Embedding economics in weed risk management to assess contentious plants

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Summary The management of the risks associated with the use of exotic plants for production and ornamental purposes has improved considerably in Australasia in the last decade. Nationally, decision support tools and policy instruments are in place, e.g. the Australian Weeds Strategy and pre-border weed risk assessment. States and Territories across Australia have post-border weed risk management (WRM) systems to identify weed management priorities and how to respond. Despite these advances, contentious plants, those identified as posing a high risk as well as offering potential economic benefits, continue to highlight some weaknesses in current systems and policy. The failure to explicitly incorporate economic analyses into the WRM process is one impediment to the improved management of contentious plants. We outline some suggestions on the economic tools and techniques that could be embedded within the existing WRM process and provide an example of a benefit cost analysis completed for the tropical invasive grass (gamba grass) and how the results were used within a WRM framework to better inform the decision making process.

Keywords Weed risk management, invasive plants, invasive species policy, economic analysis, contentious species.

INTRODUCTION

Invasive alien plants (weeds) have been repeatedly recognised as having negative impacts (environmental, economic, social) nationally (Commonwealth of Australia 2007) and internationally (Gurevitch and Padilla 2004). In response to this threat, biosecurity and natural resource management agencies within Australia and overseas have developed and implemented weed risk management (WRM) systems. Such systems have been applied pre-border (Pheloung *et al.* 1999) to screen entry of exotic plants across national borders and post-border (Standards Australia *et al.* 2006) to screen entry across jurisdictional boundaries and/or to prioritise and guide management responses for weeds that are already present. Weed risk management systems play an increasingly important role in informing and guiding the development of invasive plant species policy and guiding management responses (Pheloung *et al.* 1999, Groves *et al.* 2001, Keller *et al.* 2007, Buddenhagen *et al.* 2009, Setterfield *et al.* 2010).

WEED RISK MANAGEMENT

The role of WRM systems A WRM system is designed to facilitate evidence-based and defensible decision making about: (i) which species should be allowed entry, (ii) which species need management priority and (iii) what, if any, restrictions need to be placed on their use for production purposes. Implicit in the guidelines for use of these systems is recognition that some exotic species can confer economic or social benefits with little invasive risk, e.g. corn, wheat, barley. Consistent with this principle, the role of such systems is to evaluate a range of potential risks (environmental, human and animal health and social and cultural values). Generally, where risk is assessed as unacceptably high, a management/policy response is triggered. With pre-border WRM systems the management response may be to prevent entry. With post-border WRM systems a range of management recommendations ranging from prevention of entry (into a State or Territory) through to containment requirements (Grice *et al.* 2010) may be made, typically by assessing both weed risk and feasibility of control (for details see Standards Australia *et al.* 2006).

Weed risk management systems have been favourably reviewed in the international literature (Keller *et al.* 2007, Gordon *et al.* 2008) and for species without economic value there is usually support for management recommendations from a range of stakeholders and a timely policy and management response. In contrast, risk assessment recommendations for contentious plants – commercial species that also pose an invasion risk – typically do not gain such uniform support and

can result in a management/policy response being delayed or in some instances absent.

Why embed economic analyses? It has been suggested that invasive species are fundamentally an economic problem in terms of their causes, effects and remedies (Perrings *et al.* 2002, Emerton and Howard 2008). Given that economic analyses are not a standard part of WRM systems, it is not surprising that contentious plants pose a particular challenge for invasive species policy and WRM systems.

Economics underpins many of the decisions related to the use of exotic species for production purposes. For example, exotic pasture grasses species are selected that are highly competitive and have high biomass. The same characteristics confer a production benefit, e.g. large amounts of well-established, disturbance-tolerant fodder, but can increase the invasiveness of the species. Where a species escapes from production areas and requires management, higher costs are typically associated with more invasive species. As such, the drivers for both selection of production species and elements of weed risk management, e.g. feasibility of control, are explicitly linked to economics. Despite this, it is rare that there is any formal economic analysis of private versus public benefits and costs. This deficiency is particularly problematic with contentious plants.

This gap has arisen not because tools and techniques to allow such explicit economic considerations don't exist, but because WRM systems (pre- and post-border) and the policy and legislative frameworks within which they are embedded do not require explicit economic assessments. For pre-border weed risk assessment this is that high risk species are prevented entry irrespective of possible economic benefits. This can be justified given ample evidence to suggest that eradication rarely occurs for invasive plants and management costs are therefore ongoing and very high (Pimentel *et al.* 2002, Sinden *et al.* 2005). For post-border WRM, where species are not present, again the absence of economic analyses may be justified based on a precautionary approach. However, where a species is already present and in commercial use, as well as posing a threat, clearly, explicit consideration of the economics is required.

We examined what types of economic analysis may assist with the risk management of contentious plants, when such analyses should be applied and different economic approaches that might be applied in relation to undertaking the analyses.

Possible economic analysis techniques Decisions about whether and how to manage a contentious plant typically involve a consideration of the benefits and costs of different options. The best known of the economic analysis options is a benefit cost analysis (BCA) (e.g. Wainger *et al.* 2007). The advantage of an extended BCA, i.e. an analysis that covers the full range of benefits and costs across social, economic and environmental parameters, is that it allows choices to be made between different management options or different combinations of these. Despite their utility as a decision support tool, a common difficulty in applying extended BCA analyses is the ability to find or generate economic data for environmental values or cultural values that cannot be assigned a monetary value, e.g. assigning economic value to loss of ecosystem function caused by weed invasion. In economic terms, these impacts are described as externalities – with weeds these are unanticipated costs arising from the use of invasive plants for productive purposes, e.g. impacts on ecosystem structure and/or function due to spread of an exotic plant from production areas to biodiversity conservation areas. Non-market valuation techniques may be used to derive these data; despite this, there are few examples of BCA being applied to the management of contentious plants in Australia.

An alternative, as outlined in the example below, is to use a partial BCA (e.g. Drucker and Setterfield 2008). A partial BCA does not seek to explicitly consider all costs and benefits; rather it focuses those that can be readily quantified. In some cases this will be sufficient to allow a decision regarding management and policy response to be made. This sidesteps the issue of costing externalities such as environmental impact, but cannot be used where the costs of invasion are primarily on indirect or non-use values, e.g. where the principle impact is on ecosystem services such as biodiversity or cultural values. Where BCA is to be applied in these cases, non-market valuation techniques are required (Emerton and Howard 2008).

Embedding economics in WRM – an example Gamba grass *Andropogon gayanus* Kunth is a high biomass, highly competitive pasture grass introduced into northern Australia in the 1930s. As a pasture grass it conferred production benefits (increased liveweight gain) but was difficult to manage as a pasture and highly invasive (Department of Natural Resources, Environment, The Arts and Sport 2010). Of particular concern was the negative impact of gamba via a grass fire cycle – high biomass grass invasion leading to hotter and more frequent fires, which caused the loss of native tree and understorey cover and replaced them with a highly flammable monoculture (Rossiter *et al.* 2003). Altered fire regimes also posed

significant threats to infrastructure, crops and fire fighters. Gamba grass was assessed as having a very high weed risk in the Northern Territory (NT); similar weed risk results were obtained in Western Australia (WA) and Queensland (QLD). Weed risk assessment results alone were enough to see gamba grass declared as an eradication target in WA where gamba was restricted to small isolated populations. In QLD and the NT the species was more widespread and being used as a pasture species. Declaration in these states did not occur until economic data had been compiled and a formal benefit cost analysis completed for gamba grass (Drucker and Setterfield 2008).

Gamba grass BCA In assessing the costs and benefits of gamba grass in the NT, a partial BCA approach was adopted (for details see Drucker and Setterfield 2008). Direct impacts in the form of management costs on- and off-farm (the latter including long-term monitoring and education/awareness raising programs), roadside management, and changed fire management costs were quantified. A number of secondary impacts (e.g. health costs, increased risk to fire fighters, damage to ecosystem services and loss of cultural values) were identified, but could not be assigned an economic value within the project timeframe. In this instance, consideration of the direct impacts noted above was sufficient to allow a comparison of private production benefits versus the mostly public costs of management and damage costs. Production benefits and management costs were modelled over a twenty year time period.

Drucker and Setterfield (2008) found that, except under the optimal production scenario for which the available evidence suggested was rarely realised, net private benefits estimated at $6.7 million were matched by net public management costs of $6.05 million. They noted that management costs were an under-estimate of the costs of externalities such as biodiversity impacts and cultural losses, which were not quantified. On the basis of this BCA result and the WRM system findings, the legislative response in the NT was to ban further planting, transport and sale of gamba grass or gamba grass seed. Two management areas were identified: the first, where gamba was in very limited use and populations were small and isolated, was targeted for eradication; the second, where gamba was widespread and being actively used on some properties, had control and containment requirements put in place to minimise future spread. The policy response intention was to (a) allow private benefits to be derived subject to management conditions, (b) make users responsible for some of the management costs and (c) restrict the range of gamba grass through the eradication of outlying populations (Department of Natural Resources Environment the Arts and Sport 2010).

Conclusions A central element in the management of contentious species is an understanding of the economic drivers underpinning demand and the economic impacts of unintended consequences or externalities. As such, improved management of contentious species will need to incorporate tools that allow explicit consideration of these elements. Additionally, action is needed to ensure market, policy and institutional instruments encourage assessment and decision making that explicitly considers externalities in addition to production benefits. Limited weed management resources and growing demand for new exotic plants, e.g. biofuels, highlight the need for economic analysis tools to be a key part of the weed management toolkit.

The gamba grass declaration highlights both the challenges for WRM systems and policy and some possible solutions that can be delivered via economic analyses. Gamba grass provides an example of how private and public benefits and costs can be considered. It also highlights how, in the absence of explicit consideration of economics, there had been a market, policy and institutional failure to consider the externalities associated with its use as a pasture grass. The majority of costs associated with managing the risks and impacts were borne by the public rather than being internalised by the pastoral industry, which derives the private production benefits. Perrings (2002) has highlighted that with invasive species, externalities are self-perpetuating even after the source activity (e.g. planting gamba grass) has stopped. As such, the market failure is potentially greater than conventional economics or our studies of gamba grass to date would predict.

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