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Assessment of Invasive Alien Species in Latvia

**A CBA framework for ranking avoided damages for IAS
control management**

Latvia Nature Conservation Agency

Green Assist Advisory Assignment - Final Report

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Contents

Annex 1: A Tool for CBA of Invasive Alien Species	3
A1.1 Developing a pragmatic tool for IAS CBA.....	3
A1.2 Benefit / Impact Categories for Ecosystem Services and Human Wellbeing.....	4
A1.3 Framework for Assessing Avoided Impacts of IAS on Ecosystem Services and Human Well-being	6

Annex 1: A Tool for CBA of Invasive Alien Species

A1.1 Developing a pragmatic tool for IAS CBA

Quantifying the impacts of Invasive Alien Species (IAS) in strict monetary terms is often infeasible due to the complexity, context-dependency, and lack of market values for many affected ecosystem services—particularly non-market services such as biodiversity, cultural heritage, and regulating functions like water purification or pollination. Additionally, the spatial and temporal variability of IAS impacts, as well as the difficulty in attributing changes to specific species or interventions, pose significant challenges to conduct comprehensive economic valuations, which would provide the required inputs to Cost-Benefit Analysis (CBA).

To address the challenge of economic valuation of ecosystem services in the context of managing the impact of Invasive Alien Species, it is proposed to apply a mixed approach based on available literature research and expert opinions. We develop a **semi-quantitative ordinal ranking system** that provides a pragmatic alternative that captures the relative magnitude of avoided damage across diverse benefit categories. This approach allows for consistent, transparent, and scalable assessments of IAS control measures and management outcomes, even when data are incomplete or non-monetizable, thereby supporting informed decision-making in both ecological and socio-economic domains.

For the purpose of the current study, a rating framework has been developed, based on recent research from Blaaliid et al. (2021) and Magnussen et al. (2020), which is further complemented by the consultant team.

The IAS CBA Tool provides a structured and semi-quantitative framework for evaluating the **avoided damages resulting from the management of Invasive Alien Species (IAS)**. It enables practitioners, researchers, and decision-makers to assess the **benefits of IAS interventions** across a broad range of **ecosystem services** and **socioeconomic sectors**, including ecological, economic, cultural, and human well-being dimensions.

The tool is designed to complement the current field research and testing of IAS eradication measures. Moreover, its purpose is to:

- **Support evidence-based decision-making** by enabling transparent comparisons of IAS management benefits across sectors.
- **Facilitate cross-disciplinary communication** between ecologists, economists, policymakers, and land managers.
- **Enable prioritization of resources** by identifying areas where IAS management yields the greatest return in terms of avoided damage.
- Serve as an input for **cost-benefit analysis, multi-criteria assessments, restoration planning, and performance evaluations** of conservation programs.

Importantly, the framework accommodates both **retrospective assessment** (based on observed outcomes) and **prospective scenario planning** (based on projected impacts), allowing for flexible application across **invasive species risk assessment, management planning, and policy evaluation**.

By “rating” the impact of IAS on ecosystem services and other “human” impact categories (human health, human infrastructure), and by communicating the benefits of IAS management, this tool enhances strategic planning

and supports the justification of investments in **prevention, early detection, rapid response, and long-term control measures**.

A1.2 Benefit / Impact Categories for Ecosystem Services and Human Wellbeing

The framework is organized by major **benefit / impact categories**, aligned with the Common International Classification of Ecosystem Services (CICES), including:

Benefit / Impact Category		Description
Ecosystem Services	Supporting: ecological impact (non-use value)	This category refers to the foundational ecological processes and biodiversity elements that do not directly yield goods or services but are essential for functioning and sustaining ecosystems. It captures nutrient cycling, soil formation, habitat provision, primary production, impacts on species diversity, ecological interactions, evolutionary potential, and natural system resilience (Millennium Ecosystem Assessment, 2005; Pejchar and Mooney, 2009). These values are typically non-use in nature—people may value the existence of intact ecosystems or rare species even if they never directly interact with them. Invasive species can disrupt food webs, outcompete native species, predation, hybridization, or degrade habitat structure—leading to cascading effects that undermine long-term ecosystem integrity (Vilà et al., 2011).
	Supporting: ecological impact on endangered ecosystems (non-market / non-use value)	This subcategory emphasizes the status and stability of ecosystems classified as vulnerable, endangered, or critically endangered (e.g., wetlands, island habitats, native grasslands). The focus is on conservation value and ecosystem uniqueness, often in the absence of direct market transactions (TEEB, 2010). IAS pose acute risks in these systems, where even minor disruptions can tip fragile ecosystems into irreversible decline (Nentwig et al., 2018). Protecting these areas from IAS invasions contributes to biodiversity conservation and global ecological heritage.
	Regulating: water regulation, pollination, erosion (non-market / non-use value)	Regulating services maintain environmental conditions conducive to life and productivity. In this context, the focus is on hydrological regulation and water catchment (e.g., runoff moderation, groundwater recharge), pollination by native fauna, and flood protection and erosion control through stable vegetation cover. IAS can severely impair these functions by displacing native pollinators, altering water cycles, increasing sedimentation, or destabilizing soils (Millennium Ecosystem Assessment, 2005; Vilà et al., 2011). Though not typically bought or sold, ecosystem regulating services are critical to both ecosystems and economies, and their preservation represents a major avoided cost. By mitigating the impacts from IAS, effective IAS control helps sustain ecosystem functionality and reduces risk to human and ecological systems.
	Provisioning: food production (market / use value)	This category encompasses the direct production of consumable goods derived from ecosystems, including crops, livestock, fisheries, and forage resources. It represents tangible, market-valued outputs critical for food security, rural livelihoods, and economic activity. Examples include food, crops, livestock, fisheries. IAS may reduce yield, outcompete economically important plant species, contaminate water supply or edible products, poison livestock, or render agricultural lands unsuitable (Pejchar and Mooney, 2009; Kumschick et al., 2015). Avoiding such impacts through effective IAS management supports national food systems and market stability.
	Provisioning: non-food production (market / use value)	This includes the generation of raw materials and bioresources not used for food, such as timber, fiber, medicinal plants, biofuels, and ornamental goods. These services have direct market value and support industrial supply chains. IAS may interfere by reducing growth rates, changing forest composition, degrading rangelands, or increasing management costs (Roy et al., 2022). Preventing these disruptions is essential for preserving the economic viability of ecosystem-based industries.
	Cultural: recreation, aesthetic beauty, natural heritage (non-market / use value)	Cultural services encompass the physical, emotional, and symbolic interactions between people and nature. This includes recreation (hiking, boating), landscape appreciation, spiritual values, and connections to cultural identity and natural heritage. IAS can visually degrade landscapes, displace culturally important species, restrict access, or diminish the sense of place (TEEB, 2010; Pejchar and Mooney, 2009). In culturally significant or protected landscapes, even small changes can have outsized social and psychological impacts. IAS management helps preserve this intangible but deeply valued connection to nature. Management that avoids these disruptions helps preserve community well-being, tourism revenue, and the societal value of natural environments.

Benefit / Impact Category		Description
Other	Human Health (market / non-market)	IAS can directly or indirectly impact human health through toxic effects, allergens, physical harm, or by acting as vectors for zoonotic diseases (Roy et al., 2022; Pejchar and Mooney, 2009). Examples include invasive plants that cause dermatitis or respiratory issues, or invasive mosquito species that spread diseases. In addition, psychological distress can result from landscape degradation or biodiversity loss. These impacts may generate both direct healthcare costs and broader societal burdens. Some IAS pose serious health risks, including toxicity, increased disease exposure, or reduced access to clean water and air. Management actions that prevent or remove these risks can have significant public health benefits, particularly in vulnerable communities. IAS management can thus yield critical health co-benefits, reducing both market and non-market risks to human populations.
	Infrastructure (market / use value)	This category addresses physical damage or disruption to human-built structures and systems, including roads, buildings, water management and protection infrastructure, irrigation networks, power lines, and transport routes. IAS can cause damage through overgrowth (e.g., blocking signage or rail lines), root intrusion, burrowing, biomass accumulation, or increased fire risk. These effects often translate into real economic losses through repair, maintenance, and productivity disruptions (Nentwig et al., 2018; Kumschick et al., 2015). Avoiding such impacts can significantly reduce long-term infrastructure costs and support uninterrupted service delivery.

Each category is assessed on a **5-point ordinal scale (0 to 4)**, reflecting the **severity of potential or actual damage** that would have occurred as a result of the invasive species, **in the absence of IAS management**, thereby emphasizing the **magnitude of benefits derived from prevention, control, or eradication efforts**. Rating descriptions are tailored to reflect real-world outcomes and impacts observed or expected in specific IAS contexts.

Rating Scale Explanation:

- **0 – None:** No measurable or anticipated **damage** in the absence of IAS management.
- **1 – Low:** Minor or localized impacts with limited ecological or economic relevance.
- **2 – Moderate:** Clearly detectable damage with moderate spatial or systemic significance.
- **3 – High:** Severe damage affecting core ecosystem functions or critical services.
- **4 – Very High:** Catastrophic or irreversible damage to ecosystems, economies, or public health.

Each rating level is further contextualized through **qualitative descriptors** (*see table framework in the next page overleaf*) that capture the specific types of disruption or degradation relevant to the category in question. For example, provisioning services consider reductions in crop yield or livestock mortality, while cultural services account for loss of recreational access or heritage value.

A1.3 Framework for Assessing Avoided Impacts of IAS on Ecosystem Services and Human Well-being

Framework for Assessing Avoided Impacts of IAS on Ecosystem Services and Human Well-Being						
Benefit / Impact Category	Rating - 0	Rating - 1	Rating - 2	Rating - 3	Rating - 4	Literature / Source
Ecosystem Services	Supporting: ecological impact (non-use value) No known ecological impact. Ecosystem processes and biodiversity unaffected.	Low ecological impact. Minor disruption to native species or functions.	Potential high ecological impact. IAS presence may disrupt ecosystem functioning or species interactions.	High ecological impact. IAS significantly alters native species composition or ecosystem functioning.	Severe ecological impact. Major, possibly irreversible damage to ecosystem integrity or biodiversity.	
	Supporting: ecological impact on endangered ecosystems (non-market / non-use value) Ecosystem intact. No threat to conservation status.	Near threatened. Early warning signs of degradation.	Vulnerable. Ecosystem shows significant decline in resilience or species composition.	Endangered. Severe degradation or loss of key components; conservation urgent.	Critical. Collapse imminent or ongoing; irreversible loss likely without intervention.	
	Regulating: water regulation, pollination, erosion (non-market / non-use value) No impact on regulatory functions. Hydrology, pollination, and erosion control remain intact.	Slight disruptions. Limited or localized interference with natural regulation (e.g., minor erosion).	Noticeable effects. Reduced effectiveness of natural systems (e.g., pollination decline, altered water flow).	Major disruptions. Strong degradation of regulatory services impacting broader ecosystem or economy.	Critical loss. Regulatory services collapse, leading to systemic risk (e.g., flood risk, crop failure).	
	Provisioning: food production (market / use value) No effects on agricultural production.	Small effects. Minor reduction in crop or livestock productivity.	Moderate effects. Large reduction in area/productivity or grazing capacity.	High effects. Major losses due to toxicity or large-scale reduction in usable land.	Very high effects. Near-total loss of production capacity or high livestock mortality.	
	Provisioning: non-food production (market / use value) No known impact on resources such as timber, fiber, or biofuel.	Minor effects. Slight reduction in non-food yield or quality.	Moderate effects. Notable reduction in yield, harvest delays, or increased costs.	High effects. Severe impact on production, access, or quality of goods.	Very high effects. Collapse of resource availability or market viability due to IAS.	

Framework for Assessing Avoided Impacts of IAS on Ecosystem Services and Human Well-Being

Benefit / Impact Category		Rating - 0	Rating - 1	Rating - 2	Rating - 3	Rating - 4	Literature / Source
Other	Cultural: recreation, aesthetic beauty, natural heritage (non-market / use value)	No effect on visual or recreational values.	Minor aesthetic change. IAS are small, low visibility, no activity restriction.	Aesthetic disturbance noticeable but recreational use remains largely unaffected.	Disturbance restricts access or use in certain areas; visible and spreading presence.	Severe degradation. Major aesthetic loss, widespread restriction of recreational activities or cultural heritage.	
	Human Health (market / non-market)	No effects. IAS pose no health concern.	Mild discomfort or indirect health effects (e.g., allergens, minor skin irritation).	Harmful. IAS are poisonous/toxic, requiring precautionary health measures.	Severe health risks. Life-threatening to vulnerable populations or requiring medical treatment.	Deadly to humans. Exposure can result in fatalities or major public health emergencies.	
	Infrastructure (market / use value)	No damage to infrastructure.	Indirect effects. Slight visibility issues or minor nuisance near roads/buildings.	Moderate damage. IAS cause localized maintenance issues or interfere with infrastructure function.	Major damage. IAS impact road safety, utility functioning, or building integrity.	Severe structural damage. Widespread, costly harm to buildings, roads, or critical infrastructure.	

Source: Adapted from Magnussen et al. (2019) and further complemented by the consultant.