

National Biodiversity Strategy and Action Plan

**INVASIVE ALIEN SPECIES  
AND  
BIODIVERSITY: Indian Perspective**

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## Preface

India is one of the eight Vavilov Centres of Origin of Cultivated Plants and twelve mega-biodiversity countries of the world. It is also an active member of several regional and global alliances focusing on biodiversity conservation like the “G-15” and the “Group of 12 Allied Mega-Biodiversity Nations”. India is also a Contracting Party to several multilateral agreements on biodiversity conservation like the Convention on Biological Diversity, the Ramsar Convention and the Convention on International Trade in Endangered Species of Wild Fauna and Flora. India is also a member of the World Trade Organisation. While striving to fulfill its national commitments and obligations to biodiversity conservation, India faces serious threats to its native species of plants and animals (including their habitats and ecosystems). The threat posed by the invasive alien species is truly scaring since it is considered second only to that of habitat loss.

Through increased volume of trade and international transport over the past few centuries, natural barriers such as oceans and mountains that once prevented the movement of species have now become ineffective, ending millions of years of biological isolation. Introductions of alien species can be done deliberately and purposefully (in authorized or even unauthorized manner) or they may happen unintentionally, for example, by organisms "hitch-hiking" in containers/ ships/ cars, “hidden” in soil or just “carried away” by wind.

Many alien species are non-invasive and support our farming systems and other human livelihoods in a big way. In fact, nearly half of our food and other cultivated plants have come from other countries. Only those alien species that cause substantial negative impacts to the environment, ecosystems, habitats, native biodiversity, economies, and human health are considered the “Invasive Alien Species”. Farmers still dread the invasion by migratory swarms of yellow locust devouring their field crops in 1940s. They also pay a kind of permanent tax in the form of investing in weedicides and pesticides to get rid of noxious weeds, insect pests and pathogens that have come from abroad. Devastating effects of aquatic weeds like water hyacinth and great nuisance value of aggressive exotic species like Lantana and Parthenium are well known. More recently, the carnivorous ‘African Catfish’ (also called ‘Thai Magur’) has hit the diversity of native fish species in many parts of the country.

Measures and guiding principles for dealing with the challenges posed by invasive alien species are broadly known including the prevention of their entry, early detection, quick response to warning signals, control and management practices, restoration effort, research support, information management and public awareness. But the decisive questions are: Are we prepared?, and, Are we ready to act now?

This document, prepared on behalf of the Technical and Policy Core Group set up by the Ministry of Environment and Forests, presents information that may help in answering these questions and provides inputs to the preparation of the National Biodiversity Strategy and Action Plan. Useful suggestions and valuable inputs provided by Shri Ashish Kothari, Dr. Jeff McNealy, Dr. V. Arivudai Nambi, Shri Pandurang Hegde, Dr. Asad Rahmani, Ms. Seema Bhatt and Shri Pankaj of Kalpavriksh are gratefully acknowledged.

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# Invasive Alien Species and Biodiversity: Indian Perspective

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# **Invasive Alien Species and Biodiversity: Indian Perspective**

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## **Introduction**

Natural Forests, grasslands, wetlands and coastal and marine areas are among the natural ecosystems when not perceptibly altered by humans. These become semi-natural when altered by human actions but still retaining significant native elements. In marked contrast to them, agro-ecosystems have been entirely created and managed by human beings for their own use. The latter may often overlap with forests, grasslands and coastal ecosystems where croplands may form part of a mosaic of land uses. Proper functioning and health (capacity to provide goods and services) of all these vibrant ecosystems depend largely on the biological diversity adapted to the range of habitats and environment available in these ecological complexes.

Native biological diversity refers to the species that occur within the range they occupy naturally. The native biodiversity has, however, been often enriched to a large extent or even negatively impacted by human agencies through deliberate and purposeful introductions of flora and fauna in areas outside their natural ranges. These movements have occurred at several scales, namely, within countries and also across countries, far beyond political and geographic boundaries. Some introduced species often seem to do better in their new homes than in their place of origin, perhaps because of a paucity of natural enemies or competitors. For example, eucalyptus from Australia is widespread in India, Southeast Asia, California, and various parts of Africa. In fact, "natural" is becoming an increasingly elusive concept, as virtually all ecosystems have a strong and increasing anthropogenic component.

This paper discusses some aspects of invasive non-native species and considers broadly, in the Indian context, the ways and means of preventing their entry into our country, their early detection and eradication/ control, limiting their further spread and mitigating their negative impacts. Overall focus is on regulating and managing the intentional and unintentional introductions that may constitute biosecurity threats, posing biological risks to natural ecological systems or to the well-being of humans, animals or plants inhabiting the affected areas.

## **Invasive Alien Species (IAS)**

There are striking differences in natural distribution of species of plants, animals and microbes across different geographical areas and ecosystems based primarily on their evolutionary pathways and genetic co-adaptation to prevailing environmental factors, both physical and biotic. Although most species appear to be confined mostly to their natural habitats and ecosystems yet their distribution ranges are known to change a great deal, expanding or contracting in response to sudden climatic disturbances and widespread biotic pressures. Geographical barriers and reproductive isolation may also force some species in many situations to be confined to certain regions that may end up in having some distinct kinds of species, many among them found nowhere else and, hence, termed "endemic species". This evolutionary framework provides the basis for the concept of 'native' and 'non-native' species.

**Box 1**  
**Invasive Alien Species**

A working definition of ‘invasive alien species’ (IAS) or the ‘invasive exotics’, adopted for this discussion, refers to those ‘alien species’ that have been moved outside their natural habitats to new areas where they have the ability to establish themselves and invade the new environments acting as an agent of change by competing with and overcoming the pre-existing native flora and fauna. Found in all categories of living organisms and all types of ecosystems, they are widespread in the world; moving from one landmass to another far away or getting trans-located from one region to another neighbouring one. Plants, mammals and insects (along with their associated pathogens and pests) comprise the most common types of invasive alien species in terrestrial and aquatic environments.

The term ‘alien species’ points to non-native or exotic organisms (species, subspecies, or lower taxa) that occur outside their natural ranges and dispersal potential. In other words, they inhabit areas that they cannot occupy without direct or indirect introduction or care by humans. This term also covers any parts, gametes or propagules of such species that might survive and subsequently reproduce in their newly found ‘homes’. Species carried suddenly to new environments may usually fail to establish and survive but they may also thrive and become invasive in some cases.

Biologists are still trying to elucidate the capability of these invasive species to aggressively invade new areas in the hope that incipient invasions may be predicted and stopped. Several explanations have been proposed in this context. A major contributing factor appears to be that the invading organism has been relieved of the pressures of its predators/ parasites, that keep its population under check in its native habitat, enabling it to proliferate unhindered in its new territories. In addition, it may be biologically "very hardy" characterized by a short generation cycle and a varied diet. A common feature of many invasive species is that they often arrive in an ecosystem that has already been disturbed by humans or some other factor(s). Whatever the precise causes, the consequences of such invasions may mean severe alteration of habitats and disruption of natural ecosystem processes with catastrophic impact on the native species.

### **Intentional and Accidental Introductions**

In earlier times, natural barriers of oceans, mountains and deserts provided the isolation essential for unique species and ecosystems to evolve. These barriers have now become ineffective since the unprecedented growth in the volume of trade and tourism, coupled with the advocacy of free trade, provides more opportunities than ever before for species to be spread accidentally or deliberately. This inadvertent ending of millions of years of biological isolation has created new problems. Customs and quarantine practices, developed in an earlier time to guard against accidental introduction of new pathogens and pests, have now become inadequate safeguards against the entry of invasive alien species.

Introduced or the alien species are usually grouped in four classes as follows:

- Deliberate introduction of species for commercial or recreational purposes (e.g., fish for aquaculture; pasture species for rangelands; ornamental or other horticultural species);
- Deliberate introductions for bio-control purposes;

- Unintentional introductions of pests and diseases, and other species, through traded commodities, especially of agricultural produce, timber, livestock etc;
- Unintentional introductions of organisms through transport vectors such as shipping and aviation.

Among these four categories, the deliberate and purposeful introductions are well cared but the species imported for a limited purpose may escape on being neglected later on (Levin, 1989).

Most of the deliberate introductions have proved to be of immense value in serving human needs, more so for agricultural and forestry purposes. The great bulk of human dietary needs in most parts of the world are currently met by species that have been introduced from elsewhere (Hoyt, 1992). More than half of the plants now commercially grown in India, for example, are introductions from other lands in recent or remote past. Many among them got so naturalized and diversified here that local people find it difficult to believe that they have traveled here from far away places. A case in point is the sorghum and pearl millet crops that have their origin in Africa. Likewise, it is difficult to imagine an Africa without cattle, goats, maize, and cassava, or a North America without wheat, soybeans, cattle and pigs, or a Europe without tomatoes, potatoes, and maize -- all introduced species. Species introductions, therefore, are an integral part of agricultural biodiversity in virtually all parts of the world. Increasing concerns for maintaining the health of these introduced species also led to the introduction of additional alien species for use in biological control programmes based on the import of natural enemies of pests and pathogens from the areas of their origin. Experience revealed later on that some of these agents of biological controls themselves became invasive in certain new situations that favoured their aggressiveness showing thereby the need for monitoring and keeping constant vigil on all exotic organisms.

It is noteworthy that farmers have been fighting weeds (invasive species, both natives and exotics - that proved to be even more aggressive in many cases) since the very beginnings of agriculture but the general global problem of IAS has been brought to the world's attention only relatively recently by ecologists who were concerned about the native species and ecosystems getting disrupted (Drake et al., 1989). It turns out that much of the work to date on IAS has focused attention on their biological and ecological characteristics, the vulnerability of ecosystems to such invasions, and the use of various means of control against invasives. The time has now come to extend these considerations to cover other equally important aspects such as global trade, settlement patterns, agriculture, economics, health, water management, climate change, genetic engineering and many other relevant fields.

### **Threats to Biological Diversity**

Negative impact of the invasive alien species, together with habitat destruction, is considered to be a major cause of extinction of native species throughout the world. Although many losses of this kind have gone unrecorded in the past, there is an increasing realisation at present of the ecological costs of biological invasions in terms of irretrievable loss of native biodiversity.

Four aspects of the exotic invasives are noteworthy. Firstly, people are largely responsible for moving organisms or their reproductive/ vegetative parts from one place to another, especially through modern global transport and travel. Secondly, while some species are capable of invading well-protected/ "intact" ecosystems, IAS more often seem to invade habitats that have been already altered by humans, such as the agricultural fields, grazing lands, abandoned mining

areas, human settlements, and roadways. The degradation of natural habitats, ecosystems and agricultural lands (e.g. loss of cover and soil, pollution of land and waterways) that has occurred throughout the world has made it easier for some alien species to establish and become invasive since they are "colonising" species that benefit from the reduced competition that follows habitat degradation. Thirdly, alien species are often intentionally introduced for direct or indirect economic benefits without proper risk assessment regarding their becoming invasive later on in situations favourable to them. Fourthly, the negative consequences of IAS affect various strata of communities quite differently, the deprived sections bearing the burden more than others.

**Box 2**  
**Threats to Biological Diversity**

Every invasive alien species that becomes established in a new environment alters the composition of native biological communities in some way. These alterations can disturb the structure and functioning of the invaded ecosystems with profound socio-economic impacts. These impacts may often be irreversible and addressing them is an urgent need since this problem is growing daily with the accelerated rate of species' movements through trade, transport, travel and tourism. It is evident that a good knowledge and understanding of how alien species become harmful to ecosystems is a prerequisite for adequate mitigation and/or elimination of their adverse impacts, both at the species/population-level and also at the habitat/ecosystem-level.

Accidental introductions by definition are not exposed to a prior cost-benefit assessment, but assessments of the costs of such introductions can justify increased budgets to control and limit such accidental introductions. Whereas purposeful introductions might be controlled by legislation or regulation, accidents may be far more important in the spread of introduced species and much more difficult to control. The Convention on Biological Diversity offers an important opportunity for addressing global problems of introduced species, a threat to biodiversity that is far more immediately significant than the introduction of living modified organisms (LMOs), which to date has received far more attention under the guise of biosafety. An extended biosafety protocol, which also addresses the issues of alien species and international trade, would be far more useful for achieving all the objectives of the CBD.

It is also interesting to note that the spread of global consumerism was given a significant boost in the early decades of the 20th century through advertising and marketing that was strategically designed to motivate the public to buy more goods. This ultimately led to a desperate search to find new species to grow and market, creating consumer demand for products that previously were not present. The invasive characteristics of the newly introduced species often came as a surprise, because those responsible for the introduction were unaware of the possible negative ecological ramifications of the species involved.

The scope and cost of biological alien invasions is global and enormous, in both ecological and economic terms. The ecological cost is the irretrievable loss of native species and ecosystems. In addition, the direct economic costs of alien invasive species run into many billions of dollars annually. Arable weeds reduce crop yields and increase costs; weeds degrade catchment areas and freshwater ecosystems; tourists and homeowners unwittingly introduce alien plants into wilderness and natural areas; pests and pathogens of crops, livestock and forests reduce yields

and increase control costs. Environmental and socio-economic impacts of harmful invasive alien species are already evident in many countries as widely experienced in the case of alien aquatic weeds like water hyacinth (*Eichhornia crassipes*) and water lettuce (*Pistia* spp.) that are increasingly choking waterways and degrading freshwater ecosystems.

Unregulated discharge of ballast water together with hull fouling is also known to contribute substantially to unwanted introductions of harmful aquatic organisms, including diseases, bacteria and viruses, in marine and freshwater systems. This dimension has attracted much attention in recent years since ballast water is now regarded as the most important vector for trans-oceanic and inter-oceanic movements of shallow-water coastal organisms.

While all continental areas have suffered from biological alien invasions, the problem is particularly acute on islands in general, and for small island countries in particular. Problems also arise in other isolated habitats and ecosystems, such as in Antarctica. The physical isolation of islands over millions of years has favored the evolution of unique species and ecosystems. As a consequence, islands and other isolated areas (e.g. mountains and lakes) usually have a high proportion of endemic species and are often the centres of significant biological diversity. The evolutionary processes associated with isolation also signal that the island species are especially vulnerable to competitors, predators, pathogens and parasites from other areas. Few countries have developed the comprehensive legal and institutional systems that are capable of responding effectively to these new flows of goods, visitors and 'hitchhiker' species. It is, hence, important for the international funding agencies to help the concerned governments in improving their capacity to prevent the arrival of alien invasive species with better knowledge, improved laws and greater management capacity, backed by quarantine and customs systems that are capable of identifying and intercepting the invasive alien species.

## **Recent Developments**

It is widely recognized that most harmful exotics are not the result of intentional introductions or illegal entries facilitated by international travellers, but rather due to unintentional "hitchhiking" through international trade, with exotics stowing away in ships, planes, trucks, shipping containers, and packing materials, or arriving on nursery stock, unprocessed logs, fruits, seeds, and vegetables (OTA, 1993). Increased international trade is now considered as having the massive potential to cause introductions of more harmful exotic species (Jenkins, 1996). More proactive, more comprehensive, and effectively coordinated international efforts are needed to ensure that widely adapted invasive exotics do not further homogenize biological systems on a global scale. Indeed, the biggest hidden danger from introduced species lies in their contribution to global homogenization, also known as 'biological pollution', that reduces the diversity of crops and livestock and can increase their vulnerability to both native and exotic pests, often leading to the increased use of pesticides which may have broad negative impacts on ecosystems. Thus introductions may lead to 'cascades' of effects that were not part of the decisions that led to those introductions.

Despite some arguably positive effects on biodiversity at the local level, however, overwhelming evidence indicates the profoundly negative effects of many introductions on species and genetic diversity at both the local and global level. Such introductions can lead to severe disruption of ecological communities (Drake, 1989; Zaret and Paine, 1973; Mooney and Drake, 1986), and heavily influence the genetic diversity of indigenous species. Some protected areas established to conserve native species have been profoundly affected by introduced species and wherever the



direct cause of extinction is identifiable, introduced species head the list. Globally, almost 20 percent of the vertebrates thought to be in danger of extinction are threatened in some way by invasive species (Table 1). The single biggest tragedy is the probable loss of at least 200 of the 300 endemic cichlid species in Lake Victoria as a result of the introduction of the Nile perch, *Lates niloticus*, to the lake (Lowe-McConnell, 1993). The global effects of certain invasive species such as the European pig (*Sus scrofa*), rats (*Rattus* spp.) and the aquatic plants *Salvinia molesta* and *Eichhornia crassipes* also attest to the destructive power of invasives.

Thus, the emerging general global picture depicts a tremendous mixing of species with unpredictable long-term results. While many introduced species have special cultivation requirements that restrict their spread, many others find appropriate conditions in their newly acquired homes while many more may invade new habitats and constantly extend their distribution, thereby representing a potential threat to local species. The future is expected to bring considerably more ecological shuffling as people influence ecosystems in various ways, not the least through both purposeful and accidental introduction of species. This shuffling/ re-shuffling will have both winners and losers although the overall effect is likely be a global loss of biodiversity at species and genetic levels (McNeely, 2001).

Table 1. The percentage of threatened terrestrial vertebrate species affected by introductions in the continental landmasses of the different biogeographic realms and on the world's islands. (The total number of threatened species in the realm is given in brackets).

Taxonomic group	Mainland areas		Islands (Insular areas)	
	%	(n)	%	(n)
Mammals	19.4	(283)	11.5	(61)
Birds	5.2	(250)	38.2	(144)
Reptiles	15.5	(84)	32.9	(76)
Amphibians	3.3	(30)	30.8	(13)
Total for all groups Considered	12.7	(647)	31.0	(294)

Source: Macdonald *et al.*, 1989

### **CBD Approach to the Problems caused by Invasive Alien Species**

The Convention on Biological Diversity (CBD) is addressing the impact of invasive alien species in many ways including eradication, control, mitigation of their impacts combined with legislation and guidelines at national, regional and international levels. It is recognized as a cross-cutting issue within the Convention and priority attention is being given to geographically and evolutionarily isolated ecosystems as represented by small islands.

The Conference of Parties (COP) to CBD has referred to alien species in a number of its decisions while recognizing the importance of the Global Invasive Species Programme (GISP) calling on it to develop a second phase of its activities and requested the GEF and other bodies to provide financial support for this purpose. The Invasive Species Specialist Group (ISSG), a global group of 146 scientific and policy experts on invasive species from 41 countries and a part of the Species Survival Commission (SSC) of the World Conservation Union (IUCN), also provides advice on threats from invasives and control or eradication methods.

The COP has invited Parties to develop country-driven projects at both national and supra-national levels to address alien species and to incorporate the issue into their biodiversity strategies and action plans. Parties have been urged to carry out a number of actions regarding alien species, including application of the interim guiding principles, undertaking of case studies, development of mechanisms for transboundary, regional and multilateral cooperation, and development of education, training and public-awareness measures. The COP has also resolved that the GEF should provide adequate and timely support for country-driven projects at national, regional and subregional levels addressing the issue of alien species.

**Box 3**  
**Guiding Principles for Handling Invasive Alien Species**

Article 8(h) of the Convention on Biological Diversity requires Parties “as far as possible and as appropriate, [to] prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species”. At its fourth meeting, the Conference of the Parties (COP), recognizing the problems alien species may cause to indigenous and local communities and negative effects on local and national economies, designated alien species to be a cross-cutting issue to be taken into account in each thematic work programme under the Convention, and decided that invasive alien species would be a matter for in-depth discussion of the sixth meeting of the Conference of the Parties. Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) to CBD developed 15 Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that were adopted at the sixth meeting of the COP held at the Hague in April 2002 and recommended for use and further improvement based on relevant experiences (See Annex 3).

While reaffirming the priority to full and effective implementation of Article 8(h), COP-6 (held in The Hague in April 2002) urged the Contracting Parties, other Governments and relevant organizations to promote and implement the Guiding Principles as presented in Annex-3 to this document. It has also urged the Parties, Governments and relevant organizations to promote and carry out research and assessments on:

- The impact of invasive alien species on biological diversity;
- The socio-economic implications of invasive alien species particularly the implications for indigenous and local communities;
- The development of environmentally benign methods to control and eradicate invasive alien species, including measures for use in quarantine.
- The costs and benefits of the use of biocontrol agents to control and eradicate invasive alien species;

- Means to enhance the capacity of ecosystems to resist or recover from alien species' invasions;
- Priorities for taxonomic work through the Global Taxonomy Initiative; and
- Criteria for assessing the risks from introduction of alien species to biological diversity at the genetic, species and ecosystem levels.

**International legal instruments:** Key international legal instruments, that address the threat of invasive alien species, include the United Nations Convention on the Law of the Sea, the Convention on Biological Diversity, the Ramsar Convention on Wetlands and other multilateral environmental agreements, as well as instruments developed for the plant, animal and human health sectors, or to address particular vectors, such as the International Plant Protection Convention (IPPC) and instruments developed under the Office International des Epizooties (OIE) and specialized agencies such as the Food and Agriculture Organization of the United Nations (FAO), the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO) and the World Health Organisation (WHO).

Prevention is treated inconsistently across existing multilateral environment agreements (MEA), the level ranging from strong <sup>1/</sup> to weak. <sup>2/</sup> Most instruments provide no indicators of where prohibitions or restrictions should be imposed, unless their scope is limited to protected areas. No procedures are established for cooperation with countries that are the source/origin of alien species that may impact on biodiversity. The Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES) is the only multilateral environmental agreement to mandate species-specific reciprocal controls between States of export and import. It would probably apply to introductions of alien species if a species protected in the exporting State was considered potentially invasive in the importing State. There are also no criteria to promote consistent decision-making other than the broad references to “threat”, “serious harm” or similar general concepts.

The Convention on Biological Diversity provides the most general provision, requiring Parties “as far as possible and as appropriate, [to] prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species” (Article 8(h)). The Convention contains no specific requirements of how this is to be done, though non-binding guidance is being developed (for example: the Interim Guiding Principles; and recommendations under various thematic programmes). A similar situation exists with other multilateral agreements excepting the legally-binding measures of the Antarctic Treaty as seen in the Madrid Protocol on Environmental Protection that lays down stringent rules.

The Convention on the Law of the Sea requires Parties to take all measures necessary to prevent, reduce or control pollution of the marine environment resulting from the intentional or accidental introduction of alien or new species to a particular part of the marine environment, which may cause significant and harmful changes thereto (Article 196). Regionally, environmental protocols to four conventions developed under the UNEP Regional Seas Programme contain specific requirements to prevent introductions to marine and coastal ecosystems (Eastern African region, Wider Caribbean region, South-East Pacific and Mediterranean).

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<sup>1/</sup> Prohibition under AEWa and the Alpine Convention Protocol, strict control under the Convention on Migratory Species and the Bern Convention.

<sup>2/</sup> The ASEAN Agreement, “endeavour to regulate, and where necessary, prohibit...”.

- **Instruments to protect plant, animal and human health**

Some of the earliest instruments that address the threats of invasive alien species aim at controlling the introduction and spread of pests and diseases in order to protect human, animal and plant health. For example, the IPPC provides a framework for international cooperation to secure common and effective action to prevent the introduction of pests of plants and plant products, and to promote appropriate measures for their control. The IPPC was revised in 1997 primarily in response to the adoption of the 1995 WTO Agreement on the Application of Sanitary and Phytosanitary Measures (the “SPS Agreement”). However, the IPPC concerns only with pests classified as “injurious to plants or plant products”. This wording covers alien organisms that could damage wild plants but not explicitly those that may harm ecosystem functions or plant genetic diversity.

The Office International des Epizooties develops standards and guidance on pests and diseases of animals (but not animals themselves as pests). Standards are set out in the International Animal Health Code for Mammals, Birds and Bees, including on import risk analysis and import/export procedures, and in the International Aquatic Animal Health Code, the aim of which is “to facilitate trade in aquatic animals and aquatic animal products”.

The 1995 WTO Agreement on the Application of Sanitary and Phytosanitary Measures is relevant to alien species characterized as pests or diseases. A WTO member may adopt national measures to protect human, animal or plant health/life from risks arising from the entry, establishment or spread of pests, diseases, or disease-causing organisms and to “prevent or limit other damage” within its territory from these causes.

The 1969 WHO International Health Regulations, amended in 1973 and 1981, aim at ensuring the maximum security against the international spread of diseases. The goals are to: (i) detect, reduce or eliminate sources from which infection spreads; (ii) improve sanitation in and around ports and airports; and (iii) prevent dissemination of vectors. These Regulations are being revised and modernized to adapt to changes in disease epidemiology and control and to substantial increases in the volume of international traffic.

- **Instruments to address risks from transport**

No binding standards apply to international transport, though some countries have moved ahead and adopted legislation in this area. IMO has adopted Guidelines (voluntary) for the Control and Management of Ships' Ballast Water to Minimize the Transfer of Harmful Aquatic Organisms and Pathogens. <sup>3/</sup> Mandatory international regime to regulate and control ballast water is under preparation. The Cartagena Protocol on Biosafety includes provisions for handling, transport, packaging and identification (Article 18).

There are several gaps in the regulatory framework associated with transport. Voluntary aviation-related standards do not go beyond civil aviation. Land transport is not formally regulated to minimize transfer risks. For inland waterways, there seems to be no guidance on water-borne transport or risks associated with canal links connecting drainage basins or coasts.

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<sup>3/</sup> Annex to resolution A.868 (29), 20th IMO Assembly, 1997, which updates the 1993 IMO Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Waters and Sediments Discharges (IMO Assembly Res. A.774 (18)).

- **Provisions relating to intentional introductions:**

A major gap exists in relation to the introduction of alien species into freshwater systems. The work programme on the biodiversity of inland waters under the Convention on Biological Diversity (decision IV/4) recommends that Parties should conduct inventories and impact assessments of alien species in such ecosystems and mitigate negative consequences of such species on inland water ecosystems especially at the watershed, catchment and river basin level. The FAO Code of Conduct for Responsible Fisheries provides some guidance, for example, for pre-introduction discussion with neighbouring States when non-indigenous stocks are to be introduced into transboundary aquatic ecosystems. It calls for harmful effects of non-indigenous and genetically altered stocks to be minimized especially where significant potential exists for spread into other states or country of origin. The Code proposes that States should collaborate in the elaboration, adoption and implementation of international codes of practice and procedures for introductions and transfers of aquatic organisms. However, there are no binding instruments on deliberate introductions. The International Watercourses Convention (which is not yet in force) sets in place measures for prevention of introductions of alien species to watercourses that may have adverse transboundary impacts.

The FAO Code of Conduct for the Import and Release of Exotic Biological Control Agents has been adopted as an international standard under the IPPC. It sets out internationally agreed procedures for agents capable of self-replication for research, for field release for biological control or for use as biological pesticides.

The Cartagena Protocol on Biosafety includes provisions for advance informed agreement by the receiving country for living modified organisms for intentional introduction into the environment (Articles 7–10). <sup>4/</sup>

- **Standards for risk assessment**

Risk assessment is an important activity to determine whether or not it is justified to carry out a certain measure, and, risk assessment is widely employed in the sectors of plant, animal and human health. There are no legally binding international guidelines for risk assessment of invasive alien species *per se*. General guidelines, including those recently developed for aquatic animals, do exist for assessing the risk of introduction and spread of exotic animal disease and plant pests, including weeds. The Cartagena Protocol on Biosafety includes provisions for the management of risks posed by living modified organisms (Article 16), and includes a list of points to be considered in risk assessment.

For WTO members, national measures for prevention of alien species that may affect international trade must be consistent with WTO principles and rules, as expressed through the SPS Agreement. Where an international standard is set by an organization recognized under that Agreement, States should base national measures on that standard. The SPS Agreement currently recognizes standards set by IPPC (pests of plants and plant health), OIE (pests and diseases of animals) and Codex Alimentarius Commission (food safety and human health). This excludes taxa that are pests in their own right but are not vectors of disease or injury to plants, plant products and animals. The mandates of the three organizations are broad enough to cover certain environmental and societal impacts, but no standards (adopted to date) take these dimensions adequately into account. However a working group under the IPPC is exploring the option of incorporating such environmental criteria into its standards for risk analysis.

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<sup>4/</sup> A simplified procedure applies for LMOs intended for direct use as food or feed, or for processing (Article 11).

Several international instruments, including the Convention on Biological Diversity, the Biosafety Protocol and the FAO Code of Conduct on Responsible Fisheries have advocated precautionary measures. There is need to integrate all the inputs to evolve a suitable strategy.

Lack of reliable, consistent and comprehensive data is possibly the biggest challenge in the successful application of risk assessment to invasive alien species. This is particularly true for biological baseline data and economic impacts. These gaps exist both in the type and the quantity of data available, compared to what is required for comprehensive risk assessments to be undertaken. In addition, lack of coordination in data collection programmes may yield data that cannot be used to form a comprehensive picture of the situation. Poor accessibility to information also hinders the majority of countries in their development of representative tools and procedures.

With animal health, the process of listing of notifiable diseases is not currently geared towards notification of broader environmental pathogens. However, once an animal disease is added to the list, there is an effective reporting system, recommended diagnostic techniques, and international networks on the topics.

In the context of plant health, more guidance and much more implementation are needed in capturing the potential economic impacts of invasive species. In the implementation of the IPPC, currently there is a bias towards cultivated plants, and the potential to address other invasive species that impact on plants is not fulfilled. “New” pests that do not fall within the plant health mandate, such as flatworms that predate on native earthworms or poisonous spiders, may be left unregulated but these mean potential hazards unless properly handled.

## **REVIEW OF CASE-STUDIES**

At its fourth meeting, SBSTTA requested the Executive Secretary to invite Contracting Parties to CBD, other Governments and relevant bodies urgently to submit available case studies on invasive alien species to contribute to the work of preparing advice on this item. The Conference of the Parties, at its fifth meeting, endorsed the outline for case studies proposed by SBSTTA, and urged Parties, Governments and relevant organizations to submit case studies based on their experiences. The clearing-house mechanism of the Convention was requested to disseminate and compile those case studies.

Thirty case studies had been received as of December 1999 and were used by the Executive Secretary in the preparation of his note on the subject for the fifth meeting of SBSTTA (UNEP/CBD/SBSTTA/5/5). Thirty additional case studies were received by 30 October 2000. These additional studies came from Argentina, Australia, GISP, India, Japan, Mexico, New Zealand, Seychelles, Sweden, United Kingdom, and the United States of America among others..

An analysis of the main issues, emerging from these case studies, is presented below, broken down into six main areas: prevention, detection, eradication, containment, control and general issues/points.

### **A. Prevention**

Attempts to develop tools to predict whether a species is likely to become invasive have had some success. In some cases, it may be possible to identify that a species is highly likely to be invasive, for example, because it has been invasive in a similar habitat. Saying with certainty that a species will not be invasive appears to be more difficult, however, and the case studies include examples of where predictions about behaviour were incorrect. For this reason, it can be

concluded that a precautionary approach would be to treat every alien species as potentially invasive until there is evidence to indicate that it is not.

Case studies and scientific literature provide examples of invasive alien species in all major taxonomic groups. It is therefore apparent that no such group can be treated as a low risk, and prevention, detection and management systems would ideally be able to handle all groups, including microorganisms. An understanding of the reproduction strategies and habitat requirements of the species is needed to assess its invasiveness, and general rules based on its taxon type do not apply.

The case-studies indicate that species in their natural environment may exhibit quite different characteristics when they are translocated elsewhere. Therefore, while behaviour in the originating environment may indicate potential problems, it is unlikely to be an indicator of safety. In many cases, species that became invasive outside of their natural range did not show invasive characteristics in their natural environment. In some cases, the species even became endangered in their natural habitat. The scientific literature includes discussion of a number of reasons why a species may behave differently in a new environment. Lack of natural predators and diseases is a frequently cited reason, and successful biological control operations illustrate this point. Another reason may be differences in the ability of the native species in the invaded habitat to cope with the tactics used by the invader.

All regions of the world and most countries have been the origin for invasive alien species causing problems in other locations. Thus, every country is a potential risk to its neighbours and trading partners.

It is not just alien species that have crossed national boundaries that are potentially invasive. The case studies include species that have become invasive when moved to areas outside their home range within national boundaries (and are therefore alien to their new location).

Speciation is in part the result of natural barriers to the movement of genetic material. These include the isolation of habitats such as lakes, islands, reefs, and estuaries by distance or physical barriers. Any species that is moved across that barrier through human intervention can be treated as alien to its new home. Political borders and biological borders do not always coincide. In many cases, political borders cut across continuous habitat, or encompass areas that are not biologically connected. Most “border control” work has been focused on political borders, but increasingly countries are developing regional or subnational controls on the movement of alien species.

Cross-border movements of goods and people are frequent, and increasing. This means that even a fairly ineffective vector can result in a high rate of invasions over time. Prevention systems are not able to detect all possible importations of alien species, although with sufficient effort it may be possible to reduce the risk to levels close to zero. Less than perfect systems may still greatly reduce the rate of invasion, and therefore the effort needed for management. Interim guiding principle 2 states that prevention is generally the most cost-effective approach. The rate of invasions can be reduced by a border control system, backed up by surveillance around the entry points to allow early detection of failures, and immediate eradication of new incursions. The border used for this purpose may match the political border, or be within the country, or be regional. Prevention systems can significantly reduce the number of problems that need to be

tackled, even if some failures are inevitable. Alien species can be moved by people deliberately or accidentally. They can also spread naturally from an original invasion site.

## **B. Detection**

Normal decision-making processes for activities such as eradications can be protracted. In the cases considered, it would be necessary to allow considerable time for technical assessments, public consultation, and any necessary legal processes. In addition, the response may be slowed by lack of available funding, and by uncertainty about what agency is responsible and has the necessary authority. An early response is facilitated if contingency procedures are in place.

The guiding principles recognize that early detection is an important component of any prevention/eradication approach. Information document UNEP/CBD/SBSTTA/INF/3 sets out a range of ways in which the rate of early detection can be increased. Several case studies show that the ability to undertake eradication successfully is often dependent on early action. In addition, case studies show that rapid response to an invasion may be essential to prevent irreversible damage occurring. The case-studies and information document UNEP/CBD/SBSTTA/INF/3 include examples where early detection can be achieved through formal monitoring/surveillance programmes, as well as through less formal means, including public reporting of new species.

Several case studies indicate that the ability to mount a rapid response would be greatly enhanced if there already existed:

- A clear allocation of responsibilities to agencies with the ability to undertake the work;
- Authority to take actions already established (e.g. the use of certain types of poisons may have already been approved through the normal process, ready for when they are needed, or relevant laws may be in place);
- Established funds, or access to a fast-track funding process;
- The ability to undertake actions that would not normally be allowed (e.g. blocking the movement of goods and vehicles, destroying private property) where such actions are needed to respond to an emergency;
- Clearly understood and established procedures for responding to new incursions that outline who is responsible for taking initial actions, rules for gaining additional government funding, how decisions will be taken on an appropriate response, and what actions can be taken to prevent further spread.

## **C. Eradication**

Eradication is recognized in the interim guiding principles to be the preferred method for dealing with invasive alien species if prevention is not successful. The guiding principles recognize that this depends on it being cost effective. The case studies include examples where eradication was difficult and expensive. They also include examples, however, where eradications were successful and cost-effective, and show that our knowledge base and capacity to undertake eradication is increasing. In a number of cases where eradications were undertaken, the benefits reported were wide-ranging, including prevention of expected damage, and recovery of ecosystems.

## **D. Containment**



Containment is recognized in the interim guiding principles as a useful approach, and the case studies provide a number of circumstances where this approach has been employed. These include its use as a temporary measure while long-term measures are being decided, to prevent the spread of the species to new areas, or to allow localized eradication without the cleared area being immediately re-invaded.

## **E. Control**

There is a wide range of control measures available, which can be used to mitigate the impacts of alien invasive species. The most frequently mentioned methods for mitigating the effects of alien species are mechanical removal, biological control, poisoning, and trapping. However, the case studies provide a variety of other options, including the development of physical barriers to the movement of species and changing the nature of potential vectors. Sometimes measures have been adopted which produce significant short-term impacts (for example, damage to other biodiversity), or have had significant social effects (for example, restricting the movement of people, animals or goods). As well as the success stories, the case studies include failed programmes, which also provide valuable information for other Parties.

Some case studies showed that where an area is subject to more than one invasion, the removal of one species may result in changes in the populations of the other species that may then result in a greater overall problem for biodiversity. This would suggest that it is important for the planning of a control programme to include consideration of the likely effects of the programme on other invasive alien species present in the area.

Information document UNEP/CBD/SBSTTA/6INF/3 suggests biological control may be a valuable option, but not without risks. The case studies include both successful use of biological control, and problems created by poorly designed projects. Careful research and assessment is necessary in any proposed biological control programme.

## **F. General points/issues**

The case studies include examples where failure to take early enough action resulted in intractable problems and potentially irreversible impacts. They also include examples that indicate that eradication, containment and control of invasive alien species become progressively more difficult as the population of the species, and its geographic extent, increase. The case-studies show that established invasive species can cause significant impacts to biodiversity, and those impacts may sometimes be irreversible.

Many invasions documented in the case studies did not occur by direct transfer from the country to which the species is indigenous. Often the species spread from an earlier invasion source. In some cases, invasions have resulted in very high population numbers, and active dispersal behaviour, increasing the likelihood of spread to new areas. In addition, the case studies indicate that the chance of humans moving the species deliberately or accidentally is increased if there are more potential sources.

Some cases studies identified genetic contamination of indigenous species as a significant impact from alien species invasions. In some cases, such contamination has resulted in the effective extinction of the native species. Even where the effect was not as severe, the case studies cite a loss of fitness of some species, or impacts on the ability to undertake recovery work on threatened species.

A number of case studies documented the direct economic costs of alien species invasions. The economic costs of some of these invasions were very high. Identifying costs was cited in some cases as a major factor in gaining support for prevention and management programmes. Most of the economic studies focused on alien species in the primary production sectors, rather than those affecting biodiversity, but these species often also have biodiversity impacts. The economic costs of alien species identified in the case studies included the following:

- Direct and indirect costs of prevention, eradication or control (including delays to the movement of goods and passengers);
- Direct effects on economic sectors (e.g. agriculture, forestry, shipping);
- Effects on human health, resulting in lost productivity and medical costs;
- Indirect costs to the economic sector, for example from loss of markets or damage to the tourism industry.

While there is a wide range of prevention, eradication and control options available, the overriding message from the scientific literature (see UNEP/CBD/SBSTTA/6/INF/3) indicates that the best option needs to be carefully chosen, taking into account effectiveness, costs, and impacts of its use. The successful operations reported generally included careful planning and design. Sometimes drastic measures were considered to be justified. In addition, some case studies indicate that the effect of managing one invasive species on the impacts of other invasive species must be considered. Experience from the case studies suggest that the planning process should be able to draw on relevant experience elsewhere, but that the approach taken needs to be tailored to the particular circumstances of the affected country. Information collection and research were important elements of some of the successful case studies provided, as were public consultation and involvement.

Several case studies state that cost-effective and/or acceptable control or eradication techniques were not available for many existing or likely alien species problems. While there is evidence in the case-studies of significant work being undertaken to manage the effects of alien species on biodiversity, they also showed that in some cases the ability to undertake this work is limited by the lack of a technique which is effective, affordable, acceptable to the public, and does not have unacceptable negative effects on other biodiversity values or on other sectors.

Some case-studies included information indicating that prevention, eradication and control can be very costly, and that therefore prioritizing actions was an important element in that country's alien species work. Prioritizing was used to allow scarce resources to be targeted to where they would achieve optimal benefit. This included deciding what actions would not be taken in the foreseeable future, and what actions would be deferred. In some cases, partial actions were undertaken to retain future options, but with a complete response deferred (until a suitable management method was available).

The case studies show that alien species may threaten many sectors of society. Several case studies identified the need for integration between the sectors to increase the cost-effectiveness of alien species work. Key sectors mentioned were health, agriculture, forestry, fisheries, aquaculture, tourism, shipping, and construction. In addition, there were examples showing that the way in which invasive species were managed had implications for affected sectors, including implications for economic and social development.

Many of the alien species described in the case studies were reportedly introduced as a result of a deliberate decision, or by the unintentional introduction of the species where that could have been prevented. Subsequent problems created by the species led to costs for parties not involved in the decision that resulted in importation. In some cases, equitable sharing of costs between those creating the problem and those suffering as a result of the problem was seen as an important part of planning responses to an invasive alien species.

Several case studies exemplified how public attitudes to alien species problems can greatly affect the effectiveness of prevention, eradication and control programmes. Public willingness to comply with border control restrictions, for example, was cited as having a major influence on their effectiveness. Several case studies show that the public affected political decision-making, and/or had a direct control over the ability to undertake management actions. Public opinion was cited in several cases as a major factor in determining accessibility to management methods such as the use of poisons, the killing of vertebrates, and the temporary destruction of habitat (e.g. draining a pond to eradicate fish). Case studies ranged from examples where public opinion resulted in opposition to the work, to those where it resulted in active support for alien-species management. Public-awareness campaigns in some cases were reported to have greatly enhanced public understanding of the impacts of alien species, and the practicalities and risks of various management options.

Almost all the thematic national reports identified a lack of resources as a major limiting factor for alien species response work. Some case studies included examples of the use of community and international volunteers in detection and management programmes. These case studies suggest that the use of communities and volunteers may represent a significant untapped resource for other programmes.

The case studies included examples showing that cooperative efforts between countries provided major benefits, and in some cases was essential for the effective treatment of the problem. The reasons for cooperative arrangements varied, and included the following:

- Countries share biodiversity that was threatened;
- Countries were the source of the alien species, and the site of the invasions (this was particularly relevant for biological control work);
- Countries faced similar problems, and sharing of experiences or cooperative development of new information or techniques benefited both;
- Countries had political relationships, for example, a donor-recipient relationship;
- Activities (for example, management of border-control arrangements) needed to be operated at a regional level;
- Mitigation effort in one country was considered to be fruitless because of the threat of constant re-invasion from a neighbouring country that was not carrying out mitigation actions.

### **Review of National Reports on Implementation of Article 8(h) on IAS:**

The objective of national reporting, as specified in the Article 26 of the Convention, is to provide information to the Conference of the Parties on measures taken by the Contracting Parties for the implementation of the provisions of the Convention and their effectiveness in meeting the

objectives of the Convention. At its fifth meeting, the Conference of the Parties considered and endorsed the guidelines and format for future national reporting that were developed by the Secretariat through a pilot project, carried out in collaboration with a number of Parties, to identify a methodology for assessing the status of the implementation of the Convention. This involved: (i) identifying the obligations on the Parties deriving from the provisions of the Convention and the decisions of the Conference of the Parties; and (ii) formulating these as questions designed to elicit responses that would reveal the level of implementation, relative priorities, constraints encountered and issues not yet addressed.

By the end of January 2002, a total of 65 reports had been received from the Parties and one from non-Parties. By regional breakdowns, the Secretariat had received 13 reports from Asia, 17 reports from Africa, nine reports from Central and Eastern Europe, eight reports from Latin America and the Caribbean and 19 reports from the Group of Western and Other States (WOGS). Seventeen reports have been received from the least developed Parties (out of a total of 49 such Parties) and seven reports from Small Island Developing Parties (out of a total of 37 such Parties). The differences among regional groups of Parties in the implementation of the Article 8(h) are not remarkable. However, some regional groups of Parties are further advanced in legislation and policy and programme development than other groups of Parties. Generally the Parties of all groups are at a similar level of implementation, which may be attributed to the fact that the issue of alien species is relatively new and the work on various aspects of the issue is still ongoing within CBD or other relevant forums.

#### Box 4

##### Invasions by *Mikania* and *Chromolaena*

*Mikania micrantha* is a native to Central and South America, where it grows in and near forests, along rivers and streams and in disturbed areas such as roadsides. It is a fast growing, perennial, creeping and twining plant, commonly called “mile-a-minute” because of its vigorous and rampant growth habit. It grows best where fertility, organic matter, soil moisture, and humidity are all high, as obtaining in North Eastern Himalayas. The flowers, white to greenish-white, are arranged in dense terminal or axillary corymbs. Once established, this plant spreads at an alarming rate, readily climbing and twining on any vertical support, including crops, bushes, trees, walls and fences. Vegetative reproduction is also efficient and vigorous. Although intolerant of heavy shade, it readily colonises gaps and damages or kills other plants by cutting out the light and smothering them. In this respect it is especially damaging in young plantations and nurseries. It also competes for water and nutrients, but perhaps even more importantly, it is believed that the plant releases substances that inhibit the growth of other plants.

*Chromolaena odorata*, (Synonym: *Eupatorium odoratum*) native to tropical America and Mexico, arrived in India around 1900. and became the most dominant weed in and around Karapura, Kakanakote and Heggadadevana Kote forests in western ghats replacing all other ground vegetation including the noxious *Lantana*. It is believed to have been introduced in tea plantations of northeast India where it became particularly aggressive in the higher elevations as well as in the sub-Himalayan states. Its subsequent spread to South India is generally associated with retuning of the plantation workers to Kerala. It is a herbaceous perennial

shrub, considered to be a plant of 'secondary succession', in that it invades clearings and persists until shaded out by the overgrowth of forest trees. It is incredibly fast growing, producing hundreds of thousands of wind-dispersed seeds per plant.

Both these species have been nominated as among 100 of the "World's Worst" invaders. In their places of origin, they are kept in check by a number of factors including attack by native insects, other arthropods and diseases, together with competition with related plants. However, due to the absence of these species-specific factors these species have nearly naturalized in India. Strategies to manage them include clearance campaigns with increased awareness and funding. Another possibility is the release of biological control agents, natural predators or parasites.

Use of a defoliating arctiid moth has been tried in some places to control *Chromolaena*. Another approach is to find ways to use it - in particular as a biopesticide. A number of alcohols, chalcones, aromatic acids and an essential oil have been isolated from the weed; the oil exhibits insecticidal activity.

Source: ISSG Website.

Judging from the responses concerning identification of alien species, risk assessment and measures taken, it is clear that more needs to be done for a full implementation of the Article 8(h), though a number of Parties have made some progress in scientific research, monitoring, legislation and planning. Some Parties have identified the following as constraints for implementation of the Article 8 (h): weak capability of research, inventorying, risk assessment and monitoring; lack of measures to control unintentional introduction; inconsistency of policy among relevant sectors and industries; weak information exchange and cooperation among the Parties at the regional level; and lack of regulatory and technical tools. Relevant portion of India's National Report dealing with alien species is presented in Annex-1 for reference.

At the national level, most countries have at least a minimal system in place for regulating alien species introductions. Except for a few countries, these are rarely comprehensive and they were not designed to conserve biodiversity against invasion impacts (except, possibly, in a limited way for protected areas).

Quite often, suitable tools are in place but under-used. Competent authorities usually have general powers under quarantine/agricultural legislation to adopt import/movement regulations for designated 'noxious weeds' and to require farmers and landowners to control such weeds. However, implementing regulations are not always issued promptly or publicized and applied.

Effective prevention also depends on restricting further imports and internal movements of alien species that present invasion risks: this is important to support containment strategies and prevent spread to other areas. This is potentially a gap under the IPPC whose provisions apply only where the species concerned is designated as a quarantine pest and thus subject to official control. Where an invasive alien species is not regulated as a plant pest by an individual country, IPPC provisions do not apply. The IPPC does provide for regulation of non-quarantine pests, <sup>5/</sup> but

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<sup>5/</sup> Defined as "pests whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing party".

this concerns pests on propagation material and does not appear to support restrictions on pests with environmental impacts.

### **Invasive Alien Species: The Indian Scene**

Plant diversity in India is remarkably rich largely because of the vast variations in soil, altitudinal and climatic conditions. About 46,000 plant species have been documented here, of which nearly 17,000 are vascular while *ca* 5,000 among them are endemic (Nayar and Sastry, 1987). Indian flora is considered a part of the Indo-Malayan sub-kingdom under the paleotropical kingdom. Hooker (1904), however, felt that flora of India was merely a mixture of the floras of surrounding countries, viz., Malaya, Africa, Tibet, China and Japan, and there was no Indian flora as a separate entity.

High mountain ranges in the North and presence of sea on three sides of the Indian sub-continent provide favourable situation for the preservation of unique flora. Although these natural barriers have protected the indigenous flora yet the land mass connections in the north and the west have provided migratory routes to many exotic elements from North-East Africa or West Asia, and South-West China. As a result, a large number of species have come to India from the surrounding countries viz., Myanmar, Malaya, South- West China, Eastern China, Japan, West Asia, Sri Lanka and Africa. Although the vegetation of most of these regions is very different from India yet the great influence of these countries on the flora of India is evident (Chatterjee, 1940).

Exotic weeds have been established in India ever since the arrival of Portuguese who introduced several economically important plants brought from Brazil, Mexico, parts of Africa and other places on their commercial route. They introduced many ornamental and medicinal plants also. In the process, seeds of many obnoxious weeds also got mixed up and they firmly established here and spread widely. These weedy species after their introduction were aided to some extent by shifting agriculture, faulty pasture practices, establishment of townships and colonies, and mass shifting of labourers from one region to another for construction or plantation work.

#### **Box 5 The Case of Scotch Broom**

The Nilgiris district in Tamil Nadu, known for its tea and coffee plantations set in beautiful natural ecosystems, has faced increasing pressure from settlements and urbanization. This ecologically fragile area along with all the *shola* grasslands of the Nilgiris has been invaded by a fast spreading exotic weedy species called the Scotch broom (*Cytisus scoparius*). This shrubby clover, a native of the Mediterranean region, has wide adaptability. It has overtaken more than a million hectares in southern states of USA and also large area in British Columbia in Canada. It has also become a problem in Australia and New Zealand and has also been reported from Sri Lanka. There have been reports of livestock loss due to the ingestion of alkaloids produced by this plant and its flowers and seeds cause nausea and vomiting on ingestion by humans.

In the Nilgiris, the progressive expansion of this yellow flowering alien species has threatened the biodiversity values of these famous grasslands impacting upon the native species such as the endangered bird 'Nilgiri Pipit', several species of herpetofauna and many

ground orchids. *Sambhar*, the major prey species in this area, and the Nilgiri *tahr* are entirely dependent on the grasslands and they alongwith their predators are getting affected adversely.

This invasive species has already degraded vast portions of the *shola* grasslands in the Upper Bhavani, Western Catchment area, Lakkadi, Pykara and almost all other areas in this altitudnal range. There seems to be a close association between reservoirs and this invasive species' expansion as it has totally replaced grasslands along the borders of all major and minor reservoirs in the area. It continues to spread further up the mountain slopes, with thickets now seen at Dodabeta (the highest peak in the Nilgiris). The alarm bells are ringing and this challenge needs to be met on top priority.

Source: Ashfaq Ahmed Zarri. Scotch Invasion! Published in *Sanctuari Asia*, August 2002.

It is estimated that 18% of Indian flora comprises invasive aliens, of which about 55% are American, 10% Asian, 20% Asian and Malesian and 15% European and Central Asian species (Nayar, 1977). Neo-tropical weedy species, in general, have proved to be aggressively invasive in nature endangering the native flora. Notable examples include *Eupatorium odoratum*, *E. adenophorum*, *Acanthospermum hispidum*, *Parthenium hysterophorus*, *Mikania micrantha*, *Erigeron karvinskianus*, *Conyza bonariensis*, *Flaveria australasica*, *Tithonia diversifolia*, *T. tagetiflora*, *Synedrella nodiflora*, *Crassocephallum crepidioides*, *Xanthium strumarium*, *Tridax procumbens*, *Amaranthus spinosus*, *Cassia tora*, *C. occidentalis*, *Cannabis sativa*, *Chenopodium ambrosioides*, *Nicotiana plumbaginifolia*, *Alternanthera pungens*, *Gomphrena celosioides*, *Euphorbia prostrata*, *E. geniculata.*, *Jatropha gossypifolia*, *Oxalis richardiana*, *O. cernua*, *O. corymbosa*, *Scoparia dulcis*, *Argemone mexicana*, *Lantana camara*, *Croton bonplandianum.*, *Hyptis suaveolens*, *Peristrophe bicalyculata*, *Caotropis spp.*, and several grasses. They have over-run the native vegetation in many parts of India.

Of these, the recently introduced *Parthenium hysterophorus* (commonly referred to as 'Rag weed', 'Santa Maria' or 'White top') has become the greatest menace to natural flora in the plains. This weed, first reported from Poona (Rao, 1956), has spread amazingly fast across agricultural fields, fallows, railway lines, roadsides, aquatic situations, forest-cleared areas and even forested areas. Believed to have entered India in the early 1950s and also known as 'Congress grass' or 'Carrot weed', it is the most dominant and obnoxious weed today invading almost all habitats and supplanting the native flora.

Similarly two species of *Eupatorium*, *E. odoratum* and *E. adenophorum* have become quite adventive in comparatively open forests, fallows and roadsides on hills of Himalayan region as well as in parts of Western Ghats. At lower elevations, *Mikania micrantha* has become a great menace to forests of northeast India where this weedy species climbs over forest trees masking the photosynthetic surface of host plants, suppressing forest undergrowth as well as tree seedlings and creating nuisance in forestry operations. It is another example of a recently introduced tropical American species that has become a dominant element of the flora in most parts of northeast India. Another weed that has been naturalized in a remarkably short span of time is *Croton bonplandianum*, a South American weed that arrived here around 1900.

A large number of exotic weeds of the Compositae family, in particular, have become naturalized in India impacting negatively on the distribution of native flora. *Ageratum conyzoides*, like other tropical american weeds, is an adventive species that occupies wastelands, agriculture fields, and forestlands in India. *Ageratina adenophora*, a native of tropical America and Mexico, that entered India around 1900, has also become an aggressive weed at higher elevations throughout the tropical belt in the Himalayas and also in Nilgris in South India. *Chromolaena odorata*, native to tropical America and Mexico that arrived here around 1900, became the most dominant weed in and around Karapura, Kakanakote and Heggadadevana Kote forests replacing all other ground vegetation including the noxious *Lantana*. It has become particularly aggressive in the higher elevations as well as in the sub-Himalayan states. It is said that it was first introduced in northeast India (Rao & Suryanarayana, 1979), particularly in tea plantations and has been introduced to south India by plantation labourers returning to Kerala.

Although the spread of alien weeds depends to a large extent on disturbance of the native habitat, there are many instances that indicate that invasion of weeds like *Ageratina*, *Chromolaena*, *Mikania* and *Parthenium* can proceed even without continuing disturbance. Nevertheless, disturbed habitats are being created at a much faster pace than ever before in the country. Botanists need to assess the species that have become extinct or rare in different biogeographic regions of the country due to the introduction of exotic weeds. Alien species are also known to cause major economic losses in agriculture, forestry and several other segments of Indian economy and these losses should be systematically assessed through appropriate criteria and indicators. Some rough estimates, based on some simplistic and selective criteria, indicate economic and environmental losses to exceed US \$ 115 billions per year (Pimentel et al., 2001).

Pimental's paper shows some estimates of economic losses in India as follows:

<u>Category</u> <u>Of IAS</u>	<u>Est. losses</u> <u>Billion US\$</u> <u>Per year</u>	<u>Basis of estimation</u>
Crop weeds	37.80	In India, weeds are estimated to cause a 30% loss of potential crop production(Singh 1996)* worth about US\$ 90 billion per year in reduced crop yields. Assuming that 42% of the weeds in crop production are alien (Khuspe et al. 1982, Nandpuri et al. 1986)*, the total cost associated with them is about 37.8 billion US\$ per year.
Pasture weeds	0.92	<i>Lantana</i> has invaded Indian pasture lands and its control costs US\$ 70 per hectare. Since about 4% of India's land area is pasture, the damage from <i>Lantana</i> is estimated to be US\$ 924 million per year (Singh et al. 1996)*.
Insect pests	16.80	In India, approximately 30% of the insect and mite crop pests are alien species (David and Kumaraswami 1975, Lal 1990)*. Arthropods as a group reduce potential crop production by 18.7% (Oerke et al. 1994). Based on total potential crop production in India, crop losses



to alien arthropods total US\$ 16.8 billion per year.

Plant diseases	35.50	In India, plant pathogens reduce potential crop production by about 16% for a total of US\$ 48 billion per year (Singh 1996). Around 30,000 species of plant pathogens attack Indian crops. Approximately 74% of the major plant pathogens in India are considered alien species, based on the major plant pathogens in vegetable crops (Singh 1985)*. The estimated cost of alien plant pathogens to Indian crops amounts to about US\$ 35.5 billion per year.
Rats	25.00	India harbours around 2.5 billion rats, each causing at least US\$ 10 per year in damages (Vasantharaj and Kumaraswami 1975)*. To sum up, rats cause about US\$ 25 billion per year.

These estimates, however, require validation based on proper socio-economic surveys conducted for this purpose.

### **Some Experiences**

#### **Water Hyacinth (*Eichhornia crassipes*)**

Native of tropical South America, it has become naturalized throughout the tropics, growing gregariously and inhabiting stagnant or slow-moving waters. It was introduced in India from Brazil in the beginning of the 20<sup>th</sup> century due to its ornamental appeal. It is a free-floating or surface perennial and one of the worst aquatic weeds that presently occurs all over the globe. When floating freely, large bladder-like swollen petioles cause the plant to float high and it is easily blown about by wind making it a very troublesome weed. It is a serious threat to wetlands biodiversity, particularly in West Bengal where it is estimated to infest over 15,000 ha of once clear water surface choking ponds, lakes and rivers. The affected areas enlarge alarmingly in monsoon months. "Rafts" of water hyacinth are reported to break loose and get driven off by wind moving back and forth while tearing up and destroying valuable submerged food resources and aquatic fodder grasses. This weed has also invaded paddy fields making them unproductive.

Effective interventions by several States are noteworthy. In Bengal, the eradication of water hyacinth has been made compulsory by legislation within notified areas. Special water hyacinth weeks are organized during which people in groups clear infested areas. In Assam, provisions have been made in Municipal and Local Self Government Acts to enforce land holders to eradicate this weed. The Madras Agricultural Pests and Diseases Act 1919, makes the destruction of the weed obligatory on the part of the owner or holder of the land, channel or pond. In U.P., the State Government has assisted in the removal of water hyacinth through grants for compost making.

In view of the amazingly quick spreading ability of this weed, eradication can be effective only when the chances of re-infestation are totally blocked. Its primary sites of occurrence are inland waters and, hence, greater attention needs to be paid to them. Numerous methods for its

eradication have been tried but without any spectacular success. Recent focus seems to be on finding ways and means of utilizing its biomass.

**Lantana** (*Lantana camara*)

Out of the four important species of Lantana in India, *Lantana camara* is considered to be the most noxious pest. It is a prickly perennial shrub. A native of tropical America and introduced in this part of the world as an ornamental and hedge plant in the beginning of 19<sup>th</sup> century, it is now completely naturalized here and found throughout India. Due to its prolific growth habit and wide adaptability, lantana has overrun large areas including cultivable and waste lands, forests, grazing and pasture lands and even plantations. Worst affected areas are parts of Deccan, Coorg, Wynnaad, Nilgiris and lower hills of Western Ghats. It has also invaded parts of U.P. and Assam. Lantana also poses serious fire hazard in deciduous forests because of its ability to burn even when green. Another highly invasive alien species, namely, *Chromolaena odorata*, which is a climber, is reported to be replacing lantana in parts of Karnataka. Studies in these areas have revealed the negative impact of this species on biodiversity conservation and the livelihoods of local people who depend largely on natural forest resources (Poulsen, 2002).

Measures to eradicate Lantana or even to check its spread have not succeeded largely because too little was done and also too late. It has high regeneration potential and sporadic efforts have not yielded the desired results. Uprooting of this species and its replacement by planting fodder trees have potential application in plains but this approach is not feasible in hilly terrains. Chemical control appears to be effective but it is not practicable in wide areas in view of huge costs involved and also possible environmental risks. Biological control, using Lantana eating insects like the bug (*Telenomia scrupulosa*), has had some success as reflected in Government's recognition through an ICAR award to Mr. Chandrasekar Louhmi's for his outstanding contribution in this field. This approach has not been tried, however, on a large scale in carefully selected situations. The management approach, based on utilizing this species locally and also on commercial scale, holds some promise but remains to be tested on a large scale (Tripathi *et al.*, 1985).

**Box 6**  
**The Case of Exotic Honey Bees**

Bee keeping is being promoted by the government of India to enable marginal and small farmers to generate additional income in selected areas. In fact, harvesting honey from wild bees is an age-old tradition in India and several indigenous groups are recognized as 'honey gathering tribes'. Unmatched importance of the role of honey bees in pollination of cross-pollinated crops and naturally growing species is also well recognized. Although honey bees are known to have co-evolved with locally adapted flora yet human beings have made repeated attempts to move bees from one region to another with a view to enhancing honey yield in apiaries. These human interventions have not met with any spectacular success in most cases but have ended in negative impact on diversity of locally adapted bee species and their varieties in many areas.

Indian bees are usually recognized as *Apis dorsata*, *A. cerana* and *A. florea* with enormous variation within each of them. They are known to be foraging on a wide range of plant species growing in their habitats. Several attempts have been made since colonial days to introduce *Apis mellifera* (African bee) in India considering its much higher potential for honey yield. It is generally considered to be mono foraging and restricted mostly to a few species. Despite initial failures, this species has now been established in northern states of Punjab, Haryana, U.P., Bihar and West Bengal largely because of the extensive mono-foraging areas of rapeseed and other crops. There are striking behavioural differences also. Although honey yield from the exotic bees is higher as compared to the local bees yet the quality of honey of the latter is considered to be much superior and of higher market value. Even so, the promotion pressure in favour of the exotic species has led to its notable spread in recent years affecting adversely the diversity of indigenous bees. It is also believed to have increased the risk of exotic diseases associated with the imported stocks. Experiences in introduction of African bees in Brazil and Japan are also reported to be disappointing in many ways.

Source: Pandurang Hegde, Personal Communication.

**Mesquit (*Prosopis juliflora*)**

This species is native to west tropical and sub-tropical North and South America where climate ranges from the arid to semi-arid conditions. It was introduced in India through seed obtained from the Kew Botanical Garden, and the earliest records of its cultivation in the Indian subcontinent date back to 1877. Then Nawab of Radhanpur introduced it in the Rann area of Kachchh in 1900. State Forest Department started planting this species on coastal area in 1953 as part of the Desert Immobilization Programme. Plantations were carried out extensively for checking the spread of desertification towards mainland and for establishing a shelterbelt. Unexpectedly, this species invaded the vital grasslands in Banni and other areas that were grazing ground of chinkara, wild ass, bluebull and black buck as well as prime habitat of grassland birds including bustards and cranes. Within five decades, this invasive exotic has colonized progressively more areas in Saurashtra, Kachchh and North Gujarat. Remote sensing data show an area of around 43,000 ha occupied by mesquit in Little Rann of Kachchh (Singh *et al.*, 1999). Its colonization has brought major impact on the ecology of the region since its dense impenetrable cover does not permit the growth of other species underneath.

### **The White-head/ Carrot Weed (*Parthenium hysterophorus*)**

Widely distributed in native America, this is one of fast spreading and most dreadful weeds in India. It is an annual, prolific seeder with high dispersal ability. Commonly referred to as 'Rag weed', 'Santa Maria', 'White top', 'Congress grass' or 'Carrot weed', it has become the greatest menace to natural flora in the plains. This weed, believed to be accidentally introduced in India through the import of foodgrains from USA and first reported from Poona (Rao, 1956), has spread amazingly fast across agricultural fields, fallows, railway lines, roadsides, aquatic situations, forest-cleared areas and even forested areas. It is the most dominant and obnoxious weed today invading almost all habitats and supplanting the native flora.

Infestation of *Parthenium* is posing a serious problem in agricultural crops and vegetables, its spread being reportedly to be more in irrigated crops like sugarcane than under rainfed conditions (Survey conducted by the Maharashtra State Government). Some host specific natural enemies of *Parthenium*, such as *Zizogramma bicolorata*, appear to be helpful in checking its growth in field trials. In Karnataka and some parts of Maharashtra state, a leguminous undershrub (*Cassia sericea*) has been reported to have effectively replaced (and thus controlled) *Parthenium* by inhibiting its germination and preventing its establishment due to phenolic leachates (Joshi, 1991; Mahadevappa and Patil, 1998; Mahadevappa, 1999).

### **Introduction of Exotic Trout Fishes and Carps**

India is very rich in fish diversity with 2118 species documented from 8 aquatic ecosystems across the country. Over 350 species among them are considered to be of exotic origin. Introduction of tilapia, the Chinese carps (silver carp and grass carp) and the common carp have greatly helped the country in enhancing production in composite fish culture and adding substantially to the meager income of fish farmers. The larvicidal exotic fish, *Gambusia affinis*, has similarly helped in eradication of malaria.

Exotic fish stocks and species are still being introduced for increasing aquaculture production, boosting sport fishery and supporting aquaria and ornamental fish trade. Brown and rainbow trout fish, for example, were introduced in northern upland stream (cold water) ecosystems in the beginning of 20<sup>th</sup> century to encourage amateur sport fishery combined with delicious food. These virgin streams accepted trout as welcome additions attracting thereby eager anglers.

Competing with the native species (like rohu, catla, mrigal and snow trout) for food and habitat niche, the exotic species appear to have negatively impacted upon the locally adapted indigenous species, often reducing their effective population size and causing genetic drift and loss of genetic variation in them. Other adverse genetic effects may arise from inter- and intra-specific hybridization among the native and exotic fish species resulting in introgression and homogenization of the gene pool and possible loss of adaptation to the local environment.

### Box 7

#### The Case of Exotics in the Andaman Islands

Oceanic islands, like the tropical Andaman and Nicobar Islands, are geographically isolated ecosystems and they are rich in biological diversity with their own groups of native species, many found nowhere else and termed "endemic species". The Andaman Islands comprise around 350 islands and islets covering an area of 8,249 km<sup>2</sup> (about 87% of this area has been notified as either Reserved Forest or Protected Forest). The presence of these islands was known since at least the second century A.D. but virtually no attempt to colonise them was made till the end of the 17<sup>th</sup> century. These islands are presently facing the twin challenge from large scale clearance of virgin forests for expanding settlements and the adverse impact of exotic species, introduced intentionally or unintentionally during the past three centuries or so, particularly since 1858 when the British arrived for the second time to stay on these islands (See: Mohanraj *et al.*, 1999).

Many among these islands are very small and their fragmentation has a number of obvious consequences for the life forms that inhabit them. The Interview Island is situated in the west of Middle Andaman, separated by a sea distance of about 10 km. This island was subjected to selective logging in 1950's and early 1960's. Elephants were taken there by a company from the mainland for timber operations and they were abandoned subsequently when the company went bankrupt in 1962. It is estimated that about 40 elephants were left behind and became feral in the Interview Island Sanctuary and Diglipur Forest Division. These elephants, presently numbering around 70, have become a matter of concern because of their likely adverse impact on regeneration of natural vegetation in this area and the increasing incidences of crop raiding by them (See: Sivaganesan and Kumar, 1994; Ali and Krishnan 2001).

The common peafowl, the mynah, the dog and the cat had all been introduced earlier into the Andamans along with a large number of crop plants including the coconut palm. Invasive weedy species also arrived with them. Other plants of commercial and ornamental value were also introduced and so were a number of mammals and birds like the house sparrow and the grey partridge. Introduced insects of economic importance, like the honey bee and a pollinating weevil, have spread and got naturalized in many areas. The giant african snail was introduced by the Japanese during their occupation of these islands by them between 1942 and 1945. The spotted deer, introduced from the mainland India by the British in 1930's, is a powerful swimmer and has now spread through out North, Middle and South Andaman Islands up to the Rutland island (See: Aul, 2002).

The Andaman Islands present a unique opportunity to study and quantify the impact of exotics in isolated and fragmented ecosystems. Expanding populations of some of the introduced large herbivorous mammals is of special concern in the absence of their natural predators. Informed opinions differ on suggestions for management practices and regulatory mechanisms. There is an urgent need to develop an effective system of auditing backed by a scientific database. International funding agencies should support such projects on top priority under Article 8h of the Convention on Biological Diversity.

**Source: Pankaj, Kalpavriksh.**

Accidental entry of silver carp in Govindsagar and its subsequent dominance over the native catla and mahseer fisheries is a shocking experience. Tilapia has similarly been reported to have adverse effects on indigenous species in Vaigai reservoir in Tamil Nadu. Another aquacultural

species, the bighead carp, and a very recent intruder, the African catfish (also called Thai magur) seem to have posed even far greater threats to native fish fauna.

### **Key Actors and Major Stakeholders**

A large number of primary and secondary stakeholders are concerned with the possible impact of invasive alien species that threaten ecosystems, habitats, species and natural base resources. Regeneration of renewable natural biological wealth, the pace of area development programmes and livelihoods security are also of immense interest. The Union Ministry of Agriculture is the nodal governmental agency for dealing with this subject in the country and also for liaising with the FAO and other international/ regional organizations on relevant programmes and activities. There are several other union ministries/ departments that have jurisdiction over different components of this complex and cross-cutting thematic area. This subject is also of high priority to the state governments since agriculture and forestry are on the concurrent list of items. In addition, there are numerous other stakeholders including research organizations, developmental agencies and civil society organizations besides the farming and local communities who are the primary stakeholders but happen to be weak in asserting their rights. Their listing, though far from being exhaustive, is given as follows:

Nodal Union Ministry: Agriculture

Departments: Agriculture & Cooperation  
Agricultural Research & Education/ ICAR  
Animal Husbandry & Dairying

Other major union ministries/ departments:

Environment and Forests  
Science & Technology/ Biotechnology  
Health & Family Welfare  
Commerce  
Ocean Development  
Mines  
Tourism and Culture  
Tribal Affairs  
Finance/ Revenue (Customs)  
Industry  
Planning and Programme Implementation

State Governments Ministries: Agriculture

Forests  
Environment  
State Agricultural Universities

Universities/ National Research Centres/ Lead Institutes

Development Agencies

Non-Governmental Organisations

Farming and other local communities

## Regulation of the Import of Plants and Animals

- **Authorities**

Nodal Authority: Union Ministry of Agriculture

**Plants** (including seeds and propagation materials):

Department of Agriculture & Cooperation,  
under advice of Plant Protection Advisor.

- Bulk Import for Commercial Use/ Consumption:  
Jt. Secretary, Plant Protection, Ministry of Agriculture  
Directorate of Plant Protection, Quarantine & Storage, Faridabad.
- Samples for Research: National Bureau of Plant Genetic Resources, New Delhi.

**Animals** (including fish and other aquatic species):

Directorate General of Foreign Trade under advice of Animal Husbandry & Dairying Department  
/ Animal Husbandry Commissioner to the Govt. of India.

**Fishes** (and other aquatic species)

Fisheries Development Commissioner to the Govt. of India  
Animal Husbandry & Dairying Department

**Plant Quarantine:**

Plant quarantine is legal enforcement of measures that collectively aim at preventing the introduction of exotic pests through imported seeds, plants and plant material and to contain the spread of exotic pest that are accidentally got introduced to the country by implementing the provisions of The Destructive Insects & Pests Act, 1914 and the regulations issued there under. The Joint Director (PP) heads the Plant Quarantine scheme. There are five regional plant quarantine stations at Amritsar, Calcutta, Chennai, New Delhi and Mumbai and 21 minor PQ stations functioning at various sea ports/airports and land borders.

- **Structure:** The Central Sector Scheme “Plant Quarantine Facilities in India”

Objectives: To prevent introduction of exotic pests inimical to Indian Fauna and Flora, and To assist the foreign Governments’ as an international obligation, making arrangements for issuance of Phytosanitary Certificates for exportable plants/plant materials.

Salient features:

- Enforcement of Destructive Insects & Pests Act, 1914, and the Plant Quarantine Regulations entitled “The Plants, Fruits and Seeds (Regulation of Import into India) Order, 1989” issued thereunder.
- Regulation of import of plants and plant materials including seeds, fruits, soil living insects, fungi, etc.
- Quarantine inspection/treatment and release of the imported materials

if found free from exotic pests, or otherwise deport/destroy.

- Issuance of Phytosanitary Certificates for exportable agricultural commodities in compliance with the provisions of International Plant Protection Convention, 1951 of FAO.

Pattern of assistance: 100% grant by Ministry of Agriculture, Government of India

**Implementation:**

The statutory provisions under DIP Act, 1914 and PFS Order, 1989 are implemented through 26 Plant Quarantine Stations situated at 10 international airports, 9 seaports and 7 at land frontiers.

**Person to be contacted:**

The Joint Secretary  
Plant Protection Division  
Department of Agriculture & Cooperation  
Krishi Bhawan, New Delhi 110001.

Date of start/duration: 1948

**Implementation status:**

The powers delegated under DIP Act, 1914 & PFS Order, 1989 are implemented by the officers & staff of 26 Plant Quarantine Stations situated all over the country at all international airports/seaports & land frontiers.

**Issuance of Import Permit:**

No consignment shall be imported into India without a valid import permit issued by the Competent Authority as stated below.

- (a) Bulk import of seeds / plant materials for sowing, planting and propagation:

Plant Protection Advisor to the Government of India  
Ministry of Agriculture

- (b) Import of seeds/plant material for consumption:

Plant Protection Advisor to the Government of India  
Ministry of Agriculture

- (c) Import of germplasm / Research and Breeding materials:

The Director, National Bureau of Plant Genetic Resources (NBPGR) is authorised to issue permits for import of germplasm / research and breeding material for public / private sector in the country including institutions and organisations of Indian Council of Agricultural Research (ICAR), State Agricultural Universities (SAU) and International Crop Research Institute for Semi Arid Tropics (ICRISAT).

Forest Research Institute, Dehradun: For forest plants.



Botanical Survey of India, Kolkatta: For the remaining plants of economic and general Interest.

### **Authority for Post Entry Quarantine**

Plant materials:

Plant Protection Advisor for bulk imports

Director, NBPGR, for small samples imported for research

Animal materials:

Animal Husbandry Commissioner/ Animal Quarantine Unit

Domestic Plant Quarantine:

Under the DIP Act, Directorate of Plant Protection, Quarantine and Storage, Faridabad headed by the Plant Protection Advisor to the Government of India (under the Ministry of Agriculture) is responsible for enforcing domestic quarantine, regulating the inter-state movement of plant and plant materials to prevent the further spread of dangerous pests and pathogens still restricted in their distribution in the country. There is domestic quarantine regulations for nine pests and pathogens at present.

### **Institutional Support:**

#### **Directorate of Plant Protection, Quarantine & Storage:**

The Directorate of Plant Protection, Quarantine & Storage (Dte of PPQS), established in 1946 with Plant Protection Advisor to Government of India as its head under the Ministry of Agriculture, is the apex plant protection organisation in the country having the following key functions:

- To enforce Plant Quarantine Regulations issued under The Destructive Insects & Pests Act, 1914 and amendments issued there under to prevent introduction & spread of exotic pests
- To implement the provisions of The Insecticides Act, 1968 and rules framed there under for effective control over use of pesticides
- To fulfill international commitment and obligations in respect of locust control and phytosanitary measures
- To introduce and popularize innovative plant protection technologies such as integrated pest management (IPM) practices
- To import training in areas of plant protection technology, pesticide quality testing & pesticide residue analysis etc.
- To coordinate and liaise with State/Union Territory Governments in all matters relating to plant protection

The Plant Protection Adviser to the Government of India heads the Directorate of PPQS, which is located at N. H. IV, Faridabad-121001 (Haryana). The Directorate implements five central sector schemes in the area of plant protection viz., expansion of plant quarantine facilities, integrated pest management programmes, implementation of Insecticide Act, locust control and training in plant protection.

### **National Bureau of Plant Genetic Research (NBPGR), New Delhi:**

NBPGR is the nodal institution for germplasm exchange in India at the national, bilateral and international levels. It has been authorized under PFS Order 1989 to undertake quarantine clearance of the germplasm of agri-horticultural crops imported in small quantities for research use. Director, NBPGR issues import permit for germplasm materials on application from both public and private sectors. This Bureau has a separate Division of Plant Quarantine for this purpose that is serviced by highly trained scientific and technical specialists working in well equipped laboratories with the latest technology.. It has developed a national networking system that has insect-proof screen houses and environment controlled green houses located at New Delhi, Hyderabad, Bhowali and Kanpur.

- **Legal Backup**

This section lists a number of the major legal authorities of the Government of India that deal with invasive species. It does not represent a complete or definitive list of all legal authorities on invasive species but includes those most relevant ones to this subject. Some international agreements are also briefly described that are concerned with the impact of IAS.

#### **Legal Authorities Available to the Union Ministry of Agriculture:**

The Destructive Insects and Pests Act, 1914 (as amended upto 2001)

The Plants, Fruits and Seeds Order, 1989 (and Amendments, 2001)

The Seeds ACT, 1966 (and the Seeds Rules, 1968)

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Indian Livestock Importation Act, 1898 (and amendments, 2001)

The Fisheries Act, 1897 (along with State Fisheries Acts)

The Protection Of Plants Varieties & Farmers Rights Act, 2001

Learning from the experience of other countries, a plant quarantine legislation was passed on 3 February 1914 by the Governor General of India, named “Destructive Insect and Pests Act 1914 (DIP Act). This Act empowers the Central Government to:

- Prohibit or regulate the import into India of any article or class of articles likely to cause infection to any crop;
- Prohibit or regulate the export from a State or the transport from one State to another in India, of any article or class of articles likely to cause infection to any crop;
- Make rules prescribing the nature of documents which shall accompany any article or class of articles, the export or transport of which is subject to the conditions imposed or which shall be held by the consignor or consignee thereof, the authorities which may issue such documents and the manner in which these documents shall be employed.

This Act authorizes the State Governments to make rules for detention, inspection, disinfection or disinfestation of any article or class of articles in respect of which a notification has been issued and for regulating the powers of the officers whom it may appoint in this behalf. It also provides for penalty for persons who knowingly contravene the rules and regulations issued under this Act. Plant quarantine rules and regulations have been framed by the Government under the provisions of the DIP Act.

Responding to emerging requirements, a comprehensive Plants, Fruits and Seeds (Regulation of Import into India) Order 1984 was promulgated by the Government in exercise of the powers

conferred by sub-section (1) of section 3 of the DIP Act. Following the announcement of the 'New Policy on Seed Development' by the Government of India in October 1988 liberalising the import of seeds and other planting materials for the benefit of Indian farmers, PFS Order 1989 was issued by the Government in suppression of the 1984 Order. The PFS Order 1989 works in conjunction with the DIP Act authorize the Union Ministry to regulate the importation and movement of field crop, pasture and forage, or vegetable seed that may contain noxious weed seeds. Provisions under these Acts authorize the government authorities to prohibit or restrict the importation or interstate movement of any plant, plant product, biological control organism, noxious weed if the Competent Authority, Plant Protection Advisor and others, determines that the prohibition or restriction is necessary to prevent the introduction into India, or the dissemination within India, of a plant pest or noxious weed. A "plant pest" is any living stage of any of the following that can directly or indirectly cause damage to, or cause disease in any plant or plant product: a protozoan, nonhuman animal, parasitic plant, bacterium, fungus, virus or viroid, infectious agent or other pathogen. A "noxious weed" is a plant or plant product that can directly or indirectly injure or cause damage to crops (including nursery stock or plant products), livestock, poultry, or other interests of agriculture.

**Plant Quarantine:** The DIP Act and PFS Order emphasise the plant quarantine requirements and specifically authorize the Plant Protection Advisor (and others to whom the authority is legally delegated) to hold, seize, quarantine, treat, apply other remedial measures to destroy or otherwise dispose of any plant, plant pest, noxious weed, biological control organism, plant product that is moving (or has moved) into or through India or interstate, if the Ministry considers it necessary in order to prevent the dissemination of a plant pest or noxious weed that is new to or not known to be widely prevalent or distributed within or through out India.

These Acts also authorize the Ministry to order an owner, or an agent of the owner, of a plant, biological control organism, plant product, plant pest or noxious weed to treat, destroy, or otherwise dispose of those items. In addition, when a State is unable or unwilling to take the necessary action to prevent the dissemination of a plant pest or noxious weed, the Union Ministry has the authority to declare an extraordinary emergency and take appropriate actions. They also specifically authorize the Union Ministry to develop integrated management plans for noxious weeds for the geographic region or ecological range where the noxious weed is found in India.

In addition, these Acts authorize the Union Ministry to cooperate with other Ministries, States, national governments, local governments of other nations, domestic or international organizations, domestic or international associations, and other persons to carry out their provisions.

**Animal Quarantine:** Ministry's authority to regulate the importation and interstate movement of invasive animal species derives primarily from the "Livestock Importation Act 1898"(and its amendments upto 2001). The animal quarantine requirements under them authorize the Competent Authority (Animal Husbandry Commissioner/ Fisheries Development Commissioner/ Animal Quarantine Division) to promulgate regulations and take measures to prevent the introduction and dissemination of communicable diseases and pests of livestock and poultry. The animal quarantine rules authorize the Competent Authority to regulate the importation and interstate movement of all members of the animal kingdom, domestic and wild, except man, for the purpose of regulating communicable diseases and pests of livestock and poultry. Under these rules, the Competent Authority is authorized to seize, quarantine, and dispose of animals, animal products, or other material that can harbor disease or pests of livestock or poultry that are moving

or are being handled, or have moved or have been handled, in interstate or foreign trade if they are infected with or exposed to a communicable disease of livestock or poultry.

Fishes are not included in the Wildlife (Protection) Act. The main available legal instrument covering fishes is the Indian Fisheries Act, 1897 that was enacted to protect aqua resources and also covered direct and indirect revenue earning. States have also enacted their Fisheries Acts and framed rules and regulations for implementation. Provisions of the Indian Livestock Importation Act, 1898 (and amendments, 2001) have been extended to cover fishes also.

### **Legal Authorities Available to the Union Ministry of Environment and Forests:**

The Forest Act, 1927

The Wildlife (Protection) Act, 1972 (Amendment Act, 1991)

The Forest (Conservation) Act, 1980

The Wildlife (Protection) Act, 1972 and subsequent amendments up to 1993

The Environment Protection Act, 1986

The Coastal Regulation Zone Act, 1991

The Environment Impact Assessment Notifications Act, 1994

The Ministry is required to develop and maintain a forest management plan for each administrative unit of the National Forest Management System. Forest plans establish forest-wide and area-specific management direction and may include management direction relating to the control of invasive species. The other Acts, pertaining to the protection of environment, also empower the Competent Authority to frame relevant rules and regulations and also to issue directions to States when necessary.

### **Legal Authorities Available to the Union Ministry of Commerce and Industry:**

The Import and Export (Control) Act 1947

Foreign Trade (Development and Regulation) Act, 1992

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Provisions under these regulatory measures work in conjunction with the above mentioned legislation enacted by different Ministries.

### **Leadership Role and Coordination:**

The Ministry of Agriculture is expected to provide the leadership and also coordinate the regulatory actions among all the concerned ministries and departments/ agencies in liaison with the State Governments. It is also the nodal Ministry regarding linkages with the FAO, OIE, IPPC and other regional and international organizations concerned with genetic resources for food and agriculture. It is also responsible for quarantine operations, both at the national and domestic levels.

Ministry of Environment & Forests is the nodal agency for matters related to biological diversity, habitats and ecosystems and has links to CBD, CITES, CMS and Ramsar Convention. Ministry of Commerce and Industry in cooperation with the Ministry of Agriculture is the nodal ministry for implementation of the WTO Agreement on the Application of Sanitary and Phytosanitary Measures.

There is no clear focus on invasive alien species though several ministries and departments are primarily or partially dealing with them. Jurisdiction, authority and responsibilities seem to be overlapping with little accountability. Negotiations on this subject under the auspices of CBD are handled by the Ministry of Environment & Forests in association with the Ministry of Agriculture. Low priority is reflected in the National Report submitted to CBD on the implementation of Article 8h (Alien Species) included here as Annex-1. There is an obvious need for perspective planning and proactive lead role, both at national and international levels.

### **An Operational Overview of the National System**

**Measures for Prevention:** Actions to prevent or minimize the entry of unwanted alien organisms are preferred considering the technical difficulties and high costs of detecting, eradicating or containing the introduced species that become invasive. Hence, high priority is being accorded to prevention measures in India. Tools for prevention include prohibitions and permits (especially for deliberate introductions), quarantine measures (especially for incidental introductions on commodities), and destruction of the unwanted species through biological control and physical or chemical means. Since such controls are transboundary by nature, international cooperation is therefore vital. International instruments play an important role in providing a generally accepted regulatory framework for preventive measures taken at the national level.

The use of import and export controls to prevent introduction of pests is long established in India. National plant and animal health services and customs authorities play a key role in implementation of border controls, import restrictions and other quarantine measures.

Quarantine systems theoretically cover all introductions that can involve the transfer of pests but in practice there are wide variations in the scope and administrative working. Serious constraints are faced regarding legal authority, inspection facilities, taxonomic capacity, access to information, and human and financial resources. These controls are located in the Ministry for Agriculture but their implementation involves active participation of several other ministries/ departments/ agencies. Although all sectors involved in these operations are expected to be appropriately engaged and accountable yet the coordination between agencies remains far from being effective.

**Summing up:** Notwithstanding all the available regulatory provisions, the prevention and early detection measures for invasive alien species have not proved to be very effective. The entire system works on the voluntarily disclosures at the designated ports of entry with hardly any strict checking system in place. The Directorate of Plant Protection, Quarantine and Storage, the nodal authority, does not have the powers of 'search and siege'. These powers rest only with the Customs authorities and they intercept any seed/ planting materials noticed by them in the accompanied baggage of incoming passengers and pass them on to the quarantine officials for examination and due clearance. Regulatory system for the intentional introductions for research appears to operate effectively but this component forms just a small part of the total inflow of biological materials in the country. The national system has recently been strengthened under a World Bank Project and it remains to be seen how the entry of all plants and animals (including fish and other aquatic organisms) can be regulated under a unified, autonomous and statutory, national authority with assured funding and operational facilities.

**Measures for early detection:** The tools available for the early detection of invasive alien species include general surveillance or collation of information, site-specific surveys (for example, through trapping at likely entry points to ascertain the distribution of a known invasive or to detect a particular pest through trapping), monitoring, taxonomic identification, and public-awareness campaigns.

A significant developing tool is the use of information systems for regulatory purposes. The series of publications, brought out by NBPGR, on plant pathogens and pests not known to occur in India is relevant here (Sharma *et al.*, 1990; Lal and Kapur, 1992). While there is consensus on the need to enlarge databases on known and potential invasive species and to make this information accessible as part of global capacity-building on invasive alien species, it must be recognized that some kinds of information may have commercial or political implications.

Infrastructure for the early detection of invasive alien species is being strengthened rapidly in India. Monitoring for crop pests is particularly active programme. Early detection relies mostly on workers on the ground (farmers, extension staff), research organisations, field naturalists, NGOs and members of the public. Public-awareness schemes together with education and reporting mechanisms can contribute significantly to early detection and monitoring of alien species.

IPPC, OIE and Codex Alimentarius support the establishment of surveillance systems as part of national frameworks and provide a basis for emergency action. Under the IPPC, elements include identification of pests already present and identification and surveillance of areas that are pest-free or from which a pest has been eradicated. In practice, national and regional capacity and also the funding are critical to effective surveillance.

Nationally, monitoring and early warning systems are still weak due largely to lack of information about species already present (baseline data) and lack of accessible information systems. Weak institutional linkages limit the ability of environment, veterinary, phytosanitary and health authorities to cooperate on prompt action.

**Summing up:** Lack of a national database on this subject is the major limitation. Access to information, held by the governmental system, is very limited and linkage with lead institutions and non-governmental agencies is weak. Surveillance at the field level for some prioritized species/ pathogens is in operation but its working and linkages need to be monitored and reviewed. Public education and awareness on this topic remains extremely low. Detection of species is weaker for lower taxonomic categories. Coverage of pathways is still inadequate, notably for the alien freshwater aquatic species. Finally, the networking and early warning systems leave much to be desired to be effective.

While terrestrial systems are mostly supported by the measures developed under agricultural conditions, particularly for weeds and insects, all major plant pathogens are not adequately covered by the existing capacities and merit greater attention. Awareness of some diseases and of certain taxa such as nematodes, flatworms and snails is gradually building up. Animal pathogens are well covered but only to the extent that the invading species is on the list of international notified diseases.

Aquatic weed control is now getting more attention because of public outcry. Some progress has been made with invasive fish species and aquatic animal pathogens also. Best practices regarding introductions and transport of alien fish species need to be given more attention. The recent inclusion of aquatic animal diseases (of fish, shrimp and others) among officially notified

diseases are expected to reduce the spread of pathogens to natural populations surrounding aquaculture and adjacent processing sites.

Selective elimination of fumigants and pesticides due to environmental concerns may need attention in future. This is particularly true for agricultural trade where certain chemicals are being phased out or banned because of health concerns as well as environmental objections.

**Measures for Eradication and Control of IAS:** Where an alien species has become invasive, options to prevent its establishment and spread include eradication (where feasible and cost-effective), containment or long-term control measures, and measures to mitigate the impacts of invasive alien species. Integrated pest management (IPM) technologies have been developed, most strongly for the management of insect pest problems in agriculture. These technologies have been directed at a complex of pests that affect a particular crop system. Good progress has been made in implementation but only for a few selected species.

Eradication requires prior effective surveillance on the distribution of the pest, containment to prevent the spread of the pest, a good understanding of the biology of the target organism, and sufficient funding for training and follow-up measures to prevent re-invasion. Eradication is more likely to be successful in the early stages of invasion. Even so, total eradication of an established alien species is often difficult to achieve as experienced in several weedy species.

The aim of controlling invasive alien species has been either to contain the species within a geographical area or to suppress the overall abundance of the species to a level where it no longer causes any significant economic, social or ecological damage. Control measures for either containment or suppression fall into the following categories:

- Physical or mechanical (e.g., mechanical harvesters, hunting, trapping);
- Chemical (e.g., herbicides, insecticides);
- Biological (this includes a number of tools: the introduction, conservation or augmentation of natural enemies, the application of microorganisms as a biopesticide, host plant resistance (HPR), and other tools such as behaviour modifying chemicals (e.g. pheromones), male sterile release and fertility control);
- Habitat management (e.g. crop rotation, nutrient management);
- Integrated pest management, utilizing combinations of the above four main measures.

**Summing up:** National legislative measures are weaker on eradication and control than on the prevention on the entry of exotics. Other constraints include poor institutional linkages, narrow mandates and lack of a strategic framework for remedial action. Prerequisites like surveillance on the distribution of the pest, proper understanding of the biology of the target organism and a risk analysis are found mostly wanting. Control measures for either containment or suppression of noxious weeds like Lantana, Parthenium and water hyacinth have not achieved notable success, primarily due to fragmented efforts that permit regeneration. While many tools exist for control of some invasive species, more work on generating technical knowledge and developing new methods is required for several other taxa. There is an urgent need for developing a national programme with identified institutional support.

**Mitigation of impacts and Adaptation Measures:** Strategies to control the impacts of established alien invasive species have included reduction or elimination of the invasive species

and their spread through mitigation measures, such as eliminating the invasive alien species completely, containment (keeping the invasive alien species within regional barriers); or suppression (reducing population levels of the invasive alien species to an acceptable threshold), that would curtail the extent, duration and impacts of the invasion.

It is now appreciated that the mitigation of impact would be most effective when it employs a long-term, ecosystem approach rather than an approach directed to controlling invasive species in isolation (Ramakrishnan and Vitousek, 1989).

Restoration may involve reintroduction or re-establishment of populations of native species and/or enhancement of native biodiversity and the structure and functions of the habitats or ecosystems that have been degraded as a result of invasion by alien species (Ramakrishnan, 1991). Restoration techniques, based on detailed information on invasive species biology and ecology, site assessments, beneficial plantings and monitoring of the effects of disturbances such as fire and flooding, have allowed the recovery of some terrestrial habitats/ecosystems to nearly their states before invasions (Sankaran *et al.*, 2001).

There is need to develop guidance for restoration work. This could be based on best practices for appropriate uses of native and desirable non-native species, the best available techniques for restoring habitats/ecosystems, as well as management practices that promote regeneration of native species and habitats/ecosystems (MSSRF-CABI, 2000).

**Summing up:** Attempts at predicting impacts have generally been unsatisfactory. There is a need for better and wider quantification and measurement of what invasive species do. In the context of preserving biodiversity, such studies are urgently needed. Data from countries where a species has previously invaded and been controlled can provide useful information on approaches to management. In addition, best practices for restoration of degraded ecosystems with the help of native species need to be documented and promoted.

### **Shortcomings and Gaps**

**Policy Support:** Overall policy support to deal with the challenges posed by the invasive alien species in India is weak, particularly considering that this country is more vulnerable as it is acknowledged to be the center of origin of numerous cultivated plants and a region of mega-biodiversity. This general perception is reflected by the low key at which India participates in international inter-governmental negotiations on this subject. This inference also emerges from India's national report submitted to CBD on the implementation of Article 8(h): Alien Species. Three one-page sketchy case studies contributed by India with a view to sharing knowledge in this area have made a poor impression as they seem to ignore the wealth of information available in the country. Other developing countries expect India to play a lead role in these negotiations in view of the enormous scientific expertise and also experiences available here on this topic.

**Setting of Priorities:** Programmes and activities bearing on the prevention (including regulation of introductions and quarantine measures), containment, control and management of invasive alien species and also on mitigation of their impact require a more balanced approach and prioritization, particularly in terms of responsibilities and fund allocation.

**Lack of Transparency:** The major limitation to work on IAS is the lack of national database on intentional and accidental introductions in the country and their distribution. Access to information on different key aspects is restricted, particularly from the governmental sources.



Several websites developed by some government departments, in an effort to promote awareness about their activities, are of limited help as most of them are either not updated or remain inaccessible.

**Diffused Lines of Command:** Authority to deal with different components of biodiversity (plants, animals, aquatic species, insect pests and pathogens) is fragmented in tight compartments with weak linkages and ineffective coordination and monitoring mechanisms. This leaves serious gaps and also leads to avoidable overlaps.

**Weak legal protection to aquatic organisms:** There is no legal power of search and seize delegated to the quarantine staff as these entirely rest with the customs staff who often work with little orientation training or even proper briefs on invasive species. For example, not much effective actions have been taken to prevent unauthorisedly introduced fishes and punish the person/ organization violating the provisions of the Livestock Importation Act. Strengthening of State Fisheries Acts to include authority to prohibit sale of illegally introduced exotic fishes.

**Structural Weaknesses:** Massive effort to strengthen the plant quarantine system with assistance from the World Bank notwithstanding, the quarantine component covering animal and aquatic species appears to have limitations of effective networking with the plant side. There is an obvious need for developing a unified national system with strong linkage with the relevant State Departments. Leadership role appears to be missing in this subject of national importance. There is also an imbalance in programmes since major focus of import regulation and quarantine operations remains on crop weeds, pests and pathogens of agricultural importance.

**Quarantine Effectiveness:** Enforcement of quarantine regulations at all the major disembarking ports needs to be improved and streamlined to make them more effective. Role of the Designated Inspection Authorities is very crucial and requires coordination and monitoring. A separate 'Living Organisms Quarantine Declaration Card', like the one used for 'Customs Declaration Card', needs to be introduced for the passengers disembarking in India enabling them to declare any plant materials/ seeds/ animals/ aquatic organisms brought by them as accompanied baggage. All these items should then be subjected to quarantine check and clearance. All State Governments should have separate quarantine wings/ units to effectively implement the domestic quarantine regulations.

**Domestic Quarantine:** Only nine pests/ pathogens have been covered at present under domestic plant quarantine regulations. There are, however, a number of other serious pests/ diseases that are still localized and not covered under these regulations. Even in the case of these nine pests, domestic quarantine is not being enforced properly with the result that these pests continue to spread to more areas/ states in the country. There appears to be no serious concern as yet on alien species invading and dominating public places, forest areas, freshwater systems and wastelands.

**Low Level of Public Awareness:** The level of awareness on this subject remains low, particularly among the political leadership, policy makers and managers. There is an urgent need to organize public opinion and undertake campaigns on a war footing towards eradication/control/ management of top ten invasive species in the country and restoration of the affected habitats/ecosystems. This requires collection and analysis of data on socio-economic impact of the alien species in major areas of their occupation so as to relate the problem to local people/ communities.

### **Law Enforcement Problems: The Case of Bighead Carp and African Catfish/ Thai Magur**

Based on the reports of various State Governments, state fisheries departments and followed by detailed field studies and a survey of fish farmers and fish traders, the National Bureau of Fish Genetic Resources concluded that the culture of two unauthorized exotic fish species, namely, the Bighead Carp and Thai magur (also called African Catfish), was spreading in different parts of the country (NBFGR Annual Report, 1997).

This survey also revealed that the Bighead carp, believed to arrived illegally from Thailand via Bangladesh more than 15 years back, was becoming more popular than even the widely cultured Silver Carp (one of the Chinese Carps) that was introduced legally earlier to boost fish production and fish farmers' income.

Since its introduction in 1975 at the Thu Duck Aquaculture Station in South Vietnam, the African catfish (also called Thai magur in India) has spread to Cambodia, Laos, China, Thailand, Bangladesh and India covering a large part of Asia. Deep concerns expressed about its negative impact on the indigenous fish fauna notwithstanding, the fact remains that culture of this species and its hybrids is also spreading rapidly.

Although the Indian scientists, environmentalists and NGOs decry the unauthorized introduction of these two invasive alien species in the country yet the way to stop their entry and spread into Indian waters is yet to be found.

The National Committee to oversee and regulate Introduction of Exotic Aquatic Species in Indian Waters discussed the issue of "unauthorized introduction of exotic magur and bighead carp" in its first meeting held on 9 October 1997, under the Chairmanship of Joint Secretary (Fisheries), and recommended as follows:

"The Ministry of Agriculture should write to all the States/ Uts to take immediate steps to destroy the existing stock of exotic magur and bighead which have been introduced into the country without official sanctions. All hatcheries may be identified and destroyed by the concerned States. It was stressed that exotic magur (*Clarias gariepinus*) should not establish in the natural environment and cross with the endemic species *Clarias gariepinus*. A strict controlling measure should also be adopted to avoid spread of exotic disease(s) from *Clarias gariepinus* to the endemic fishes."

The Fisheries Development Commissioner wrote to the Secretary (Fisheries), State Governments vide DO No.31016/1/96-FY dated 19 December 1997 requesting that necessary action may be taken immediately on this recommendation.

This order was challenged by C. Sebastian and others before the Hon'ble High Court of Kerala claiming that the two exotic fishes were very high yielding and commonly cultured throughout India for the last 15 years and destroying their stocks would bring losses to fish farmers. The Hon'ble Court directed the Government to provide all available relevant scientific data. This direction has been complied with and the matter stands there.

This case illustrates some of the problems encountered in implementation of the measures aimed at prevention, detection, eradication and mitigation of the impact of alien invasive species offers lessons to be learned.

## **A Look at the US Management Plan for Meeting the Invasive Species Challenge** (NISC, 2002)

The United States of America depicts a scenario where nearly all crop and livestock species are non-indigenous (alien). These alien crops like maize and wheat and livestock like cattle and poultry are vital to the food system, agriculture and national economy. These outstanding benefits, however, do not diminish the enormous negative impacts of many other non-indigenous species on agricultural and other managed and natural ecosystems. A real challenge now lies in preventing further damage from invading alien species. In this context, some features of the United States' Management Plan, for meeting the challenge of invasive alien species, are presented here to show the comprehensive treatment of the subject as well as precision and clarity of the proposed actions (NISC, 2001). This approach may be considered by the Government of India for taking some basic inputs and building upon them to develop our own strategies to suite our requirements in view of the fact that India is one of the mega-biodiversity countries and also among the eight Vavilove Centres of Origin of Cultivated Plants.

### **Box 8**

#### **How USA is Facing the Threat of Invasive Alien Species?**

The Executive Order 13112 on Invasive Species was issued by the US President Clinton in February 1999 creating the **National Invasive Species Council**, co-chaired by the Secretaries of Agriculture, Commerce and the Interior; and includes the Secretaries of State, Treasury, Defense, and Transportation, and the Administrator of the Environmental Protection Agency.

The Order directs the **Council** to form a non-Federal **Invasive Species Advisory Committee** to advise the Council in its work. The Council, promptly established, is mandated to work for the following objectives:

- To provide national leadership on invasive species;
- To see that their Federal efforts are coordinated and effective;
- To promote action at local, State, tribal and ecosystem levels; identify recommendations for international cooperation;
- To facilitate a coordinated network to document and monitor invasive species;
- To develop a web-based information network; provide guidance on invasive species for Federal agencies to use in implementing the National Environmental Policy Act; and
- To prepare the National Invasive Species Management Plan.

**The National Invasive Species Management Plan** has been prepared in record time and presents nine interrelated and equally important areas to which the Council has accorded priorities in addressing invasive species problems. The States play a key role in the management of invasive species within their borders; therefore, this Plan reflects the need to build capacity and capability at State and local levels to coordinate, detect, and respond to invasive species. Additional steps are also needed to ensure a unified, effective, and coordinated Federal response. The Council will undertake actions relevant to the mandated nine areas in coordination and partnership with other stakeholders as appropriate:

**Leadership and Coordination:** The Council is directed by the Order to provide national leadership and oversight on invasive species and to see that Federal agency activities are coordinated, effective, work in partnership with States, and provide for public input and participation. When appropriate, the Council and its staff will draw on various existing organizations for coordination and leadership. These include, among others, State agencies, State invasive species committees and councils, regional organizations such as regional weed boards, the Aquatic Nuisance Species Task Force, the Federal Interagency Committee on the Management of Noxious and Exotic Weeds, the Committee on Environment and Natural Resources, and various non-government organizations.

**Prevention:** The first line of defense is prevention. Often, the most cost-effective approach to combating invasive species is to keep them from becoming established in the first place. Diverse tools and methods are needed to prevent invasive species from becoming established in ecosystems where they are not native. A risk-based approach is mandated by the Order and requires consideration of the likelihood an invasive species will establish and spread as well as the degree of harm it could cause.

**Early Detection and Rapid Response:** We cannot prevent all introductions. However, early detection of introductions and quick, coordinated response can eradicate or contain invasive species at much lower cost than long-term control, which may be infeasible or prohibitively expensive. Invasive species should be detected and dealt with before they become established and spread. An integrated approach involving research and development, technical assistance, and operations is needed to facilitate and implement effective action. No comprehensive national system is in place for detecting and responding to incipient invasions. Unfortunately, inadequate planning, jurisdictional issues, insufficient resources and authorities, limited technology, and other factors often hamper early detection and rapid response in many locations.

**Control and Management:** When invasive species appear to be permanently established, the most effective action may be to prevent their spread or lessen their impacts through control measures. Control and management of invasive species encompasses diverse objectives such as eradication within an area, population suppression, limiting spread, and reducing effects. Complete eradication is not generally feasible for widespread invasive species or where adequate control methods are not available. Integrated pest management (IPM) is an approach to pest control (including invasive species) that flexibly considers available information, technology, methods, and environmental effects. Methods include physical restraints (e.g., fences and electric dispersal barriers), mechanical removal (e.g., hand-pulling, burning and mowing), judicious use of pesticides, release of biological control agents (such as host-specific predatory organisms), cultural practices (e.g., crop rotation), and interference with reproductive capacity (e.g., pheromone-baited traps and release of sterile males). Consideration of cumulative environmental impacts requires that environmentally sound methods be deployed, especially in vulnerable areas. Because control actions have local effects and cross jurisdictional borders, they are often carried out by or in cooperation with State or local agencies. Adequate funding and public awareness are critical to success.

**Restoration:** Executive Order 13112 requires Federal agencies to “provide for restoration of native species and habitat conditions in ecosystems that have been invaded.” Without restoration, areas may become reinfested by the same or new invasive species.

**International Cooperation:** The U.S. cannot succeed in addressing its domestic invasive species problems unless it takes a leadership role in international cooperation and invests in strategies that raise the capacity of other nations to manage the movement of invasive species. Our ability to prevent invasive species from entering the U.S. depends a great deal on the capability of other countries to effectively manage invasive species and invasion pathways domestically. Once invasive species become established within one country, they pose a threat to an entire region, as well as to trading partners and every country along a trading pathway. If an invasive species never leaves its native country, it will never become a problem in the U.S.. Actions by the U.S. have sometimes contributed to the invasive species problems faced by other countries. Despite good intentions, we have occasionally facilitated the introduction of invasive species to other countries through development assistance programs, military operations, famine relief projects, and international financing.

**Research:** Research supports each aspect of the Plan. Complementary research projects ranging from basic investigations with broad application to highly targeted applied efforts are required. Federal research outcomes, where appropriate, will be transferred to Federal, State, local, tribal and private sector stakeholders for their utilization.

**Information Management:** The Council is charged with establishing a coordinated, up-to-date information-sharing system. Although there are many sources of information concerning invasive species, incompatible database formats and other factors impede information sharing. The Council is currently developing an information "gateway" accessible through the Council's website – [www.invasivespecies.gov](http://www.invasivespecies.gov). The long-term goal is to provide accessible, accurate, referenced, up-to-date, comprehensive, and comprehensible information on invasive species that will be useful to local, State, tribal, and Federal managers, scientists, policy-makers, teachers, students, and others.

**Education and Public Awareness:** How invasive species are viewed is molded by human values, decisions, and behaviors. The prevention and control of invasive species will require modifying behaviors, values, and beliefs and changing the way decisions are made regarding our actions to address invasive species. A wide variety of education, outreach, and training programs are needed.

## **Recommendations**

The challenges posed by invasive alien species in India are enormous, both in dimensions and intensity. In marked contrast to this alarming situation, level of preparedness and response of the Central and State Governments appears to be inadequate. There is no unified national system geared to address the problems created by biological invasives and the authority/ responsibilities dealing with plants, animals, fishes and other aquatic species are rigidly compartmentalized. A holistic approach to face the prevailing and impending threats is missing and, above all, participation of key players and major stakeholders in decision making and problem solving is either lacking or ineffective. There are, however, examples of good work done in some areas but they do not seem to be part of a planned national effort. Some suggestions are offered here with a view to stimulating fresh thinking on this subject and drawing attention to some pivotal aspects of the national system that require re-orientation.

## **Role of the Central Government**

- Overall authority regarding regulation of imports (of plants and livestock) and quarantine;
- Leadership, perspective planning, coordination and monitoring;
- National system development, infrastructure, database, institutional support, linkages;
- Early Warning and Watch: Detection, containment, quick response and monitoring;
- Legislation and enforcement;
- Capacity building and research support (Developing technologies to manage IAS);
- Education and public awareness;
- Fund mobilization; and
- Regional and international cooperation  
(also inter-governmental negotiations/ national reporting)

➤ **Establishing ‘Unified Command for Plant and Animal Quarantine’:**

A proposal for establishment of an autonomous **Quarantine Authority of India**

Authority for import and quarantine of plants and seed materials is presently with the Plant Protection Advisor to the Govt. of India, Department of Agriculture & Cooperation, who heads the Directorate of Plant Protection, Quarantine & Storage. Director, National Bureau of Plant Genetic Resources, working under ICAR, shares the delegated responsibility for import of germplasm of agri-horticultural crops. Authority for import and quarantine of livestock (including fishes and aquatic species) rests with the Department of Animal Husbandry & Dairying with technical advice of the Animal Husbandry Commissioner and Fisheries Commissioner.

The plant quarantine activities in the country are presently regulated through implementation of Plants, Fruits, Seeds (Regulation of Import into India) Order, 1989 notified under the DIP Act, 1914 while the animal quarantine is regulated through implementation of the provisions under the Livestock Importation Act 1898 (as amended upto 2001).

Being the signatory to the International Plant Protection Convention (IPPC), India is obliged to have a National Plant Protection Organisation (Central Regulatory Agency) responsible for meeting international obligations relating to phytosanitary measures. Effective functioning of such a regulatory agency enjoins upon its necessary financial and administrative flexibility. Hence, an urgent need has been felt to establish an autonomous authority under the Government of India to undertake the scientific requirements of pest risk analysis, development of national standards, domestic and national quarantine, etc. Accordingly, a proposal to establish a Plant Quarantine Authority of India for this purpose is under consideration in the Department of Agriculture. Being the signatory to IPPC, India is obliged to have a National Plant Protection Organisation (Central Regulatory Agency) responsible for meeting the international obligations relating to phytosanitary measures.

This proposal needs to be made more comprehensive covering quarantine measures in respect of animals and aquatic organisms (including fish) also. Accordingly, a recommendation is being made here to enact legislation for establishing an autonomous Quarantine Authority of India, taking inputs from the set up of the United States Department of Agriculture’s Animal and Plant Health Inspection Service.

### Box 9

#### A Proposal for Setting up 'National Invasive Species Council' in India

Considering that the scope of dealing with invasive alien species is multi-dimensional and requires multi-disciplinary inputs, there is an urgent need for establishing the National Invasive Species Council to advise the Government on this subject and to work for the following objectives:

- To provide national leadership on invasive species;
- To see that the Central efforts are coordinated and effective;
- To promote action at local, State and ecosystem levels;
- To identify recommendations for international cooperation;
- To facilitate a coordinated network to document and monitor invasive species;
- To develop a web-based information network;
- To provide guidance on invasive species for Central Govt. agencies; and
- To prepare the National Invasive Species Management Plan.

**Co-Chairs:** Secretary, Agriculture; Secretary, Environment & Forests

**Members:** Secretary, Animal Husbandry; Secretary, Commerce; Secretary, Health; Secretary, Biotechnology; Secretary, Ocean Development, Directorate General of Foreign Trade; two Risk Analysis Experts (one for plants and the other for animals), four Regional Representatives nominated by the concerned States, one representative of the farmers and two NGOs (working in the fields of wildlife and agriculture)

The proposed Council should prepare, within one year of its establishment, a National Invasive Species Management Plan focusing on both the preventive and management aspects according priority to restoration of the heavily infested ecosystems. It should also evolve clear guidelines on the introduction of alien species keeping in view the following considerations:

- There should ordinarily be no further introduction of such species into the wild (terrestrial or aquatic ecosystems). Exceptional approvals to this recommendation should pass through stringent EIA giving due weightage to biodiversity and ecosystem functioning.
- Introduction of alien species into farming systems should also be preceded with a rigorous EIA with a focus on agricultural biodiversity and livelihoods of local people.
- The Precautionary Principle should be paramount in cases where the critical information is inadequate or the potential impacts are unclear.
- Liability to pay for damages should be on the person or the agency applying for the introduction of an alien species.
- A proper Surveillance and Early Warning (and also quickly responding) System must be set up involving the local people and NGOs working in this area.
- Priority attention may be accorded on a war-footing basis to the fast spreading and most noxious species such as the following:

Plants: Water hyacinth, *Lantana camara*, *Parthenium hysterophorus*, *Mikania micrantha* and *Phalaris minor*.

Fishes: The African catfish and the Bighead Silver Carp.

Microbes: Banana Bunchy Top Virus, Potato Golden Nematode and HIVs.

#### Role of State Governments

- Assert their partnership right in preparation of the National Action Plan on IAS;

- Play the Area Commander's role in all Central Governments's field programmes dealing with invasive alien species;
- Establish Surveillance, Early Warning and Quick Response System dealing with IAS;
- Strengthen their plant quarantine capacity and assist the Central Government in enforcing regulations of domestic quarantine;
- Enlist progressively greater involvement of *Panchayati Raj* (local self-government) institutions with capacity building activities;
- Mobilize funds based on proposals for field programmes and preparation of Case Studies;
- Involve local institutions and consultants in demonstrative restoration of the ecosystems;
- Organise Bio-Security Campaigns for disinfection of the invaded areas;
- Support socio-economic studies, monitoring work and public awareness campaigns in partnership with civil society organizations and self-help groups.

### **Role of Institutions**

- Providing expertise, research backup and policy inputs;
- Extending research, technical and technological support;
- Developing and strengthening linkages;
- Conducting socio-economic studies;
- Developing case studies;
- Organising workshops and discussion meetings;
- Providing consultants/ subject matter specialists; and
- Leading the effort on restoration of ecosystems and mitigation of negative impacts.
- Project based mobilization of funds, particularly from international funding agencies.

### **Regional and International Cooperation**

#### **International Agreements and Authorities:**

India cannot succeed in facing its domestic invasive species problems unless it plays a leadership and proactive role in regional and international cooperation, and also in intergovernmental negotiations on this subject in international fora.

Key international legal instruments, that address the threat of invasive alien species, include the United Nations Convention on the Law of the Sea (UNCLOS), the Convention on Biological Diversity (CBD), the Ramsar Convention on Wetlands and other multilateral environmental agreements, as well as instruments developed for the plant, animal and human health sectors, or to address particular vectors, such as the International Plant Protection Convention (IPPC) and instruments developed under the Office International des Epizooties (OIE) and specialized agencies such as the Food and Agriculture Organization of the United Nations (FAO), the International Civil Aviation Organization (ICAO), the International Maritime Organization (IMO) and the World Health Organisation (WHO). Key features of these multilateral agreements are as follows:

- **United Nations Convention on the Law of the Sea (UNCLOS), 1982**  
Nodal Ministry/ Department: Ocean Development

Provides comprehensive legal framework for the protection and preservation of the marine environment including conservation of living resources. This is recognized in the UN Conference on Environment and Development (UNCED)'s agenda 21, chapter 17



which states that UNCLOS provides the basis upon which to pursue the protection and sustainable development of the marine and coastal environment.

- **Convention on Biological Diversity (CBD), 1993**  
Nodal Ministry: Ministry of Environment and Forests

Article 8 of the CBD on *In Situ* Conservation provides that each contracting Party shall, as far as possible and as appropriate, prevent the introduction of, control, or eradicate those alien species that threaten ecosystems, habitats, or species. The CBD is in the process of further developing and promoting the Guiding Principles for the prevention, introduction, and mitigation of impacts of alien species. The Global Invasive Species Programme (GISP) works closely with the CBD, to provide expert assistance through the CBD's Subsidiary Body on Science, Technology, and Technical Advice (SBSTTA).

- **The World Trade Organization (WTO) Agreement on the Application of Sanitary and Phytosanitary (SPS) Measures, 1995**; Nodal Ministry: Commerce and Industry

The SPS Agreement is a supplement to the World Trade Organization Agreement. It provides a uniform framework for measures to protect the health and lives of humans, plants, and animals.

Sanitary and phytosanitary measures are defined as actions whose goal is to: 1) protect human, animal, or plant health from the entry or spread of pests, disease, or disease carrying organisms; or 2) prevent or limit other damage from the entry or spread of pests. The SPS Agreement has chosen the international standards, guidelines, and recommendations of three organizations – International Plant Protection Convention (IPPC), Codex, and Office International des Epizooties (OIE) -- as the preferred measures for adoption by WTO members. The relevant scope and work of these three organizations is discussed below.

- **International Plant Protection Convention (IPPC), 1951 with revision in 1987**  
Nodal Ministry: Ministry of Agriculture

The FAO Conference approved the IPPC in November 1951 for submission to Governments for acceptance. India ratified it on 9 June 1952. The IPPC applies primarily to quarantine pests in international trade. It creates an international regime, based on standards and policies, to prevent the spread and introduction of pests to plants and plant products. The IPPC's provisions and standards for quarantine pests are applicable to invasive species that harm plants or their products. In 2000, a working group of the IPPC recommended that the Convention develop a set of standards on the trade of relevant invasive species. Parties to the IPPC have established national and regional plant protection organizations with authority in relation to quarantine control, risk analysis, and other relevant measures.

- **International Office of Epizootics (OIE)**; Nodal Ministry: Ministry of Agriculture

The mission of OIE (in French, the Office International des Epizooties) is to prevent the spread of animal diseases. OIE's major functions are to collect and disseminate

information on the distribution and control of animal diseases, to coordinate research on contagious animal diseases, and to develop international standards for the safe movement of animals and animal products in international trade. While the OIE has traditionally focused on diseases of livestock and on setting diagnostic standards (e.g., for vaccines), it has recently begun to address disease risks associated with wildlife, including aquatic species.

- **Convention on International Trade in Endangered Species of Wild Fauna and Flora**  
Nodal Ministry: Ministry of Environment and Forests.

Regulates the intentional trade in certain species of wildlife and plants worldwide. CITES procedures could be involved when a species listed in one of the appendices has the potential to become invasive in the importing country.

### **Summing Up**

India is highly vulnerable to the invasions of aggressive alien species in view of its vast ('porous') borders, wide spectrum of climatic and soil conditions, rich native biological wealth, endemic repository of wild relatives of cultivated plants, weak enforcement of biodiversity and environmental protection laws, ineffective implementation of regulatory measures for import of living organisms (plants, livestock, fishes and other aquatic species, insects and accidental introduction of virulent pathogens), expanding tourism and liberalization of trade. National system to respond to the prevalent and impending threats of AIS is weak with notable shortcomings and gaps. It has, however, the scientific strength and capability to face these challenges provided that the priorities are set rightly at various levels, required funds are mobilised and the actions are taken without further delay with full administrative support and political will. The Central and State Governments must work together for this purpose in active partnership with lead research institutions and civil society organizations and with effective involvement of *Panchayati Raj* institutions and local people. It is also desirable that campaigns for clearance of already heavily infested areas and restoration of invaded ecosystems be linked to Government's 'Food For Work' Programme in case a real headway is to be made in this direction.

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**INDIA'S SECOND NATIONAL REPORT  
TO THE CONVENTION ON BIOLOGICAL DIVERSITY**

**Implementation of the Article 8h: Alien species**

1. What is the relative priority afforded to implementation of this Article and the associated decisions by your country?					
a) High		b) Medium	+	c) Low	
2. To what extent are the resources available adequate for meeting the obligations and recommendations made?					
a) Good		b) Adequate		c) Limiting	+
d) Severely limiting					
Further comments on relative priority and on availability of resources: <b>No comments</b>					

3. Has your country identified alien species introduced?	
a) no	
b) only major species of concern	+
c) only new or recent introductions	
d) a comprehensive system tracks new introductions	
e) a comprehensive system tracks all known introductions	
4. Has your country assessed the risks posed to ecosystems, habitats or species by the introduction of these alien species?	
a) no	
b) only some alien species of concern have been assessed	+
c) most alien species have been assessed	
5. Has your country undertaken measures to prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species?	
a) no measures	
b) some measures in place	+
c) potential measures under review	
d) comprehensive measures in place	

***Decision IV/1 Report and recommendations of the third meeting of SBSTTA***

6. Is your country collaborating in the development of projects at national, regional, sub-regional and international levels to address the issue of alien species?	
a) little or no action	
b) discussion on potential projects under way	+
c) active development of new projects	
7. Does your national strategy and action plan address the issue of alien species?	
a) no	
b) yes - limited extent	+
c) yes - significant extent	

**Decision V/8. Alien species that threaten ecosystems, habitats or species**

8. Is your country applying the interim guiding principles for prevention, introduction and mitigation of impacts of alien species in the context of activities aimed at implementing article 8(h) of the Convention, and in the various sectors?	
a) no	
b) under consideration	
c) limited implementation in some sectors	+
d) extensive implementation in some sectors	
e) extensive implementation in most sectors	
9. Has your country submitted case-studies to the Executive Secretary focusing on thematic assessments?	
a) no	+
b) in preparation	
c) yes	
10. Has your country submitted written comments on the interim guiding principles to the Executive Secretary?	
a) no	
b) yes	+
11. Has your country given priority to the development and implementation of alien invasive species strategies and action plans?	
a) no	
b) yes	+
12. In dealing with the issue of invasive species, has your country developed or involved itself in mechanisms for international co-operation, including the exchange of best practices?	
a) no	
b) trans-boundary co-operation	
c) regional co-operation	
d) multilateral co-operation	+
13. Is your country giving priority attention to geographically and evolutionarily isolated ecosystems in its work on alien invasive species?	
a) no	
b) yes	+
14. Is your country using the ecosystem approach and precautionary and bio-geographical approaches as appropriate in its work on alien invasive species?	
a) no	
b) yes	+
15. Has your country developed effective education, training and public-awareness measures concerning the issue of alien species?	
a) no	
b) some initiatives	+
c) many initiatives	

16. Is your country making available the information which it holds on alien species through the CHM?	
a) no	
b) some information	
c) all available information	
d) information available through other channels	+
17. Is your country providing support to enable the Global Invasive Species Programme to fulfil the tasks outlined in the decision and its annexes?	
a) no	+
b) limited support	
c) substantial support	

➤ The sign + denotes the ticked response of the Government of India.



## **THE DESTRUCTIVE INSECTS AND PESTS ACT, 1914**

ACT NO.II OF 1914

PASSED BY THE GOVERNOR GENERAL OF INDIA IN COUNCIL

(Received the assent of the Governor-General on the 3rd February, 1914)

AN ACT TO PREVENT THE INTRODUCTION INTO AND THE TRANSPORT FROM ONE STATE TO ANOTHER IN INDIA OF ANY INSECT, FUNGUS OR OTHER PEST WHICH IS OR MAY BE DSTRUCTIVE TO CROPS.

Whereas it is expedient to make provision for preventing the introduction into India of any insect, fungus or other pest, which is or may be destructive to crops; it is hereby enacted as follows:

### 1. Short title:

(a) This Act may be called The Destructive Insects and Pests Act, 1914.

(b) It extends to the whole of India.

### 2. Definitions:

In this Act, unless there is anything repugnant in the subject or context-

(a) "Crops" includes all agricultural or horticultural crops and all trees, bushes or plants;

(b) "Import" means the bringing or taking by sea, land or air, across any customs frontier defined by the Central Government;

(c) "Infection" means infection by any insect, fungus or other pest injurious to a crop.

### 3. Power of the Central Government to regulate or prohibit the import of articles likely to infect:

(i) The Central Government may, by notification in the Gazette of India, prohibit or regulate, subject to such restrictions and conditions as the Central Government may impose, the import into India, or any part thereof, or any specified place therein, of any articles or class of articles likely to cause infection to any or of insects generally or any class of insects.

(ii) A notification under the section may specify any article or class of articles or any insect or class of insects either generally or in any particular manner, whether with reference to the country of origin, or the route by which imported or otherwise.

### 4. Operation of notification under Section 3:

A notification under section 3 shall operate as if it had been issued under section 19 of the Sea Customs Act, 1878 (VIII of 1878), and the officers of Customs at every port shall have the same powers in respect of any article with regard to the importation of which such a notification has been issued as they have for the time being in respect of any article, the importation of which is regulated, restricted or prohibited by the law relating to Sea customs and the law for the time being in force relating to Sea customs or any such article shall apply accordingly.

4. (a) Power of Central Government to regulate or prohibit transport from State to State of insects or articles likely to infect:

The Central Government may, by notification in the official gazette, prohibit or regulate, subject to such conditions as the Central Government may impose, the export from a State or the transport from one State to another State in India of any article or class of articles likely to cause infection to any crop or of insects generally or any class of insects.

4. (b) Refusal to carry article of which transport is prohibited:

When a notification has been issued under section 4 A, then, notwithstanding any other law for the time being in force, the person responsible for the booking of goods or parcels at any railway station or inland steam vessel station-

(i) Where the notification prohibits export or transport, shall refuse to receive for carriage at, or to forward or knowingly allow to be carried on the railway or inland steam vessel from that station anything, of which import or transport is prohibited, consigned to any place in India outside the State in which such station is situated;

(ii) Where the notification imposes conditions upon export or transport, shall so refuse, unless the consignor produces, or the thing consigned is accompanied by a document or documents of the prescribed nature showing that these conditions are satisfied.

4. (c) Deleted.

4. (d) Power of Central Government to make rules:

The Central Government may, by notification in the official gazette, make rules prescribing the nature of the documents which shall accompany any article or insect, the export or transport whereof is subject to conditions imposed under section 4 A, or which shall be held by the consignor or consignee thereof, the authorities which may issue such documents and the manner in which the documents shall be employed. Provided that the said notification, shall be placed, as soon as may be, on the table of both chambers of the Parliament.

5. Power of local Government to make rules:

(i) The State Government may make rules for the detention, inspection, disinfection, or destruction of any insect or class of insects or of any article or class of articles in respect of which a notification has been issued under section-3 or under section-4A or of any article which may have been in contact or proximity thereto, and for regulating the powers and duties of the officers whom it may appoint in this behalf.

(ii) In making any rule under this section, the State Government may direct that a breach thereof shall be punishable with fine, which may extend to one thousand rupees.

5. (a) Penalties:

Any person who knowingly exports any article or insect from a State or transports any article or insect from one State to another in India in contravention of a notification issued under section 4A, or attempts so to export or transport any article or insect, and any person responsible for the booking of goods or parcels at a railway or inland steam vessel station who knowingly contravenes the provisions of section 4B shall be punishable with fine which may extend to two

hundred and fifty rupees and upon any subsequent conviction, with fine which may extend to two thousand rupees.

6. Protection to persons acting under Act:

No suit, prosecution or other legal proceedings shall lie against any person for anything in good faith done or intended to be done under this Act.

List of amending Acts and adaptation orders:

- 1.The Destructive Insects and Pests (Amendment) Act, 1930 (20 of 1930)
- 2.The Government of India (Adaptation of Indian Laws) (Order, 1937)
- 3.The Destructive Insects and Pests (Amendment) Act, 1938 (6 of 1938)
- 4.The Destructive Insects and Pests (Amendment) Act, 1939 (3 of 1939)
- 5.The Indian Independence (Adaptation of Central Acts and Ordinances) Order, 1948
- 6.The Adaptation of Laws Order, 1950
- 7.The Part B States (Laws) Order, 1951 (3 of 1951)
- 8.The Jammu & Kashmir (Extension of Laws) Act, 1956 (62 of 1956)

**GUIDING PRINCIPLES FOR THE PREVENTION, INTRODUCTION AND MITIGATION OF IMPACTS OF ALIEN SPECIES THAT THREATEN ECOSYSTEMS, HABITATS OR SPECIES (As recommended by the 6<sup>th</sup> meeting of the Conference of Parties to CBD, held in The Hague on 8-19 April 2002):**

**Introduction**

This document provides all Governments and organizations with guidance for developing effective strategies to minimize the spread and impact of invasive alien species. While each country faces unique challenges and will need to develop context-specific solutions, the Guiding Principles give governments clear direction and a set of goals to aim toward. The extent to which these Guiding Principles can be implemented ultimately depends on available resources. Their purpose is to assist governments to combat invasive alien species as an integral component of conservation and economic development. Because these 15 principles are non-binding, they can be more readily amended and expanded through the Convention on Biological Diversity's processes as we learn more about this problem and its effective solutions.

According to Article 3 of the Convention on Biological Diversity, States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

It should be noted that in the Guiding Principles below, the terms listed in footnote 57 are used.  
57/

Also, while applying these Guiding Principles, due consideration must be given to the fact that ecosystems are dynamic over time and so the natural distribution of species might vary without involvement of a human agent.

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57/ The following definitions are used: (i) "alien species" refers to a species, subspecies or lower taxon, introduced outside its natural past or present distribution; includes any part, gametes, seeds, eggs, or propagules of such species that might survive and subsequently reproduce; (ii) "invasive alien species" means an alien species whose introduction and/or spread threaten biological diversity (For the purposes of the present guiding principles, the term "invasive alien species" shall be deemed the same as "alien invasive species" in decision V/8 of the Conference of the Parties to the Convention on Biological Diversity.); (iii) "introduction" refers to the movement by human agency, indirect or direct, of an alien species outside of its natural range (past or present). This movement can be either within a country or between countries or areas beyond national jurisdiction; (iv) "intentional introduction" refers to the deliberate movement and/or release by humans of an alien species outside its natural range ; (v) "unintentional introduction" refers to all other introductions which are not intentional, and (vi) "establishment" refers to the process of an alien species in a new habitat successfully producing viable offspring with the likelihood of continued survival (vii) "risk analysis" refers to: (1) the assessment of the consequences of the introduction and of the likelihood of establishment of an alien species using science-based information (i.e., risk assessment), and (2) to the identification of measures that can be implemented to reduce or manage these risks (i.e., risk management), taking into account socio-economic and cultural considerations.

## **A. General**

### *Guiding principle 1: Precautionary approach*

Given the unpredictability of the pathways and impacts on biological diversity of invasive alien species, efforts to identify and prevent unintentional introductions as well as decisions concerning intentional introductions should be based on the precautionary approach, in particular with reference to risk analysis, in accordance with the guiding principles below. The precautionary approach is that set forth in principle 15 of the 1992 Rio Declaration on Environment and Development and in the preamble of the Convention on Biological Diversity.

The precautionary approach should also be applied when considering eradication, containment and control measures in relation to alien species that have become established. Lack of scientific certainty about the various implications of an invasion should not be used as a reason for postponing or failing to take appropriate eradication, containment and control measures.

### *Guiding principle 2: Three-stage hierarchical approach*

1. Prevention is generally far more cost-effective and environmentally desirable than measures taken following introduction and establishment of an invasive alien species.
2. Priority should be given to preventing the introduction of invasive alien species, between and within States. If an invasive alien species has been introduced, early detection and rapid action are crucial to prevent its establishment. The preferred response is often to eradicate the organisms as soon as possible (principle 13). In the event that eradication is not feasible or resources are not available for its eradication, containment (principle 14) and long-term control measures (principle 15) should be implemented. Any examination of benefits and costs (environmental, economic and social) should be done on a long-term basis.

### *Guiding principle 3: Ecosystem approach*

Measures to deal with invasive alien species should, as appropriate, be based on the ecosystem approach, as described in decision V/6 of the Conference of the Parties.

### *Guiding principle 4: The role of States*

1. In the context of invasive alien species, States should recognize the risk that activities within their jurisdiction or control may pose to other States as a potential source of invasive alien species, and should take appropriate individual and cooperative actions to minimize that risk, including the provision of any available information on invasive behaviour or invasive potential of a species.
2. Examples of such activities include:
  - (a) The intentional transfer of an invasive alien species to another State (even if it is harmless in the State of origin); and
  - (b) The intentional introduction of an alien species into their own State if there is a risk of

that species subsequently spreading (with or without a human vector) into another State and becoming invasive;

(c) Activities that may lead to unintentional introductions, even where the introduced species is harmless in the state of origin.

3. To help States minimize the spread and impact of invasive alien species, States should identify, as far as possible, species that could become invasive and make such information available to other States.

#### *Guiding principle 5: Research and monitoring*

In order to develop an adequate knowledge base to address the problem, it is important that States undertake research on and monitoring of invasive alien species, as appropriate. These efforts should attempt to include a baseline taxonomic study of biodiversity. In addition to these data, monitoring is the key to early detection of new invasive alien species. Monitoring should include both targeted and general surveys, and benefit from the involvement of other sectors, including local communities. Research on an invasive alien species should include a thorough identification of the invasive species and should document:

- (a) the history and ecology of invasion (origin, pathways and time-period);
- (b) the biological characteristics of the invasive alien species; and
- (c) the associated impacts at the ecosystem, species and genetic level and also social and economic impacts, and how they change over time.

#### *Guiding principle 6: Education and public awareness*

Raising the public's awareness of the invasive alien species is crucial to the successful management of invasive alien species. Therefore, it is important that States should promote education and public awareness of the causes of invasion and the risks associated with the introduction of alien species. When mitigation measures are required, education and public-awareness-oriented programmes should be set in motion so as to engage local communities and appropriate sector groups in support of such measures.

## **B. Prevention**

#### *Guiding principle 7: Border control and quarantine measures*

1. States should implement border controls and quarantine measures for alien species that are or could become invasive to ensure that:

- (a) Intentional introductions of alien species are subject to appropriate authorization (principle 10);
- (b) Unintentional or unauthorized introductions of alien species are minimized.

2. States should consider putting in place appropriate measures to control introductions of invasive alien species within the State according to national legislation and policies where they exist.

2. These measures should be based on a risk analysis of the threats posed by alien species and their potential pathways of entry. Existing appropriate governmental agencies or authorities should be strengthened and broadened as necessary, and staff should be properly trained to implement these measures. Early detection systems and regional and international coordination are essential to prevention.

*Guiding principle 8: Exchange of information*

1. States should assist in the development of an inventory and synthesis of relevant databases, including taxonomic and specimen databases, and the development of information systems and an interoperable distributed network of databases for compilation and dissemination of information on alien species for use in the context of any prevention, introduction, monitoring and mitigation activities. This information should include incident lists, potential threats to neighbouring countries, information on taxonomy, ecology and genetics of invasive alien species and on control methods, whenever available. The wide dissemination of this information, as well as national, regional and international guidelines, procedures and recommendations such as those being compiled by the Global Invasive Species Programme should also be facilitated through, *inter alia*, the clearing-house mechanism of the Convention on Biological Diversity.

2. The States should provide all relevant information on their specific import requirements for alien species, in particular those that have already been identified as invasive, and make this information available to other States.

*Guiding principle 9: Cooperation, including capacity-building*

Depending on the situation, a State's response might be purely internal (within the country), or may require a cooperative effort between two or more countries. Such efforts may include:

(a) Programmes developed to share information on invasive alien species, their potential uneasiness and invasion pathways, with a particular emphasis on cooperation among neighbouring countries, between trading partners, and among countries with similar ecosystems and histories of invasion. Particular attention should be paid where trading partners have similar environments;

(b) Agreements between countries, on a bilateral or multilateral basis, should be developed and used to regulate trade in certain alien species, with a focus on particularly damaging invasive species;

(c) Support for capacity-building programmes for States that lack the expertise and resources, including financial, to assess and reduce the risks and to mitigate the effects when introduction and establishment of alien species has taken place. Such capacity-building may involve technology transfer and the development of training programmes;

(d) Cooperative research efforts and funding efforts toward the identification, prevention, early detection, monitoring and control of invasive alien species.

**C. Introduction of species**

*Guiding principle 10: Intentional introduction*

1. No first-time intentional introduction or subsequent introductions of an alien species already invasive or potentially invasive within a country should take place without prior authorization from a competent authority of the recipient State(s). An appropriate risk analysis, which may include an environmental impact assessment, should be carried out as part of the evaluation process before coming to a decision on whether or not to authorize a proposed introduction to the country or to new ecological regions within a country. States should make all efforts to permit only those species that are unlikely to threaten biological diversity. The burden of proof that a proposed introduction is unlikely to threaten biological diversity should be with the proposer of the introduction or be assigned as appropriate by the recipient State. Authorization of an introduction may, where appropriate, be accompanied by conditions (e.g., preparation of a mitigation plan, monitoring procedures, payment for assessment and management, or containment requirements).

2. Decisions concerning intentional introductions should be based on the precautionary approach, including within a risk analysis framework, set forth in principle 15 of the 1992 Rio Declaration on Environment and Development, and the preamble of the Convention on Biological Diversity. Where there is a threat of reduction or loss of biological diversity, lack of sufficient scientific certainty and knowledge regarding an alien species should not prevent a competent authority from taking a decision with regard to the intentional introduction of such alien species to prevent the spread and adverse impact of invasive alien species.

#### *Guiding principle 11: Unintentional introductions*

1. All States should have in place provisions to address unintentional introductions (or intentional introductions that have become established and invasive). These could include statutory and regulatory measures and establishment or strengthening of institutions and agencies with appropriate responsibilities. Operational resources should be sufficient to allow for rapid and effective action.

2. Common pathways leading to unintentional introductions need to be identified and appropriate provisions to minimize such introductions should be in place. Sectoral activities, such as fisheries, agriculture, forestry, horticulture, shipping (including the discharge of ballast waters), ground and air transportation, construction projects, landscaping, aquaculture including ornamental aquaculture, tourism, the pet industry and game-farming, are often pathways for unintentional introductions. Environmental impact assessment of such activities should address the risk of unintentional introduction of invasive alien species. Wherever appropriate, a risk analysis of the unintentional introduction of invasive alien species should be conducted for these pathways.

#### **D. Mitigation of impacts**

##### *Guiding principle 12: Mitigation of impacts*

Once the establishment of an invasive alien species has been detected, States, individually and cooperatively, should take appropriate steps such as eradication, containment and control, to mitigate adverse effects. Techniques used for eradication, containment or control should be safe to humans, the environment and agriculture as well as ethically acceptable to stakeholders in the areas affected by the invasive alien species. Mitigation measures should take place in the earliest



possible stage of invasion, on the basis of the precautionary approach. Consistent with national policy or legislation, an individual or entity responsible for the introduction of invasive alien species should bear the costs of control measures and biological diversity restoration where it is established that they failed to comply with the national laws and regulations. Hence, early detection of new introductions of potentially or known invasive alien species is important, and needs to be combined with the capacity to take rapid follow-up action.

*Guiding principle 13: Eradication*

Where it is feasible, eradication is often the best course of action to deal with the introduction and establishment of invasive alien species. The best opportunity for eradicating invasive alien species is in the early stages of invasion, when populations are small and localized; hence, early detection systems focused on high-risk entry points can be critically useful while post-eradication monitoring may be necessary. Community support is often essential to achieve success in eradication work, and is particularly effective when developed through consultation. Consideration should also be given to secondary effects on biological diversity.

*Guiding principle 14: Containment*

When eradication is not appropriate, limiting the spread (containment) of invasive alien species is often an appropriate strategy in cases where the range of the organisms or of a population is small enough to make such efforts feasible. Regular monitoring is essential and needs to be linked with quick action to eradicate any new outbreaks.

*Guiding principle 15: Control*

Control measures should focus on reducing the damage caused as well as reducing the number of the invasive alien species. Effective control will often rely on a range of integrated management techniques, including mechanical control, chemical control, biological control and habitat management, implemented according to existing national regulations and international codes.