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CARBON MARKETS: A POTENTIAL SOURCE OF INCOME FOR FARMERS AND RANCHERS

Luis A. Ribera[1] and Bruce A. McCarl[2]

Efforts to reduce global warming are opening up new opportunities for income for Texas farmers and ranchers.

In the past few years, many governments worldwide have begun trying to halt climate changes by limiting the amount of greenhouse gases (GHGs) that can be emitted by industry. To comply with these laws, large emitters such as power plants are allowed to either alter their own operations or pay others to reduce emissions. Often it is less expensive for large emitters to pay others than to retrofit their operations to reduce emissions.

Agricultural operations can usually reduce emissions more cheaply than can large emitters such as power plants. In Texas, some farmers and ranchers can reduce carbon emissions by reducing stocking rates or changing from conventional to reduced or no tillage production.

Those producers could sell carbon credits to large companies needing to reduce emissions. The earnings that Texas producers could expect under 2009 market conditions range from $1 to $5 per acre per year; that amount could rise or fall depending on whether the U.S. government mandates the reduction of emissions.

Agriculture producers considering entering the carbon market need to know:

- The origins of the carbon market.
- Participants in that market.
- Types of projects that agriculturists can undertake.
- Status of the U.S. market.
- Steps and requirements to participate in the carbon credits marketplace.
- Potential cash flows for cropland and rangeland management offset projects.

[1]Assistant Professor and Extension Economist – Management
[2]Distinguished Professor of Agricultural Economics
The Texas A&M University System

Producers who understand these factors will be better able to determine whether, when, and how to augment their income by selling carbon offsets.

ORIGINS OF THE CARBON MARKET

In the past 20 years, more people have become concerned that human activities are changing climates worldwide. Scientists believe that these climate changes are being caused by the buildup of GHGs in the atmosphere.

The term *greenhouse gas* refers to a group of gases that cause the Earth's atmosphere to reflect and trap more heat. Of the greenhouse gases, carbon dioxide is the largest in both emissions and concentration. Many scientists are predicting dramatic climate changes if current levels of GHGs continue to be emitted.

To address the problem of climate change, more than 160 nations developed a treaty in 1997 called the Kyoto Protocol. In the Kyoto Protocol, the developed nations (such as the U.S., the United Kingdom, and Canada) agreed to limit their GHG emissions to below the levels emitted in 1990.

Currently, the U.S. emits about 6 billion metric tons (tonnes) of carbon dioxide plus about 1 million more carbon dioxide-equivalent (CO_2e) in other gases. Within the Kyoto Protocol, the U.S. emissions were to be reduced to 7 percent below the 1990 levels of $6.2 billion by 2008 to 2012. Given projected emissions growth, this would have required scaling back emissions by 30 to 40 percent of what would have occurred in the 2008 to 2012 period.

In 2002, the U.S. stated that it would not ratify the Kyoto Protocol. The U.S. administration then set a goal of an 18 percent reduction in GHG emissions per dollar of gross domestic product by 2010, which was about one-sixth of the Kyoto obligations, according to an article by T. A. Butt and B. A. McCarl in the *Journal of the American Society of Farm Managers and Rural Appraisers*. In April 2008, the administration set a national goal of stopping the growth of U.S. greenhouse gas emissions by 2025.

The U.S. emission reductions in both the 2002 and 2008 goals are voluntary. Hence, there is no widespread policy stimulus that will create a significant value for GHG offsets. However, there is an international and a small domestic voluntary carbon market.

PARTICIPANTS IN THE CARBON MARKET

As for all markets, carbon markets require buyers and sellers. A buyer of carbon offsets would be an entity needing to reduce or offset emissions. The largest buyers of carbon offsets are likely to be the largest emitters, such power plants, transportation companies, and industry as a whole.

The U.S. Environmental Protection Agency (EPA) estimates that more than 80 percent of current emissions come from coal and petroleum combustion in about equal proportions; the agricultural share is small.

Potential sellers come from various sources such as agricultural farms and ranches, wind farms, and hydroelectric plants, among others.

HOW AGRICULTURISTS CAN REDUCE OR OFFSET EMISSIONS

Farmers and ranchers can participate in this process by either reducing emissions or by capturing and storing emissions. To reduce emissions, producers could:

- Decrease fertilization.
- Alter manure management.
- Reduce fuel consumption.
- Change feeding practices.
- Switch to alternative fuels, such as from coal to natural gas or bioenergy.
- Produce biofuels feedstock.
- Implement rotational grazing programs.

Agriculturists can also capture and store emissions in a process called sequestration. One type of sequestration is biological sequestration, which uses the characteristics of plants to capture emissions. Agricultural forms of biological sequestration include:

- Changes in tillage practices.
- Crop rotations.
- Conversion of acreage to grasslands.
- Afforestation, which is the planting of trees or seeds to change open land into forest or woodland.

A practice that both reduces and sequesters emissions is the reduction of stocking rates.

However, these activities are costly, and producers must have an economic incentive to change their production practices to participate in the carbon market. Another drawback is that landowners participating today in the CCX market may not be eligible for possibly more lucrative markets in the future.

STATUS OF THE U.S. MARKET

The ability of farmers and ranchers to enter a GHG market depends heavily on the existence of the market and on the policies that the government uses to limit or reduce GHG emissions and to allow market participation. Because the U.S. federal government's program for GHG emission reduction is voluntary, it has not stimulated a widespread national market.

However, initiatives to reduce GHG emissions have been implemented at the state and private industry levels. For example, *The New York Times* reported that 10 Northeastern states, including New York, Maine, and Maryland, have joined to create the first mandatory carbon cap-and-trade program in the U.S. The Northeastern market aims to reduce emissions from power plants by 10 percent in 10 years. California is also setting up such a market.

Moreover, according to the *U.S. News and World Report*, the bank holding company Morgan Stanley announced in October 2006 that it would invest $3 billion in the carbon market over the next 5 years—the largest single investment to date. Also, firms are voluntarily buying and selling GHG offsets in an experimental voluntary market called the Chicago Climate Exchange (CCX).

In 2008, the price for carbon offsets in the U.S. was about $6 per tonne, which is the price for a metric ton or the equivalent offset of 2,204 pounds of carbon dioxide. In Europe, the carbon offset price is about $35 per tonne, much higher than in the U.S. because the emission regulations are stricter there.

If the U.S. implements tighter emissions controls, the domestic price of carbon offsets will likely increase. For example, the U.S. Department of Energy estimated in 1998 that the cost could rise as high as $250 per tonne of carbon if the U.S. acted to meet its Kyoto Protocol target for reducing emissions. However, if carbon offsets are traded internationally, the cost was expected to fall to about $25 per tonne of carbon. Estimates from the Department of Energy are based on an overall reduction of GHG emissions, including those from agriculture, fuel substitution, and energy production/consumption.

In 2007, the U.S. Supreme Court ruled on the Massachusetts v. Environmental Protection Agency case that the federal government, through the EPA, has the authority to regulate the carbon dioxide and other GHG produced by motor vehicles. If the EPA decides to regulate GHG emissions, it could increase the demand for carbon offsets, which would probably increase the price.

In addition, the members of the Intergovernmental Panel on Climate Change (IPCC) recently won the Nobel Peace Price for their work on climate change, another indication of increased awareness and interest on the topic.

HOW TO SELL OFFSETS

In the U.S., suppliers of GHG offsets can sell their offsets through direct contracts with buyers or through the CCX.

Direct contact: An example of selling GHG offsets through direct contract is the funding of planting over 150,000 trees by the Houston-based energy company Reliant Energy. The company hopes to capture an estimated 215 tonnes of carbon dioxide from the atmosphere, generating "carbon credits" that will be retained by Reliant.

CCX: Launched in 2003, the CCX is a trading operation based on a voluntary but legally binding association of emitters and offset suppliers. The commodity traded at the CCX is the Carbon Financial Instrument (CFI), each of which represents 100 tonnes of CO_2e.

The volume traded on the CCX in the first quarter of 2008 was about 25 million tonnes of CO_2e, or about 100 million tonnes annually. Although theamount of CO_2e traded on the CCX has been increasing since it was launched, the total amount traded represents less than 5 percent of the full Kyoto Protocol level.

The CCX has established guidelines for participating in a carbon sequestration program through crop production, rangeland management, and/or afforestation. One of the most restrictive requirements for agriculturists to participate in the CCX market is that an entering group must represent a minimum of 10,000 tonnes of CO_2e. A contract of that size would require a cropland farmer to have about 25,000 acres, making this option impractical because few farmers have that much acreage.

A practical alternative for most producers involves the use of an aggregator, which is an entity that pools, or aggregates, producers. An aggregator would act like the "county elevator" for the carbon credits marketplace. An aggregator combines carbon credits from agricultural offset projects initiated by farmers, ranchers, and private forest owners.

HOW TO ENROLL

To participate in CCX trading, sellers must complete an application form requiring information about the landowner and the tract, including:

- Land maps to document ownership for a given tract of land, including the legal land description of the tract.
- Documentation of management practices, such as program forms for cropland, grass, and forest management.
- A signed contract between the landowner and the Chicago Climate Exchange or an aggregator for the appropriate management practices.

Before the contract is signed, the landowner will be provided an estimate of the amount of carbon to be sequestered. Once the landowner has confirmed the amount of carbon to be sequestered, a third party reviewer must verify it. The amount will be verified annually.

There is no enrollment fee. Contracts run on a 5-year period for crop production and/or rangeland management projects. After the 5 years, producers are free to renew the contract for another 5 years or let the contract expire. There is no limit on the number of times the landowner can renew his/her contract. Once a contract expires, producers have no more obligations to the CCX or the aggregator.

However, if a landowner discontinues the approved sequestration practices before the end of the contract, the CCX or aggregator will ask the owner to return the amount of carbon that would have been sequestered up to that point or pay for the same amount of carbon at market price. The project owner will also not be allowed to participate further in the CCX.

If the landowner sells land under a carbon sequestration contract, the buyer must accept the previous arrangement and continue the established practices; otherwise, the first landowner could face penalties for breaking the contract.

If the land is rented out during the contract, the tenant must agree to the contract terms and continue with the contracted land practices, or the contract holder will face penalties and lose the account.

Every project owner is paid yearly, and carbon payments do not disqualify participants from any governmental payments programs. The typical price paid to landowners for carbon has ranged between $2 to $5 per tonne, but currently is about $6 per tonne. The exact amount a farmer would be paid depends on the market conditions at the time of the sale and the amount of carbon sequestrated during the year. Prices can rise or fall daily, as they are dictated by market forces.

The landowner can partner with an aggregator if the volume of carbon produced by the landowner is not the minimum required (10,000 tonnes per year) by the CCX, or if the landowner produces more than the minimum and does not want to complete the enrollment paperwork directly with the CCX. Aggregators charge between 8 to 10 percent of the value of a carbon credit at market price on a yearly basis. Some aggregators require a minimum of 250 acres for a landowner to enroll in a contract.

The fees required for a landowner to sell carbon offsets in the carbon market include:

- A registration fee of $0.15.
- A trading fee of $0.05 per credit
- A verification fee of $0.10 to $0.12 per credit to pay for the third party that verifies the projects.

Third-party reviewers verify that the landowner is following the correct procedures to sequester the carbon. The verifier does not measure the initial level of carbon or the changes in soil carbon levels, only that the contracted practices are being followed.

Finally, the CCX or aggregator sets aside 20 percent of the annual carbon credits from every project as an insurance pool to protect against any carbon storage reversal that might occur in unfortunate events such as fires or hurricanes. The maximum amount of storage reversal that a project owner could face is the amount withheld at the retention pool. In addition, the total amount of carbon set aside in the retention pool is paid back to the landowner during the last year of the contract.

CROP PRODUCTION OFFSET PROJECTS

The CCX specifies that all crop production contracts are for a minimum of 5 years of continuous conservation or no tillage practice. In this arrangement, at least two-thirds of the soil surface must be left undisturbed and at least two-thirds of the residue must remain on the field surface. An additional requirement is that soybeans may not be planted for more than 2 years of the 5-year contract.

For more detailed conservation tillage practices allowed by CCX, see the *National Handbook of Conservation Practices*, published by the Natural Resources Conservation Service.

The CCX has determined the amount of carbon that can be sold via changes to crop production tillage (Fig. 1).

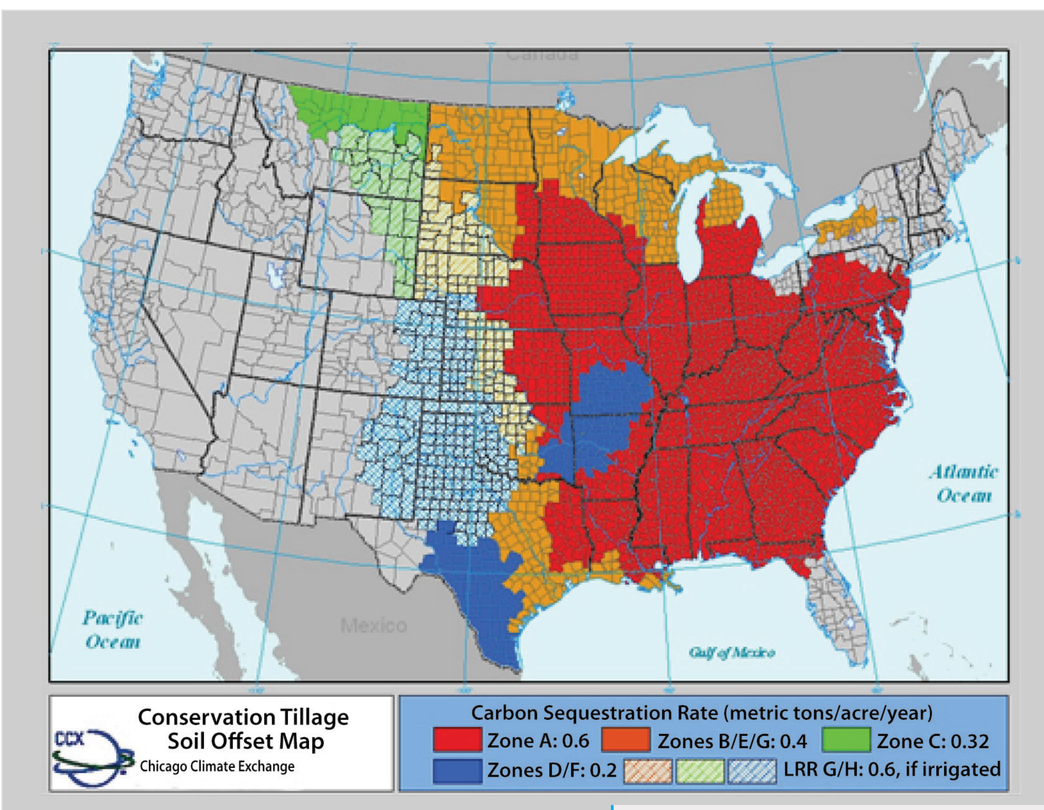

Figure 1. Conservation tillage soil offsets.

The amount ranges from 0.2 to 0.6 tonnes of CO_2e per acre per year, depending on the state and county where the land is located (NRCS).

For example, in South Texas (dark blue area), the rate of carbon sequestration is 0.2 tonnes per acre per year and remains the same for each year of the 5-year contract, as long as the verifier certifies that the landowner is following the specified conservation tillage practices. This means that at current prices, the annual gross income potential is about $1.20 per acre, and the farmer must use continuous reduced or no-till practices for the length of the contract.

Some special contracts can be arranged for farmers who can guarantee specific practices on the land.

RANGELAND MANAGEMENT OFFSET PROJECTS

Rangeland management sequestration practices include reducing stocking rates and rotating grazing to allow forage regrowth and seasonal use as needed in eligible locations. To be eligible, the projects must be on non-degraded rangeland or previously degraded but restored rangeland as a result of changes in management practices undertaken on or after January 1, 1999.

For a more detailed description of practices approved by the CCX, see the *NRCS Field Office Technical Guides*, which includes guidelines for managing the controlled harvest of vegetation with grazing animals.

All projects must occur on rangeland in which the long-term average precipitation is no less than 14 and no more than 40 inches. The CCX estimates that the amount of carbon sequestered in rangeland management projects is between 0.12 to 0.52 tonne per acre per year, depending on the state and county in which the land is located (Fig. 2). There are two sequestration rates for each area in Figure 2; the first one is for sequestration on non-degraded rangeland; the second is for sequestration on previously degraded but restored rangeland.

Gray areas in Figures 1 and 2 are areas that do not have a predetermined rate of carbon sequestration. Farmers and ranchers in those areas need to contact the CCX or an aggregator directly to find out if they are eligible.

Examples of cash flow for crop and rangeland management offset projects

Tables 1 and 2 give examples of gross cash flow estimates for crop production and rangeland management offset projects in Texas. In these examples,

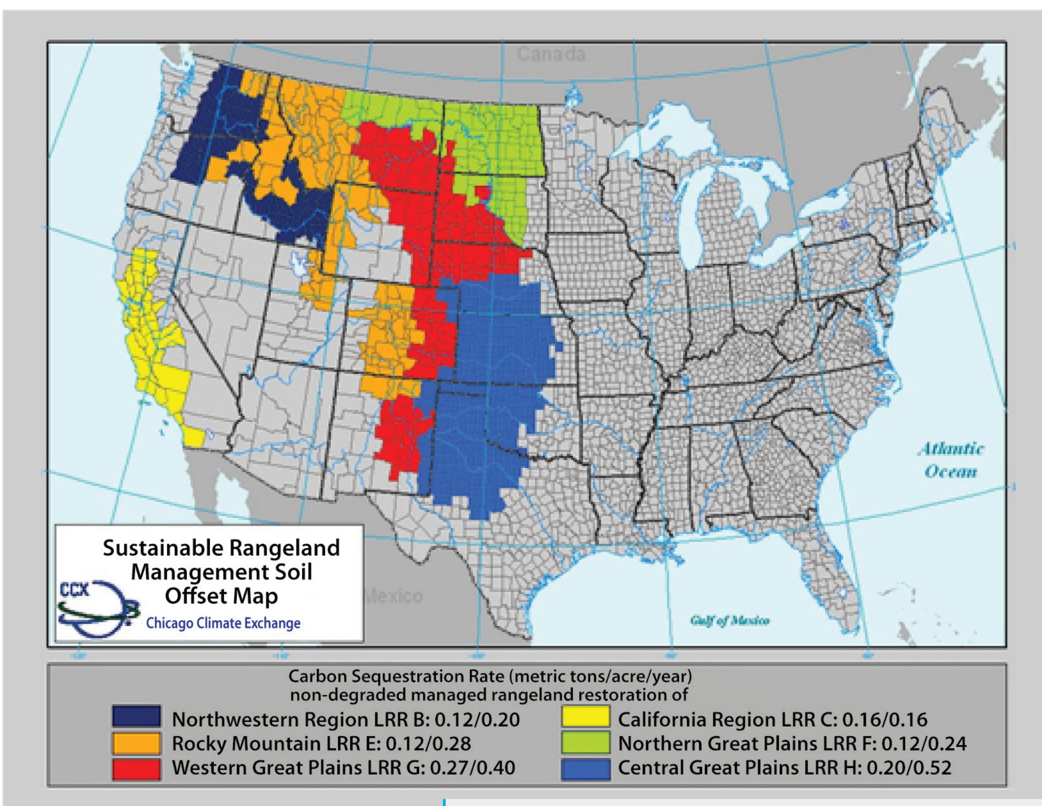

Figure 2. Sustainable rangeland management soil offsets.

TABLE 1. EXPECTED GROSS RETURNS FOR A CROP PRODUCTION OFFSET PROJECT ON EAST TEXAS FOR A 2,500-ACRE FARM.					
Market price (/tonne)	$6.00				
Aggregator fee (/tonne)	$0.60				
Verification fee (/tonne)	$0.12				
Registration fee (/tonne)	$0.15				
Trading fee (/tonne)	$0.05				
Total feed(/tone)	$0.92				
Actual price (/tonne)	$5.08				
Acreage	2,500				
Rate of sequestration (tonnes/yr)	0.4				
Year	1	2	3	4	5
Carbon sequestered (tonne)	1,000	1,000	1,000	1,000	1,000
Retention released (tonne)	200	200	200	200	200
Carbon retention (tonne)	800	800	800	800	800
Retention released (tonne)					1,000
Gross returns	$4,064	$4,064	$4,064	$4,064	$9,144
Average gross returns	$5,080				
Total gross returns (5 yr)	**$25,400**				

it is assumed that the landowner will participate in the CCX market through an aggregator for a fee of 10 percent of the market price for carbon. Verification, registration, and trading fees were set at $0.12, $0.15, and $0.05 per credit, respectively.

In Table 1, the expected gross cash flow is shown for a crop production offset project in East Texas on a farm with 2,500 acres being tilled. The rate of carbon offsets for East Texas (gold area, Fig. 1) is 0.4 tonne per acre per year. Assuming a constant market price of $6 per tonne of carbon each year, the total fees add up to $0.92/tonne, yielding an actual price paid to project owners of $5.08/tonne of carbon sequestered, or $2.03 per acre.

The total amount of carbon sequestered for the entire farm will be 1,000 tonnes per year, of which 200 tonnes (20 percent) is set aside in the retention pool. Therefore, the total amount of carbon available to sell each of the first 4 years of the contract is 800 tonnes, giving a cash flow of $4,064 per year for the entire farm.

On the fifth year, besides the usual 800 tonnes of carbon available to sell, the carbon that had been retained in the pool also becomes available for sale, giving a total cash flow for the fifth year of the contract of $9,144.

On average, the cash flow for the entire farm would be $5,080 per year, including the retention pool, for a total gross return of $25,400, or $10.16 per acre over the life of the 5-year contract. Naturally, this would be offset or possibly augmented by the differential crop production returns arising under the tillage alteration, which would account for changes in yields, labor costs, fertilization, pesticides, and use of fossil fuel.

Table 2 lists average annual gross returns per acre under different carbon sequestration rates and carbon prices. The different rates of carbon sequestration cover all offset ranges for practices in either crop production or rangeland management projects across the U.S.

The different prices for carbon across the table were selected to show the effect of the price on the average gross returns. Although the prices listed across the top of Table 2 are the alternative market prices of carbon, the prices used to calculate the expected gross returns are the actual prices paid to the project owner. In other words, the price used to calculate each average

TABLE 2. EXPECTED GROSS RETURNS PER ACRE OF FARM OR RANCH LAND WITH DIFFERENT CARBON SEQUESTRATION RATES AT SELECTED CARBON PRICES.								
SEQUESTRATION	CARBON PRICE							
RATE	($/TONNE)							
(tonnes/ac)	2.00	4.00	6.00	10.00	15.00	25.00	35.00	45.00
0.12	0.18	0.39	0.61	1.04	1.58	2.66	3.74	4.82
0.16	0.24	0.52	0.81	1.39	2.11	3.55	4.99	6.43
0.20	0. 30	0.66	1.02	1.74	2.64	4.44	6.24	8.04
0.24	0. 36	0.79	1.22	2.08	3.16	5.32	7.48	9.64
0.27	0.40	0.89	1.37	2.34	3.56	5.99	8.42	10.85
0.28	0.41	0.92	1.42	2.43	3.69	6.21	8.73	11.25
0.32	0.47	1.05	1.63	2.78	4.22	7.10	9.98	12.86
0.40	0.59	1.31	2.03	3.47	5.27	8.87	12.47	16.07
0.52	0.77	1.71	2.64	4.51	6.85	11.53	16.21	20.89
0.60	0.89	1.97	3.05	5.21	7.91	13.31	18.71	24.11

Note: These do not account for alterations in the net income from crop production after alterations in yields and inputs such as fertilizer, diesel, gasoline, water pumping, pesticides, or labor.

gross return is the market price minus all four fees—aggregator, verification, registration, and trading fees.

To find the expected return per acre for a specific project:

1. Find the rate of sequestration for a specific county (Figs. 1 or 2).
2. Locate the market price of carbon at the top of Table 2.
3. Scale the price up or down to find the expected return for a specific farm or ranch size.

To illustrate for a farming operation in Nacogdoches County, find the sequestration rate for Nacogdoches County (red area), which is 0.6 tonne per acre per year. At $6 per tonne, the expected average return would be $3.05 per year per acre, or $3,048 per year on 1,000 acres and $6,096 on 2,000 acres.

Using the same sequestration rate, 0.6, at the current U.S. carbon price of $6 per tonne and the current European price of $35 per tonne, the expected average gross returns per acre would be $3.05 and $18.71 per year, respectively.

CONCLUSION

Concerns about climate change caused by human activities have greatly increased in the past several years. Scientists believe that the buildup of GHG concentrations in the atmosphere is causing the climate to change, and efforts to stabilize the emissions of GHGs have begun both nationally and worldwide. In the international arena, these efforts mainly involve the Kyoto Protocol; in the U.S., federal and state programs are under way.

The U.S. Chicago Climate Exchange provides some opportunities for buyers and sellers to trade carbon credits. The agricultural industry could play a role in the reduction of atmospheric GHGs by sequestering carbon through crop production, rangeland management, and afforestation offsets.

However, there is a limited economic opportunity for landowners to participate in the carbon market; carbon prices have ranged over the years between $2 and $5 per tonne and currently is about $6, garnering returns of about $1 to $5 per acre. In addition, the current volume traded is small compared to what would happen with a widespread program, in which a large influx of participants would likely drive prices lower.

On the other hand, several factors indicate a move toward a mandatory program such as a cap-and-trade program in the U.S.:

- The recent ruling of the Supreme Court that granted the EPA authority to regulate motor fuel emissions
- The presidential platforms of both 2008 major party candidates
- Emerging state programs in California and the Northeast

If the U.S. decides to regulate GHG emissions, the prices of carbon would likely increase, giving an economic incentive to farmers to participate in the carbon market.

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