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Application of the Environment and Safeguards Compliance Policy on Invasive Species

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Acronyms

CONABIO National Agency on Biodiversity

LAC Latin America and Caribbean

1. INTRODUCTION

The Inter-American Development Bank requires analysis of the risk of introducing invasive species through Policy Directive B.9 of the Environment and Safeguards Compliance Policy which states that the Bank "*will not support operations that introduce invasive species*."

Invasive species result in an estimated annual economic cost of US$1.4 trillion[1] – 5% of the global economy. Within the LAC (Latin America and Caribbean) region, the estimated annual agricultural cost of invasive species in Brazil is estimated to be US$42.6 billion[2] while the health and environmental costs of invasive species are US$6.7 billion. The socio-economic and environmental implications of invasive species are equivalent to those caused by climate change and habitat loss and the management of invasive species is therefore an environmental and socio-economic imperative.

The purpose of this note is to provide guidance on the implementation of the invasive species element in Policy Directive B.9 to improve efficiency and consistency.

2. WHAT IS AN INVASIVE SPECIES?

An invasive species can be defined as a species that has been introduced to an ecosystem by human action that subsequently causes socio-economic, cultural or environmental change[3].

Ecosystems are made up of populations of species categorized into three major groups: endemic, native, and introduced (also referred to as alien). Endemic species are those that are found only in that specific ecosystem and nowhere else; native species are found naturally in that ecosystem but are also present in other areas; and introduced species are those that arrived in the ecosystem as a result of human intervention. Species often move among different ecosystems naturally as they migrate, are transported on wind and air currents, or move attached or inside other species. Humans, however, accelerate the movements of species; the receiving socio-ecological systems struggle to respond.

Humans have moved species from one ecosystem to another for millennia, in large part because of agricultural and aquaculture expansion such as in the case with many grasses, ungulates, and fish and crustacean species. Movements may also have occurred accidently, for example many species have been moved around the world in the soil and water ballast contained

[1] UNEP 2010
[2] Pimentel 2002
[3] Invasive species are defined by IDB OP-703 as a "*species that is (i) nonnative (or alien) to the ecosystem under consideration; and (ii) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.*"

within the ship's hull. Human intervention includes direct transportation of a species and/or the indirect breaking down of natural barrier between ecosystems – for example through the construction of a canal between two isolated waterways.

The movement of a species from one place to another results in the introduction of a new species, often termed "introduced" (also referred to as "alien"). The majority of such introductions into a new ecosystem "fail" because the species does not establish in the new ecosystem. Species fail to establish because the climatic or environmental conditions may be unsuitable, or because the ecological circumstances of competition and predation are too difficult. However, under some conditions, an introduced species may establish and flourish and have substantial effects on the "host" ecosystem resulting in an invasion, also termed "biological contamination," frequently with substantial adverse environmental, social, economic, and cultural impacts.

Without human influence, it is difficult for a new species to move from one area to another because these movements are blocked by natural barriers. Barriers to species movements include waterways – even small rivers can restrict the distribution of bird species – mountain ranges, and unwelcoming habitats including grass lands which forest species will not cross. These natural barriers isolate species and are important in the processes of evolution and the formation of new species - the basis of biodiversity. Some species are adapted to disperse and move among different ecosystems and in many cases these species tend to be ubiquitous and concentrated in habitats close to transportation mediums including beaches, estuaries, and mangroves.

Many human introductions are benign, but in some cases and under some circumstances, can become problematic. While it may be easy, with hindsight, to explain why a particular species became a problem, it is often difficult to predict this with foresight. As a result, there is risk associated with any intentional introduction of a species or infrastructural changes (for example ports, airports, canals and roads) that might break down natural barriers to the movements of species.

Two classical examples of invasions in the LAC region are presented in Box 1 and 2. There are other examples of invasive species that have substantial effects in the realms of agriculture and health (see examples in Box 3 & 4). From these examples, it can be appreciated

that the form of impact of invasive species can be widespread, ecologically complex, and very difficult to predict.

Invasive species can impact socio-ecological systems and biodiversity through a variety of mechanisms. These mechanisms include competition, toxicity, carrying or acting as a reservoir for parasites and pathogens, hybridizing with native species, depredation, altering food webs, disrupting pollination, modifying whole ecosystems, and ultimately by causing extinction of native and endemic species.

Box 1: The weeping grass (*Eragrostis plana*) invasion in the southern grasslands of Brazil

Weeping grass was accidentally introduced from South Africa with pasture grasses in 1969. Weeping grass is ecologically dominant and structures grasslands and savannas and has invaded the traditional pastures of southern Brazil with a distribution of over 4.5 million hectares predicted by 2015. The invasion has an estimated economic cost of over US$55 per hectare per year putting the cost of this invasion at an estimated US$600 million from 1995 to 2015. Aligned with these economic impacts are the social and cultural consequences for the *gaucho* communities of the area.

Box 2: The cactus moth (*Cactoblastis cactorum*) invasion in Mexico

A second example comes from Mexico, where the cactus moth (*Cactoblastis cactorum*) invaded after being introduced from the Caribbean where it is used as a biological control agent. Its original range is restricted to Argentina, Paraguay and Peru but it is now found throughout Australia, South Africa, and the Caribbean. In Mexico, the introduction of the cactus moth has affected the endemic and native cactus species including the lucrative nopal and prickly pear trades with an estimated value of almost US$200 million (2006 estimate).

Box 3: The yellow fever mosquitoes (*Aedes aegypti* and *A. albopictus*) global invasion

The yellow fever mosquito (*Aedes aegypti*) was originally from Africa but has now spread throughout the world and carries yellow fever and dengue amongst other diseases of humans and livestock. The Asian tiger mosquito (*A. albopictus*) is similarly an important viral vector which was originally from Asia and now is found throughout the Americas and the Caribbean. Both species are highly invasive and move around the world as larvae inside water holding containers such as vehicle tires that are shipped across the world. They are remarkably adaptive to a range of environments and present a huge risk to human and animal health.

Box 4: The Mediterranean fruit fly (*Ceratitis capitata*) invasion

The Mediterranean fruit fly causes damage to a wide range of important fruit crops. The species was originally native to the Mediterranean but has now spread to most corners of the world. The most effective control mechanism for this species has been the introduction of sterile individuals – a technology now applied throughout its new range. Successful introduction seems to depend on multiple introduction events, and so controlling the entry of the species to a country is also an important control mechanism.

3. POLICIES ON INVASIVE SPECIES

Particular ecosystems are very susceptible to invasive species risks. Amongst these are those that are surrounded by natural barriers such as islands where endemic species have evolved under isolation. Other particularly susceptible habitats include wetlands in Latin America which are isolated by land and marine barriers and mountain areas.

Globally, the Convention on Biological Diversity (1992) recognized the threat posed by invasive species under Article 8(h) which reads *"as far as possible and as appropriate: (h) prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species.*" Subsequently, during the 2002 sixth Conference of Parties, Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species were adopted. However, subsequent reviews have indicated substantial shortfalls in implementation resulting from gaps in institutional, organizational and human capacities, weak political will, limited public awareness of the issues, and limited financial resources applied to the problem.

In addition, the International Plan Protection Convention (1952) provides a framework to help prevent the spread of plant pests and standards on phytosanitary measures. The International Maritime Organization (1948) has established mechanisms to control and manage ship ballast through the Convention for the Control and Management of Ship's Ballast Water and Sediments (2004) while the International Civil Aviation Organization has also resolved to address alien species.

3.1 NATIONAL POLICY AND LEGISLATION

Very few LAC countries have incorporated specific policy and legislation relating to invasive species. However, several countries have established phytosanitary and movement controls to help protect important agricultural bases including controlling for animal and plant diseases.

Brazil, Mexico, Uruguay, Ecuador, Chile and Colombia have specific institutional mechanisms relating to invasive species. In Brazil, the Environmental Crimes Law (9.605/1998) includes article 32 that prohibits the introduction of species into the country without a permit; article 61 determines that it is a criminal offence to distribute diseases, pests, or species that affect other species, habitats or ecosystems. Decree 4339/2002 consolidates the text of the Convention on Biological Diversity as national legislation and decree 4340/2002 prohibits the

introduction of non-native species into protected areas. The state of Paraná established a list of invasive species through Portaría IAP 125/2009; other states are following with similar lists.

Mexico is developing a national strategy on invasive species through the National Agency on Biodiversity (CONABIO). Uruguay has published a preliminary list of invasive species and is developing a national strategy that should be concluded in 2010. Chile has established a national committee for invasive alien species and is developing a national strategy. Colombia is in the process of publishing a national strategy and developing a risk analysis system. Finally, Ecuador has well developed invasive species management systems for the Galapagos Islands and has incorporated in article 73 of the constitution the prohibition of the introduction of organisms, organic or inorganic materials that can affect national genetic assets.

3.2 BANK POLICY REQUIREMENTS

The interpretation of Policy Directive B.9 of the Environment and Safeguards Policy is difficult and complicated by the following factors that need to be addressed in the preparation and implementation of Bank funded operations. These factors include: i) a species that is invasive elsewhere may not be invasive in a new location, ii) there is a cumulative effect of introductions which increase the probability of invasion by changing the gene pool of introduced species and spreads the risk over wider geographical areas, iii) climate change will affect the probability of a particular species becoming invasive, and iv) once a species has been introduced, it is almost impossible to eradicate and very expensive to control. In the case of infrastructure projects, it is also difficult to demonstrate that the project, itself, is introducing invasive species – however, infrastructure such as roads, canals, and ship movements break down barriers among ecosystems increasing the probability of species movements.

With invasive species risks, Policy Directive B.4 (Other Risk Factors) is also relevant. This directive indicates that the "*the Bank will identify and manage other risk factors that may affect the environmental sustainability of its operations. These risk factors may include elements such as the governance capacity of executing agencies/borrower and of third parties.*" In the case of invasive species, many countries lack the institutional and organizational capacities and so, where an introduction is involved, this must be considered as an additional risk factor.

Policy Directive B.5 on environmental assessment requirements also indicates the need for environmental assessment and the analysis of alternatives in high risk projects – including

those involving introductions. Environmental assessments involving invasive species may call for specific risk assessments as described later. In such a case, attention should be paid to the possibility of utilizing either native or non-invasive species alternatives.

4. OPTIONS FOR MANAGING INVASIVE SPECIES RISKS

The main challenge to effectively reducing the impacts from invasive species is to build public and, consequently, organizational understanding of invasive species issues. Most urban dwellers will neither come into contact with nor be directly affected by invasive species whose main impacts are experienced in agricultural areas and natural habitats. In addition, the majority of urban dwellers live surrounded by introduced species of plants, including house and garden plants; in some sense, there is an inherent acceptance of the homogeneity that arises from urban circumstances. Except for private interests who suffer agricultural losses, invasive species affect public goods and services and entail government expenditures on their control and eradication. Consequently, despite being the third most important agent of ecological destruction, after climate change and habitat loss, invasive species receive remarkably little public attention.

The costs of eradication of invasive species are extremely high, so much so that eradication is often not feasible. In highly specialized circumstances, eradication may be effected over small areas – for example the eradication of goats from islands within the Galapagos National Park – but the high costs of eradication often supersede the socio-economic and biodiversity costs of living with the invasion. There is, however, a history of species eradication associated with health and agricultural threats – for example, the eradication of malaria mosquitoes from many parts of the original range and the eradication of human diseases including smallpox. These processes are complex and frequently global efforts requiring resources from many nations. Eradication is therefore, in most cases, not a tenable risk mitigation option – once an introduction has occurred it should be assumed that it will persist. The second option of controlling invasive species – limiting population expansion to levels that are not damaging – is also expensive. Mechanisms include local eradication, integrated pest management, and the use of biological control agents. Where the invasive species affects human health, livestock health, and crops through disease or predation, these costs can be incurred through long term public programs with recurring costs and established institutional and organizational capacities.

Given the costs of eradication and control mechanisms, the best and most cost effective management option is to prevent the arrival of invasive species. Thus, the best tool to reduce risks is environmental assessment of new projects with particular attention paid to invasive species risks. Mitigation of these risks may be possible either by enhancing institutional and organizational barriers to introductions through entry controls or by choosing alternative

Box 5: Best practice management and control of invasive species
Ecuador has legally established for the Galapagos Islands a "Total Control Plan for Invasive Species." This plan addresses several aspects of the invasive species problem from preventing arrival and establishment through to eradication, control and rapid response systems. The total control plan works toward controlling access points to the islands – through increased monitoring and oversight at ports and airports. The plan also regulates and limits the entry of products to the islands using a list of prohibited products that cannot be brought to the islands. This list has been developed using structured risk assessments which are also used to prioritize control activities for species already introduced to the islands. The plan establishes control and eradication strategies and a rapid response system with early detection systems with the support of farmers and local communities. The plan and the associated Special Law for the Galapagos Islands establish an institutional and organizational framework financed by revenues from tourism that polices entering visitors, flights, and boats including movements among the islands.

initiatives that do not involve introducing invasive species. With particular high risk invasive species including agricultural and health pests, early warning and rapid response systems can help eradicate new introductions in high risk areas.

Some countries have invested in developing capacity for invasive species management – Ecuador has established safeguards for endemic species in the Galapagos Islands and several countries have strong phytosanitary controls. However, in general, there is relatively little institutional or organizational capacity in the LAC region for the management of invasive species. This is of particular concern given the possible synergies of invasive species outbreaks with climate change and the increased risk of introduction from regional and global trade routes.

5. APPLYING BANK POLICY REQUIREMENTS

Perhaps the greatest challenge facing implementation of the B.9 Policy Directive on invasive species is the lack comprehension of the associated risks. This challenge exists on several levels including the acceptance of invasive species impacts and risks among Bank and borrower staff. While there is a broad literature on the economic impact of introductions, most studies have focused on invasive species that have health, agricultural or forest impacts; estimation of the

economic costs of biodiversity loss – the major cost of most introductions – is still in its infancy. A second issue is the difficulty of explaining probabilistic risks because establishment does not automatically follow introduction.

The decision making process relating to invasive species in projects is described in Box 6. At the beginning of this process is the primary question as to whether or not the operation leads to the movement of species from one place to another. These movements can be direct as in the case of moving livestock, crops, fish, or micro-organisms or indirect as results from breaking down barriers between ecosystems through roads, bridges, or canals. The second phase of analysis is, where possible, to examine the species involved in movements and to undertake a risk assessment of the "invasiveness" of the species involved (see Annex III for examples).

The ground work to demonstrate the risks [4] from invasive species is particularly important. Demonstrating this risk requires (i) clear identification of the species involved, (ii) evaluation of the potential impacts and "invasiveness" of the species through knowledge of its life history, history of invasiveness and that of related species[5], (iii) verification of the presence or absence of the particular species in the project area, (iv) evaluation of the effect of introduction in terms of the likelihood of establishment, invasion or hybridization, (v) undertaking an analysis of the costs and benefits of the introduction, (vi) examining the range of additional risks (including of introducing diseases with the target species), and (vii) evaluating the ability within the project and nationally to manage the risks. These requirements often extend environment assessment procedures and necessitate a specially designed examination and application of a risk assessment protocol.

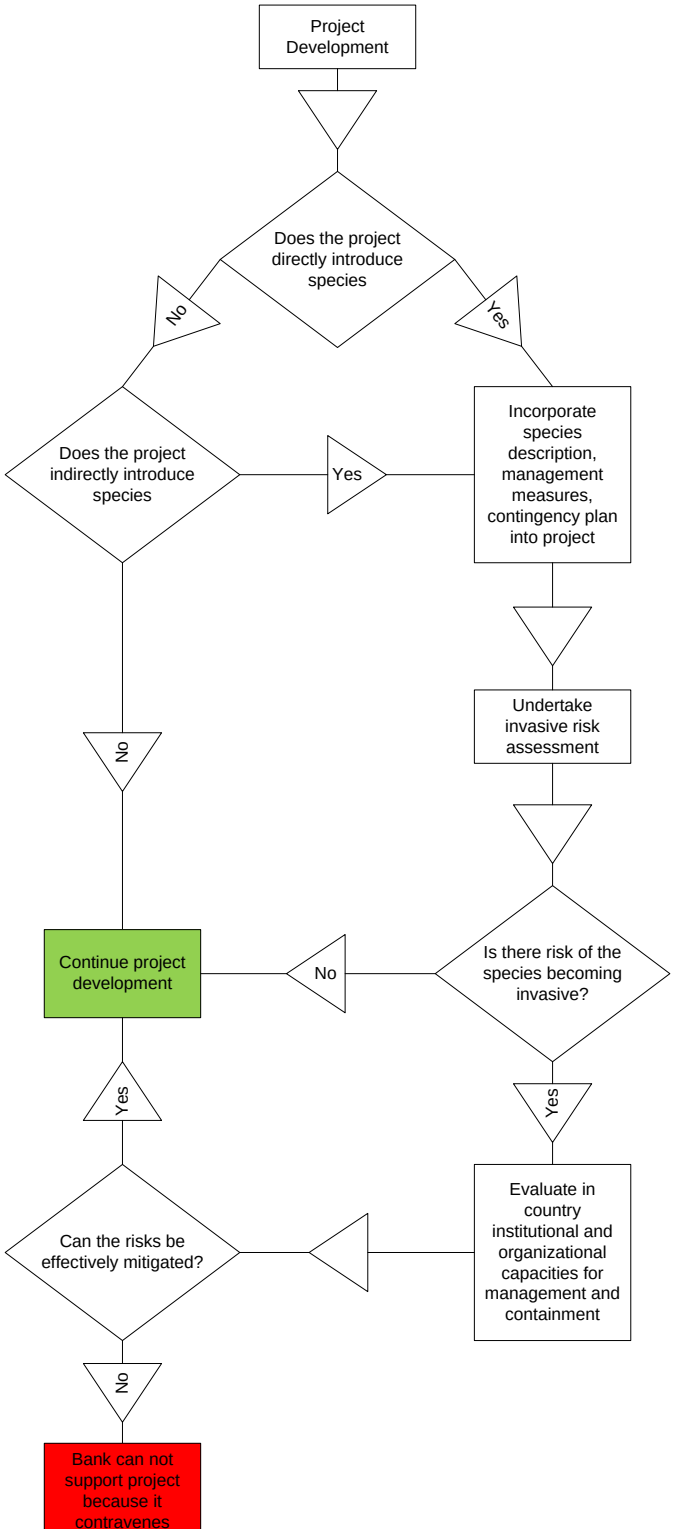
The risk assessment for an invasive species should focus on two major questions. The first question relates to the risk that the species involved will become invasive and the second relates to capacities in the site of introduction to manage the risks. The second question requires a full understanding of institutional frameworks and organizational capacities for managing and mitigating invasive species risks. In the case of a project supporting the introduction of an invasive species, the project will need to demonstrate that the mitigation measures substantially reduce the risk of invasion. However, it should be emphasized from the outset that prevention of

[4] *The possibility that environmental, social, health and safety, governance or operation-specific factors may affect the environmental sustainability of the operation* (OP-703 definition)

[5] Risk analysis includes evaluating the history of invasiveness of the species, feasibility of control and eradication, history of introductions into the area, life history characteristics of the species, distribution of the species, and resource dependence of the species; risk analysis tools exist for weeds and crop pests as do categorization tools, for example, in South Africa, New Zealand, Brazil, and the Galapagos Islands

introduction is much more effective than establishing mechanisms for control and/or eradication once a species has entered the ecosystem.

Box 6: Decision tree for evaluating projects involving the introduction of species



There are particular projects that involve the direct or indirect introduction of invasive species. Biofuels initiatives are part of a broader strategy to reduce greenhouse gas emissions; most plant species considered for biofuels tend to have high growth rates, produce substantial biomass, and are often introduced from other locations. These characteristics also make these species good candidates as invasive pests, while the large scale of biofuels initiatives increases the risk of invasion of native grasslands and other ecosystems. Biofuels projects should therefore consider additional weed risk assessment evaluation protocols, climate analysis, evaluating the potential to hybridize with native species, and analysis of the susceptibility of surrounding ecosystems.

Similar concerns exist with the introduction of grasses for pasture, aquatic organisms for aquaculture, and risks from genetically modified organisms in agriculture. The movement of agricultural and aquaculture species also entails risk in that the transported individual animals and plants may carry with them diseases, pathogens, and other invasive species.

A third major group of projects which had indirect invasive species consequences are infrastructure projects – in particular those involving transportation. Roads and canals serve as routes through ecological barriers, along which organisms can readily travel – the Panama Canal, for example, serves as a conduit for the interchange of species from different oceans. Sea and air ports are also major conduits for moving organisms and expanding trade brings with it an increasing risk of the movements of species among ecosystems. Regional and global integration initiatives should also consider the need to establish regional control mechanisms, such as checkpoints at borders and in ports, which raise awareness and restrict the movements of species.

6. CONCLUSION

The 2006 Bank Environment and Safeguards Compliance Policy is part of a process of change within the Bank toward internalizing environmental and social risks. The Policy arose because of concerns about the sustainability of Bank interventions and the Bank is still learning through doing. Establishing a consistent approach to implementing the Policy is a key element in the learning process. Ultimately, however, as with any process to change, the key will be to continue to communicate about, and raise awareness of invasive species issues. These guidelines serve as a working document to support the process of internal evaluation and learning.

Annex I: Useful Online Databases on Invasive Species

Horus Institute (Brazil) www.institutohorus.org.br includes databases on invasive species in LAC

Global Invasive Species database www.issg.org/database

Global Compendium of Weeds www.hear.org/gcw

Non-Indigenous Species database www.nisbase.org/nisbase/index.jsp

Non-Indigenous Aquatic Species database nas.er.usgs.gov

Hawaiian Ecosystems at Risk www.hear.org

Annex II: Useful References on Invasive Species

Convention on Biological Diversity, Article 8h and Decision VI/23 [Available at www.cbd.int]

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Annex III: Risk Assessment Protocols and Results

Botanical name:	*Jatropha curcas*	**Outcome: Reject**		
Common Name:	Pinhão-manso / physic nut			
Analyst:	Rafael Zenni, The Horus Institute	Brazil		
Biogeography/ historical				
Domestication/	1.01	Is the species highly domesticated?	N	0
cultivation	1.02	Has the species become naturalized where grown?	Y	1
	1.03	Does the species have weedy races?	?	
Climate and	2.01	Species suited to climatic conditions in your country (0-low; 1-intermediate; 2-high)	?	2
distribution	2.02	Quality of climate match data (0-low; 1-intermediate; 2-high)	?	2
	2.03	Broad climate suitability (environmental versatility)	N	0
	2.04	Native or naturalized in regions with climates equable to that of your country	?	
	2.05	Does the species have a history of repeated introductions outside its natural range?	Y	
Weed	3.01	Naturalised beyond native range	Y	2
elsewhere	3.02	Garden/amenity/disturbance weed	N	0
	3.03	Weed of agriculture	N	0
	3.04	Environmental weed	Y	4
	3.05	Congeneric weed	Y	2
Biology/Ecology				
Undesirable	4.01	Produces spines, thorns or burrs	N	0
traits	4.02	Allelopathic[6]	Y	1
	4.03	Parasitic	N	0
	4.04	Unpalatable to grazing animals	N	-1
	4.05	Toxic to animals	Y	1
	4.06	Host for recognised pests and pathogens	N	0
	4.07	Causes allergies or is otherwise toxic to humans	Y	1
	4.08	Creates a fire hazard in natural ecosystems	N	0
	4.09	Is a shade tolerant plant at some stage of its life cycle	N	0
	4.10	Grows on a range of soils conditions	N	0
	4.11	Climbing or smothering growth habit	N	0
	4.12	Forms dense thickets	N	0

[6] Capacity of certain plants to release chemicals into the soil to prevent the germination of seeds or hinder the growth of species.

Plant type	5.01	Aquatic	N	0
	5.02	Grass	N	0
	5.03	Nitrogen fixing woody plant	N	0
	5.04	Geophyte	N	0
Reproduction	6.01	Evidence of substantial reproductive failure in native habitat	N	0
	6.02	Produces viable seed.	Y	1
	6.03	Hybridises naturally	?	
	6.04	Self-compatible or apomictic	N	-1
	6.05	Requires specialist pollinators	N	0
	6.06	Reproduction by vegetative fragmentation	Y	1
	6.07	Minimum generative time (years)	3	-1
Dispersal mechanisms	7.01	Propagules likely to be dispersed unintentionally (plants growing in heavily trafficked areas)	Y	1
	7.02	Propagules dispersed intentionally by people	Y	1
	7.03	Propagules likely to disperse as a produce contaminant	?	
	7.04	Propagules adapted to wind dispersal	?	
	7.05	Propagules buoyant	Y	1
	7.06	Propagules bird dispersed	N	-1
	7.07	Propagules dispersed by other animals (externally)	N	-1
	7.08	Propagules survive passage through the gut	N	-1
Persistance attributes	8.01	Prolific seed production (>2000/m2)	?	
	8.02	Evidence that a persistent propagule bank is formed (>1 yr)	?	
	8.03	Well controlled by herbicides	Y	-1
	8.04	Tolerates, or benefits from, mutilation or cultivation	Y	1
	8.05	Effective natural enemies present in your country	N	1

These protocols consist of a group of spreadsheets in Excel format. A questionnaire is answered to obtain results. Each question is worth a number of points, according to its relevance in indicating higher or lower risk. These protocols are time-consuming to fill out and require some biological expertise, so it is recommended that available assessments are used for support (Brazil, Pacific Islands, Hawaii, New Zealand, and Australia). Protocols are available for plants, terrestrial vertebrates, and fishes. One example of the protocol for plants is provided above, for reference.

Results of risk assessment for some species of commercial relevance are provided below, and should be used as arguments to avoid usage. Thresholds are set according to the level of risk

the country is willing to accept. The result is generated by the sum of points, and then recommends that the species is accepted, further assessed when the number of questions answered is insufficient, or rejected when risk is high.

Plants

Latin name	Common name	Level of risk	Result	Source
Agave sisalana	Sisal	Low	Accept	The Horus Institute, Brazil
Arundo donax	Arundo	High	Reject	Hawaii and Pacific Islands www.hear.org/wra
Azadirachta indica	Neem	High	Reject	Hawaii and Pacific Islands www.hear.org/wra
Elaeis guineensis	African oil palm	High	Reject	The Horus Institute, Brazil
Elaeis guineensis	African oil palm	High	Reject	Hawaii and Pacific Islands www.hear.org/wra
Jatropha curcas	Physic nut	High	Reject	The Horus Institute, Brazil
Jatropha curcas	Physic nut	High	Reject	Hawaii and Pacific Islands www.hear.org/wra
Prosopis juliflora	Mesquite	High	Reject	Hawaii and Pacific Islands www.hear.org/wra
Prosopis juliflora	Mesquite	High	Reject	The Horus Institute, Brazil
Ricinus communis	Castor bean	High	Reject	The Horus Institute, Brazil
Ricinus communis	Castor bean	High	Reject	Hawaii and Pacific Islands www.hear.org/wra
*Urochloa brizantha**	Braquiaria	High	Reject	The Horus Institute, Brazil

* All species in the genus *Urochloa* that have been assessed by the Horus Institute for Brazil result high risk. These are very aggressive and invasive African grasses used in grazing activities.

Terrestrial Vertebrates

Latin name	Common name	Level of risk	Result	Source
Lithobates catesbeianus	Bull frog	Very high	Reject	The Horus Institute, Brazil
Sus scrofa	Wild boar	Very high	Reject	The Horus Institute, Brazil
Capra hircus	Goat	Very high	Reject	The Horus Institute, Brazil

Fish

Latin name	Common name	Level of risk	Result	Source
Cyprinus carpio	Common carp	Very high	Reject	The Horus Institute, Brazil
Oncorhynchus mykiss	Trout	Very high	Reject	The Horus Institute, Brazil
Ictalurus punctatus	Channel catfish	Very high	Reject	The Horus Institute, Brazil
Tilapia rendalli	Tilapia	Very high	Reject	The Horus Institute, Brazil
Oreochromis niloticus	Nile tilapia	Very high	Reject	The Horus Institute, Brazil
Clarias gariepinus	African catfish	Very high	Reject	The Horus Institute, Brazil

Source: The Horus Institute, Brazil, www.institutohorus.org.br, email contato@institutohorus.org.br