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# Full-cost accounting of coastal disasters in the United States: Implications for planning and preparedness

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## ARTICLE INFO

### Article history:

Received 17 January 2006

Received in revised form

10 January 2007

Accepted 29 January 2007

Available online 26 March 2007

### Keywords:

Coastal disasters

Full-cost accounting

Disaster policy

## ABSTRACT

As coastal disasters become more frequent and costly, a full assessment of costs becomes more important. This paper aims to identify costs of coastal disasters to human, social, built and natural capital and their associated services at the local site of a disaster and in the regions and nations that respond for relief and recovery. The spatial and temporal magnitude and scale of costs is captured differently in typical cost accounting and a more comprehensive approach, full-cost accounting. The difference between these approaches will be demonstrated using Hurricane Katrina (2005) as a case study, though we do not attempt to perform a full-cost accounting of this actual event. We examine how disaster planning and preparedness becomes more cost effective when the full cost of disasters is calculated. A full-cost accounting of coastal disasters sets the stage for rigorous comparisons of strategies for post-disaster development. The rudimentary analysis of this paper indicates that continued population development as well as the maintenance of current settlements in particular regions along the coasts may not be in the national interest. In this way, full-cost accounting could help reduce vulnerability to future disasters.

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## 1. Introduction

Coastal disasters are affecting more people and communities every year. This is due to the increased frequency in natural disasters along the coast confounded by the migration of people from in-land areas to coastal regions around the world (Martinez and Intralawan, 2007-this issue). Local government and business officials must balance costs for planning and preparing for disasters with more immediate demands on resources. The cost of disasters has been widely reported based on the costs to human capital (lives lost) and built capital (public and private infrastructure) at the local level (Boswell et al., 1999), although some efforts have been made to estimate local public costs for recovery and response during hurricanes (Boswell et al., 1999). In many cases, these costs

have not proven high enough to lead local or federal decision makers to implement sufficient mitigation actions in order to reduce vulnerability and damage. Furthermore, in the United States policies at the federal level encourage resettlement in particularly vulnerable coastal areas rather than migration inland (Bagstad et al., 2007-this issue).

In this paper, we examine the full costs related to coastal disasters including losses to natural, social, human and built capital and the often uncounted or immeasurable costs of services provided by all four capitals in disaster relief and recovery. The specific objectives of this paper are as follows: (1) identify salient costs to built, human, natural and social capital resulting from coastal disasters; (2) identify salient costs of services provided by each capital in disaster relief and recovery; (3) examine the importance of spatial and

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temporal scale in disaster accounting; (4) differentiate costs captured by typical and full-cost accounting; and (5) examine policy implications of performing a full-cost accounting of disasters including pre-disaster planning, demographic policy and allocation of funds during recovery.

Although we have not attempted to conduct an actual full-cost accounting for any one disaster, this paper is clearly framed by the recent hurricane activity on the Gulf Coast. Where possible, we have included values for Hurricane Katrina in our discussion.

## 2. Disaster cost accounting methodologies

Cost accounting typically selects as its object a particular product or process, a business or organization or the activities of an entire country or industry (Bebbington et al., 2001). It is typically applied to human activities for which both benefits and costs can be assessed, and for which externalities are often ignored. Application of this method to disasters is unique in that the ‘offender’ is a natural phenomenon, although human disturbance and policy may accentuate resulting losses. It is important to keep in mind that the ultimate purpose of accounting is to be informative; thus, we argue that decisions made in disaster cost accounting must keep in mind how the analysis will be used in policy decisions.

### 2.1. Typical disaster cost accounting

Although there is no well defined, accepted method for disaster cost accounting in the literature, the methods typically used to predict costs including those developed and implemented by the National Institute of Building Sciences (NIBS), and the Federal Emergency Management Agency (FEMA) focus on property loss, public and private infrastructure loss, agricultural losses, casualties and economic losses due to unemployment. Insured losses are often estimated separately by insurance companies (Boswell et al., 1999). A model developed by Boswell et al. (1999) aims to predict public costs of response and recovery including debris removal, protective measures, as well as repair of public infrastructure (roads, signs, parks, buildings, utilities, etc.) which despite accounting for 75% of total public expenditures resulting from hurricanes are not typically included in the FEMA or NIBS models (Boswell et al., 1999). We refer to all of these accounting methods as ‘Typical Cost Accounting’ to distinguish what is typically done, from what might be encouraged under a full-cost accounting or social cost accounting framework.

### 2.2. Expanding the analysis: full-cost accounting

Just as there is no clear definition of traditional or typical cost accounting in the literature, it is difficult to find a clear definition in the ecological economics literature for ‘full-cost accounting,’ which also has been described as social cost accounting or true cost accounting. Social cost benefit analysis sums the total benefits and the total costs to a society of a particular event, policy, or action (Harberger, 1984). In describing a full-cost accounting approach for disasters we clearly aim to expand what is typically accounted for, however, the guidelines to do so appear to be

vague and problem specific. We draw significant insights from the Cost-Benefit Accounting (CBA) literature which aims to account for all the effects of a project on society, regardless of who is affected and whether the impacts can be captured in monetary units (Sugden and Williams, 1978). Indeed, the framework laid out by CBA provides for a full social cost accounting that incorporates all of the impacts to society of an event or proposed project including those captured by markets and those that are clearly non-market costs and benefits. The framework of CBA incorporates the challenges of uncertainty, impacts over time, impacts of different types and units and effects on various groups of people (Sugden and Williams, 1978). In practice, however, CBA is often criticized as being too limited in scope particularly with respect to intergenerational accounting, distribution impacts, indirect effects and non-market goods and services.

Despite the lack of clear definitions for typical and full-cost accounting, we must differentiate and justify the type of exercise proposed in this paper from that which is typically done following a disaster. Again, drawing from the CBA literature we are presented with three distinctions that must be considered when deciding how to identify and classify impacts in a cost accounting exercise. First, we must distinguish between real and pecuniary effects. The former refers to effects that result in the actual loss or gain of valued resources, whereas the latter refers to transfers resulting from price changes that increase revenues for some people but harm others (Campen, 1986). For example, the loss of buildings is measured as a real loss whereas the change in property values of remaining structures, due to their proximity to the disaster, is measured as a pecuniary value. In the case of disasters, typical cost accounting focuses on real impacts and ignores pecuniary effects. In the context of ecological economics, which recognizes distribution as a core issue of concern, we must include pecuniary effects in a full-cost accounting. Attempts to incorporate distributional aspects of a social cost benefit analysis have been incorporated into elaborate distribution weighting methods (Harberger, 1984). Since we do not attempt to place monetary values on any of the costs or benefits discussed in this paper, we avoid this problem. Nonetheless, there are excellent examples of pecuniary benefits especially in the region surrounding a local disaster zone. However, it is important that the relatively higher impact of disasters on the poor be well recognized (Masozera et al., 2007-this issue).

The second distinction in cost accounting requires attention to direct versus indirect effects (Campen, 1986). Direct effects are much easier to account for and in the case of disasters focus on local damage and costs of rebuilding in the near-term. Indirect effects, many of which occur at the regional, national or even international scale and may extend far into the future, must be incorporated in a full-cost accounting of a disaster. As with any accounting of indirect effects, a boundary must be set in order not to include the exponentially increasing list of indirect impacts which are often poorly documented, difficult to assess and may have negligible costs. Drawing these boundaries can be quite difficult, though we could gain insight from the Life Cycle Assessment (LCA) literature in particular when rebuilding costs are calculated. Life cycle assessment (LCA) is a multi-parameter tool that was developed under ISO 14000. It provides an evaluation of the direct and indirect environmental, economic and technological costs of a product or

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