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Exploring the Feasibility of a Local Carbon Offset Market in Western North Carolina

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Abstract

One solution to counteract climate change is to provide individuals the opportunity to balance their climate footprint through a carbon offset market. Carbon is stored in forests and carbon offsets are financial instruments used to counteract emissions through the protection of currently forested land. Specifically, private landowners are paid to keep their land forested. One criticism of existing carbon markets is they face issues of reliability and accountability. Many offsets are in remote places and cannot be monitored, creating a sense of distrust between buyers and sellers. A solution is to create a local carbon market where individuals could buy carbon credits from landowners in a particular region. Western North Carolina provides an interesting case study since it is heavily forested, supplying significant potential for carbon storage. Interest exists in the area for protecting landscapes and purchasing offsets. The purpose of this research is to explore the feasibility of a local carbon market in Western North Carolina. An assessment of Forest Inventory Analysis data is used to estimate the amount of carbon stored per acre for the region. The information provides the potential number of carbon offsets for the region, which is compared with the local demand for offsets. Potential buyers include the City of Asheville, University of North Carolina Asheville, and local businesses. The results are significant because there is no convenient way to bring together suppliers and demanders of offsets. The research contributes a pilot study that could be replicated in other communities where there is interest in a locally verifiable carbon market. This study is important because it could facilitate the creation of a local carbon market. A federal requirement to offset carbon emissions is likely, and individuals may prefer a market which can help them achieve local land use objectives related to open space protection.

Keywords: climate change, carbon market, carbon offsets

1. Introduction

Global climate change is arguably the most important and widespread issue the world faces today. The International Panel for Climate Change (IPCC) defines anthropogenic climate change as, "human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods".[1] Effects of this phenomenon will be widespread throughout the globe. Some observed changes over the last 50 years include much more frequent and severe weather events such as droughts and hurricanes, rapidly melting Arctic ice, and rising sea levels[2]. To avoid the most destructive effects of climate change, it is imperative to focus on the causes of these threats. It is necessary to assess a variety of approaches to remedy these issues, especially those that reduce greenhouse gas emissions (GHGs), which are the driving force of climate change. Six main GHGs contribute to climate change: methane, carbon dioxide (CO_2), nitrous oxides (NOx), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride[3]. CO_2 is the most prevalent GHG and accounts for over 80% of the total human induced emissions in the U.S.[4]. Deforestation activities account for over 18% of the

total GHG emissions, and reductions in deforestation could have immediate and important effects on climate change[5].

It is important, therefore, to direct attention toward forests' ability to act as carbon sinks by actually removing CO_2 from the atmosphere and storing it in the trees themselves.[6] One approach to the protection of natural carbon sinks is through the construction of a carbon offset market. Offsets are "the results of an action implemented to avoid, sequester or displace emissions of carbon dioxide"[7]. Offsets may become credits that are traded in a market setting. One way to analyze the practical application is to begin with a pilot market in a localized setting such as Western North Carolina. The purpose of this research is to assess the feasibility of such a market in the region. Private landowners own the majority of land in the region, but many are pressured to sell their land for development purposes[8]. Protection of these natural carbon sinks will decrease the costs of mitigation in future years and will have local and global implications.

2. Background

Climate change is expected to have serious impacts globally. Every individual emits GHGs through their activities, but at this point most do not have to pay for them because there is no monetary value placed on environmental damage. The economic, environmental, and social effects especially in the longer term are uncertain at this time. It is expected, however, that climate change will lead to a permanent decrease in overall welfare[9]. According to the Stern Review, a key climate change assessment, atmospheric changes have begun and future projections include: declining crop yields in whole regions leading to widespread hunger, major changes in the availability of clean water, potential collapse of entire ecosystems such as coral reefs and the Amazon rainforest, and an increased risk of extreme weather events[10].

2.1 Carbon sinks in Western North Carolina

Carbon sinks are able to sequester significant amounts of carbon[11]; forests in the southeastern U.S. are carbon sinks and are important for a variety of other reasons as well[12]. Western North Carolina boasts a rich heritage, high levels of biodiversity, and recreational activities that draw tourists. Moreover, when the region is compared to areas equivalent in size in the Piedmont and near the coast, Western North Carolina sequesters about 44% more carbon per acre[13]. The increased carbon storage is primarily due to maturing live trees, which will continue to grow and sequester carbon if forests remain intact.

However, the southern region of the U.S. is expected to lose 12 million acres of forestland by 2020, 8% of the total[14]. The southern Appalachian mountains, which includes Western North Carolina, is projected to be one of the most concentrated regions for this loss[15]. Even though the impacts of deforestation are known, financial incentives are not yet in place for landowners to protect these valuable sinks.

Landowners must deal with rising tax burdens because of property value increases. Currently, the most profitable action a landowner can take is to harvest timber and develop land. The single largest threat to forestland in the region continues to be fragmentation due to residential development[16]. For those interested in keeping their land, relatively few options are available to do so, with the exception of forest stewardship programs which enable landowners to receive technical help to sustainably manage their forested lands for at least ten years[17]. However, many landowners are unable to participate in programs such as these because the program is systematically underfunded[18]. If an additional revenue source was put into place, landowners would have a viable alternative to selling land for residential development[19].

2.2 Tradable pollution permit scheme

A tradable pollution permit scheme is a market-based policy to reduce the amount of pollutants in the atmosphere. A tradable pollution permit scheme for carbon, also known as "cap and trade" system, sets an overall limit on the level of carbon emissions allowed into the atmosphere. Permits are created for this level of pollution[20]. Permits are either initially issued for free or sold by a regulatory agency. A cap and trade system offers more assurance in terms of how much pollution is emitted because it sets limits on the amount of pollution allowed into the atmosphere, compared to other emissions reductions strategies such as government regulations. The permits may be traded so that firms with high costs of pollution reduction may purchase permits from those with low abatement costs. The cap and trade method doesn't put a specific price on emissions, rather it allows for the market to set the price thus

lowering the transactions costs of policymakers. Significant cost savings compared to regulations have been observed under existing cap and trade systems[21]. It is also possible for non-polluters who want to see the overall amount of pollution reduced to purchase permits as well.

Arguably, the most important example is of the successful regulation of sulfur dioxide (SO_2) and nitrous oxide (NO_x) under the Clean Air Act Amendment of 1990[22]. The purpose was to reduce emissions of SO_2 and NO_x from levels in 1980. Results included the emergence of a well-functioning market, cost savings of over $1 billion compared to command and control regulations, and very positive environmental consequences[23].

The first large-scale carbon cap and trade program in the world is the European Union Emissions Trading System (EU-ETS). It covers six industrial sectors including electric power, oil refineries, coke ovens, metal ore and steel, cement kilns, glass, ceramics, paper and pulp mills, approximately 12,000 installations in all 25 countries[24]. Industries are required to measure and report their levels of CO_2 emissions, and either purchase or receive an allowance for each ton of CO_2 emitted over the course of the compliance year[25]. In lessening the burden of compliance, it is possible for firms to purchase offsets both within and outside of the E.U. Offsets include forest and agricultural carbon sequestration, or storage[26].

The first mandatory cap and trade project in the U.S. aimed at reducing CO_2 emissions is the Regional Greenhouse Gas Initiative (RGGI). The main purpose of RGGI is to set up a model cap and trade system that may be replicated at a national level to reduce CO_2 emissions. Ten northeast and Mid-Atlantic States have agreed to a cap and trade system to reduce GHGs in the electric power sector. Firms included in the project are electric power plants 25 megawatts or larger[27]. A limited number of permits were sold at auctions in 2008 and the revenue generated is being spent on other energy efficiency projects within the region. Offsets are also used to lower compliance costs for participating firms; up to 3.3% of total emissions reductions may be avoided with offsets. Offsets approved for RGGI include landfill methane recovery, carbon sequestration from reforestation and afforestation[28].

A carbon offset program may function voluntarily or be incorporated into a cap and trade system. The offset program's purpose is to counteract CO_2 emissions through the practice of avoided deforestation. Firms who are attempting to lower their levels of emissions to be in compliance with a cap and trade system would benefit from an offset program. Companies would not have to reduce their levels as quickly if they purchase offsets, lowering the costs associated with reductions and protected land that actually absorbs CO_2.

One pilot project offset market in northern California, established in 2008 and called the Garcia River Forest Project. The Conservation Fund, a nonprofit land trust, has implemented a set of forest protocols through the Climate Action Reserve that verifies the amount of carbon sequestered in the forest through avoided deforestation[29]. The forest is the one of the first and largest to be verified by the Climate Action Reserve[30]. Since verification, carbon offsets have been sold to individuals and firms interested in lowering their carbon footprint. Thus far, the project appears to be well functioning but the longer term effects are yet to be seen.

3. Previous Research

Extensive research is being done on methods that may stabilize CO_2 emissions. According to Sohngen, carbon policies that include deforestation reductions could be one cost effective action that averts climate change. Strong cases exist in favor of this policy tool as well as in opposition to it. Possibly the most significant argument in favor of avoided deforestation is its cost-effectiveness. According to Tavoni, reductions in tree removals would make the cost of removing carbon from the atmosphere up to 50% cheaper than using new technologies that serve the same function. If a carbon cap and trade program or carbon tax is established, the benefits of including forestry activities are three times the cost[31].

Not all offsets are reliable, and the current systems of carbon offsets face major issues of accountability. No single third party certification system exists, leading to a lack of consensus about what should be counted as an offset[32]. Factors that affect the amount of carbon stored in a particular forest include dominant species, stand age, location, soil type and depth, as well as leafy and woody biomass[33]. A certification system that explains the parameters of a carbon offset program taking into account these variables would remedy the issues of reliability.

4. Methodology

This research determines the feasibility of a local carbon offset market by estimating proxies for supply and demand. For purposes of this paper, western North Carolina includes 18 counties[34]. 74% of timberland in the region is

privately owned while 26% is publically owned and only the private sector is included in this analysis[35]. Public lands are excluded from the analysis because they are already protected. The total potential demand as well as total supply for offsets was assessed with the use of preexisting data.

The potential demand for the offsets was estimated with the use of the latest Census Bureau statistics to determine the population in each county. Both high and low averages of per capita carbon emissions were used to get a range of demand for offsets. The total population of the region was multiplied by the emissions number to determine a total potential demand for offsets. A series of interviews with potential buyers in Western North Carolina were used to determine levels of actual interest in the purchase of carbon offsets.

Estimates of carbon sequestered on privately owned timberland were derived using the USDA Forest Service Forest Inventory Data Online (FIDO), EVALIDator 4.01. The tool retrieves data on the amount of carbon stored in particular areas, based on attributes selected. The attributes are chosen because carbon is primarily stored in these areas of a forest and include carbon in live trees above and below ground, carbon in standing dead trees, carbon in down dead trees, carbon in forest litter, and carbon in soil for the most recent survey year, 2007. EVALIDator 4.01 was chosen because of its reliability.

5. Results and Discussion

The total amount of carbon sequestered on privately owned lands in Western North Carolina, estimated using the EVALIDator 4.01 tool, is approximately 161,199,371oven dry tons. The amount of carbon stored here is almost as much all combined fossil fuel emissions in the state of North Carolina over the period of a year[36]. As of 2008, the population in the study region was 832,964[37]. A lower estimate of carbon emissions levels per person is 18.04 tons annually[38], while a higher estimate is 19.78 tons per year[39]. Total emissions levels, according to the low average, are estimated at 15,026,670 tons annually. The potential for offset demand for the high estimate based on population statistics is about 16,476,028 tons of CO_2. Sufficient carbon is stored in privately owned forests in the region to meet even the highest per capita estimates of potential demand in the region, allowing for the possibility of firms outside the region to purchase offsets.

5.1 voluntary versus mandatory market participation

If there is no policy that requires emitters to purchase offsets, the market would be considered a one and significantly lower involvement may be expected. Garcia River is an example of a voluntary market, where individuals and companies may choose to offset their emissions. RGGI is a mandatory market for all electrical power industries within the boundaries of participating states. Companies under this regulation are required to reduce their emissions levels and are therefore much more likely to engage in offset purchasing. A new carbon market would need to be set up differently whether it is voluntary or mandatory.

If CO_2 emissions become federally regulated, the market could change fundamentally leading to much higher participation rates. One such example is legislation proposed in 2009 by the EPA entitled “Prevention of Significant Deterioration and Title V Greenhouse Gas Tailoring Rule” that will regulate facilities that emit over 25,000 tons of GHGs a year[40]. If the regulation of these firms is carried out by a cap and trade system, it is probable that offsets will be used as alternative options to emissions reductions. If avoided deforestation is one offset option, offset prices will rise in the market due to the increased demand.

Several large potential carbon offset demanders in Western North Carolina were interviewed to find out levels of interest in the region. Biltmore Estate was very interested in the program because the company has 5,000 acres of managed forestland that could be qualified for carbon offsets [41]. The company could thus potentially offset its own emissions. Seven-Star Events is a company that reduces the environmental impacts of large events all over the country. They are highly interested in purchasing locally verifiable offsets when they host large events in the region to reduce the event’s carbon footprint[42]. The City of Asheville is uninterested in purchasing offsets at this point because their focus is currently placed on energy reduction strategies; they also don’t have revenue available to spend on offsets[43]. However, within the next ten years interest in the city expects to be interested in purchasing offsets because they will have reduced their emissions levels as much as possible in conservation measures[44]. The University of North Carolina Asheville was unsure whether they would be interested in a program such as this[45]. However, if federal regulations were established, Biltmore Estate, the City of Asheville, and the University would all likely need to reduce and offset emissions because of their large size and emissions levels. As an example of demand in the local community, if a federal regulation was established that required large institutions to offset their

emissions in the electricity and motor fleet transportation sector, the city would have to purchase about 18,000 tons of carbon offsets[46].

5.2 limitations of analysis

Limitations of this study include the estimates of offset demand and offset supply. The higher estimated annual per capita emissions level is based on a national estimate and may be different for this region. Another limitation exists in the proxy for supply. A more precise estimate would be obtained if a third party were to physically evaluate all privately owned land in the 18 counties. It is not likely that all the land will be included in an offset program because landowners may be unaware of the program, may not be interested due to the transactions costs associated in the certification process, or have plans to develop the land. It is also unlikely every individual in the region will want to purchase offsets if it is voluntary because of the monetary costs and other factors. However, companies and individuals from outside the region may be interested in purchasing these offsets, which may increase the demand.

5.3 market establishment

The Western North Carolina Regional Air Quality Agency (WNCRAQA) could be the regulatory body that oversees the offset market, which is one of three regional entities in the state under North Carolina Department of Air Quality (NCDAQ). Although the agency does not currently oversee 18 counties in the region, the structure could be expanded using financial and personnel resources of NCDAQ. The regulatory agency would be responsible for setting the exact parameters of the market, such as the definition of an eligible forest, the elements of landowners contracts, and the type of carbon calculator used. It is expected that a well functioning offset market would pay for itself in terms of initial investment and cover the costs incurred by the regulatory agency. It is also expected to become profitable for landowners. Offset prices currently range from about $10 a ton[47] to $29 per ton[48]. If the offset's price is $10 per ton, up to $1,611,993,710 in revenue could be generated if all private landowners participated. If the offset's price is $29 per ton, up to $4,674,781,759 is possible in revenue over the duration of the program. At the onset of the market, the government may need to offer incentives to get landowners interested in the project. The incentive could take the form of a subsidy on the price of the verification required for landowner participation.

In order for the market to be well-functioning, individuals and firms would need a uniform method for estimating their CO_2 emissions. A single process for calculating emissions levels would be used to avoid discrepancy because there are so many conflicting methods for emissions analysis. One emissions calculator was developed by World Resources Institute[49]. The calculator is suggested because it is essentially a spreadsheet where an institution may simply put in total kilowatt hours for electricity usage, the number of miles travelled for commuting and travel purposes, and therms, a unit of measurement for natural gas heating. Another reliable calculator that could be used to analyze emissions levels is the "Household Emissions Calculator" developed by the EPA[50]. For either calculator, interested parties in purchasing these offsets would have a reliable but simple method to use to estimate their total emissions levels.

After the market is established, landowners would be expected to cover the cost of certification. In order to have a credible offset market, landowners would have to go through an extensive process to get their land certified. Landowners would have to agree upon a specific time period to conserve forested land and would hire independent auditors to go into the field to measure the exact amount of carbon by measuring the height and diameter of the trees found on a sample plot of land. These numbers would then be entered into a database to determine the number of tons of carbon that is stored on the land. The database would be very similar to the EVALIDator 4.01 tool because of its reliability in the determination of carbon storage in forests of Western North Carolina. Landowners with a forest management plan already in place would have a full inventory analysis of all trees completed by a third party, and therefore be able to bypass much of the process[51]. Between 1992 and 2007, 782 forest management plans have been approved, adding up to 98,762 acres of forested land[52]. These landowners are more likely to be early participants in an offset market.

After requirements are met for forested land, the number of tons of carbon demonstrated to be sequestered in the forests would become available for offset purchase. It is possible that offsets would be available for purchase online to promote ease of the transaction. The price of the offsets would vary over time. Three main factors determine the price of offsets: the number of landowners willing to participate in the program and how much land they have in the program, and the number of people interested in purchasing those offsets. If many landowners participate but few are willing to purchase offsets, the price of the offset will be low. Conversely, if there are many individuals who

want to purchase offsets and a low number of offsets available for sale, the price of the offset will increase accordingly. The increase in offset price levels could serve as an incentive for more landowners to enter the market. In order to protect against severe price drops and spikes, safety valves, or price ceilings and floors, could be established[53]. The purpose of safety valves is to protect against extreme volatility of the market, promoting predictability for a more successful policy. Safety valves would eliminate the need for firms to be concerned with major fluctuations in the price level.

5.4 challenges

Two important issues must be addressed in terms of any carbon based project: permanence and additionality. Permanence may become an issue because it is possible the carbon may not be held in these lands for the allotted time period[54]. If a forest fire occurred, the sequestered carbon would be released into the atmosphere, and the purchased offset is no longer counteracting the firm's activities. However, because this region is much wetter forest fires are less intense and less likely to occur here than in other regions of the country; this is another benefit of an offset program in Western North Carolina[55]. A second issue that must be addressed is additionality: would there be incremental exogenous increases in the amount of carbon sequestered in the forests? Depending on how the program is set up, there may or may not be actual increases in the amount of carbon stored in the region. Open space would be protected which would lead to a variety of other benefits. From a community perspective these benefits, such as biodiversity, natural beauty, and recreation may be sufficient to provide interest in implementing this offset market. Further research could address the question of additionality to determine whether actual increases are present with the program in place.

6. Implications

A robust market for carbon offsets, with many buyers and sellers, efficiency in the supply and distribution of offsets, and successful regulation of the market, would have positive impacts for the region's economy. It is assumed landowners' revenue would increase if they receive offset payments compared to the amount they receive for existing use of the land; landowners wouldn't participate in the offset program if they were not going to be better off than with existing opportunities. If all eligible landowners participated in this market, between $1 and $4 billion may be expected in revenue over the time span of the program. A successful market would likely lead to the establishment of new jobs for individuals who audit landowners' property, and is also expected to boost the economy because significant additional revenue would be generated. Landowners must deal with opportunity costs because if they sell their land now or harvest forests to sell in a timber market, they would profit from a one-time transaction, but would then lose the ability to profit over a much longer term. If people's willingness to pay for carbon emitting offsets due to a voluntary and eventually regulated carbon market, landowners would generate increasing revenue more often over a much longer term. It would make landowners' decision to keep land in a forested state more attractive.

The successful introduction of an offset market would have effects that go beyond the realm of economics as well. Residents in Western North Carolina are concerned with the loss of open space and they believe it is important to protect these areas for purposes of scenic beauty and jobs for local farmers. [56]. Residents also indicated that scenic quality and land protection are integral to residents' quality of life in the region. Visitors to the region also believe that it is important to protect these areas. The natural beauty of this region is a main attraction that draws tourists to the area and leads to significant sources revenue for the region. If forest removal continues, it will affect the quality of life of residents as well as destroy the immense biodiversity and rich heritage the region has to offer; it may also decrease tourism. If a local carbon offset market is established, it would be possible to conserve these natural amenities while also protecting the economic well-being of residents in Western North Carolina.

Western North Carolina, already recognized for its natural beauty, could also be seen as a leader in climate mitigation. The market could be replicated in other places with an interest in protecting forested landscapes. An offset market such as this one could fit under a mandatory cap and trade market based policy at a regional level, such as RGGI. If successful, it is possible that this offset market and others like it could fit under national regulations currently being considered in Congress. A local carbon offset market would solve issues with existing international markets that lack credibility and verifiability.

7. Conclusion

Global climate change is a pressing issue today. In order to avoid the most detrimental effects, prompt action is necessary. Although the extent of the effects is yet to be determined, welfare is expected to be permanently reduced[57]. A variety of mitigation strategies will need to be implemented, but one major focus should be on the protection of natural carbon sinks such as forests. In order to slow down deforestation practices, it is possible to implement a carbon offset program that would protect forested areas. This research suggests it is possible to implement a locally verifiable carbon offset market. The participation levels in an offset market would depend on whether the market is voluntary or mandatory. Higher levels of participation would be seen if the federal government acts to regulate carbon emissions. Whether voluntary or mandatory, the protection of forests is paramount and should be a part of any climate change mitigation strategy.

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