# MINISTRY OF ENVIRONMENT, SCIENCE AND

# **TECHNOLOGY & INNOVATION**



# **INVASIVE ALIEN SPECIES POLICY**

# DRAFT

December, 2014

Acknowledgement

# List of Acronyms

APD	Animal Production Directorate
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species of flora and fauna
GRATIS	Ghana Regional Appropriate Technology and Industrial Services
COP	Conference of Parties
CSD	Crop Services Directorate of MoFA
CSIR	Council for Scientific and Industrial Research
CSO	Civil Society Organization
ECOWAS	Economic Community of West African States
EIA	Environmental Impact Assessment
EPA	Environmental Protection Agency
FSD	Forestry Services Division of the Forestry Commission
FC	Fisheries Commission/Forestry Commission
GMA	Ghana Maritime Authority
GAEC	Ghana Atomic Energy Commission
GAF	Ghana Armed Forces
IAS	Invasive Alien Species
MDA	Ministries, Departments and Agencies
MEAs	Multilateral Environmental Agreements
MESTI	Ministry of Environment Science Technology and Innovation
MLGRD	Ministry of Local Government and Rural Development
MMDAs	Metropolitan, Municipals and District Assemblies
MoFA	Ministry of Food and Agriculture
NADMO	National Disaster Management Organization
PPRSD	Plant Protection and Regulatory Services Directorate of MoFA
SEA	Strategic Environmental Assessment
VRA	Volta River Authority
WD	Wildlife Division of the Forestry Commission
WRC	Water Resources Commission

Foreword

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### 1.0 Background

There has been an increasing incidence of introduction, establishment and spread of invasive plants and animal species in Ghana in the past few decades. Notably among these species are Siam weed/'Akyeampong' (*Chromolaena odorata*), Water hyacinth (*Eichhornia crassipes*), Kariba weed (*Salvinia molesta*), Larger Grain Borer (*Prostephanu struncatus*), fire ants (*Solenopsis maginata*) and some white flies (*Bemisia tabaci*).

In addition, the country faces threats of newer species as a result of increase in trade especially within the Economic Community of West African States (ECOWAS) and the international maritime trade. The introductions have led to significant biodiversity losses and disruption of ecosystem services and livelihoods. With the envisaged severity of Climate Change, these impacts are anticipated to be more devastating on ecosystems, public health and socio-economic activities of the country.

Ghana is a signatory to key international conventions and protocols aimed at addressing Invasive Alien Species (IAS) related issues. However, not much has been achieved in terms of domesticating and implementing the provisions of these conventions and protocols as a result of inadequate policy direction.

Attempts have been made to address specific threats posed by some invasive alien species however; the results have been short lived, unsustained and not coordinated. The problem has been compounded by the weak institutional and legal environment for effectively dealing with the challenges posed by the invasive alien species. Besides, there is no holistic policy to deal with the problem. There is therefore the need to formulate a holistic policy that would bring together all stakeholders to work in a coordinated manner to comprehensively address the problems of IAS.

#### 1.1 Purpose

This policy is to:

- i. Provide measures to prevent, control and manage introductions, establishment and spread of IAS in Ghana.
- ii. Minimize economic, ecological and human health impacts of IAS.
- iii. Harmonize and coordinate institutional actions aimed at addressing IAS related issues in Ghana.
- iv. Ensure effective national regional and international collaboration on IAS.

## **1.2 Policy Formulation Process (to be reviewed after SEA, Stakeholder consultations)**

In the formulation of this policy existing sectoral polices were reviewed, involving broad stakeholder consultations. These include academia and research, regulatory, Metropolitan, Municipal and District Assemblies, (MMDAs), and Civil Society Organizations (CSOs). The policy was subjected to Strategic Environmental Assessment (SEA) to identify the opportunities and risks associated with policy actions.

#### 2.0 Situation Analysis

#### 2.1 Occurrence and Impacts

Ghana has experienced a number of biological invasions, some of which have been intentional and others unintentional. Available information indicates that over 70 different microbes, plants and animal species have invaded Ghana. These range from viruses, bacteria and fungi that cause various diseases of plants and animals and also affect both man and ecosystems (Appendix 1). Ghana).

Many water bodies in the country have varying degrees of aquatic weed infestation. Floating invasive water weeds such as *Eichhornia crassipes* (water hyacinth), *Salvinia molesta* (kariba weed) and *Pistia stratiotes* (water lettuce ), and submerged weeds *Vallisneria spiralis/gigantea and Ceratophyllum demersum* have posed tremendous threats to some water bodies in the country. These include the Oti River, the Tano-Abby Lagoon Complex, the Kpong Head pond and Lower Volta River.

The invasive aquatic weeds impact fishing, water transport, water supply and public health of riparian communities, and threaten hydropower generation. Invasive aquatic weeds also provide refuge for the host snails of bilharzia parasite, resulting in high prevalence of bilharzia. Evapotranspiration loss from water weeds on the River Oti and Kpong Headpond was estimated at 33.6 million cubic meters in 2007( EPA, Baseline studies, Integrated management of Invasive AquaTic Weeds Project), equivalent to the amount of water needed to generate about 1.9MW of power at the Akosombo and Kpong electricity generating stations. According to the Volta River Authority (VRA) about US\$327,038 is spent in monitoring and managing the weeds in the Oti River annually. The Environmental Protection Agency also spent US\$ 2.5 million dollars in controlling the weed in the critically infested Rivers over the period 2006-2011 during the implementation of the Invasive aquatic weeds project supported by the African Development Bank.

The witch weed, *Striga hermonthica* known to compete with cereals and legumes for nutrient, destroying and causing high losses in crops yields is found in Ghana. Estimated losses in yield resulting from this weed in Ghana and Nigeria were 0 .17 and 3.75 million tonnes per year respectively (Proceedings of Regional workshop, 2004). *Broussonetia papyrifera* (Paper Mulberry) a common terrestrial invasive alien species threatens the River Afram Headwaters Forest Reserve. The aggressive growth, over shading tendencies and high water absorption rate of this plant, has resulted in the destruction of major food and cash crops such as maize, cassava, cocoyam and cocoa. Studies conducted

in Amentia and Abofour communities in 2007 indicated that land rentals could decrease to 50% depending on the severity of infestation by Paper Mulberry. The study further established a decrease in the yield of maize and cassava by 75% and 90% respectively (Trenor, 2007).

Other invasive pests have posed challenges in the agricultural sector. These include *Prostephanus truncatus* (Larger grain borer) on grains and cereals, *Phenacoccus manihoti* (Cassava mealy bug) on cassava and the giant land snails *Achatina fulica*. The alien pest Cape St. Paul's Wilt has destroyed coconut plantations along the coast of Ghana and affecting livelihoods in several communities.

Several interventions have been instituted to manage invasive alien species in Ghana. These include:

- National Biological Control Programme: 1992-1994. (Funded by the Austrian/German Governments).
- Integrated Control of Aquatic Weeds: 1994-1996. (Funded by the European Union).
- Water Weed Management in West Africa/Ghana Water Bodies: 2000-2002. (Funded by the FAO).
- Removing Barriers to Invasive Plant Management in Africa from 2005-2010. (Funded by UNEP/GEF)
- Integrated Management of Invasive Aquatic Weeds Project 2006 2011. (Funded by the African Development Bank).
- Biological control of invasive papaya mealy bug 2011- 2012. (funded by FAO TCP)
- Classical biological control of cassava green mites , cassava mealy bug and mango mealy bug 1987 – 1990 (funded by IITA/ABCP)

Current efforts to manage introduced species though effective to some extent have still not contained the general problem. This is because intervention measures are adhoc and directed at specific invasive alien species menace in the country. There is therefore the need to set up a coordinating body to provide national leadership on invasive alien species management in a coordinated and effective manner.

### 2.2 International Policy Environment

A number of protocols, treaties and conventions have been negotiated to provide the bases for countries to develop actions to deal with the problem of IAS. Ghana is a party to some of these conventions and

protocols which have provisions to deal with IAS. These include, the Convention on Biological Diversity (CBD), Ramsar Convention on Wetlands, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), International Plant Protection Convention (IPPC), Convention on Migratory Species (CMS) and a number of Multilateral Environmental Agreements (MEAs).

Ghana has made efforts to deal with IAS using these conventions but the lack of policy direction has resulted in ineffective use of the tenets to manage IAS in the country. Again Ghana participates regularly in the meetings of the COP of the Conventions and Protocols; however the decisions taken at these meetings are poorly shared among national stakeholders and implemented. Coupled with this, the effective management and control of IAS in the West African sub-region has been hampered by weak collaboration among member states.

#### 2.3 Legal, Institutional and Regulatory Framework

In meeting the obligations under the relevant conventions, lead institutions have been assigned with the responsibility of dealing with IAS issues (Appendix 2). Though, the impacts of IAS cut across sectors such as Forestry, Agriculture, Trade and Environment, managing IAS issues have been largely fragmented and uncoordinated. The results have been short of the desired outcome, hence the problems persist and exerting further impact on the environment and the economy.

There is also inadequate infrastructure, human and financial resources to manage IAS in the country. For example, there are very few taxonomists and research personnel and inadequate quarantine facilities to support IAS management. These have limited the ability of line institutions to adequately prevent entry of IAS at the frontiers and manage the establishment and spread within the country. Besides phyto-sanitary control measures, there is a general lack of relevant protocols to guide personnel to prevent and control the entry of other potential IAS into the country.

Several implementation actions have evolved in a reactive and piecemeal manner, responding to new problems and pathways relating to invasive alien species. However, these isolated unilateral actions have not been sufficient to manage the full range of activities and processes that generate invasions. It is therefore necessary that the relevant institutions collaborate through an open consultative process to prepare strategies and action plans from a well thought through policy for dealing with IAS.

IAS line institutions have attempted to control and mange IAS, however their efforts have been hampered by the fact that many of these species have no legal status as regulated materials in the country. Besides, there are no regulations regarding the introduction, handling and use of these materials.

Presently, several national policies and legislations exist relating to the control and management of invasive alien species. These pieces of policies and legislations are scattered in the statute books and do not adequately address the problem of invasive alien species. They, however, provide a starting point for updating, formulating and/or amending the range of legislative provisions relating to invasive alien species in the country.

#### 2.4 Pathways for Introduction and Dispersal

Several pathways exist for the introduction of invasive alien species. In Ghana, a number of IAS have been introduced through travel and tourism, trade, agriculture; research the police and military on peace keeping duties. IAS menace in Ghana have been largely addressed on an adhoc basis and interventions directed at specific IAS. The problem has been compounded by the weak institutional and legal environment for effectively dealing with the challenges posed by the invasive alien species. Besides, there is no holistic policy to deal with the problem.

The Paper Mulberry (*Broussonetia papyrifera*) for example was introduced to Ghana for research into the development of pulp for paper industry in 1969. However, the research was not decommissioned leading to its spread in the forest ecosystem. In agriculture the pathways for introduction and spread include movement of livestock and transportation of grains and seeds. The introduction and culturing of the edible snail, *Achatina fulica* without adequate control and containment, led to the wide proliferation and spread of the species. The nursery, landscaping and gardening industry have also contributed to the spread of water hyacinth to new areas such as Lower Volta River.

The introduction and spread of the larger green borer (*Prostephanus truncatus*) in Ghana was through trade. It was believed to have initially entered the country from Togo in 1989 through the Volta Region through imported grains contaminated with the beetles (Addo, Birkinshaw, & Hodger, 2002). Subsequent spread to other parts of the country was through recycling of contaminated packaging materials.

Nevertheless, introduction of the species alone does not guarantee its invasiveness. The introduced species must be able to establish, reproduce and have competitive fitness in order to spread within an ecosystem. Human activities tend to create the ecological condition that enables an introduced species to thrive and spread. Such was the case for the spread of paper mulberry in the Afram Head Waters Forest

Reserve where massive bush fires in 1983 created an enabling environment for the spread of the mulberry by reducing their competitors.

Some indigenous species which hitherto were not invasive have become invasive as a result of human induced changes in the ecosystem. For example the Hippo grass (*Vossia cuspidata*) an indigenous species has spread to cover about 2500 ha in the lower Volta after the construction of the Kpong dam 1981 (EPA, 2000 Baseline studies).

Other pathways have been documented in other countries but are not known to have occurred in Ghana. These pathways are generally associated with unintentional introductions where species are carried along with the importation of materials into an ecosystem. They include:

- Non-food animal pathways (aquarium trade, animals for research).
- Non-living animal and plant related pathways (frozen seafood, untreated wood, mulch, straw).
- Bio-control agent which could become invasive (release of species to control another which then becomes invasive itself).
- Transboundary waterways (trans-national rivers, freshwater canals, estuaries).
- Natural occurrences (ocean currents, migratory animals, plants dispersal).
- Wastes (unserviceable machinery, drill cuttings, hydrocarbons, electronic waste).

It is necessary for adequate procedures and measures to be put in place to detect and address any unintended entries through these pathways.



Vossia Cuspidata

Water Hyacinth

Broussonetia papyrifera

Table 1: Summary of IAS Issues

Policy Focus	Issues
Prevention and Control	<ul> <li>No coordinated system for detection, prevention and controlling the spread of IAS.</li> <li>Inadequate mechanism for tracking the spread of IAS</li> <li>No framework for identifying and monitoring introductions of IAS along the pathways</li> <li>No regulatory framework for prevention and control of IAS</li> <li>No assessment of the impacts of IAs on ecology prior to its introduction</li> <li>Limited regulations and guidelines on IAS/ Weak enforcement of national legislations on the introduction of specific exotic species into the country.</li> </ul>
IAS Governance	<ul> <li>Legal status of IAS is weak.</li> <li>Fragmented and uncoordinated policies and actions.</li> <li>Inadequate institutional capacity and infrastructure.</li> </ul>
Research, Innovation and	<ul> <li>Limited financial and infrastructural support for IAS research.</li> <li>Inadequate researchers with requisite knowledge and skills in IAS</li> </ul>
Information and Knowledge Management	<ul> <li>Lack of a species register on IAS.</li> <li>Lack of mechanism for data and information sharing.</li> <li>Limited technology for improving manual control methods</li> </ul>
IAS Mainstreaming	<ul> <li>IAS issues not integrated into the EIA procedure and other permits such as water use regulations/permit</li> <li>No guidelines for integrating IAS issues into EIAs of Projects and SEAs of policies, plans and programmes.</li> </ul>
Awareness Creation and Education	<ul> <li>Very limited knowledge on what constitutes IAS and their threats to ecosystem and livelihood</li> <li>Very little local knowledge on IAS in the communities</li> <li>IAS issues not integrated into educational curricula.</li> <li>Inadequate personnel to teach IAS issues in schools</li> </ul>
International Cooperation and Collaboration	<ul> <li>Decisions of International and sub-regional meetings poorly disseminated.</li> <li>Inconsistent country positions on issues prior to international negotiations</li> <li>Uncoordinated policies and actions at the sub regional levels.</li> <li>Limited utilization of available platform for information sharing at the international level.</li> </ul>

# 3 Guiding Principles, Policy Goals and Objectives

# **3.1 Guiding Principles**

Recognizing international conventions and national laws that deal with the introduction, control and management of invasive alien species, the key principles that have guided the development of Policy on Invasive alien species (IAS) include the following:

- Ensuring the prevention of the introduction of invasive alien species
- Ensuring early detection to reduce their impact on the environment, biodiversity, economy and human health.
- Maintaining the integrity of ecological systems where invasive alien species have been introduced.
- Adopting an adaptive management approach that incorporates and continually improves on policies and practices by learning from outcomes of operational programmes as they progress.
- Ensuring the capacity development of stakeholders in the management of IAS.
- Mainstreaming international IAS conventions and concerns into national and district policies, plans, programmes and projects.
- Creating awareness and involving the public in actions to address the threat of invasive alien species.
- Promoting sub-regional and international cooperation in the management of IAS.

# **3.2 Policy Goals and Objectives**

The policy aims at providing a holistic direction and guidance for actions in the regulation and management of invasive alien species to ensure biodiversity conservation. In this regard, the policy will seek to achieve the following objectives:

- i. To prevent the introduction and control the spread of Invasive alien species in the country.
- ii. To establish a coordinated framework for the prevention, containment, eradication, control and efficient management of IAS in the country.
- iii. To promote and support research, innovation and technologies for IAS management.
- iv. To ensure the availability of adequate and reliable data and improve information and knowledge sharing to support early detection, risk analysis and rapid response.
- v. To mainstream IAS issues into national, sectoral and district policies, plans, programmes and projects.

- vi. To create awareness and educate the public on the risks and benefits of prevention and control of IAS.
- vii. To collaborate and cooperate with regional and international bodies to ensure harmonized and coordinated policies and actions on IAS.

# 4 Strategies for Implementing the Policy

**4.1 Policy Statement:** Institute measures to detect entry, prevent and control spread of IAS.

**Objective:** To prevent the introduction and control the spread of Invasive Alien Species in the country.

## Actions:

- Review and update existing protocols, guidelines, regulations and develop new ones where necessary to prevent the introduction of new IAS.
- Develop rapid response plans for action against new Invasive alien species (IAS) infestations.
- Develop ecosystem specific (marine, freshwater, forest, and savanna) strategies to address introductions.
- Build capacity of relevant personnel to implement protocols and Phyto-sanitary measures.
- Provide infrastructure for quarantine services at the entry points.
- Develop and implement a ballast water management plan

4.2 Policy Statement: Strengthen IAS governance.

**Objective:** To establish a coordinated framework for the prevention, eradication, control and efficient management of IAS in the country.

## Actions:

- Establish a national IAS coordinating body.
- Build on existing efforts to develop, support, and implement an interagency early detection and rapid response network.
- Establish effective operational and sectoral coordination among relevant MDAs and MMDAs.
- Build community capacity for implementation of site-based plans for IAS management.
- Recognize and reward community and CSOs achievement in IAS management.
- Support District Assemblies to enact by-laws for IAS management.
- Develop a legal and regulatory framework for managing IA

**4.3 Policy Statement:** Improve existing interventions and approaches to IAS management through research, technology and innovation

**Objective:** To promote and support research, innovation and technologies for IAS management.

- Establish a funding mechanism for sustained IAS management.
- Create funding mechanism to support IAS research

- Identify and facilitate programmes to develop new technologies for IAS management
- Develop technological innovations for harnessing opportunities associated with IAS management for socio-economic benefits.

**4.4 Policy Statement:** Enhance knowledge base for effective management of Invasive Alien Species (IAS).

**Objective:** To ensure the availability of adequate and reliable data and improve information and knowledge sharing to support early detection, risk analysis and rapid response.

# Actions:

- Develop a GIS based IAS register and periodically update the status in specific ecosystems.
- Establish an IAS monitoring system at all levels
- Create platform for information sharing among policy makers, regulators, industry and practitioners at the local, national, sub-region and international levels.
- Build databases of research findings on IAS.
- Establish and manage an IAS information system which is linked to international sources of information.
- **4.5 Policy Statement:** Mainstream IAS issues into national, sectoral and district policies, plans, programmes and projects.

**Objective:** To mainstream IAS issues into national, sectoral and district policies, plans, programmes and projects.

## Actions:

- Produce guidelines for integrating IAS issues into policies, plans and programmes as well as EIAs of Projects and other procedures by related institutions.
- Develop materials and guidelines for mainstreaming IAS into curriculum of educational institutions.
- Build capacity of personnel on the management of IAS
- Undertake risk assessment of the introduction of biological materials into the country.

4.6 Policy Statement: Increase awareness on Invasive Alien Species (IAS).

**Objective:** To create awareness and educate the public on the risks and benefits of prevention and control of IAS.

# Actions:

- Develop Invasive Alien Species (IAS) Communication Strategy and Action Plans.
- Develop and demonstrate best practices for IAS management among industries, public agencies and communities.
- Develop and implement public awareness and education programmes on IAS.
- Develop targeted awareness raising materials, messages and integrate into existing programmes of relevant institutions.
- Provide adequate funding for sustained awareness creation and education programmes on IAS.
- Integrate IAS issues into the National Education Strategy.
- Train educational personnel in IAS management

4.7 Policy Statement: Enhance international cooperation and collaboration on IAS management.

**Objective:** To collaborate and cooperate with regional and international bodies to ensure harmonized and coordinated policies and actions on IAS.

## Actions:

- Build networks and partnerships with sub-regional and international organizations on IAS issues.
- Disseminate IAS related information at the regional and international levels.
- Promote the formulation of a sub-regional policy on IAS.
- Establish an institutional framework for negotiating and implementing IAS agreements.

## **5** Implementation Arrangement

The problems posed by IAS are not simply the responsibility of a single institution. There are many institutions that play different roles in the prevention and control of IAS in Ghana. Addressing the problems of IAS successfully will therefore require effective coordination and collaboration among these various institutions from government, NGOs, civil society organizations, private sector, local communities and international organizations. The specific roles of the various institutions mentioned are defined in appendix 3. The Ministry of Environment, Science, Technology and Innovations and its allied institutions (i.e. EPA, TCPD, CSIR, GAEC,) has the overall responsibility for the implementation of this policy.

## **Funding Arrangements**

The successful implementation of this policy would require the adequate and timely availability of funding from various sources. These include:

- Budgetary Allocations
- Existing projects and programmes
- New projects to attract funding from international sources
- National Environment Fund (NEF)
- Administrative, Permits and Certifications Fees
- Fines and penalties for introducing IAS.
- A percentage of Tariffs from water, electricity, forests and wildlife products.

## Monitoring, Evaluation and Policy Review

The Ministry responsible for Environment would have the overall monitoring, evaluation and periodic review of this policy. This can be effectively achieved if this policy is integrated into the National Environment Policy. This policy should be reviewed every five (5) years to ensure relevance and effectiveness.

The Ministry responsible for Environment will promote institutional and inter-agency collaboration towards effective implementation of the Policy through the development of action plans and measures to realize the objectives of the policy.

CATEGORY FLORA/FAUNA	COMMON NAME(S)	SCIENTIFIC NAME	ORIGIN	ENTRY PATHWAYS- YEAR OF ENTRY	DISPERSAL PATHWAYS	REMARKS- COMMENTS (e.g. severe, common rare etc)
FLORA/MICROBES						
VIRUSES	Banana bunchy-top virus disease (BBTV)	Babuvirus	Southern Asia		Transmitted by the Banana aphid <i>Pentalonia</i> <i>nigrovervosa</i>	Attacks Banana
	Badana virus (BSV)				Insects	Attacks Banana
	Cape St Paul's Wilt, Lethal Yellowing Disease		Not known	Volta Region 1932, Western 64, Central 83	Phytoplasma -through leafhoppers, plant hoppers and psyllids -	Attacks Coconut
BACTERIA	Cassava bacteria blight	Xanthomonas manihoti	South America		Seed borne ( transfer of infected plants across plantation)	Attacks Cassava
	Mango bacterial blight	Xanthomonas citri pv mangiferae	India	2013		Attacks mango
FUNGI	Angular leaf spot	Pseudo-cercospora angolensis	Angola -Africa	2010		Attacks Citrus fruits
	Black Sigatoka disease	Mycosphaerella fijiensis	Fiji Island (South Pacific)	1990'S		Attacks Banana
HERBS/SEDGES	Asian Witch weed	Striga asiatica	Asia & sub- Saharan Africa			Attacks cereals
	Purple/ Giant Witch weed	Striga hermonthica*	Africa, Asia, Australia			Attacks cereals
	Caribbean stylo, pencil flower, mother segal	Stylosantes hamata	N. /C. Americas, Caribbean	Humans-As ruminants feed	Humans/Wind/Water	
	Shrubby stylo, Pencil flower	Stylosantes scabra	S. America, Caribbean	Humans-As ruminants feed	Humans/Wind/Water	
	Tree marigold, Mexican sunflower	Tithonia diversifolia	E. Mexico & C. America	Man-horticulture	Man-horticulture/ animals/wind	
GRASSES	Itchgrass, raoulgrass	Rottboelia cochinchinensis	Africa, Asia and Australia		Seeds spread by water /harvesting machines	
SHRUBS	Siam weed/ Acheampong	Chromolaena odorata	Tropical N. Americas	Introduced 1960's	Man/ wind	

	Barbados Nut, Physic Nut	Jatropha curcas	Tropical N./C. Americas	Man-fences/ biofuels	Man-fences/ biofuels	
	Bellyache bush, or cotton-leaf physicnut,	Jatropha gossypiifolia**	Tropical N./C. Americas	Man-fences/ biofuels	Man-fences/ biofuels	
	Big sage, wild or red sage, tickberry,	Lantana camara	C./South America	Man – insects horticulture	Man – insects horticulture	
	Giant Sensitive Tree	Mimosa pigra	Neo-tropics			
TERRESTRIAL FLORA						
TREES	Neem, Indian lilac	Azadirachta indica	India	Man-wood fuels	Man-birds/ animals	
	Paper muberry	Broussonetia papyrifera	Asia- China, Japan, Korea, Thailand, India	1969, Research, R. Afram, R. Pra Anum Asenayo Fr Reserves,	Man-pulp industry- animals/birds; Habitat changes	
	Trumpet tree, snakewood, Acacia	Cecropia peltata Leucena leucocephala	Tropical America	Unintentional from Ivory Coast Planned introduction for afforestation	Man/ animals/wind	
TERRESTRIAL FLORA	Spanish cedar, Mexican cedar	Cedrela odorata	West Indies/ C. & S. Americas	Intentional - Forestry	Man-Forestry/insects/ Wind	
TREES	Chinese lantern tree, Sicklebush	Dichrostachys glomerata	Africa	Native	Insects/ Habitat changes	
	Leucaena, Jumbie bean, White lead tree	Leucaena leucocephala	S. Mexico and N. Central America	Intentional-Agro- forestry, MoFA, 1980's?	Man/Wind, Animals/ Insects	
	Tree Jasmine, Indian Cork tree	Millingtonia hortensis	South and S. E. Asia	Intentional- horticulture	Man, Insects	
	Teak, Burmese Teak	Tectona grandis	S. & S. E. Asia	Intentional- Forestry	Man/ Wind	
AQUATIC FLORA						
FERNS	Red water fern	Azolla filiculoides	W./N. America; S. to C. America	1990 R. Tano/ Lagoon	Man-boaters/water	

	Kariba weed/Giant salvinia	Salvinia molesta	South East Brazil, S. America	1990 R. Tano/ Lagoon	Man-boaters/water	
HERBS/SEGDES	Coontail, hornwort	Ceratophyllum demersum	All continents except Antarctica	Native	Man-boaters/water	
HERBS/SEGDES	Papyrus, Papyrus reed	Cyperus papyrus	Central Africa	1960's KNUST - UG; 2003 Kpong headpond	Man-boaters/water, wind	
	Water hyacinth	Eichhornia crassipes	Amazon Basin	1984, Tema; '87 Accra; '90 R. Tano/ Lagoon; '98 R. Oti; 2003 Kpong ; 2009 Lower Volta	Horticulture, Waterways, Tourists, Boaters	
HERBS/SEGDES	Yellow Burr head/ Yellow velvet leaf	Limnocharis flava	N./S. Americas, Caribbeans	1997	Man/water/birds	
	American lotus	Nelumbo lutea	North America	1960's Legon		
	Water lettuce/ Water cabbage	Pistia stratiotes	S. America / Africa/ Cosmopolitan	Native	Man/water	
	Cattail	Typha domingensis	Temperate Eurasia, N. Africa N. America	Not known??	Man/ water; wind	
	Eel grass/tape grass	Vallisneria aethiopica	Not determined		Man/water	
GRASSES	Hippo grass	Vossia cuspidata	Tropical Africa/ Asia	Native	Man/water/wind	
SHRUBS	Giant sensitive plant/ Cat claw mimosa	Mimosa pigra	Tropical America	Not known??	Man/water/animals	
FAUNA/ANIMALS						
ARACHNIDS	Cassava green mite	Mononychellus tanajoa	South America	1984		
INSECTS	African army worm	Spodoptera exempta	Africa		Moths migration	
INSECTS	African invader fly	Bactrocera invadens	Sri Lanka (S.W. Asia)	2005	Plant material	
	Cassava mealybug	Phenacoccus manihoti	S. America	1980	Plant material	
	Diamond-back moth	Plutella xylostella	Europe			

	Fire ant (Charles Taylor)	Solenopsis geminata	S. America	2000?		
	Fruit and shoot borer	Leucenoides orbonalis	Africa and Asia			
	Larger grain borer	Prostephanus truncatus	S. America	1992		
	Mango mealybug	Rastrococcus invadens	S. Eastern Asia	1984		
	Medfly	Ceratitis capitata	Africa			
	Papaya mealybug	Paracoccus marginatus	Mexico/South America	2009		
INSECTS	Spiraling whitefly	Aleurodiscus dispersus	C. America	1980's?		
	White flies	Bemisia tabaci	India/Asia	Unknown	Plant materials	Transmits a no of viral diseases/ remove nutrients
FAUNA						
BIRDS	Red-billed Quelea, Weaver bird, weaver-finches,	Quelea quelea	Sub Saharan- Africa excl deeply forested areas & S Africa,	Not known??	Migration	Most destructive/ most numerousbird pest in the world
ANIMALS						
MOLLUSCS	Giant African land snail	Achatina fulica	Eastern Africa	2003? Western Region	Man/migration	
VERTEBRATES						

<b>Appendix 2: Focal</b>	points for International	<b>Conventions and Protoco</b>	ls related to IAS in Ghana
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Focal Institution	Conventions and protocols
Ministry of Environment Science	-Convention on Biological Diversity
Technology and Innovation	-Cartagena Protocol on Biosafety
	-Framework Convention on Climate Change
Forestry Commission- Forestry Services	
Division	
	-Convention on Wetlands (RAMSAR)
	-Convention on International Trade in Endangered Species of
	Wild Fauna and Flora (CITES)
Forestry Commission Wildlife Division	-Convention on Migratory Species of Wild Animals (CMS)
Forestry Commission- whome Division	-African Convention on the Conservation of Nature and
	Natural Resources
	-Agreement on the Conservation of African-Eurasian
	Migratory
Plant Protection and Pagulatory Services	-International Plant Protection Convention (IPPC)
Directorete	-WTO Agreement on the Application of Sanitary and
Directorate	Phytosanitary Measures
Fisheries Commission	-Food and Agricultural Organization code of conduct on
Fisheries Commission	responsible fisheries
Ghana Maritime Authority	Convention on the Law of the Sea (UNCLOS)
Ministry of Health	
Ministry of Agriculture (crops, animals)	

# Appendix 3: Roles of Institutions with bearing on IAS

Ministries, Departments, Agencies	Mandate /Role
Ministry of Environment, Science, Technology	
and Innovation	
Ministry of Lands and Natural Resources	
Ministry of Local Government and Rural	
Development	
Ministry of Food and Agriculture	
Ministry of Fisheries and Aquaculture	
development	
Ministry of Trade and Industry	Policy formulation, Monitoring and Evaluation
Ministry of Finance	
Ministry of Transport	
Ministry of Foreign Affairs and Regional	
Integration	
Ministry of Tourism, Culture and Creative Arts	
Ministry of Health	
Ministry of Water Resources, Works &	
Housing	

Ministries, Departments, Agencies	Mandate /Role
National Development Planning Commission	Act 479: Advices the president on development planning policy and strategy.
Water Resources Commission	Responsible for the regulation and management of the utilization of water res and for the coordination of policies.
Ghana Atomic Energy Commission	Act 588, 2000: The promotion, development and utilization of the peaceful application of nuclear and biotechnology techniques for economic and social advancement of Ghana.
Forestry Commission	Is responsible for the regulation of the utilization of forest and wildlife resources, conservation and management of those resources and the coordination of policies
Fisheries Commission	Is responsible for the regulation and management of the utilization of the fisheries resources of republic and the coordination of policies
Environmental Protection Agency	Lead Agency in charge of the environment.
Wildlife Division	To conserve wildlife in Ghana and manage wildlife protection areas.
Forest Services Division	
Plant Protection and Regulatory Services Directorate	Plant and Fertilizer Act 2010 (Act 803) which include aspects to control the importation of plant materials contaminated with exotic pests which include weeds, insect pests and pathogens, bacteria, fungi, viruses, nematodes, phytoplasma etc.
Volta River Authority	Act 46 Generate and supply electricity for industrial, commercial and domestic use in Ghana.
Ghana Revenue Authority (Customs Division)	Act 791 To integer and manage domestic tax and custom.
Veterinary Services Division	To ensure a stable animal health situation through the provision of quality of animal health care services by both public and private sector veterinary practitioners to ensure livestock poultry and companion animals' production and productivity.
Ghana Immigration Services	Regulate and monitor the entry and residence and employment and exit of all foreigners and members of Ghanaian in and out of country.
Ghana Maritime Authority	Regulate, monitor and coordinate activities in the maritime industry.
CSIR	To purse the implementation of government policies on scientific research and development.
Forestry Research Institute of Ghana (FORIG)	To conduct forest and forest product research for social, economic and environmental benefit of the society.
Water Research Institute	

Ministries, Departments, Agencies	Mandate /Role		
	To provide farmers in the three northern regions with		
Sayanna Agricultural Passarch Instituta	appropriate technologies sustainable to increase their food,		
Savanna Agricultural Research Institute	fibre crop production based on a s production system which		
	maintains and/or increases soil fertility.		
Crop Research Institute	Mandate covers all food and industrial crops.		
Animal Basaarah Instituta	To develop and transfer technologies related to livestock		
Annual Research Institute	and poultry production in Ghana.		
	To undertake research into all aspects of water resources		
	(both living and non-living) of Ghana in order provide		
Universities	scientific and technical information and services needed for		
Universities	the sustainable development, utilization and management		
	of these natural resources for socio-economic advancement		
	of the country.		

# **Appendix 4: Policy Matrix**

Policy Focus	Issues	Objectives	Strategies	Lead Institution	Collaborating Institutions
Prevention and Control	<ul> <li>No coordinated system for detection, prevention and controlling the spread of IAS.</li> <li>No framework for identifying and monitoring introductions of IAS along the pathways</li> </ul>	To prevent the introduction and control the spread of Invasive alien species in the country	<ul> <li>Review and update existing protocols, guidelines, regulations and develop new ones where necessary to prevent the introduction of new Invasive alien species (IAS).</li> <li>Develop rapid response plans for action against new Invasive alien species (IAS) infestations.</li> <li>Develop ecosystem specific (marine, freshwater, forest, and savanna) strategies to address introductions.</li> <li>Build capacity of relevant personnel to implement protocols and Phytosanitary measures.</li> <li>Provide infrastructure for quarantine services at the entry points.</li> </ul>	MESTI MoFA EPA	FC WRC GMA CSIR Universities International organizations Ministry of Transport CEPS GIS AG GHS Parliament Ministry of Finance NADMO GAF EPA GMA MMDAS CSIR VRA
IAS Governance	<ul> <li>Limited regulations and guidelines on IAS/ Weak enforcement of national legislations on the introduction of specific exotic species into the country.</li> <li>Legal statuses of IAS are weak.</li> </ul>	To establish a coordinated framework for the prevention, eradication, control and efficient management of IAS in the country.	<ul> <li>Establish a national IAS coordinating body.</li> <li>Build on existing efforts to develop, support, and implement an interagency early detection and rapid response network.</li> <li>Establish effective operational and sectoral</li> </ul>	MESTI EPA	FC WRC GMA VRA CSIR Universities International organizations Ministry of Transport CEPS

Policy Focus	Issues	Objectives	Strategies	Lead	Collaborating
	<ul> <li>Fragmented and uncoordinated policies and actions.</li> <li>Inadequate institutional capacity and infrastructure.</li> </ul>		<ul> <li>coordination among relevant MDAs and MMDAs.</li> <li>Build community capacity for implementation of site- based plans for IAS management.</li> <li>Recognize and reward community and CSOs achievement in IAS management.</li> <li>Support district assemblies to enact by-laws for IAS management.</li> <li>Establish a funding mechanism for sustained IAS management.</li> </ul>		GIS AG GHS MoFA Parliament Ministry of Finance Ministry of Trade and Industry NADMO GAF EPA GMA MMDAS CSIR
Research, Innovation and Technology	<ul> <li>Limited financial and infrastructural support for IAS research.</li> <li>Inadequate researchers with requisite knowledge and skills in IAS management.</li> </ul>	To promote and support research, innovation and technologies for IAS management	<ul> <li>Establish a funding mechanism for sustained IAS management.</li> <li>Create funding mechanism to support IAS research</li> <li>Identify and facilitate programmes to develop new technologies for IAS management</li> <li>Develop technological innovations for harnessing opportunities associated with IAS management for socio-economic benefits.</li> <li>Create funding mechanism to support IAS technology</li> </ul>	MESTI	FC WRC GMA CSIR VRA Universities International organizations Ministry of Transport CEPS GIS AG GHS MoFA Parliament Ministry of Finance Ministry of Trade and

Policy Focus	Issues	Objectives	Strategies	Lead	Collaborating
				Institution	Institutions
			development.		Industry NADMO GAF EPA GMA MMDAs CSIR GAEC GRATIS NBSSI
Information and knowledge management	<ul> <li>Lack of a species register on IAS.</li> <li>There is no mechanism for data and information sharing.</li> <li>There is the need to introduce new technologies to improve manual control.</li> </ul>	To ensure the availability of adequate and reliable data and improve information and knowledge sharing to support early detection, risk analysis and rapid response.	<ul> <li>Develop a GIS based IAS register and periodically update the status in specific ecosystems.</li> <li>Establish an IAS monitoring system.</li> <li>Create platform for information sharing among policy makers, regulators, industry and practitioners at the local, national, sub- region and international levels.</li> <li>Build databases of research findings on IAS.</li> <li>Produce and manage an IAS information system which is linked to international sources of information.</li> </ul>	EPA CERGIS	FC WRC GMA CSIR Universities International organizations Ministry of Trade and Industry Ministry of Transport CEPS VRA GIS AG GHS MoFA Parliament Ministry of Finance NADMO GAF EPA GMA MMDAS CSIR

Policy Focus	Issues	Objectives	Strategies	Lead	Collaborating
				Institution	Institutions
					Ministry of Trade and
					Industry
IAS Mainstreaming	<ul> <li>IAS issues not integrated into the EIA procedure.</li> <li>No guidelines for integrating IAS issues into EIAs of Projects and SEAs of policies, plans and programmes.</li> </ul>	To mainstream IAS issues into national, sectoral and district policies, plans, programmes and projects.	<ul> <li>Produce guidelines for integrating IAS issues into SEAs of policies, plans and programmes and EIAs of Projects.</li> <li>Develop materials and guidelines for mainstreaming IAS into curriculum of educational institutions.</li> <li>Build capacity and undertake risk assessment of the introduction of biological materials into the country.</li> </ul>	NDPC MESTI	FC WRC GMA CSIR VRA Universities International organizations Ministry of Trade and Industry Ministry of Transport CEPS GIS AG GHS MoFA Parliament Ministry of Finance NADMO GAF EPA GMA MMDAs CSIR Ministry of Trade and Industry, Ministry of Education, Ministry of
Awaranaca	• Warma line it a d law a seale de	To granta	- Develop Investing Alling	Miniat of	Information EC
Awareness	• very limited knowledge on	10 create	• Develop Invasive Alien	Iviinistry of	I L WDC
creation and	what constitutes IAS and	awareness and	Species (IAS)	Information,	
Education		educate the public		Ministry of	GMA

Policy Focus	Issues	Objectives	Strategies	Lead	Collaborating
				Institution	Institutions
	<ul> <li>their threats to ecosystem and livelihood</li> <li>IAS issues not integrated into our educational curricula.</li> <li>Inadequate personnel to teach IAS</li> </ul>	on the risks and benefits of prevention and control of IAS.	<ul> <li>Communication Strategy and Action Plans.</li> <li>Develop and demonstrate best practices for IAS management among industries, public agencies and communities.</li> <li>Develop and implement public awareness and education programmes on IAS.</li> <li>Develop targeted awareness raising materials, messages and integrate into existing programmes of relevant institutions.</li> <li>Provide adequate funding for sustained awareness creation and education programmes on IAS.</li> <li>Integrate IAS issues into the National Education Strategy.</li> <li>Train requisite educational personnel in IAS management</li> </ul>	Education, MESTI,	CSIR VRA Universities International organizations Ministry of Trade and Industry Ministry of Transport CEPS GIS AG GHS MoFA Parliament Ministry of Finance NADMO GAF EPA GMA MMDAs CSIR Ministry of Trade and Industry, CSOs
International cooperation and collaboration	Decisions of International and sub-regional meetings poorly disseminated. Inconsistent country positions on issues prior to international negotiations Uncoordinated policies and	To collaborate and cooperate with regional and international bodies to ensure harmonized and coordinated	<ul> <li>Build networks and partnerships with sub- regional and international organizations on IAS issues.</li> <li>Disseminate IAS related</li> </ul>	Ministry of Foreign Affairs and Regional Integration Ministry of Justice and	FC WRC GMA CSIR VRA Universities International

Policy Focus	Issues	Objectives	Strategies	Lead Institution	Collaborating Institutions
	actions at the sub regional levels. Limited utilization of available platform for information sharing at the international level.	policies and actions on IAS.	<ul> <li>information regionally and internationally.</li> <li>Promote the formulation of a sub-regional policy on IAS.</li> <li>Establish an institutional framework for negotiating and implementing IAS agreements.</li> </ul>	AG	organizations Ministry of Trade and Industry Ministry of Transport CEPS GIS AG GHS MoFA Parliament Ministry of Finance NADMO GAF EPA GMA MMDAs CSIR Ministry of Trade and Industry, Ministry of Education, Ministry of Information