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Landowner attitudes and willingness to accept compensation from forest carbon offsets: Application of best–worst choice modeling in Florida USA

José R. Soto [a,*], Damian C. Adams [a], Francisco J. Escobedo [b]

[a] School of Forest Resources and Conservation, University of Florida, P.O. Box 110410, Gainesville, FL 32611, USA
[b] Functional and Ecosystem Ecology Unit (EFE) Biology Program, Faculty of Natural Sciences and Mathematics, Universidad del Rosario, Kr 26 No 63B-48, Bogotá D.C., Colombia

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ABSTRACT

Little is known about institutional preferences and barriers for non-industrial private forest landowner participation in carbon (C) offset programs — factors that influence participation in such programs. To address this, we used Florida (U.S.) as a case study, and identified barriers to forest landowner participation in a hypothetical carbon-offset program and landowner willingness-to-accept compensation for enrollment. Preferences were elicited via survey methods and a recent innovation to best–worst scaling (BWS), called best–worst choice (BWC), which retains the analytical features of scaling while enabling measurements in a traditional discrete-choice framework. Results indicate that NIPF landowners are more influenced by revenue than early withdrawal penalty or contract duration, but will exchange revenue for other contract features. We estimate that programs offering $20 or $30 per-acre-per-year have significantly stronger impacts on enrollment than $5 or $10. The least preferred feature was a 100-year commitment. Overall our BWC approach is novel in that it circumvents BWS' limitation by providing an ability to estimate actual willingness-to-pay/accept. The U.S. has a new policy to cut 32% of 2005 power plant carbon emissions by 2030 and allow forest C offsets. Thus, results can also be used to inform state-level policies that compensate landowners for capturing C emissions.

1. Introduction

Forest-based carbon (C) sequestration has been recognized as a cost-effective policy to mitigate global climate change (Lubowski et al., 2006; Alig et al., 2010; Stainback and Alavalapati, 2002). In 2012, forest activities (e.g., Land Use, Land-Use Change, and Forestry) were responsible for sequestering approximately 15% (979.3 $TgCO_2$) of total United States (U.S.) greenhouse gas emissions (GHG; U.S. Environmental Protection Agency, 2014). Forests account for approximately one-third of all U.S. land area (751 million acres), with much higher proportions in several other states. In Florida, forests cover roughly half (17.3 million acres) of the state (Brown and Nowak, 2012). More than half of this forestland (423 million acres) is owned by individuals, corporations, and other private groups (Smith et al., 2009). Private tenure forest lands in the United States (U.S.) could therefore be enlisted by states in C offset efforts that meet new state-specific carbon emission reduction goals (EPA CPP Final Rule, 2015).

Using existing C markets and/or voluntary C offset programs could both mitigate climate change effects and provide important benefits to forest landowners (Miller et al., 2012). In particular, nonindustrial private forest landowners are a group that could be incentivized to participate in such programs. While private forest landowners in the U.S. are anticipated to play a major role in the implementation of compliance portfolios and carbon accounting programs, little is known about their institutional preferences and willingness to participate in such environmental C offset markets (e.g., contract length, institutional trust, and compensation). Lack of available knowledge on these issues has been cited in the literature as a barrier to participation in similar programs (Butterfield et al., 2005), however a few recent studies have identified several C market features (e.g., payments and penalties) as potentially important to non-industrial private landowners (Dwivedi et al., 2009).

We add to this literature by surveying non-industrial private forest (NIPF) landowners in the state of Florida U.S. on their institutional preferences and potential barriers to participation in C offset programs. In this study we implement a recent innovation in best–worst scaling (BWS), called best–worst choice (BWC), which produces 1. Measurements of traditional discrete-choice experimentation (DCE) and 2. BWS estimations as well. The use of BWC performs both tasks (BWS and DCE are subsets of BWC) by asking respondents to select a best and a worst attribute from an offset program profile (BWS) and to accept or reject an entire scenario (DCE). This approach can better elucidate preferences for and barriers to such programs.

* Corresponding author.
E-mail addresses: josesoto@ufl.edu (J.R. Soto), dcadams@ufl.edu (D.C. Adams), fjescobe@gmail.com (F.J. Escobedo).

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2. Background

The use of forest C markets that pay landowners to capture GHG emissions — for example by planting trees, preventing forest degradation, or improving forest management practices is currently being considered by more than 20 U.S. states, two Canadian provinces, and six Mexican observant regions under three major regional blocks: Western Climate Initiative (WCI), RGGI, and the Midwestern Greenhouse Gas Accord (MGGA). The California Air Resources Board (CARB) is the institution tasked with reducing emissions below 1990 levels by the year 2020 under California's AB32 (California AB 32, 2013). Additionally, the U.S. Environmental Protection Agency's (EPA) announcement of the Clean Power Plant (CPP) rule to cut 32% of 2005 power plant carbon (C) emissions by the year 2030 is another opportunity for forest landowners (GISTEMP, 2015; EPA CPP Final Rule, 2015). These regional efforts to mitigate GHG are at various stages of implementation, but the CPP is likely to support their development and encourage emulation nationwide.

United States forest landowners currently have four major national options to engage forest carbon markets: CARB, Climate Action Reserve (CAR), American Carbon Registry (ACR), and Voluntary Carbon Standard (VCS). These programs have commitment periods that range from 20 to 100 years and compensation ranging from U.S. $2.50 to U.S. $30 per ton of carbon-dioxide equivalent (see Charnley et al., 2010). Risk from intentional or unintentional (e.g., natural disaster) reversals is managed by instituting a series of accountability measures, such as allowing participants to propose insurance products (ACR), carbon buffer pools (ACR, VCS, CAR, CARB), and in some cases, a buy-out option (ACR). Buffer tools are used by programs to "pool" or spread the risk of reversals among all registered producers, similar to insurance (American Carbon Registry, 2010). While the CPP proposal and other policies (e.g., AB32 and RGGI) have created a state of exceptional policy relevance for forest C offsets, to date, few studies have explored some of the institutional aspects of carbon markets in the U.S. (Peters-Stanley and Yin, 2013). In a 2007 pilot survey of private landowners in Massachusetts, Fletcher et al. (2009) used a ratings choice task to examine the likelihood of producing carbon offsets. Participants were surveyed on socioeconomic questions, management activities, reasons for owning land, but also asked to rate alternative carbon credit programs with varying attributes. All options required project verification by a certified professional forester. Their results using a Tobit model indicate that positive ratings increase with expected payment and, surprisingly, commitment length; but decrease with penalty for withdrawal. While this study was limited by its pilot nature, it innovated carbon market research by exploring WTA in the context of different institutional arrangements.

Markowski-Lindsay et al.'s (2011) survey of Massachusetts family forest owners yielded observations of attribute level ratings of carbon sequestration programs including the following: management plan, contract length, percent of land required to enroll, revenue, additionality, penalty for early withdrawal, and institutional trust (implemented by public or private sector). Results from their random effects ordered probit model found significant preferences for programs with higher net revenue, no withdrawal penalty, shorter contract lengths, and no additional requirements, such as "no requirement that forests must be managed to sequester more carbon than if nothing was done." The researchers also calculated participation probabilities of three types of carbon programs with low, medium, and high participation.

Another Massachusetts study of NIPF landowners surveyed forestland owners using the following: revenue, contract length, management plan, and penalty for early withdrawal, to construct alternative hypothetical carbon sequestration programs (Dickinson et al., 2012). Results, using ordered logit regression, indicate that respondents prefer programs with lower time commitments and those that do not require a management plan or penalize for early withdrawal. They estimated that 43% of landowners would participate in a program with the following: no management plan, a five-year commitment, a $30 per-acre annual revenue compensation, and no penalty for early withdrawal.

Elsewhere, a similar survey using the contingent valuation (CV) method with Texas NIPF landowners was used to explore WTA at different levels of contractual duration (Simpson and Li, 2010). Participants were presented with questions regarding a hypothetical carbon program consisting of a contract with three different time commitment levels, each with a different annual per-acre compensation, to sell environmental credits, with an option for timber harvesting, as long as it generated additional credits. Factors affecting participation were analyzed using a logit model; and awareness of carbon credits, size of forest landownership, current cost-share participation, and importance of managing forestland for producing income were assessed. Also in the Lake States (Michigan, Wisconsin, and Minnesota), a survey of family forest owners assessed interest in selling C credits (Miller et al., 2012). The study presented participants with carbon market programs with varying revenue and contract duration. The results from this study indicate that approximately 50% participation would require $18 per-acre per-year compensation, and contract length was negatively related to participation.

In general, non-market valuation techniques (e.g., stated preference methods like conjoint analysis and other attribute based tools) typically require participants to rank, choose, or rate particular scenarios of attributes on a given scale (Foster and Mourato, 2002; Elrod et al., 1992; Fletcher et al., 2009). But, a relatively new innovation in scaling methods (best–worst) consists of creating profiles of different attribute levels, and asking participants to choose a "most important" and a "least important" option (Finn and Louviere, 1992; Lusk and Briggeman, 2009; Lusk and Parker, 2009; Campbell and Erdem, 2015). This tool measures the maximum-difference (maxdiff) between attribute-levels under a common utility scale, while offering an alternative approach that overcomes some of the shortcomings of other available methods (e.g., attribute impact measurements that are confounded with level scale values in discrete choice experimentation [Flynn et al., 2007]; and subjective scale measurements resulting from ratings-based methods [Lusk and Briggeman, 2009]). Several other conceptual advances to best, worst, and best–worst choice probabilistic models are being used in applied economics studies (Marley and Louviere, 2005; Brooks and Lusk, 2011; Rigby et al., 2015). The best–worst choice method (Marley et al., 2008), first implemented by Coast et al. (2006) in the field of epidemiology, and applied in this study, is one of these recent innovations to BWS. The BWC method differs from BWS in that it asks subjects to perform an additional choice-task of accepting or rejecting the entire scenario of attributes and in doing so also estimate a traditional DCE (Flynn et al., 2007).

More specifically, the two tasks of BWC measure utility differently — directly and indirectly. The first task of BWC, the BWS instruction, measures utility directly by observing attribute level tradeoffs (choose one element, from a profile of attribute levels, that is "best" and one "worst"). The second task (the "accept" or "reject" instruction) is a conjoint choice method, or traditional DCE, that requires survey participants to consider an entire profile of attribute levels (Louviere et al., 2000). Conjoint choice methods infer attribute level utility indirectly by analyzing an outcome measure, such as "accepting" or "rejecting" an entire profile, or choosing one profile from several (Louviere and Islam, 2008). This method produces DCE measurements consistent with traditional demand theory (e.g., willingness-to-accept or pay values; Lusk and Parker, 2009; Aanesen et al., 2015; Oleson et al., 2015). Several studies have shown that BWS and conjoint choice methods produce different measurements of utility (e.g., Louviere and Islam, 2008; Whitty et al., 2014). Thus, BWC has the advantage of producing both BWS direct measurements, as well as estimates consistent with traditional demand theory.

Another contribution of this paper is the use of "risk" as an attribute, which has rarely been addressed in the forest economics and policy