

## **Factors Influencing Current Interests and Motivations of Local Governments to Supply Carbon Offset Credits from Urban Forestry**

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### **Abstract**

This study conducted a nationwide survey of municipal governments in the United States to assess their motivations, willingness, and technical as well as managerial capacities of cities to store carbon and sell carbon offsets. The analysis reveals that cities are fairly interested in selling carbon offsets and their interest in carbon trading is driven by the degree of urbanization, the awareness and interest of their voting constituents, and the need for additional revenues that can be generated from carbon offset sales. An understanding of urban forest carbon sequestration and familiarity with carbon market institutions such as the Chicago Climate Exchange (CCX) significantly increased the likelihood of a city wanting to sell urban forest carbon offsets. While a majority of cities currently have technical and managerial capacities to begin a carbon trading project, there appears to be a fundamental disconnect to market participation.

**Keywords:** Urban Forestry, Carbon Credits, Supply, Municipalities

## Introduction

Recent studies reported that global air temperature at the earth's surface increased by as much as 0.6° C since late 1800s (Nowak and Crane 2002). In the future, the dynamics of global climate will probably be further affected by the growing world population and associated human activities. Scientists have also argued that climate change has already affected the forests in the United States. For example, recent studies have linked warming temperature and early snowmelt to numerous forest management issues such as forest fires (Bosworth et al., 2008), and bark beetle outbreaks and higher tree mortality (Breshears et al., 2005).

A key mitigation initiative taken so far is to use the offset mechanism to compensate the concentration of Green House Gas (GHG) in the atmosphere. For example, the Kyoto Protocol recognizes a variety of emission reducing projects including forestry. Since trees absorb atmospheric carbon in the form of carbon dioxide in the photosynthesis process, the idea of trees as a sink for atmospheric carbon has widely been recognized (Sedjo et al., 2001; Van Kooten, 2007; Bigsby, 2009). Research suggests that the forests in the United States alone sequestered more than 750 million tons of carbon dioxide in 2003 (US EPA, 2005).

With growing public concern about global warming, markets for carbon offsets are emerging. Companies can purchase certified emission reductions or carbon offsets from other entities, such as those generated by urban forests, which capture atmospheric carbon dioxide and safely store it. The Chicago Climate Exchange (CCX) is an example of an offset trading system in the North America, where interested sellers and buyers of carbon credits participate in a voluntary, but legally binding, scheme to trade carbon offsets (Chicago Climate Exchange, 2009).

Several previous studies have examined carbon sequestration in urban forests. Nowak and Crane (2002) estimated that urban forests in the conterminous United States can absorb 22.8 million tons of atmospheric carbon annually, which was equivalent to \$460 million in revenue at current prices from selling carbon offsets. These figures provide the evidence that urban trees in the United States potentially could serve as an important carbon sink. In addition, there has been an increasing interest among urban managers in participating in climate change mitigation initiatives, including carbon trading. For example, 8 municipalities, 3 counties, and 2 states have already enrolled in the carbon trading program of CCX.

To date, most forest carbon sequestration studies have focused on measuring the amount of carbon stored in urban forests and evaluating ecological aspects of sequestration (Birdsey 1992, Hoover et al. 2000, Smith et al. 2004, Myeong et al. 2006, Pouyat et al. 2006, and Smith et al. 2006, Rowntree and Nowak 1991, McPherson 1998, Jo and McPherson 2001, Brack 2002). Others have also examined the economic and marketing aspects of forest carbon offsets (Birdsey 2006, Call and Hayes 2007, Cathcart 2000, Sedjo and Marland 2003, Esuola and Weeksink, 2006). None of the previous studies, however, have examined the interests and motivations of local cities and municipal governments in supplying carbon offsets based on carbon stored in urban trees. To fill this gap, this study develops an econometric framework for explaining factors that influence the likelihood of government participation in carbon offset trading.

## Methods

A web-based survey was implemented between November 2007 and January 2008 to determine the willingness, motivations, and ability of cities and municipal governments to participate in carbon offset markets. Urban foresters, arborists, and other individuals responsible for the management of urban trees were identified and invited to participate. The survey consisted of questions about their current urban forest information and management practices, their interests and activities in climate change mitigation, and participation in voluntary carbon reduction schemes. They were also asked to report their city's characteristics such as land area and population. Some questions solicited responses in categorical or open-ended format, whereas other questions were about the level of interest, preference or agreement utilized Likert scales of various points (Likert, 1932).

A conceptual model was developed, based on the idea that motivations of local governments to participate in carbon trading depend on their knowledge of carbon sequestration and markets, current climate change mitigation activities, supplemental income needs, and social and political characteristics. The willingness to participate in urban carbon credit trading was represented by a discrete choice variable, which indicated whether the city was currently interested in selling carbon. A five-point Likert scale was converted into a binary variable, recorded as 1 if a city was currently interested or very interested in selling carbon, 0 otherwise. A bivariate Probit model (Greene, 2003) was used to explain this dependent variable as a function of nine explanatory variables. Those included: (1) awareness, which was the respondent's reported rating (5 = very familiar, to 1 = not at all familiar) of their level of knowledge of carbon sequestration prior to reading the survey; (2) revenue, which captured the importance of income from expected sales of carbon offsets (5 = extremely important, to 1 = extremely unimportant); (3) market information dummy, which took a value of 1 if the city is familiar or has used the Chicago Climate Exchange (CCX), 0 otherwise; (4) green house gas reduction goal dummy, which took a value of 1, if the city has a goal of reducing GHG, 0 otherwise; and (5) voluntary participation dummy, which took a value of 1, if a city had already participated in any kind of voluntary actions to help mitigate global warming. Subsequent variables captured the characteristics of a city, and included: (6) population density; (7) cost of living; (8) education level of city residents; and 9) forest area, which captured the amount of forest area within the immediate city's surroundings. City level data representing population density, cost of living and education were obtained from the U.S. Census Bureau, whereas the proxy for forestland was obtained from the National Outdoor Recreation System database (NORSIS) (Cordell and Betz, 1997).

## Results

A total of 150 completed surveys were returned yielding an effective overall response rate of 54%. Respondent cities were uniformly distributed in terms of their population size and geographical location. Cities were fairly aware of a range of climate change mitigation options. Some of them had actively engaged in climate change mitigation activities. About 26% of respondents reported that reducing their carbon emissions is a priority program of their city.

Another 11% reported that it is one of the goals but has not been in priority yet. Similarly, 17% had discussed reducing their carbon emissions even though they did not have a defined goal. Respondents were also asked about their knowledge of carbon sequestration and credits. Approximately one-third (32%) were familiar or very familiar with carbon sequestration before reading the survey. However, nearly half (45%) were either not familiar with, or unsure about, carbon sequestration. Similarly, less than a third of respondent cities (21%) were familiar with carbon market institutions such as CCX, which is currently the largest market platform in the United States for carbon trading. Very few (1%) of had actually used CCX for carbon trading purposes. However, about one-third (34%) reported never hearing of CCX, whereas another 44% were unsure about their knowledge of CCX. Regarding interest in selling carbon offsets, 29 out of 150 cities noted that they were currently interested or very interested in carbon trading.

Data fit quite well into the Probit model designed to explain the current willingness of local governments to sell carbon offsets from urban forests. Most of the explanatory variables were significant and had expected signs. Local governments' knowledge about carbon storage before reading the survey was positively related ( $p=0.02$ ) to their willingness to participate in carbon trading. Similarly, the revenue variable, which captured the local governments' rated importance of income from expected sales of carbon credit was also positively associated ( $p<0.01$ ) with their interest to participate in carbon trading. As expected, the coefficient on the variable capturing market information variable was positive and statistically significant ( $p=0.03$ ).

Variables capturing a city's characteristics also significantly explained local governments' interests in selling carbon. Population density, which measured the level of congestion was positively related ( $p=0.04$ ) with the city's interest in engaging in carbon trading. On the other hand, the variable capturing the cost of living in the city, was negatively associated with the city's willingness to sell carbon ( $p<0.01$ ). Likewise, the education level of residents had a positive effect ( $p<0.01$ ) on the city's willingness to participate in carbon trading. Even though the sign of coefficient for forest area variable was consistent with our hypothesis, it was not statistically significant. This is probably because we used the forest area of the county in which the city was located as a proxy to represent the city's vegetative coverage.

## **Discussion and Conclusion**

Overall, the results indicate that the local governments in the United States are fairly interested in selling carbon. Nevertheless, their willingness to participate in carbon trading was influenced by various factors. Cities located in densely populated areas and with a higher proportion of college-educated residents were more likely to participate in carbon trading. This in turn implies that their willingness to participate in carbon markets was likely driven by the degree of urbanization, and the awareness and interest of their voting constituents. Their willingness to participate in carbon selling also depended on their understanding of urban forest carbon sequestration, familiarity with carbon market institutions (e.g., CCX), and importance of revenue from expected carbon offset sales. The negative effect of cost of living on their willingness indicate that governments located in less affluent neighborhoods appear more interested in carbon trading schemes; this may be explained by the need for revenue.

Future increases in market prices of offset credits possibly resulting from a passage of mandatory regulations may further increase their motivations. However, the fact that only one-third of cities are currently familiar with the carbon sequestration and carbon offset trade, and more than two-thirds of them were unaware or had no market information, indicates the presence of an information barrier and fundamental disconnect to market participation. While agencies interested in promoting markets for carbon credits can have little or no control over the characteristics of the city, policy instruments could be devised to influence the willingness of potential suppliers to enter the market. For example, developing new or revising existing urban forestry extension programs could help local governments better understand the costs, benefits and technical details of urban forest carbon storage.

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