Environmental Economics Research Hub

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"Yes we can ..." : Using Cost-Benefit Analysis for Biosecurity

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Cost-benefit analysis can help ensure that appropriate and cost-effective biosecurity measures are taken.

The development of trade and tourism between regions and countries is an increasingly important characteristic of modern economies. In this regard, border quarantine and local surveillance programs have generally provided an essential protection against the incursion and spread of exotic pests and diseases, protecting both local industry, human health and the environment.

Border quarantine, as its name suggests, requires specific actions at the border, typically at airports and shipping docks (e.g., inspection of containers, quarantine and customs inspections), to screen and secure against potential threats. But not all pests and diseases pass through border stations and customs check-points. Local surveillance provides for the early detection of pests and diseases in the local environment, for example, on farms, in national parks and in horticultural and tropical areas. Trap programs for fruit flies in northern Queensland - with pathways from the Torres Strait Islands - is a good example, as is local surveillance against the incursion of ants and weeds in protected areas. Proposals from landholders need to be assessed in a way that identifies preferred projects for funding. The reality is, public funds are often allocated with little knowledge of project outcomes.

However, quarantine and surveillance programs impose costs, in terms of both the cost of the programs themselves (e.g., border inspection stations, traps, blood tests, and x-rays) and any trade restrictions that may occur as a result of potential or perceived threats. In some cases, vast expenditures may be required on quarantine and surveillance activities to take the probability of an incursion to near zero. In other cases, where disease or pest pathways are well known and controllable, far less expenditures may be required.

What is the role of cost-benefit analysis (CBA) in biosecurity measures? Policy makers and economists have long recognized that a sound CBA - measuring all of the relevant costs and benefits of a policy measure to determine an implied rate of return or a ratio of benefits to the costs of a particular program - is a powerful tool for allocating public funds to various activities in an efficient way. For the most part, CBA in biosecurity decisions has mostly been used to justify specific actions, often eradication and containment campaigns, after an incursion has occurred. The attempted control of Red Imported Fire Ants in Brisbane is a good example, and one supported by an extensive CBA. However, a CBA can also be performed on a potential incursion so that measures of relative benefits and costs can be known prior to specific actions, if and when required.

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In this context, if done properly, a CBA for biosecurity must follow ten basic principles:

1. The measure of benefits from a biosecurity measure should be given by all known avoided losses, as a result of an eradication or containment campaign, associated with a potential or actual incursion (e.g., losses to plant, animal and human health, damages to the environment, losses from trade bans, spill-over effects and social costs). Partial measures of benefits - ones that often involve only direct impacts and ignore key environmental concerns - are often misleading and wrongly favour the control of a certain and narrow range of invasives and key primary industries.

2. The measure of benefits is conditional on an area and density spread model and specific actions taken (and their likely effects). Avoided damages, in other words, must be tied to the biology of spread, with accumulated damages that depend both on time and the control measures (if any) put in place. A CBA that simply calculates the maximum potential damages that may occur over (potentially) a very long period of time, at full saturation, with no assumed containment of eradication activity, will badly overstate the measure of potential benefits.

3. The measure of cost is the cost of all specific quarantine, surveillance and containment or eradication actions (e.g., sprays, vaccinations, screening, inspections, blood tests, public awareness, and so on). The costs of a biosecurity activity are also time dependent, and vary considerably with the decision over eradication or various forms of containment.

4. The measures of prices and costs in a CBA will generally vary over time. For example, marginal losses tend to rise rapidly over time for environmental assets, especially for those incursions that eventually imply loss of habitat and biodiversity. In some cases, the cost of a containment or eradication action can become infinitely large as time progresses. The first incursion of hawkweed in New Zealand could, if detected early, have been easily eliminated. Now, in some areas, it is impossible to control. Incursions in specific industries (e.g., foot-and-mouth disease in cattle) can also greatly alter the price of beef as supplies of meat vary through time.

5. Where dollar amounts of costs and benefits cannot be measured by market values, non-market valuation methods must be used (e.g., contingent value, hedonic pricing or choice modelling exercises). These survey techniques are now a well-developed and powerful tool available to CBA. Choice modelling, for example, asks survey respondents to make a series of choices over preferred policy outcomes, with costs attached to particular and chosen options. This 'willingness to pay' for a preferred option can be directly calculated, augmented and added into a CBA.

6. Since streams of costs and benefits vary over time, and potentially occur at different points in time, all dollar amounts must be discounted to the present. As long as there is an interest rate, a dollar today is worth more than a dollar next year, since a dollar today can be invested and earn an interest payment. Discounting is simply compound interest turned 'upside down'. It asks the question what is a dollar next year worth today.

7. The discount rate is typically the real rate of return, or 'Treasury Bill' or 'Bank Rate' (i.e., the common or 'non-risk adjusted' rate). For environmental assets it is becoming increasingly common to use lower and/or time-contingent discount rates (i.e., rates that decline through the time horizon, or so-called 'gamma discounting'). However, a totally convincing justification for 'gamma discounting' has yet to be provided. One possible rationale involves uncertainty over future interest rates, which when probabilistically averaged in reasonable ways results in discount rates that decline through time.

8. The time horizon for discounting is normally contingent on the time over which damages occur (often endogenous to the discount rate). Comparing different eradication or containment measures across various incursions with different durations or with varying time horizons requires 'Annual Equivalent Cost Methods'.

9. Measures of net present value and/or the benefit-cost ratio should reflect likely outcomes, based on given or estimated probability distributions of key parameter values (e.g., Monte Carlo draws based on a probability distribution for spread rates gives a range of benefit-cost ratios with assigned likelihoods). In many cases the potential range of net benefits can vary widely, and policy makers need to know what the likely spread is.

10. Sensitivity analysis on parameter values (to determine their relative importance) should be reported and, where possible, estimates of net present values or cost-benefit ratios with different 'states of nature' should be constructed.

Something is still missing, however, especially with regard to surveillance activities. If CBA in biosecurity is used to measure just the potential (or actual) damages and costs of an incursion - any arbitrary incursion of a pest of disease by any given amount - then it is doing far less that it can. CBA can also take a more active stance. It can help answer the question how much should be spent to detect a potential incursion 'early'. This is the point of optimal surveillance activity.

Put simply, optimal surveillance activity uses CBA to determine the appropriate trade-off between expenditures on 'early detection' and the resulting net damages of 'waiting' to find the pest or disease later in its spread cycle. Traps to detect fruit flies in the local environment are a good example. Without early detection activities, flies may spread through an environment and cause considerable damage before being detected. Once detected, depending on the extent of spread, they may also be harder to control must less eliminate. However, placing more traps and active surveillance to 'catch' flies earlier in their growth and spread process is expensive. The optimal decision is to exploit this trade-off, to find a point of optimal early detection the balances the extra gains from early detection with more traps and surveillance expenditures, thus reducing future damages and costs in an otherwise standard CBA, against the extra cost of that added surveillance activity.

Early detection is often the key to good biosecurity outcomes. Unfortunately, in all of the recent cases that the Australian Centre for Biosecurity and Environmental Economics (AC BEE) has examined, relevant stakeholders have spent far less on early detection that what is optimal.

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