



# Pacific Invasive Species Battler Series



## USE ECONOMIC ANALYSIS TO BATTLE INVASIVE SPECIES



**SPREP**  
Secretariat of the Pacific Regional  
Environment Programme



### SPREP Library Cataloguing-in-Publication Data

Use economic analysis to battle invasive species.  
Apia, Samoa : SPREP, 2016.

16 p. 29 cm.

ISBN: 978-982-04-0615-5 (print)  
978-982-04-0616-2 (e-copy)

1. Biological invasions. 2. Introduced organisms  
3. Introduced Species. I. Pacific Regional Environment  
Programme (SPREP). II. Title.

363.78



Secretariat of the Pacific Regional Environment Programme (SPREP)

PO Box 240  
Apia, Samoa  
[sprep@sprep.org](mailto:sprep@sprep.org)

[www.sprep.org](http://www.sprep.org)

*Our vision: A resilient Pacific environment sustaining our livelihoods and natural heritage in harmony with our cultures*

Copyright © Secretariat of the Pacific Regional Environment Programme (SPREP), 2016. Reproduction for educational or other non-commercial purposes is authorised without prior written permission from the copyright holder provided that the source is fully acknowledged. Reproduction of this publication for resale or other commercial purposes is prohibited without prior written consent of the copyright owner.

Cover photo: Carlo Iacovino, SPREP

Icons: Integration and Application Network, University of Maryland Center for Environmental Science ([ian.umces.edu/imagegallery/](http://ian.umces.edu/imagegallery/)).

# TABLE OF CONTENTS

Dear Invasive Species Battler	2
About This Guide	2
Why use economic analysis for invasive species?	3
How much do invasive species cost?	4
Case study – Hawai'i	5
Case study – Guam	6
How do I estimate costs of invasive species?	8
What do I need to create an economic analysis?	9
How do I raise the desire to fund invasive species work?	10
How can I use economic analysis to help fund invasive species?	11
How do I use economic analysis when I mainstream invasive species issues?	12
How can I reduce the costs of invasive species?	12
Additional Resources	13



## Dear Invasive Species Battler,

We are a diverse bunch of people in the Pacific region, which spans a third of the earth's surface and encompasses about half of the global sea surface. We have ~2,000 different languages and ~30,000 islands. Pacific ecosystems are one of the world's biodiversity hotspots, with a large number of species found only in the Pacific and nowhere else. In fact, there are 2,189 single-country endemic species recorded to date. Of these species, 5.8 per cent are already extinct or exist only in captivity. A further 45 per cent are at risk of extinction. We face some of the highest extinction rates in the world.

The largest cause of extinction of single-country endemic species in the Pacific is the impact of invasive species. Invasives also severely impact our economies, ability to trade, sustainable development, health, ecosystem services, and the resilience of our ecosystems to respond to natural disasters. Fortunately, we can do something about it.

Even in our diverse region, we share many things in common. We are island people, we are self-reliant, and we rely heavily on our environment to support our livelihoods. We also share many common invasive species issues as we are ultimately connected. Sharing what we learn regionally benefits us and our families economically, culturally, and in our daily lives. The "Invasive Species Battler" series has been developed to share what we have learned about common invasive species issues in the region, with information and case studies that can assist you to make a decision about what to do next or where to go for further information.

The SPREP Invasive Species Programme aims to provide technical, institutional, and financial support to regional invasive species programmes in coordination with other regional bodies. We coordinate the Pacific Invasives Learning Network (PILN), a network of practitioners battling invasive species, and the Pacific Invasives Partnership (PIP), the umbrella regional coordinating body for agencies working on invasive species in more than one Pacific country.

For knowledge resources, outreach tools, and more information on SPREP, the Invasive Species Programme, PILN, and PIP, please visit the SPREP website: [www.sprep.org](http://www.sprep.org)

Thank you for your efforts,  
SPREP Invasive Species Team



### About This Guide

The presence of invasive species generally leads to negative impacts, some perhaps irreversible, and the economic costs from the impacts and their management can be substantial and long-lasting. Efforts to understand the extent of damages caused by invasive species are slowly gaining momentum globally; however, in many countries, efforts are only beginning. This guide will assist Pacific island practitioners to use the costs that result from invasive species incursions to gain support to fund prevention, management, restoration, research, and outreach. SPREP thanks James Stanford, Aaron Buncle, and Jarrod Troutbeck, who advised the development of this guide.

# Why use economic analysis for invasive species?

An economic analysis allows you to show the expenses of invasive species damages, the funds required to respond to, prevent, or reduce those damages, and the benefit (decrease in damage costs) of managing invasive species.

Invasive species can affect all segments of society, and the extent of the impact varies depending on which species and how it has spread. Traditionally, impacts from invasive species have been linked to agriculture, aquaculture, and forestry and more recently to biodiversity, but impacts or potential impacts generally extend to other sectors as well. These impacts on additional sectors or segments of society have in general not been well documented or addressed.

Invasive species, if permitted to establish, can be extremely damaging on islands for numerous reasons, including the fact that most segments of society are closely linked, space is relatively limited, and terrestrial and freshwater environments in general are less diversified than on continents.

The losses in all of these sectors are “costs”, even though the costs most commonly considered are those that translate directly into monetary units. When considering or spreading the message of invasive species impacts, it is worth including indirect expenses and unquantifiable losses in addition to direct economic costs.



### Invasive species can affect:

-  resources, including biodiversity, forestry, fisheries, and soils;
-  ecosystem resilience and ability to respond to climate change, by altering the physical environment as well as physical and genetic community structure;
-  food security, including agriculture, aquaculture, and mariculture;
-  human and animal health;
-  economies and livelihoods;
-  culture and quality of life;
-  infrastructure and facilities; and visitation/tourism.



## How much do invasive species cost?

In 2015, the TNC project '[The impacts of Invasive Species](#)' estimated the global annual costs of impacts and control efforts associated with invasive species to equal five per cent of the world's economy. Note that these values are only part of the true costs of invasive species.

Estimating the economic impacts of an invasive species can be extremely complex, and in general, estimates are based on just some impacts, not all. This limitation leads to an underestimation of true costs. Also, costs go beyond the market: invasive species damage cultural services, ecosystem services, and more, but cost estimates outside of the classic sectors are still rare.

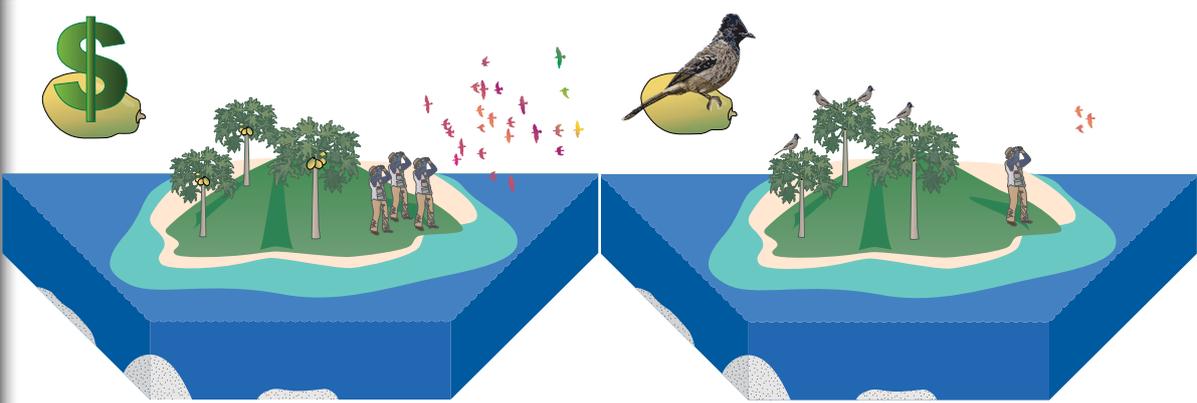
You should consider at least three components:

- **Damage costs:**  
the direct and indirect costs of the problems created by invasive species;
- **Management or response costs:**  
the cost of management actions, such as money spent on biosecurity; and
- **Benefits:**  
the cost or benefit lost or gained by the management choice.

Calculating the costs for your focal area is important. Remember that not all costs are immediately obvious as economic costs. For example, the 2013 State of Conservation in Oceania assessment showed that invasive species are the most important driver of species loss in the region, and these invasive species contribute directly to the loss of ecosystem function and loss of options to respond to climate change.



### Example: Direct and indirect costs and benefits



✓ <b>Direct benefit:</b> Getting rid of invasive birds means more papaya make it to the market for sale	✗ <b>Direct cost:</b> Invasive bulbul birds eat papaya fruits grown for sale (farmers lose money)
✓ <b>Indirect benefit:</b> Bulbul eradication boosts native bird populations, so more tourists come to watch birds	✗ <b>Indirect cost:</b> Bulbuls compete with native birds; fewer native birds means less tourism by birdwatchers

# How does spending money on response save money on damages?

The cost of damages, including the costs of missed opportunities, minus the cost of response equals the **benefit** (or loss) of taking that response action. In your economic analysis, you need to gather enough data to demonstrate whether the management is economically viable, in other words, if the cost of doing something is less than the cost of doing nothing.



## Case Study – Little fire ant in Hawai'i

Take the [little fire ant](#) as an example. In Hawai'i, spending USD 8 million (0.01% of gross state product [GSP]) in the next two to three years plus follow-up prevention, monitoring, and mitigation treatments would likely reduce control costs of the little fire ant by USD 5.496 billion (7% of GSP), economic damages by USD 538 million (0.7% of GSP), human sting incidents by 2.161 billion, and pet sting incidents by 762 million over the next 35 years (Lee et al. 2015).



**\$8 million** or **\$5.5 billion**  
cost in USD to reduce impacts over the next 2–3 years

damages in USD over the next 35 years

*It is cheaper to take action now than to let the little fire ant keep causing damage.*





## Case Study – The expensive brown treesnake in Guam

The brown treesnake was accidentally introduced to Guam in the late 1940s to early 1950s. By mid-1980s, the snake population spread throughout Guam, and the native species that were its prey began disappearing. To get support to deal with the snake, managers needed to show enough information to demonstrate a strong case for intervention.



### Direct economic impacts

- 💰 Property damages:
  - Approximately 180 brown tree snakes caused power outages yearly
  - Snake-related power outages are estimated to cost USD 1 to 4 million per year
- 💰 Increase in shipping costs and delays in shipping
- 💰 Domestic animal impacts: poultry and egg production losses
- 💰 Reduced viability of some niche markets, such as birding (other impacts to overall island visitation may also have occurred)

### Native biota impacts

- ⊗ Breeding seabird populations no longer exist on the main island
- ⊗ Ten of thirteen native forest bird species are now extinct in the wild
- ⊗ Nine of twelve native lizard species are now extinct in the wild
- ⊗ At least two mammal species have been lost
- ⊗ Remaining forest bird species are threatened
- ⊗ Regional side effects: snakes of other species in other places, some of which are threatened parts of a healthy ecosystem, have been attacked, partly because people associate snakes with the brown treesnake problem

### Societal impacts

- ⊗ Snake bite: medical treatment estimated between USD 25,000 and 48,000 per year
- ⊗ Living with snakes: quality of life impacts
- ⊗ Cultural losses, including absence of many of the islands native faunal species

### Ecosystem impacts

- ⊗ Loss of many seed dispersers and pollinators: likely resulting in reduced native forest regeneration
- ⊗ Loss of arthropod predators
- ⊗ Loss of ecosystem services

**There are likely other impacts yet to be fully realised.**

## Management options

Preventing the spread of brown treesnakes to trade partners and other Pacific islands requires:

- Guam: On-site management and pre-departure inspections
- Trade partners: Inspection of cargo and craft arriving from Guam
- Early detection and rapid response: Local and regional support
- Outreach: Awareness and buy-in
- Research: New tools for management and exploring eradication potentials
- Restoration and rehabilitation: site protection, bird population rehabilitation through relocation and/or captive breeding



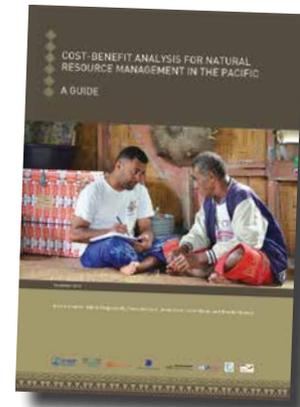
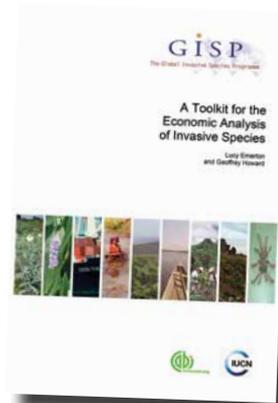
Costs and benefits of these options are calculated and compared with impact costs. Because of their close connection and similarity, Guam and Hawai'i can cooperate for the economic analysis of brown tree snake management.

- If brown tree snakes establish in Hawaii, tourism losses are predicted at USD 0.5 to 1.5 billion.
- The brown tree snake carrying capacity for Hawaii is estimated at almost 39 million snakes, and the damages are conservatively estimated at an average of USD 122 per snake per year from losses in biodiversity, power supply, and medical expenditures.
- USD 2.6 million or more is spent yearly attempting to keep these snakes from arriving and establishing in Hawaii.
- Up to USD 76,000 is spent yearly searching for snakes that have been reported through the early detection system.

## How do I estimate costs of invasive species?

The cost of invasive species issues includes money spent on their impacts and damages, money lost because of the impacts, as well as money spent on responses to invasive issues, with this response cost in turn reducing invasive species impacts and therefore those impact costs (in other words, response expenditures have economic benefits).

There are key guides prepared for the process of measuring economic costs and benefits, notably: "A toolkit for the economic analysis of invasive species", [available from ISSG](#), and '[Cost-benefit analysis for natural resource management in the Pacific](#)' from SPREP, Pacific Community, Pacific Islands Forum Secretariat, Landcare Research, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ).



Not all costs are economic, but addressing the economic impacts of invasive species is a key consideration when exploring management options and raising support.

Impacts or potential impacts, including economic impacts, should be used to inform decision processes regarding prevention, control, and management programme prioritisation, development, and support.

Ideally such information, including details of impacts in other locations, can be used to establish options before species become established.

However, in some cases, existing impacts from established species can also be used to advocate for improved management.



## What do I need to create an economic analysis?

When beginning to estimate costs for your focal area, it is important to be aware of the challenges so you can plan to overcome these challenges. You will need input from several disciplines and data to support your analysis.

True economic costs of biological invasions are not just direct damages to market items like crops or power lines but also other indirect or non-economic damages that cost money and other resources by affecting tourism, human health, biodiversity, cultural services, and more.

Invasive species impacts might not be easy to identify and can be difficult to accurately measure. The impacts of one species might add to or conflict with impacts of other invasive species. The pace of impacts can be fast—maybe even before a species is known to be there—or slow, perhaps so slow that it is hard to tell which species caused the problem. The right kind of data to understand the problem might be difficult to access or simply not available.

In the ideal situation, economic considerations will be taken into account to support invasive species prevention, rather than response after the invasive species has been allowed to come in and settle. However, when advocating for prevention, it is not possible to directly calculate the impact costs of that species for the uninvaded region. It is also difficult to know all species that could arrive, become invasive, and cause harm. Those species that do become invasive have different kinds of impacts from each other and within the same species in different areas.

Using examples from other regions will help you demonstrate what could happen and how much the damage would cost.

Attempts to value direct and indirect economic and non-economic costs of invasive species are vital for gaining support and mainstreaming invasive species issues. Support can be found in [the toolkits and guides](#) cited above, the [additional resources](#) listed at the end of this booklet, and through the [Pacific Invasives Learning Network \(PILN\)](#).

## How do I raise the desire to fund invasive species work?

Funding and support from leadership and decision makers is essential to enable practitioners to create strategies to comprehensively address invasive species. Funding and support will enable appropriate preventative measures and management of existing invasive species as well as provide mechanisms for addressing impacts and furthering community engagement.

Clearly demonstrating the potential and on-going impacts of invasive species, using cost-benefit analysis among other tools, can engage leadership and decision makers. Engaging leadership and decision makers early on and providing appropriate input and updates, including both successes and threats, is essential to ensuring the mainstreaming of invasive species issues. Stepping beyond historically linked sectors, such as quarantine, agriculture, and forestry, and linking invasive species to additional appropriate existing frameworks and structures, such as emergency preparedness, is one of the best mechanisms for mainstreaming invasive species concerns. Addressing invasive species concerns should be a multi-sectorial necessity and may be supported by establishing a working group that includes key offices and departments, such as natural resources, quarantine, border security, agriculture, fisheries, forestry, health, economics, transportation, and local and national leadership.

Showing the costs of invasive species and demonstrating the links between invasive species and other sectors (i.e. mainstreaming) are effective ways of creating a unified, strong response to invasive species issues.



### Count the Costs to Show Your Leaders

#### Impacts/Damages

- What are the real impacts of already established invasive species? (*In other words, what are we already spending, intentionally or not, on these species?*)
- What are the potential impacts of species of concern that are not yet established but could become established if appropriate prevention is not in place?

#### Responses

- What are the costs of managing established invasives species?
- What are the costs of restoration (*where feasible*)?
- What are the costs of preventing the arrival and establishment of potential invasive species?
- What is the investment value of response and prevention actions: what are the benefits (*direct reductions of impacts or indirect benefits*) of action?

## How can I use economic analysis to help fund invasive species management?

Calculating and demonstrating the economic costs of invasive species is a vital component of sourcing funds to assist with invasive species management.

In most parts of the world, invasive species concerns receive inadequate funding. However, funding is potentially available under key multilateral environment agreements, e.g. Green Climate Fund and Adaptation Fund under the United Nations Framework Convention on Climate Change and the Global Environment Facility under the Convention on Biological Diversity.

Also, economic and financial instruments can be developed, including charges and fees, fiscal instruments, bonds and deposits, and trade measures. When feasible, economic instruments should have the dual purpose of changing the incentive structure and generating revenues to cover the costs of a third party (usually government) to undertake the actions necessary for invasive species management.



Many of these instruments are based on the 'polluter pays principle', which holds that the individual or company that is a high risk for introducing, responsible for introducing, and/or responsible for spreading invasive species should bear the costs of measures to prevent, eradicate, contain, and/or manage those species and to mitigate and remediate damages. Using these instruments requires clear and supportive policy and regulations that enable authorities to appropriately charge producers, traders, and consumers with the invasive species-related cost of their actions. An idea of what those related costs are or could be and how they relate to various market elements is essential.

***Identifying and dismantling policies, price distortions, and incentives that block the ability to optimally address invasive species concerns is an important part of developing robust and sound financial instruments to address invasive species.***

## How do I use economic analysis when I mainstream invasive species issues?

It is important to show (not just tell) multiple sectors how they are affected by invasive species, and economic effects are one of the strongest arguments.

To appropriately engage leadership:

- policy planning and development should consider the fact that invasive species are a product of human trade and discourse—in other words, those who want to benefit from inter-island and international movement need to take into account the price of invasive species management;
- policy decisions should weigh anticipated costs and benefits before a new species becomes introduced, actual costs and benefits of any mitigating actions once a species has become established, anticipated costs and benefits of accommodating the change, and the comparative advantages of preventing and/or controlling one set of ecosystem changes over another;
- prevention and control decisions should be integrated to maximise the use of available resources;
- biological and economic factors should be considered jointly to determine policy outcomes and integrate optimal policy regarding existing and potential invasive species. The best policies regarding invasive species will minimise the expected damages and optimise the costs of prevention or control.

## How can I reduce the costs of invasive species?

The details of invasive species management and cost reduction are beyond the scope of this booklet, but there is one key message: preventing problems is cheaper than solving bigger problems later. The optimal invasive species strategy will likely be some combination of prevention (pre-border and border), early detection and rapid response, long-term management, eradication, restoration, research and outreach.

Managers and leadership should select strategies that minimise overall invasive species-related costs over time, including money spent on prevention and control as well as impact costs. Prevention not only reduces invasive species impacts but typically is also a lower economic burden than attempting to address invasive species once established.

Readers are encouraged to use the Pacific Invasive Species Battler series to guide their project development, with the support of the Pacific Invasives Learning Network. The booklet “Catch it early: Invasive Species Early Detection and Rapid Response” discusses important biosecurity and prevention tools.

***Invasive species are expensive, and their impacts affect all members of society. Clearly estimating and demonstrating those costs can help you make sure that the costs are paid by all members of society, not just by an under-resourced, small portion.***



## Additional Resources

The Battler Resource Base contains information materials and resources for battling invasive species. You can contact the Invasive Species Programme through the SPREP website:

[www.sprep.org/piln/resource-base](http://www.sprep.org/piln/resource-base)

Buncle A. et al. 2013. Cost-benefit analysis for natural resource management in the Pacific: A guide. SPREP, SPC, PIFS, Landcare Research, and GIZ.

Daigneault A. and Brown P. 2013. Invasive species management in the Pacific using survey data and benefit-cost analysis. 57th AARES Annual Conference, Sydney, NSW, 5–8 February 2013.

Lee D.J. et al. 2015. Taking the sting out of the little fire ant in Hawaii. *Ecological Economics* 111:100–110.

Emerton L. 2001. Using economic incentives for biodiversity planning. Asia Regional Environmental Economics Programme, The World Conservation Union (Karachi: IUCN).

Emerton L. and Howard G. 2008. [A toolkit for the economic analysis of invasive species](#). Nairobi: Global Invasive Species Programme.

Kaphengst T et al. 2011. [Taking into account opportunity costs when assessing costs of biodiversity and ecosystem action](#). Berlin: Ecologic Institute.

Keller R.P. et al. 2009. *Bioeconomics of invasive species*. Oxford: Oxford University Press.

Marbuah G. et al. 2014. Economics of harmful invasive species: a review. *Diversity* 6:500–523.

McClelland P. et al. 2015. Asian Toad Eradication Feasibility Report for Madagascar. Te Anau, New Zealand.

National Invasive Species Council. 2001. [Meeting the invasive species challenge: Management Plan National Invasive Species Council](#).

Pimental D. et al. 1999. [Environmental and economic costs associated with non-indigenous species in the United States](#). Ithaca, NY: Cornell University.

Rodda G.H. et al. 1998. Managing island biotas: can indigenous species be protected from introduced predators such as the brown treesnake? *Transactions of the North American Wildlife and Natural Resources Conference* 63:95–108.

SPREP. 2009. [Guidelines for invasive species management in the Pacific](#): a Pacific strategy for managing pests, weeds and other invasive species. Apia, Samoa: Secretariat of the Pacific Regional Environment Programme.





# Join the Fight

Protect our islands from invasive species



Håfa Adåi

Aloha

Mogetin

Rahn Anim

Iokwe

Alii

Kaselehlie Len Wo

Ekawomir Omo

Mauri

Mālō te ma'uli

Halo

Tālofa nī

Halo

Tālofa

Halo

Tālofa

Bonjour

Ni sa Bula Fakaalofa lahi atu

Mālō e lelei

Kia Orana

Ia Orana  
Bonjour

Hello

Kia Ora

