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Benefit-Cost Analysis of Melaleuca Management in South Florida[1]

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Introduction

Benefit-cost analysis (BCA) is a technique that has been used extensively to help determine the economic viability of legislation and investment projects. Since the 1930s, BCA has been used by many U.S. agencies to determine if the benefits of their policies outweigh the costs to society (Prest and Turvey 1965). Many past U.S. Presidential administrations have recognized the value of this type of analysis because it requires one to clearly delineate the costs and benefits of a proposed policy/course of action (Whittington and Grubb 1984). There are many definitions of what constitutes a BCA; however, there are generally some key similarities between the definitions of the process. One description suggests that BCA is a "generic term embracing a wide range of evaluative procedures which lead to a statement assessing costs and benefits relative to project alternatives" (Sassone and Schaffer 1978). Another more specific definition states that it is "a process of identifying, measuring, and comparing the social benefits and costs of an investment project or program" (Campbell and Brown 2003). BCA has also been described as a procedure for "measuring the gains and losses to individuals, using money as the measuring rod of those gains and losses, and aggregating the money valuations of the gains and losses of the individuals and expressing them as net social gains or losses" (Pearce 1983).

While the biological research on Melaleuca is quite extensive, there is a noticeable paucity of socio-economic research on this invasive species. A few researchers have sought to analyze the economic impacts of Melaleuca in Florida. Balciunas and Center (1991) discussed the prospects and dilemmas that could arise if biological control is used in the fight against Melaleuca. They also conducted a benefit-cost analysis under the worst-case scenario in which Melaleuca is allowed to spread unchecked. Diamond, Davis, and Schmitz (1991) considered the economic impact associated with the addition of Melaleuca to the Florida Prohibited Aquatic Plant List. Their analysis included an extensive benefit-cost analysis of the effect of Melaleuca on eco-tourism, sport fishing and hunting, agriculture, and ecosystems generally. Both of these studies, however, were done during the early stages of the

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Melaleuca eradication/treatment initiative, and many changes have taken place since then.

Methods

In this study of benefits and costs of Melaleuca control, primary data were gathered through mailed surveys of professional land managers and resident households in 10 counties of south Florida during 2003 (see companion reports FE671 and FE672). This analysis was focused on valuing benefits to ecological function, agricultural productivity, agricultural land market value, and recreational benefits from Melaleuca treatments on public and privately held lands. Values reported in the survey were expanded to represent the population of agricultural managers in south Florida. It was assumed that benefits can only accrue in areas where Melaleuca was actually killed and that those benefits accrue immediately after treatment. In addition, it was assumed that treatments were 90 percent effective (Laroche and Taylor, pers. comm.).

A mathematical model was developed that relates the benefits of Melaleuca control to the area treated on specific land uses. Monetary values associated with loss in ecological function due to Melaleuca infestation were based on average global values for ecosystem services as shown in Table 1 (Costanza et al., 1997). Monetary values associated with loss in recreational value on park/preserve lands were based on estimates of the direct economic impacts of visitors at state and national parks in the study area, based on number of visitor days, by local and non-local visitors, and average spending per visitor, per day (Baxley, pers. comm.; MGM2, 2003).

Four equations were specified to capture the benefits of Melaleuca treatment/removal. Figure 1 shows the steps involved in the estimation of benefits. Park/preserve lands were evaluated for the benefits to ecological function and recreational benefits, while agricultural lands were evaluated for benefits to ecological function, agricultural productivity, and agricultural land market value. The average value of agricultural goods produced in the survey area was used as a proxy for agricultural productivity ($1,034 per acre), while the average market value of agricultural land ($7,017 per acre) was taken from the 2002 Agricultural Census (USDA-NASS 2002). The analysis accounted for the 23 percent average loss in recreational value of park/preserve land due to Melaeluca infestation as reported by professional park/preserve managers (Table 2).

The issue of fire danger associated with dense Melaleuca stands has been documented over the years. Fire-fighting cost estimates were compiled from Florida Division of Forestry (FDOF) and municipal fire departments (Wasil and Lewis, pers. comm.). Costs per acre range from $2 to $10 for wildland fires and $6 to $30 for municipal fires.

Calculations of costs for Melaleuca control were taken from survey results for expenditures by professional managers and resident households.

Results

The total benefits of Melaleuca control in south Florida in 2003 were estimated at $23.26 million (Mn), including $13.38 Mn for ecosystem function, $6.68 Mn for agricultural land markets, $2.15 Mn for agricultural productivity, $703 thousand for recreation, and $360 thousand for avoidance of fire damages (Table 3). Total benefits due to Melaleuca control on public lands in 2003 were estimated at $14.02 Mn, while benefits on private agricultural lands were estimated to be $9.24 Mn.

Total expenditures for Melaleuca controls during 2003 were estimated at $10.87 Mn for park/preserve managers and $1.18 Mn by agricultural managers. Expenditures for Melaleuca control by resident households in 2003 were estimated at $13.21 Mn. In addition, costs for the TAME Melaleuca program in 2003 were $915 thousand.

The resulting benefit-cost ratio for Melaleuca control for all types of land use in 2003 was 1.76. The BC ratio for park/preserve lands was 1.29. The BC ratio for agricultural lands was higher (7.83) because these properties have the additional benefits of agricultural productivity and market value. Also, agricultural managers reported lower costs since they have not been treating Melaleuca as aggressively, and therefore have a greater marginal value at this stage of their control efforts.

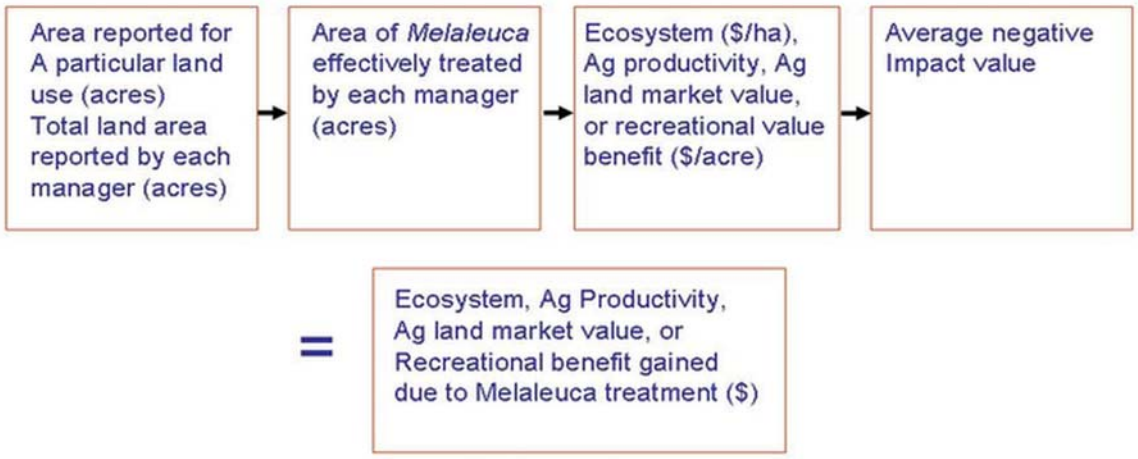

Figure 1. Calculation of benefits of Melaleuca control.

Conclusions and Implications

The results of this analysis support the assertion that Melaleuca control in Florida provides a net benefit to society since the benefit-cost ratio is greater than one (1.76). Therefore it is recommended that public funding for control efforts be maintained at current levels or increased.

The vast majority of treatments to control Melaleuca in south Florida occur on public lands. This is due to the legal mandate that requires public agencies to remove invasive plants from their management areas. Greater control efforts are needed on private lands in order to stop the continued spread of Melaleuca in the state. To achieve greater control on private lands, it may be necessary to enact more stringent laws requiring effective control treatments, assigning specific penalties for those in violation of the control laws, and providing more rigid enforcement of these laws. This would require greater efforts by enforcement agencies. Another way to achieve greater control of Melaleuca would be to implement a requirement for Melaleuca removal in the state building code.

To date, there is no one agency that comprehensively monitors the level of infestation and treatments used to control Melaleuca in Florida. It would be helpful to have a database of the areas infested and treated each year, and the costs for those treatments. It would also be helpful to determine the typical time-course of treatment effects in order to better assess the benefits of control measures. Conducting additional studies to develop specific ecosystem values for Florida rather than relying upon global value estimates would improve the accuracy of cost-benefit analysis of Melaleuca control in the state. As part of the TAME Melaleuca program, follow-up surveys will be conducted to measure adoption of recommended management practices.

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Table 1. Ecosystem values by land use.

Ecosystem Classification	Value	Corresponding Land Use from Survey
	($/ha/year)*	
Terrestrial	946	Right-of-Way, Other
Forest	1,140	Park/Preserve, Forest
Grass/Rangeland	273	Pasture/Rangeland
Wetlands	17,393	Mitigation Area/Constructed Wetlands
Lakes/Rivers	9,997	Lakefront
Cropland	108	Crop, Fruit/Citrus Grove, Nursery

* Adjusted for Inflation using GDP Implicit Price Deflator.
Source: Costanza et al. (1997).

Table 2. Negative impacts of *Melaleuca* reported by surveyed land managers.

Impact	Park Manager Averages	Agricultural Manager Averages	Corresponding Land Use Classification
	(%)	(%)	
Reduced Agricultural Productivity	N/A	24	Pasture, Crop, Fruit, Nursery
Lowered Market Value	N/A	11	Pasture, Crop, Fruit, Nursery
Reduced Ecological Function	23	23	All Land Classifications
Diminished Recreational Use	23	25	Park/Preserve

Table 3. Total benefits of *Melaleuca* control in 2003.

Benefit	Value
	(*million dollars*)
Agricultural Productivity	2.15
Agricultural Land Market Value	6.68
Ecological Function	13.38
Recreational Value	0.70
Avoidance of Fire Damages	0.36
Total	23.26