Forest Landowners' Willingness to Sell Carbon Credits: A Pilot Study

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ABSTRACT

Sequestered carbon is a new forest product that could help private forest owners earn financial returns while keeping their forests intact. Private forest owners are responsible for 78% of forests in Massachusetts, and the carbon these trees sequester could be traded in emerging cap-and-trade carbon markets in the United States. In forming policy about climate change and forestry, it is important to understand the factors that influence the likelihood of landowners choosing to sell sequestered carbon and participate in the carbon marketplace. In this pilot study, we explored the likelihood of Massachusetts forest owners selling carbon sequestered on their forestland. We found that landowners significantly favor higher payments, no withdrawal penalty, and, unexpectedly, longer time commitments. We also found that at current carbon prices, very few participants (less than 7%) would be willing to sell. Additional studies need to be conducted, with a larger sample of respondents, which may elucidate how socioeconomic variables and ownership attitudes influence forest owners' willingness to enroll in carbon markets.

Keywords: carbon credits, carbon sequestration, private landowners, climate change policy, willingness to sell

Sequestered carbon is a new forest product that could be used to encourage private forest owners to earn money by keeping their forests intact while selling carbon credits. Forests in the United States sequester about 200 million metric tons of carbon per year, enough to offset approximately 10% of fossil fuel emissions annually (Birdsey et al. 2006, Woodbury et al. 2007). Family forest owners own 42% of forestland in the United States (Butler and Leatherberry 2004), and private forest owners own 78% of forests in Massachusetts (Birch 1996). As trees grow on these private lands, they sequester considerable quantities of carbon annually.

In forming policy about climate change and forestry, it is important to understand the factors that influence the likelihood of landowners choosing to sell sequestered carbon in the emerging US cap-and-trade carbon market. In this pilot study we explore the responses of a small group of private forest owners in Massachusetts with respect to their willingness to sell carbon credits in several alternative hypothetical carbon programs. The landowner responses can assist in the development of future surveys to more meaningfully assay landowner attitudes. Future studies could aid in the creation of programs that could successfully engage private landowners in carbon registries.

Background

Forest carbon is stored in live trees, snags, coarse woody debris, understory vegetation, and the soil. Northeastern forests sequester 12–20% of the total CO_2 emissions from the Northeast (Perschel et al. 2007). Currently, about 6.8 billion tons of carbon are stored in Northeast forests, with an average of 75 tons/acre (Perschel et al. 2007). Researchers have developed simple ways of estimating carbon stocks and sequestration on small forest tracts from traditional forest inventories (Hoover et al. 2000, Smith et al. 2006, Pearson et al. 2007).

Because of historic land clearing by European settlers, most of the forests in the Northeast are relatively young and are a net carbon sink (Pregitzer and Euskirchen 2004). Forest management techniques such as thinning, removal of dying trees, and low-impact logging can influence the rate and extent of carbon sequestration (Hoover and Stout 2007, Perschel et al. 2007). Currently, forest management plans do not incorporate carbon sequestration as a goal, but this may change with an increase in the potential for landowners to receive financial returns for this ecosystem service.

Although carbon markets could help to preserve, expand, and promote sustainable management, carbon accounting protocol and criteria are in a state of flux in the United States (Heath and Smith 2003, Birdsey 2006, Sampson et al. 2007). The Kyoto Protocol currently limits the role of forestry as a greenhouse gas sink to afforestation and reforestation (Ruddell et al. 2007). The United States has not ratified the Kyoto Protocol and thus is not constrained by these limitations (Ruddell et al. 2007). Various greenhouse gas registries, cap and trade programs, and other market mechanisms, with different policies and program requirements, have been evolving in the United States. Private landowners can access the major U.S. carbon registries through offset aggregators. Aggregators, or forest offset providers, are carbon credit buyers who aggregate carbon credits from multiple small landowners into lumps of tradable units (Birdsey 2006).

Our goal is to improve our understanding of private landowner's attitudes and potential participation in carbon registries. We believe this is an important component for consideration as policymakers

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Table 1. Results of regression models including program attributes only.[a]

Variable	Tobit parameter estimate without average rating	Tobit parameter estimate with average rating	Logit parameter estimate
Intercept	4.33 (0.826)[b]	0.25 (0.918)[c]	−4.78 (1.33)[b]
Eligibility	−0.19 (0.456)[c]	−0.08 (0.370)[c]	0.10 (0.66)[c]
Time	0.20 (0.098)[d]	0.14 (0.079)[e]	0.26 (0.14)[e]
Expected pay	0.06 (0.022)[b]	0.06 (0.021)[b]	0.06 (0.03)[d]
Early withdrawal	−0.13 (0.049)[b]	−0.13 (0.039)[b]	−0.07 (0.07)[c]
Average rating		0.822 (0.128)[b]	
n	102	102	102
Log likelihood			72.46[e]

[a] Standard errors in parentheses.
[b] Significant at the 0.01 level.
[c] Not significant ($P > 0.10$).
[d] Significant at the 0.05 level.
[e] Significant at the 0.10 level.

struggle to develop successful guidelines for the forest sector in carbon market activity. We are interested in determining the aspects of carbon trading programs that appeal to landowners and the aspects that might deter landowners from potentially participating in the carbon marker. We hypothesize that landowners will have more willingness to enroll in carbon programs given greater expected prices for carbon credits and fewer requirements for enrollment and commitment.

Methods

In 2007, we administered a pilot survey to 17 private forest owners in western Massachusetts as part of a larger study about forest management. Study respondents were recruited by random invitations from a mailing list of landowners (>3-ac parcels) and were paid $50 each for participation. The survey posed questions focused on the respondent's landownership, socioeconomic characteristics, forest management activities, and reasons for owning forestland. Respondents were asked to assume that a forest carbon permit system would soon be developed in the state of Massachusetts. Each participant was then confronted with six alternarive potential carbon credit programs consisting of four atrributes: eligibility requirement (formal management plan or no plan), time commitment (5 or 10 years), expected payment ($5, $15, or $30 per acre per year), and a penalty for early withdrawal (none or $10 per acre). All programs required verification by a professional forester, which is consistent with major carbon registry requirements as of mid-2007 (Sampson et al. 2007). We assumed payment levels to be based on general sequestration rates of roughly 1-3 tons of carbon per acre per year. Each participant was asked to rate six programs. Respondents were instructed to use a 10-point rating scale, where 1 indicated programs they would definitely not undertake, and 10 indicated programs they would definitely enroll in. The final part of the questionnaire consisted of a series of follow-up questions focused on how certain the respondents were about their ratings and about the factors respondents considered in making their rating decisions.

Two types of regression models were used to investigate the relationships among program ratings, program attributes, and socioeconomic characteristics of participants. A Tobit model (very similar to standard ordinary least squares regression analysis except it accounts for the bounded nature [1 to 10] of the program rating-dependent variable) was run with and without the inclusion of an average rating predictor variable. The average rating (for each respondent) is included to account for the fact that individuals tend to anchor on different portions of the rating scale. A logistic regression (logit) model was used to estimate landowners' willingness to sell carbon credits at various prices. Data for the logit model was arranged as follows. Each respondent's rating for each of the six programs was coded 0 if the rating was less than 9 and 1 if the rating was equal to or greater than 9 on the 10 point rating scale. Since the four attributes that define each program have levels that vary among programs, there are six observations of both the dependent and independent (attribute) variables for each respondent, resulting in a total of 102 observations.

Results

The average participant owned 105 acres (range, 4–293 acres), was 51–65 years old (none <30 years old), was a college graduate, lived on or less than 10 miles from their woodland, and had owned their property for more than 10 years. This average is fairly consistent with average family forest owners of the northern United States in 2003 (Butler and Leatherberry 2004).

Results derived from the Tobit and logistic regression models are presented in Table 1. The models in Table 1 were also estimated with socioeconomic variables included. However, in most cases these variables were not statistically significant. Consequently, models including socioeconomic-independent variables are not analyzed in this article.

The Tobit analysis produced the following statistically significant results (Table 1): program rating increased with expected payment ($P = 0.0082$) and decreased with an early withdrawal penalty ($P = 0.0072$). Program rating also increased with the length of the program commitment ($P = 0.0417$), suggesting that landowners are interested in longer, as opposed to shorter, time commitmenrs.

Calculations from the logit model of participant willingness to sell carbon credits were based on a rating of 9 or 10, indicating a sale (all other variables held at mean level except for payment). Only about 5% of participanrs would sell for a payment of $15 per acre per year; about 13% would sell for $30 per acre per year, and about 33% would sell for $50 per acre per year. It is important to note that between April and December 2008, the price of carbon credits ranged between roughly $1 and $6 per ton (Chicago Climate Exchange 2008) and forestland in Massachusetts sequesters up to 1–3 tons per acre per year. Based on the high value of $6 per ton, this translates to $6–$18 per acre per year in carbon credit revenue. At this price range, very few participants (less than 7%) would be willing to sell.

Discussion and Conclusions

It is logical that landowners' willingness to sell carbon credits is influenced positively by price. On the other hand, landowners are often uninfluenced by timber prices in their management decisions, and they do not necessarily manage their timber in a financially optimum manner because of ownership preferences other than net revenue (Butler and Leatherberry 2004). Carbon credit market values are currently low in response to the current economic crisis, but they are likely to rise as the pressure fot carbon emitters to reduce their emissions increases (Chicago Climate Exchange 2008). As the prices paid for carbon credits increase, a threshold may be reached where the financial return becomes worth a landowners' investment in time, money, and perceived invasion of privacy. Butler and Leatherberry (2004) estimate very low rates of private landowner participation in conventional forest management programs (e.g., 3% of owners nationwide have a management plan; 16% have sought management advice). Perhaps a heightened environmental awareness of climate change and a type of forest management that does not involve harvesting timber may inspire landowners who had previously rejected more conventional forms of forestry to participate in carbon management.

It is also logical that landowners' willingness to participate in these programs decreased when an early withdrawal penalty was imposed. The protocols concerning carbon permanence are still in a state of flux in the United States; however, most registries have a penalty for landowners who withdraw their forests from enrollment or harvest below their baseline carbon stock (Sampson et al. 2007).

A particularly interesting result from this pilot study was that respondents rated programs with longer time commitments more favorably. It is unexpected that landowners would be more interested in programs with longer time commitments, and this result brings up questions that need to be explored with additional research. Likewise, our limited sample did not allow us to explore the possible influences of socioeconomic factors on participation. Our preliminary results indicate that age of respondent, highest level of education attained, ownership tenure, size of ownership, and distance between residence and property were insignificant variables unrelated to willingness to participate. Our sample population was not randomly selected, and respondents are not representative of overall private woodland owners. Furthermore, more statistically rigorous study is warranted, as other research indicates different segments of the landowner population have diffetent goals for their land and may behave or respond differently (e.g., Finley and Kittredge 2006).

This was a pilot study of a limited sample of landowners who were self-selected. Additional studies need to be conducted, with a larger sample of respondents, which may elucidate how socioeconomic variables and ownership attitudes influence forest owners' willingness to enroll in carbon markets. However, our results suggest that at current carbon prices, very few landowners would be willing to sell carbon credits. Subsidies may therefore be required if policymakers wish to increase likely participation rates.

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