Water Resources and Economics 14 (2016) 13–30

Contents lists available at ScienceDirect

Water Resources and Economics

journal homepage: www.elsevier.com/locate/wre

Valuation in the Anthropocene: Exploring options for alternative operations of the Glen Canyon Dam

Benjamin A. Jones [a,*], Robert P. Berrens [b], Hank C. Jenkins-Smith [a], Carol L. Silva [a], Deven E. Carlson [a], Joseph T. Ripberger [a], Kuhika Gupta [a], Nina Carlson [a]

[a] Center for Risk and Crisis Management, Center for Energy, Security & Society, University of Oklahoma, 5 Partners Place, 201 Stephenson Parkway, Suite 2300, Norman, OK 73069, USA
[b] Department of Economics, MSC 05 3060, 1 University of New Mexico, Albuquerque, NM 87131, USA

ARTICLE INFO

Article history:
Received 13 July 2015
Received in revised form
12 January 2016
Accepted 29 February 2016

Keywords:
Contingent valuation
Hydroelectricity
Non-use values
River systems

ABSTRACT

Amidst debates about what conservation and preservation mean for large coupled human and natural systems, survey-based non-market valuation approaches for eliciting non-use values also may confront the need for re-consideration. For example, proposed operational changes on highly-engineered river systems to implement environmental considerations (e.g., experimental flow regimes in a river stretch) may connect to social disruption and green-vs-green tradeoffs elsewhere in the larger connected system. Non-use value estimates for the same proposed operational changes may be sensitive to the presentation of multiple dimensions of effects in the coupled system, which may be perceived as either positive or negative by different population segments. Using an internet survey mode and a national sample, and essentially replicating a prominent prior contingent valuation study of non-use values (Welsh et al., 1995) [67] as the starting point, we illustrate such considerations within an exploratory setting involving operational changes altering both downstream environmental flows and hydroelectricity production from the Glen Canyon Dam on the Colorado River. We use a referendum-style voting format, and a set of split-sample information treatments including: (i) social disruption impacts to Native American and rural western communities that depend on hydroelectric production; and (ii) hypothetical increases in air pollution by switching to non-renewable fossil fuels in the electric power grid. Empirical results show respondents may make non-use value trade-offs, as preferences for or against operational changes are highly sensitive (e.g., reversing majority support) to information about additional value dimensions, beyond downstream environmental flow impacts.

1. Introduction

A lively debate, provocatively labeled "conservation in the Anthropocene," has been taking place over what conservation, and related notions of naturalness and preservation, means where large natural systems are increasingly inter-connected or coupled to human systems (e.g., [17,21,27,42,43]). Large river basin systems may be particularly important representations, where inherent trade-offs between, say, riverine protection and renewable hydropower production impact different communities and value frames. A selection of current examples, from both developed and developing countries, include: dam removal in Sweden [41] and the Klamath River Basin in the United States [US] [70]; hydroelectric expansion plans in Austria [44], the Chilean Patagonia [2] and the Andean

* Corresponding author.
E-mail address: bajones@ou.edu (B.A. Jones).

http://dx.doi.org/10.1016/j.wre.2016.02.003
2212-4284/

tributaries of the Amazon River in Amazonas [62]; and altering dam operations and hydropower patterns to provide flushing flows in the Ebro River in Spain [30] and experimental environmental flow changes below dams as in our focus case on the Colorado River in the western US. With changing circumstances (e.g., population growth, drought, climate change) and social concerns, resource management agencies confront questions of potential repurposing of the system or operational changes, and economic analyses are part of these evaluations.

Understanding non-market monetary values connected to proposed operational changes for the Glen Canyon Dam (GCD) on the Colorado River has been the topic of prior investigation, for both recreational use and downstream environmental non-use values (e.g., [10] and [67]). In addition to investigations of market economic impacts [22], these studies were completed in tandem with prior federally-mandated environmental assessments on GCD operations [54]. They were instrumental in bringing considerations of non-market values into environmental and economic analysis of managing large coupled human and natural systems, such as the Colorado River Basin [32,52]. But, as with other components of evaluating this complex system, these studies merit re-visiting (see [54]).

One issue concerns understanding the dimensions of non-use value (not attached to an individual's own direct in situ use, e.g., values from simply knowing that something exists; see [32]) associated with GCD operational changes. Proposed GCD alterations would attempt to improve beach conditions, mitigate erosion of archeological sites, increase vegetation, and improve native fish habitats below the dam and as the river moves through the Grand Canyon. These impacts can be a source of non-use values. One trade-off is altered hydropower (e.g., [44]), especially reductions in power to meet peak demand. Further, as communities have optimized around current operations and renewable hydropower production, changes could affect rural electricity dependence, creating social disruption. Non-use values for social disruptions have been investigated for other resource settings, including timber harvesting (e.g., [50]) and cattle grazing [8]. With coupled human and natural systems, operational changes may disrupt rural cultures and ways of life (e.g., ranching, family farming) that individuals see value in preserving [45,29]. Consistent with paternalistic altruism [25,26,51,56], or even one's own identity with a lifestyle (e.g., [45]), there may also be non-use values attached to current GCD hydropower, as it is a renewable non-fossil fuel and provides low-cost power to numerous Native American tribes and rural areas, whose sales support water and environmental programs in the region [64].

Taking the Welsh et al. [67] survey-based, contingent valuation (CV) study of non-use values for the downstream environmental effects as our reference point, the objective is to explore the sensitivity of members of the US public to additional or expanded dimensions of non-market, non-use values that may be affected by GCD operational changes. We use responses from a large nationally-representative 2014 Internet survey sample ($n=2465$) with multiple randomized informational treatments on additional value dimensions relative to a replicate of the original base case (e.g., [67]). The information treatments include potential GCD operation impacts to: (i) Native American and rural western communities connected through the use of hydroelectricity; and (ii) hypothetical increases in air pollution from the substitution of non-renewable fossil fuels for renewable hydropower. While this investigation purposefully *does not* proceed to a full valuation (i.e., producing a specific dollar value estimates), we apply basic steps in a CV approach. This includes use of a referendum-style voting question for eliciting preference responses from survey participants, both at a no cost ($0) and a single $25 payment.

Empirical results illustrate significant preference sensitivity to expanded value dimensions, as respondents confront possible non-use value trade-offs. Information treatments providing expanded dimensions of value are shown to reverse majority voting support for operational changes and result in values that range from positive to negative across different population segments. These results demonstrate that, just as conservation scientists are grappling with what conservation means in the Anthropocene, so must valuation researchers. For example, inclusion of non-use values surrounding social disruption and green-vs-green tradeoffs for complex working landscapes may change the benefit-cost calculus. We call this re-consideration, and the challenge of an inclusive value approach, “valuation in the Anthropocene,” and illustrate in this pilot study.

2. Background: exploring multiple dimensions of value

For members of the US public, hydropower is broadly understood to be a stable, secure, and renewable form of energy. A 2012 nationwide survey found that, when apprised of the distribution of current energy sources, US residents would prefer to see reliance on hydropower rise from 3% to 20% of the overall energy mix [35]. Why would Americans prefer to see such an increase? In large part it appears to be because of the perceived attributes of hydropower. In nationwide surveys taken in 2008 and 2014, large respondent majorities consistently characterized hydropower as clean, safe, and renewable. Put simply, Americans appear to strongly prefer hydropower because it – like solar and wind power – is viewed as beneficial to society and the environment [37]. An ancillary benefit of hydropower is its flexibility, such as providing either baseload or peaking power, to accommodate other intermittent renewables (e.g., wind and solar) as they are added into the energy mix for an electricity grid [23,55].

Completed in 1966, the GCD has a generating capacity of 1320 MW providing a renewable supply of hydroelectricity, and regulates flows between the upper and lower basins of the Colorado River. Hydropower produced by the federally owned and operated GCD remains far cheaper than either fossil fuels or other available renewables. And, interruption of total and peak hydropower production would likely involve significant replacement by fossil fuel based power production, at much higher cost (e.g., [58]) and with air quality pollution increases including nitrous oxides, sulfur oxides and carbon dioxide [28]. Operation of