

  Mr. Ousseynou DIOP
  Tel: 221. 834 03 97 mobile: 221. 647 27 33
  Fax: 221. 834 28 54
  E-mail: diopousseynou@hotmail.com
  P. O. Box 20054 Thiaroye, Senegal.

- Phytosanitary management at border crossings, mainly at Dakar Yoff airport, at the Dakar railway station and at the port of Dakar. Other posts within the country and at borders are managed by the *Division Législation et Quarantaine* [legislative and quarantine division] / *Direction de la Protection des Végétaux* [plant protection department]/ *Ministère de l'Agriculture et de l'Hydraulique* [department of agriculture and hydraulics. Manager:

  Mr. Séni DIEME
  Tel: 221. 834 03 97
  Fax: 221. 834 28 54
  P. O. Box 20054 Thiaroye, Senegal.

- Invasive aquatic plant management programme in the Delta of the Senegal River

  Ministère de l'Environnement et de l'Assainissement [ministry of the environment and sanitation],
  Tel: 221 961 20 17 / 961 15 33
  E-mail: cododia@yahoo.fr
  P. O. Box 74 St. Louis/Senegal

- *Projet Biodiversité Sénégal Unité nationale.* [national unity Senegal biodiversity project]

  Ministère de l'Environnement et de l'Assainissement [ministry of the environment and sanitation],
  Tel: 221. 961 91 59 / 635 06 26
  E-mail: unpsen9831@sentoo.sn

3. Relevant management departments

3.1 **Ministère de l'Agriculture et de l'Hydraulique** *[ministry of agriculture and hydraulics]*

Direction Protection des Végétaux (DPV) [plant conservation department]
Tel: 221. 834 03 97
Fax: 221. 834 28 54
E-mail: diopousseynou@hotmail.com
P. O. Box 20054 Thiaroye/Senegal.

Institut Sénégalais de Recherches Agricoles (ISRA) [Senegalese agricultural research institute]
Tel: +221. 832 24 20 / 832 24 31
Telex: 61117 ISRA SG
E-mail: dgisra@isra.sn
P. O. Box 3120 Dakar/Senegal

Société de l'Aménagement des Eaux du Delta du fleuve Sénégal (SAED) [Senegal River Delta water development company]
Tel: +221 961 1533/34
Fax: +221 96114 63
P. O. BOX 74 Saint-Louis/Senegal

Inspection régionale de l'Hydraulique [regional hydraulics inspection]
Tel: +221 961 1813
P. O. Box 374, Saint-Louis/Senegal

3.2 Ministère de l'Environnement et de l'Assainissement [ministry of the environment and sanitation]

Tel: 221 889 02 30 / 849 73 46
E-mail: mepn.dc@sentoo.sn
P. O. Box 40 055 Dakar/Senegal

Direction des eaux et Forêts et Chasses [water, forest and hunting department]
Tel: 221. 832 06 28 /832 08 56
P. O. Box 1831 Dakar-Hann/Senegal
E-mail: cissematar@sentoo.sn

Direction de l'Environnement et des Etablissements Classés (DEEC)
[environment and classified establishments department]
Tel: +221 821 07 25
E-mail: direnvi@sentoo.sn
P. O. Box 6557 Dakar/Senegal

Direction des Parcs Nationaux [national parks department]
Tel: +221 824 42 21
Tel/Fax: + 221 825 05 40
E-mail: dpn@sentoo.sn
P. O. BOX 5135 Dakar-Senegal

Centre de Suivi Ecologique (CSE) [ecological monitoring centre]
Tel: 221. 825 80 66 / 825 80 67
E-mail: niang@cse.sn
infos@cse.sn
P.O. Box 15 532 Dakar-Fann/Senegal

3.3 NGOs and projects

Union mondiale pour la nature [world nature union]
Tel: 221 869 02 80
Fax: +221 824 92 46
E-mail: iucnsn@sentoo.sn
P. O. Box 3215, Dakar

Projet Biodiversité Sénégal-Mauritanie [Senegal/Mauritania biodiversity project]
Inspecteur Régional des Eaux et Forêts [water and forestry regional inspector]
Tel: +221 961 75 37
E-mail: dahsallihi@hotmail.com
P. O. Box 229 Saint-Louis/Senegal

Wetlands International
Tel: +221 820 6478/fax:+221 820 6479
E-mail: awaisswet@sentoo.sn
Cité Djily Mbaye
Villa n° 407

NGO diapanté
Tel:+221 961 12 22
E-mail: diapante@telecomplus.sn
P. O. Box 356 Saint-Louis/Senegal

4. Management priorities

- Specific attention should be focussed on the water hyacinth (*Eichhornia crassipes*) found in gardens and on properties. It is a permanent danger for bodies of water in Senegal, about which policy-makers and riverside populations need to be made aware.
- Successful biological control needs to be monitored in the country's aquatic ecosystems of *Pistia stratiotes* and *Salvinia molesta.*
- The continuation of mechanical control activities initiated against *Typha australis* and the mbilor (*Aeschynomene elaphroxylon*).
- Undertake assessments towards a better understanding at national level of risk areas (maps) and draw up an inventory of all invasive species.
- The diagnosis of water invasion by invasive species and the assessment of environmental and socio-economic impacts.

5. List and details of experts

i. Mr. Ousseynou DIOP

Chef Division Avertissements Agricoles et Défense des Cultures/ Direction Protection des Végétaux [agricultural warnings and crop conservation/plant protection department]
Tel: +221. 834 03 97 Mobile: +221. 647 27 33
Fax: +221. 834 28 54
E-mail: diopousseynou@hotmail.com
P.O. Box 20054 Thiaroye/Senegal.

ii. Mr. Ibou SANE

Expert en Formation participative/Direction Protection des Végétaux
[expert in participatory training/plant protection department]
Tel: +221. 834 03 97 Mobile: +221 536 08 89
Fax: +221. 834 28 54
P. O. Box 20054 Thiaroye/Senegal.

iii. Mr. Séni DIEME

Chef Division Législation et Quarantaine/Direction Protection des Végétaux
[head of legislation and quarantine division/plant protection department]
Tel: +221. 834 03 97
Fax: +221. 834 28 54
P.O.Box 20054 Thiaroye/Senegal.

iv. Mr. Abdou DIA

Coordonnateur Programme de lutte contre les végétaux aquatiques envahissants dans le Delta du Fleuve Sénégal [coordinator of invasive aquatic plant control programme in the Senegal River Delta]
Tel:+ 221 961 20 17 / 961 15 33 Mobile: +221. 565 05 90
E-mail: cododia@yahoo.fr
P.O. Box 74 St. Louis/Senegal

v. Mr. Mamadou BALDE

Chercheur en Entomologie Institut Sénégalais de Recherches Agricoles
[researcher in entomology at the Senegalese agricultural research institute]
Tel: +221. 973 60 48 mobile: +221 551 18 55
E-mail: tunkanbalde@yahoo.fr
Centre National de Recherches Agronomiques [national agronomic research centre]
P.O. Box 53 Bambey/Senegal

vi. Mr. Souleymane DIALLO

Chercheur en Malherbologie Institut Sénégalais de Recherches Agricoles
[researcher in weed science at the Senegalese agricultural research institute]
Centre de Recherches Agricoles [agricultural research centre]
Tel: +221 961 17 51
E-mail: souleymane9@voila.fr
P.O. Box 240 Saint Louis/Senegal

6. Known publications

- **Appui à la Lutte contre *Salvinia molesta*.** Regional project: Mauritania, Senegal. Programme de Coopération Technique AG:TCP/RAF/0173. Final project report prepared for member governments by the UNO for food and agriculture (FAO) Rome, 2003.
- **L'antidote de l'insecte venu de l'Afrique du Sud, la *salvinia molesta* mise hors d'état de nuire**. Report by Mohamadou Sagne. Daily newspaper « Le Soleil ». Issue of Thurs 22 August 2002 Saint-Louis/Senegal.
- **Appui réussi à la lutte contre « *Salvinia molesta* ».** ONU-HEBDO FAO Sénégal N° 04/2002 of Monday 9 September 2002. Weekly bulletin published by the *Centre d' Information des Nations Unies* [United Nations information centre] for Cap -Vert, Cote d'Ivoire, Gambia, Guinea Bissau, Mauritania and Senegal. P.O. Box 154 Dakar - Senegal.

- **Un charançon dans la salade.** DIOP, O./DPV Sénégal. SPORE CTA. Bimonthly bulletin of the Centre Technique de Coopération Agricole et Rurale [farming and rural cooperation technical centre] N°62.
- **Plante nuisible, *Salvinia molesta* meurt dans la bataille biologique**. Agence de Presse Syfia-Sénégal. June 2002 Madieng Seck and Abdoul Salam Diagana of Mauritania. Financed by the FAO, Mauritania and Senegal, have led a biological management campaign against the Salvinia molesta, a harmful plant that invaded the Senegal River. Mechanical control proved insufficient but biological warfare seems to be winning.
- Regional workshops on invasive species. Ramsar/Convention on Wetlands, Union mondiale pour la nature (UICN) OMPO Patrimoine Mondial (World Heritage), Saint- Louis (Senegal) 5 au 17 octobre 2001.

- **La Capacité de Maîtrise de la Jacinthe d'eau en Afrique et au Moyen-Orient.** DIOP, O. /DPV Sénégal, regional consultant and expert adviser (Central Africa: Congo Brazzaville, DRC) and (West Africa: Benin, Burkina Faso, Cote d'Ivoire, Ghana, Guinea Conakry, Mali, Niger, Nigeria, Senegal) of the *Centre de Recherches pour le Développement International* (CRDI/IDRC) [international development research centre] October 1996 - October 1997.

- **Lutte biologique contre la cochenille du manioc (Phenacoccus manihoti) au Sénégal.** Biological management project technical reports 1992, 1993, 1994, 1995. DIOP, O. et al. /DPV Senegal.
- **Lutte biologique contre la cochenille du manioc (Phenacoccus manihoti Matilde et Ferrero) au**
- **Sénégal.** DIOP, O. /DPV Senegal. Sahel IPM N°10, August 1996, Bimonthly bulletin of the Sahel Institute, p2-8.
- **Lutte biologique contre la salade d'eau (*Pistia stratiotes*) au Sénégal.** DIOP, O. et al./DPV Senegal. Biological management project technical reports 1994, 1995.

7. Needs

- The training of participants in the sector and the financing of programmes on invasive species;
- The making of posters on invasive species to raise awareness among populations in local languages at border posts, airports and ports;
- The problem of invasive species is accentuated by the lack of utilisation of existing legal documents; also, laboratory and IT equipment is required at border posts for the purposes of phytosanitory control;
- Technical assistance towards assessing the environmental and socio-economic impact of the presence of invasive plants in the country's bodies of water.

APPENDIX 21: Country Report on Invasive Alien Species in Sierra Leone

Dr Aiah Lebbie, Center for Biodiversity Research, Njala University College, PMB Freetown, Sierra Leone

1. List of Alien Species

(i) Herbs/Grasses

a) *Alternanthera brasiliana*
b) *Bambusa vulgaris*
c) *Chromolena odorata*

(ii) Fish

a) Several species of *Tilapia spp*.

(iii) Other exotic species

Other exotic species exist in Sierra Leone, which are largely tree-based and were introduced to set up forest plantations and re-afforest degraded areas. No program of trying to understand the impact of some of these species on the local flora and fauna has been undertaken. Some of these species include:

(a) Timber Species

a) *Cordia alliodora*
b) *Gmelina arborea*
c) *Tectona grandis*
d) *Pinus carribaea* var. hondurensis

(b) Agro-forestry Trees/Fuelwood Species

a) *Calliandra calothyrus*
b) *Acacia aureocoformis*
c) *Acacia mangium*
d) *Leucaena leucocephala*
e) *Gliricidia sepium*
f) *Senna siama* (Cassia siama)

2. Existing Programs on Invasive Alien Species

There are no known or existing programmes on the management of invasive alien species nor are there awareness campaigns by government agencies or local non-governmental organizations to combat the spread of alien/exotic species. According to Ndomahina (2002) no evidence at the moment exists for alien species introductions in the marine environment but no no systematic studies have been done. It has been estimated that 300 ships discharge ballast water off the coast of Sierra Leone annually. The Institute for Marine Biology (IMBO) has prepared a proposal to study harmful algal blooms in ballast water.

3. Organizations Potentially Involved with Management of Invasive Alien Species

(a) Forestry Division
Ministry of Agriculture Forestry & Food Security
Youyi Building
Freetown, Sierra Leone

(b) Phytosanitary Unit
Ministry of Agriculture, Forestry & Food Security
Youyi Building
Freetown, Sierra Leone

(c) Environmental Foundation for Africa
1 Beach Road
Lakka
Freetown, Sierra Leone

(d) Conservation Society of Sierra Leone
2 Pyke Street
Freetown, Sierra Leone

(e) Green Scenery
Freetown, Sierra Leone

(f) Sierra Leone Maritime Services
Freetown, Sierra Leone

(g) Institute of Marine Biology
Fourah Bay College
Freetown, Sierra Leone

4. Priorities and Strategies for Management and Policy Recommendation

a) Issues and Gaps

- Lack of adequate scientific knowledge of invasive species in the various ecosystems of Sierra Leone,
- Lack of identification and monitoring mechanism for alien species,
- Lack of control and mitigation mechanisms for combating the harmful effects of alien species,
- Lack of public awareness of the harmful effects of invasive species on biodiversity,
- Lack of up-to-date policies and legal provisions for the control of importation of exotic/alien species into Sierra Leone, and
- Too much emphasis on alien or exotic species in forestation programs in Sierra Leone.

b) Strategies

- Promote scientific investigations into the types, origin and potential impacts of alien species on native biodiversity,
- Review and strengthen existing policies and legislation on alien species,
- Develop and promote programs to monitor, control and surveillance alien species,
- Enhance public education and awareness about the impacts of alien species,
- Promote the use of indigenous species in restoration work,
- Forestry Division to limit the use of invasive alien species like Acacia spp. In reforestation programs.

5. List of Experts on Biological Invasions in Sierra Leone

a) Aiah Lebbie, PhD
Center for Biodiversity Research
c/o Department of Biological Sciences
Njala University College
PMB Freetown, Sierra Leone
E-mail: aiahlebbie@yahoo.com

b) Abdul B. Karim, PhD
Department of Biological Sciences
Fourah Bay College
Mount Aureol
Freetown, Sierra Leone

*c) **Abdulai Feika***
National Herbarium
Department of Biological Sciences
Njala University College
PMB Freetown, Sierra Leone

*d) **Ernest T. Ndomahina, PhD***
Institute for Marine Biology
Fourah Bay College
Mount Aureol
Freetown, Sierra Leone

*e) **Sheku Mansaray, MSc***
Forestry Division
Ministry of Agriculture, Forestry & Food Security
Youyi Building
Freetown, Sierra Leone

6. Bibliographic References

D. W. Scotland. 1956. The introduction of plants and seeds into the colony of Sierra Leone in the early years of its foundation. Sierra Leone Studies (New Series) 7:183-187.
Ndomahina, E. T. 2002. An Assessment of the Status of the Coastal and Marine Biodiversity of Sierra Leone. A Report Prepared on behalf of the Sierra Leone Maritime Administration, Sierra Leone.

7. Current Needs for Managing Invasive Species

- Assess the role of the UN peace keeping forces in Sierra Leone in the spread of exotic and alien species,
- Regulate the introduction and spread of exotic and over-abundant species in forested areas,
- Promote measures to prevent the introduction of alien and exotic species into marine and coastal habitats,
- Develop and promote aquaculture/mariculture using native species,
- Assess the impact of the potential release of aquaculture species like *Tilapia* into freshwater ecosystems,
- Promote silvicultural techniques that encourage natural regeneration of native species.

APPENDIX 22: Country Report on Invasive Alien Species in Togo

Pocanam Yentchabré, ITRA, B.P. 1163, Lomé, Togo.
Dantsey-Barry Hadyatou, ITRA, B.P. 1163, Lomé, Togo.

Summary

Introductions of plant material into Togo from other countries are regulated by laws. However, considering the weakness in control methods and the easy crossing of borders, these introductions are practically uncontrolled.

Today, two main types of invasive plants are introduced into Togo. The land species are *Chromolaena odorata* (L.) R. M. King and Roberson, *Leucaena leucocephala* (Lam) de Wit, *Rottboellia cochincinensis* (Lour) W. Clayton, *Echinochloa colona* L., *Mimosa invisa* Mart, *Cyperus rotundus* L., *Striga* spp and *Calopogonium muconoides* Desv. The aquatic species are *Eichornia crassipes* (Mart.) Solms-Laub, *Salvinia molesta* D.S. Mitch. and *Pistia stratiotes* L..

The major control measures at national level were mainly aimed at invasive aquatic plants and involved the raising awareness among populations living near infested waters, and biological control through insect release. An interdepartmental monitoring committee was also set up for this purpose.

Key words: invasive plants, control measures, Togo.

1. List of invasive species (level of invasion and impacts)

Species	Ecology	Level of invasion	Economic impact	Ecological impact	Areas of infestation
1. Chromolaena odorata	Land	Strong	Significant	Very significant	Farming plots, fallow lands, grazing lands, plantations
2. Leucaena leucocephala	"	Weak	Weak	Weak	Agro-forestry sites
3. Rottboellia cochincinensis	"	Medium	Weak	Weak	Farming plots
4. Echinochloa colona	"	Strong	Strong	Strong	Irrigated areas
5. Cyperus rotundus	"	Strong	Strong	Strong	Research stations, mechanised farms, lawns
6. Striga spp	"	Strong	Very significant	Significant	Farming plots, fallow lands
7. Mimosa invisa	"	Medium	Medium	Medium	Farming plots and edges of roads
8. Calopogonium muconoides	"	Weak	Weak	Weak	Research stations
9. Eichornia crassipes	Aquatic	Strong	Significant	Very significant	Dams, lakes, reservoirs, irrigated areas
10. Salvinia molesta	"	Strong	Significant	Very significant	Dams, lakes, reservoirs, irrigated areas
11. Pistia stratiotes	"	Strong	Significant	Very significant	Dams, lakes, reservoirs, irrigated areas

2. Summary of preventative measures and management campaigns

Management measures at national level were mainly aimed at invasive aquatic plants such as *Eichornia crassipes, Salvinia molesta* and *Pistia stratiotes*. They involved raising awareness among populations living near infested waters, and biological control, through the release of insects (*Neohydronomus affinis, Neochetina eichhorniae* and *Neochetina bruchi*). An interdepartmental monitoring committee was also set up for this purpose. This initiative was financed by the project TCP/RAF/0066 (A) of the FAO between 2000 and 2002.

No management campaign on national level was undertaken in the case of the other invasive plants.

3. Structures involved in invasive plant control

i. Ministère de l'Agriculture, de l'Elevage et de la Pêche [department of agriculture, animal breeding and fishing]

- Institut Togolais de la Recherche Agronomique [Togolese agronomic research instititute]
- Direction de l'Agriculture [department of agriculture]

ii. Ministère de l'Environnement et des Ressources Forestières [department of the environment and forestry resources]

iii. Ministère de l'Enseignement Supérieur et de la Recherche [department of higher education and research]

- Université de Lomé

iv. Ministère de la Santé [department of health]

v. Ministère de l'Energie et des Ressources Hydrauliques [department of energy and hydraulic resources]

- Société " Togolaise Des Eaux - TDE" [Togolese water company]
- Société " Communauté Electrique du Bénin – CEB" [Benin electrical community]
- Société " Togo Electricité " [Togo electricity]

vi. Ministère de l'Intérieur, de la Sécurité et de la Décentralisation [department of home affairs, safety and decentralisation]

vii. Lomé

4. Strategic priorities

These hinge on the integrated management of the main invasive plants, namely:

- ***Striga* spp** for annual crops. Recommended measures are **agronomic (**hoeing, crop lifting, crop rotation, sowing dates, organic manure, mineral fertilisation (mainly nitrogen); **Varietal** (utilisation of resistant or tolerant varieties); **Biological**: "false host" crops (cotton, peanuts, soya, trap crops, mushrooms, insects).
- ***Eichornia crassipes, Salvinia molesta* and *Pistia stratiotes:*** mechanical and biological control by releases of insects and raising awareness among riverside populations and companies that manage dams, lakes or lagoons.
- ***Chromolaena odorata:*** Apart from raising awareness among producers about the negative effects of this plant on farming, animal breeding and ecology, no other strategic measure has been considered. A programme to manage this annual weed is being set up at the Institut Togolais de Recherche Agronomique (ITRA) [Togolese agronomic research institute] in Lomé.

5. List of experts working on biological invasions

Surname and given names	Observation	Addresses
1. Dr Agounke Dovi * 2. Doni Yaovi * 3. Gogovor Yao **	Biological control of floating aquatic plants	* P.O. Box : 1263 – Lomé Tel: : (228) 222-61-25 E-mail : isys@tg.refer.org ** P.O. Box: 1163 - Lomé Tel: (228) 225-21-48; 225-30-96; 330-00-20; 330-41-33 Fax: (228) 225-15-59 E-mail: itra@cafe.tg; yenpoca@yahoo.fr

Surname and given names		Observation	Addresses
4. 5.	Akpagana Koffi Afidegnon Dotchè	Botanists	Lomé University. Faculty of Sciences
6.	Dr Agboli Atsu Comlan	Phytopathologist, specialist des Striga	P.O. Box 1163 - Lomé Tel: (228) 225-15- 59; Fax: (228) 225-15-59 E-mail: itra@cafe.tg;
7. 8.	Pocanam Yentchabré Dantsey-Barry Hadyatou	Weed scientist Weed scientist	P.O. Box: 1163 - Lomé Tel: (228) 225-21-48; 225-30-96; 330-00-20; 330-41-33 Fax: (228) 225-15-59 E-mail : itra@cafe.tg; yenpoca@yahoo.fr

6. Bibliography on invasive plants in Togo and in the sub-region

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7. Needs for the effective management of invasive plants

*** <u>Human</u>:** training of researchers and field advisers towards a better understanding of the main invasive plants (biology, identification, characterisation, reproductive cycle, control methods, integrated management, quarantine, etc..) and towards appropriate control techniques (agronomic, biological, etc…). Two specialists will be useful for each main species or group of species: *Striga* spp, *Chromolaena odorata* and aquatic plants (*Eichornia crassipes, Salvinia molesta* and *Pistia stratiotes).*

*** <u>Logistics</u>**: **one (1) 4 * 4** vehicle to be used towards a better idea of the level of invasion of the main invasive species Two **laptop computers** to capture data gathered on each invasive species. **Geographical information system software** for maps showing the distribution of invasive species. ***<u>Running</u>**: **Fuel and lubricants** for running the vehicles. **Office and IT supplies** (reams of paper, diskettes, CD-Rom), **documentation.**

APPENDIX 23: Plenary Session on Challenges at the Country Level

In a plenary brainstorming session, participants identified and discussed the challenges that they face at a country level in addressing IAS issues. These challenges were subsequently clustered into the following categories:

Capacity issues

- Capacity building
- Strengthening national capacity
- Capacity to mitigate IAS
- Need for education at all levels
- Need more training for IAS management
- Border control

Institutional issues

- Institutional arrangements
- Setting up a national committee
- Good participatory management
- Sharing national competencies
- Holistic approach to control
- Coordination activities
- Strategic plan of action
- Development of strategies
- Harmonisation of procedures
- Lag time between invasion and action
- Bureaucracy
- Government bureaucracy
- No established channels of communication and reporting
- Strengthen the role of IAPSC
- Information unit for IAS

Awareness issues

- Public awareness and education
- Ignorance, public awareness
- Low awareness of public on IAS
- Policy makers are unaware of IAS impacts

Information issues

- Assess the level of invasion and spread of IAS
- Inventory of IAS
- Lack of complete scientific knowledge
- Lack of adequate biological information
- Exhaustive inventory of IAS
- To set up a programme for monitoring
- Information exchange

Taxonomic issues

- Problems of identification
- Identification

Policy issues

- Legislative and policy measures for IAS
- Legislation/statute on IAS
- Fragmented policy
- Early detection through policy
- Political definition of IAS
- Conflict of interest

Resources issues

- Funding for surveillance and control
- Low human and material resources
- Financial and other resources
- Financial constraints

APPENDIX 24: Summary of Working Group Sessions on 'Forging Regional Co-operation'

Two working groups addressed a series of questions concerning regional cooperation in IAS prevention and management as follows:

- **Perceived needs and opportunities for cooperation throughout West Africa?**
- **What do we want the region to achieve collectively?**
- **What are the challenges to achieving regional cooperation?**
- **What are the necessary elements for a strategy to facilitate regional cooperation?**
- **How can we promote collaboration and cooperation within existing frameworks?**
- **What are the existing resources that can be utilized to achieve regional cooperation?**
- **What additional resources are needed?**

A summary of the points discussed by each working group in answering the questions is presented here.

Working Group 1

Chairman: David Arodokoun
Rapporteur: Ousseynou Diop

Perceived needs and opportunities for cooperation throughout West Africa

- IAS do not have borders. Consistent mechanisms between countries to address need
- Legal frameworks
- Strategic action plans
- Subregional/Regional cooperation
- Use of existing agencies
- Better understanding of farming systems
- Examine existing capacities. Identify roles
- High level water interdependence creates opportunity for IAS
- Existence of water basin management organization provide opportunity and economy of scale
- Program of integrate control
- Use Existing organization better (CORAF)
- Opportunities: ECOWAS – NEPAD – African Development Bank – Project (new)
- Past project failures, understand why? (1995, '97, '98)

What do we want the region to achieve collectively?

- Collective holistic control of IAS
- First need to review national status for integration at regional level
- Putting in place cooperation mechanisms
- Common phytosanitary regulation

What are the challenges to achieving regional cooperation?

- language barriers to overcome/remove
- Improve information sharing
- Communication problems at regional level
- Mobilization of resources (human, financial)
- Training efforts to be increased to endow the region with required expertise
- Strict implementation of phytosanitary rules
- Commitment of political leaders to regional cooperation
- Improve awareness
- Need to take into account indigenous knowledge

What are the necessary elements for a strategy to facilitate regional cooperation?

- National strategies to be in place
- Inventory of IAS at regional level
- Consultation mechanism at regional level
- Strengthen existing: (IASPSC/Cameroon) (CSP/ CILSS)
- Establish regional clearinghouse mechanism for tracing species movements, (if possible by strengthening existing institutions)
- Improve regional research collaboration
- Develop a regional strategic plan

How can we promote collaboration and cooperation within existing frameworks?

- Information exchange/sharing (fix regular meetings: review of national reports on IAS)
- Strengthen existing institution and where needed broaden their mandates
- Exchange expertise
- Join training programs
- ECOWAS through agriculture and environment unit to play coordination role
- Strengthen cooperation with GISP and enrich their date base

What are the existing resources that can be utilized to achieve regional cooperation?

- Trained human resources
- Research facilities and research experience in biocontrol and IPM
- Regional/internal research (eg IARCs)
- African Development bank as potential source of funding
- Indigenous knowledge NB: Possibility of using regional association of ethnobotanists eg CAMES…
- Existence of political organisation that promote regional cooperation (ECOWAS, etc.)
- Global Environment Facility (GEF) as potential source of funding and technical support

What additional resources are needed?

- Material and financial support
- Improve communication facilities with national committees of IAS control
- Backstopping from international bodies
- Government to improve level of funding by IAS mgt
- Government efforts to be completed by increased donor support
- Additional training efforts in critical areas such as taxonomy
- Help set in place effective pre and post entry quarantine facilities
- Help establish a regional centres of excellence Eg: Taxonomy
- More support to biology and socio-economic as well as management and EIA of IAS

Working Group 2

Chairman: Ben Donnie
Rapporteur: Sankare Yacoub

Perceived needs and opportunities for cooperation throughout West Africa

- communication
- networking
- national and regional legal framework
- involvement of regional bodies such as ECOWAS
- establish and strengthen regional centres
- identify common problems within states
- exchange of information and experiences
- make IAS an agenda item for ECOWAS
- awareness for ECOWAS

What do we want the region to achieve collectively?

- sustainable programs
- proper management of water bodies
- linkages and cross-border cooperation
- harmonize legislation
- regional program with basin as sub-component
- find source of IAS, restoration programs
- establishment of functional structures
- common approach for management/control of IAS
- establishment of database on IAS
- cross border control of IAS

What are the challenges to achieving regional cooperation?

- ignorance
- insufficient public awareness
- lack of sufficient information and consultation
- conflict of interest
- dissemination of information at all levels (schools, private sector, politicians…)
- low human and institutional capacities, insufficient financial resources
- awareness of policy makers
- lack of cooperation among researchers
- cross-border global vision
- different levels of appreciation of IAS at national level
- poverty reduction
- lack of sustainability of short term projects
- involvement and participation of relevant stakeholders
- lack of national and regional strategy
- lack of information and formation on IAS
- regional conflicts
- chronic bureaucracy

What are the necessary elements for a strategy to facilitate regional cooperation?

- establishment of IAS secretariat
- national focal point and regional coordinator
- regular stock taking
- exchange of experiences
- full involvement and better use of existing sub-regional networks
- involvement of regional river basin authorities
- capacity building
- integrated research program
- mechanism for national reporting through focal points
- regular/periodic regional meetings
- establishing of a clearing house mechanism for EE
- review existing functional structures in other regions
- national structures to function under the coordination of ECOWAS
- encourage commitment of national governments

How can we promote collaboration & cooperation within existing frameworks?

- review all existing national and regional frameworks
- harmonize all national frameworks with ECOWAS
- set up objectives for cooperating with frameworks
- strengthen and revise where appropriate existing structures
- incorporate global IAS information
- incorporate our strategies and objectives into the works of international bodies such as CBD, IPPC, etc.
- engage ECOWAS/NEPAD constructively through sensitisation about the work on IAS

What are the existing resources that can be utilized to achieve regional cooperation?

- national experts (experienced individuals)
- technicians
- specialists
- academic institutions
- research institutes (private, governmental, international)
- use of local communities knowledge
- NGOs
- national agencies
- international agencies
- available training methodologies

What additional resources are needed?

- professional training
- strengthening research structures involved in IAS management
- financial resources
- exchange of experiences (local adaptation)
- logistics and equipment
- establish additional research centres where needed
- people with interests
- relevant scientific knowledge of IAS in the region
- introduce courses on IAS in university curriculum within the sub-region

APPENDIX 25: Summary of Working Group Sessions on a Regional Communication and Dissemination Strategy

A communication and dissemination strategy was identified as a key component of the regional IAS strategy for West Africa, and more detailed discussions were held to identify stakeholders, what information needs to be communicated, and what the other components of the communication strategy should cover. A summary of the working group discussions is presented here.

1. Stakeholder categories to be considered

- Farmers and fishermen
- Non governmental organizations and institutions
- Community leaders (Chiefs, Church leaders etc.)
- Media
- Youth, women
- Private sector
- Government Ministries and departments
- Religious organizations
- Trade unions
- Transport sector
- Donor agencies
- Artists and cultural groups
- Educational institutions
- Research institutes, including plant breeders
- Cooperative associations
- Regional organizations

2. Specific messages to stakeholder groups

Different messages are required for different stakeholder groups, and different methods of presentation are appropriate for the different groups. The following messages would not necessarily apply to all groups.

- What IAS are (i.e. how to define them) and how individual IAS can be recognised/identified.
- The impact of IAS on biodiversity, health and socio-economy.
- Current status of IAS in the sub-region.
- Pathways through which IAS are introduced, established and spread
- Early warning of new invasions.
- Methods for control and management of IAS, and availability of relevant expertise.
- The advantages and disadvantages of IAS.
- Financial implications of IAS (management costs and direct losses).
- Regulations on IAS and the corresponding penalties for non-compliance.
- Benefits from stakeholder involvement in IAS control.
- The roles to be played by communities.

3. Components of the strategy

- Objectives
- Problem analysis
- Stakeholders (see above)
- Implication
- Education, training, awareness creation
- Formats for messages
- Tools to be used
- Finance
- Human resources required
- Expected results
- Monitoring and evaluation

APPENDIX 26: Abstracts of Technical Papers on Invasive Alien Species Presented during the Workshop

1. Situation of water hyacinth in Bénin

Hounkpè, Cathérine *Direction des Pêches, 01 BP 383 Cotonou, Benin.*

Abstract

Originating from area of Amazon in Brazil, water hyacinth (Eichhornia crassipes of the family of Pontederiaceae), has been discovered in 1977 in Bénin. It has become the most important aquatic floting weed ten years later. It reproduces by bot stolons forming great carpets, which are easily scattered by the water current, the wind and the boatmen. It also produces important quantities of seed with a germinative ability extending fifteen (15) years. The infestation of most of the water bodies in Bénin is the revelation of the organic pollution caused by an excessive enrichment of the water in nitrogen and phosphate. Salinity of about five parts per thousand, contributes to its destruction. But as soon as the environnement conditions become favourable for them, the bot seeds germinate, multiply excessively and cover vast aquatic areas. This situation causes a lot of problems. At first, we have the environment problems like reduction of the photosynthesis, the decline of the depth level of the lake, the consumption of great quantities of oxygen during the sedimentation. Then, we have socio-economic problems such as the destruction of piles and cultivations, the decrease of fisheries productivity, and obstruction of fishing. Lastly we have health problems such as desaese like malaria, because water hacinth is the lodging of insects (mousticos). All this problems contribute to aggravate the poverty of fishing communities.

To face up to this situation, we have realised many actions. They are:

- The biological fight with the release of beetle (*Neochetina eichhorniae*). It is done by the International Institute for Tropical Agriculture (IITA), and the lagoon Fishing projet of Fishing Management office;
- The creation of fight committee and their equipment in boat by Benin Government for the manual fight;
- The training of three fishing technicians in march 2001 at Republic of Mali, about the technology of biological fight against hyacinth;
- The heightening of the waterside residents awareness of the importance of biological fight actions in their villages;
- The future actions will concern:
- The pursuit of the fight against floating vegetables (biological and manual
- fight and the fitting out of physical barriers);
- The development in agriculture of technologies which make hyacinth be useful;
- The intensification of abilities (training, information, education and communication).

2. Impact de **Chromolaena odorata** *(L.) R.King & H. Robinson dans les communautés forestières et les pâturages au sud du Bénin*

Agbani, Pierre Onodjè et Sinsin, Brice
Laboratoire d'Ecologie Appliquée FSA /UAC, 01 BP 526 Cotonou Bénin

Résumé
Le caractère envahissant de l'espèce *Chromolaena odorata* originaire d'Amérique tropicale a été étudié dans les écosystèmes forestiers et pâturés du sud du Bénin. Les relevés phytosociologiques ont permis de constater que le potentiel de régénération naturelle des essences forestières est handicapé dans les buissons très denses et étouffant de *Chromolaena odorata* avec une perte de la diversité floristique. Dans la forêt de la Lama, la densité des plantules des essences forestières varie du simple sous *Chromolaena odorata* au quintuple dans les îlots de forêt dense semi- décidue. L'influence de *Chromolaena odorata* est notoire dans les pâturages des savanes guinéennes dégradées jusqu'à 8° N. La biomasse des refus et le taux d'embroussaillement sont des paramètres qui permettent de mieux expliquer la dégradation quantitative et qualitative des pâturages. Les valeurs de ces paramètres sont plus élevées dans les pâturages naturels envahis par *Chromolaena odorata* où elles atteignent respectivement 68,2 % et 0,63. Par son énorme biomasse très

inflammable, *Chromolaena odorata* constitue une grande menace pour les écosystèmes forestiers dégradés comme c'est le cas dans la forêt classée de la Lama.

Mots clés: *Chromolaena,* pâturage, forêt

3. Problem of water hyacinth or Eichhornia crassipes *control in sahelian countries*

Ouedraogo, Louis R., Dabire Rémi et al.
INERA/CNRST CRREA-CENTRE Saria B.P. 10 Koudougou, Burkina Faso.

Abstract

The water hyacinth *Eichhornia crassipes* (Mart.) Solms Laub., an aquatic Pontederiaceae that is prolific and invading, appeared in Burkina Faso in 1986 as an ornamental plant. Its widespread proliferation was observed in 1994. For its control, several measures were undertaken very quickly, mainly consisting of informing the populations on its negative effects on biodiversity and on socio-economic activities based on stream and stretched water, the physical struggle, etc. After a good understanding of the phenomena, an integrated strategy to fight against the plant proliferation was adopted in 1997, combining physical, chemical and biological measures. Five years after using these three methods, results obtained showed some weak points that require thorough research. Climatic conditions of Burkina Faso, notably the long dry season of eight months is a new factor that may complicate activities for controlling the plant development, which is cyclic in time. Very high temperatures (40°C) from March to June during the dry season induce a break of biological predators' activities, and their massive death. The water hyacinth is adapted to drought through substantial seed production and insertion of its roots into the mudbank. Little by little, the plant transforms itself into a vegetative hemicryptophyte, until reaching the period of sound conditions for its development. The present study gives results observed under harsh conditions of its control in the Sahelian climate.

Keywords: Water hyacinth; Integrated control; Burkina Faso.

4. Biological control of aquatic weeds in Ghana

D. D. Wilson [1] & K.A.A. deGraft-Johnson [2]
Dept. of Zoology, Univ. of Ghana, Legon [1] Water Research Institute, CSIR, Accra [2], Ghana.

Abstract

The biological control of aquatic weeds in Ghana started with the National Biological Control Programme in 1992, over a decade ago. This later became part of an integrated control programme that also involved awareness campaigns and participation by local communities. Initial efforts were concentrated on the infestations in the lagoons in the border region of South-western Ghana, where the biological control agents imported for the control of water hyacinth, *Eichorniae crassipes,* water lettuce, *Pistia stratiotes,* and water fern, *Salvinia molesta,* were released. These biological control agents have become established and spread far beyond their release points and even beyond our shores into Cote d'Ivoire and can be readily recovered. There have been reductions in both plant height and density to the extent that other invasive weeds such as *Vossia cuspidata* have taken over on the banks of the lagoons in the Western region. Recent infestations of water hyacinth in the Oti arm of the Volta Lake in the Northern part of Ghana, have shifted the focus to this area, where both *Neochetina bruchi and N. eichorniae* have been released. The prospects of success in these biological control efforts look good in the long term, but additional effort would be required in tackling the new infestation of water hyacinth on the Oti arm of the Volta Lake.

Keywords: Biological control, aquatic weeds, Ghana

5. Assessment of damage in potted soybean plant in cage of the silverleaf whitefly, **Bemisia argentifolii** *Bellows and Perring*

Mbaye NDIAYE*,*
Direction de la Protection des Végétaux, BP 20054 Thiaroye Dakar, Senegal.

Abstract

Soybean seedlings at two fully expanded leaves infested with densities 0, 5, 10, 20, 40, 80 and 160 adults of *B. argentifolii* were studied in pots held in net cages. The pod weight of the control was significantly high from all infestation levels but no significant differences were found among 5, 10, 20, 40 and 80 adults of *B. argentifolii* per cage. Results from regression analyses indicated that pod weight, and root dry weight were negatively correlated to the infestation levels and the severity of the sooty mold (r ranging from 0.773 to 0.920). Therefore, the minimal pod weight loss recorded was with the infestation density of 5 *B. argentifolii* adults with 22.81g and the control 28.12 g, respectively, with a decrease in the pod weight of 18.88%) Consequently, *B. argentifolii* could cause significant damage to soybean even at low population density.

Keywords: Soybean, infestation, *B. argentifolii* and damage.

6. Bambusa vulgaris: A Quirk of Fate on Tiwai Island Wildlife Sanctuary

Aiah Lebbie, PhD*,*
Center for Biodiversity Research, Department of Biological Sciences, Njala University College, PMB Freetown, Sierra Leone.

Abstract

On the 12 km^2 rainforest island of Tiwai Island Wildlife Sanctuary, *Bambusa vulgaris* was deliberately introduced some 60 years ago by local farmers utilizing the poles in hut construction. When farming activities were terminated, the discarded poles quickly sprouted and have come to represent a significant feature of the island's flora. Many large clumps of bamboo exist with one large stand measuring 1.1ha in size. The soils of Tiwai Island are sandy and nutrient deficient, and do not appear to limit the growth and proliferation of bamboos. In most areas where the bamboo groves have been observed, they appear to limit the growth of the understory vegetation as the huge quantity of leaf litter produced decays slowly. However, to Tiwai's rich animal life, bamboos offer a valuable resource, as the shoots are eaten by *Cercocebus atys* and have been found to provide wet season refuge for rodents such as *Malacomys edwardsi, Praomys tullbergi* and *Mastomys natalensis*. Programs are underway to limit the spread of bamboos on the island.