THE RURAL LANDSCAPE INSTITUTE

A CATALYST FOR FOOD AND AGRICULTURAL INTEGRITY
IN THE AMERICAN WEST

RANGELAND CARBON SEQUESTRATION:

Opportunities for Montana ranchers to benefit from being part of the climate change solution

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OVERVIEW

Let's face it – the planet is getting warmer. Maybe not in your exact part of the country, but global weather patterns are changing as the temperature of our planet increases. Some places are seeing more rain than ever; others are drying out. That information alone should be enough to get the attention of agricultural producers in Montana: what is the future of my farm or ranching operation in a period of potentially dramatic climate change? What can I do to ensure my livelihood and my family's future? How can I help lessen the impacts of global climate change?

The goal of this paper is to explain the history of climate change, help you understand programs that have been developed in the U.S. to help lessen the impacts of human activities on the climate, and explore potential market opportunities for Montana producers.

The first section will deal with a brief overview of climate change and market-based solutions to the problem. The next section will explore how offset markets work and what types of offset project have been used in the U.S. We will then discuss a particularly intriguing opportunity for Montana ranchers: rangeland carbon sequestration projects. Finally, we will discuss the current state of carbon offset markets, pending legislation that could greatly expand this program, and future opportunities for Montana producers.

CLIMATE CHANGE AND MARKET-BASED SOLUTIONS

Climate Change and a Broken Cycle

In case you've missed all the buzz in the media, climate change is now a firmly established fact of our times. Without belaboring the point and burying you in too many statistics and graphs, it is useful to understand a few trends.

First of all, greenhouse gasses (**GHGs**) are a natural part of our climate (see text box to the right for a definition of GHGs). At appropriate levels they are downright useful: they keep our planet warm and generally make it hospitable for life.

Greenhouse Gases (GHGs)

Gases within the Earth's atmosphere that are capable of absorbing and emitting solar radiation. In other words, they can reflect heat from the sun back into space or keep heat trapped within the Earth's atmosphere. Major GHGs (along with their approximate % composition of the atmosphere) include:

1.) **Water Vapor** (36-72%)
2.) **Carbon Dioxide** (CO_2) (9-26%)
3.) **Methane** (4-9%)
4.) **Ozone** (3-7%)

Typically, there is a balance between the GHGs that are being released through natural process – through decomposition and respiration – and those that are being absorbed – through photosynthesis and dissolution in the world's oceans (see Figure 1). The main problem today is that the levels of GHGs are very high.

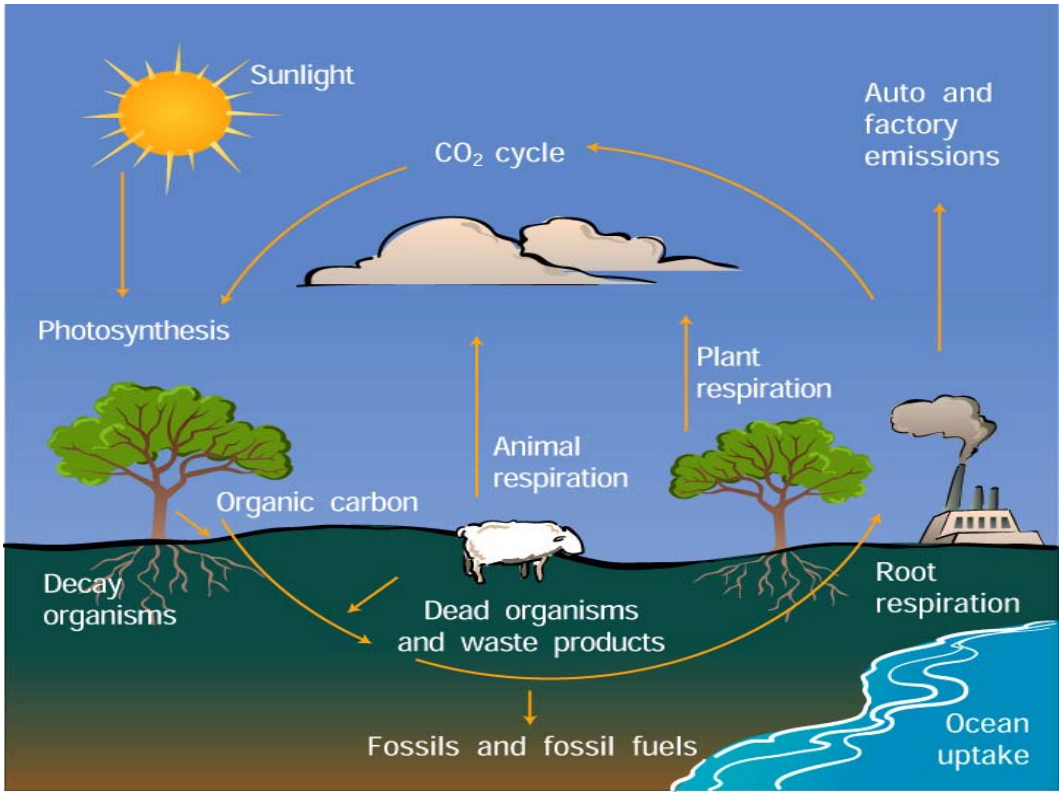

Figure 1. Figure showing the carbon cycle. *Source: University Corporation for Atmospheric Research, University of Michigan*.

How did this happen? And how can we be sure this isn't just a natural cycle? Well, the scientific community is pretty sure that current GHG levels (particularly CO_2) are due to human activity, specifically industrial processes such as petroleum use (burning gas and diesel), coal burning, and cement production. See the middle brown graph in Figure 2 showing the increase in CO_2 concentrations over the last 1000 years.

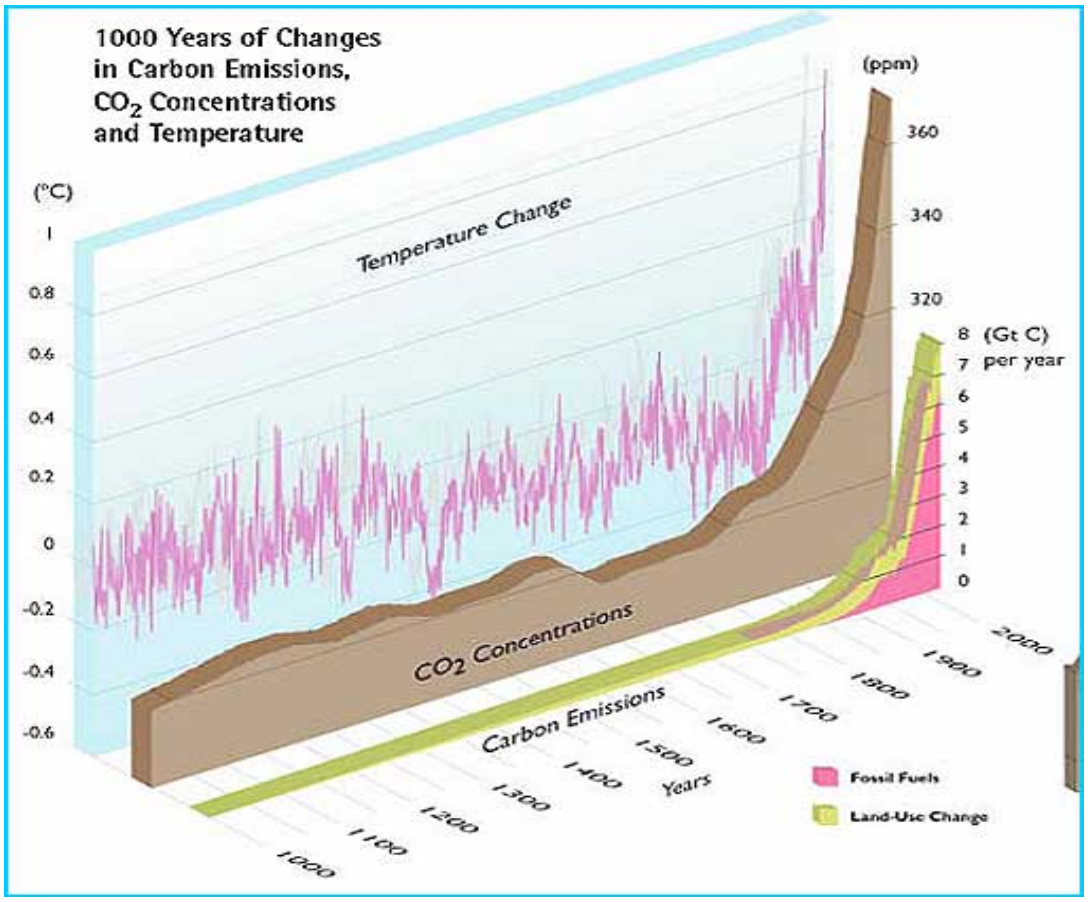

Figure 2. Graph showing effects of carbon emission from land use change and increasing fossil fuel consumption on CO2 levels and global temperature over the past 1000 years. Note how increasing CO2 concentrations track with increasing temperatures. *Source: Arctic Climate Impact Assessment*

Starting around the industrial revolution in the 18th to 19th centuries, we figured out how to tap into a new energy resource: buried carbon. Carbon reserves in the form of oil and coal can be burned to produce heat which can do all sorts of useful things like run machines, create manufactured goods, transport people, etc. The downside is that these processes take the carbon from the ground (where it isn't hurting anybody) and burn it, thus releasing GHGs as a byproduct.

Ironically, these GHGs originally came from the atmosphere: prehistoric plants used CO_2 from the atmosphere to grow, and then they got eaten by dinosaurs, wooly mammoths, and what not, all of which eventually died, were naturally buried, and decomposed into coal and petroleum deposits. Now we've released those GHGs back into the atmosphere to start the whole cycle all

over again. The problem is that we are releasing them faster than plants can do their job of taking them back out. Thus, the carbon cycle has been broken with more GHGs being released into the atmosphere than the plants can reabsorb. Making matters worse, as some areas dry out, more plants die, which means less CO_2 can be absorbed, which means more GHGs, which means still higher temperatures, which leads to more areas drying out, which means more plants dying, … you get the picture.

Scientists refer to areas that absorb CO_2 as **sinks**. Basically, healthy forests, oceans, and green rangelands all act as sinks for atmospheric CO_2. Land use changes in these areas, such as clear cutting or overgrazing, can exacerbate the climate change problem as they leave fewer plants to reabsorb the carbon. Alternatively, management practices that enhance the capacity of the land to act as a sink can increase the amount of GHGs removed from the atmosphere (more on this later).

So what's the upshot of all this? You guessed it – rising temperatures due to GHGs trapping more heat in our Earth's atmosphere. Figure 2 shows average temperatures (pink line) from around the globe starting in 1000 AD. You'll notice an upward trend in the Earth's temperatures.

Consider that the last decade was the hottest on record and 2005 was the hottest year. The year 2005 saw more and bigger hurricanes in the world's oceans, which meteorologists attribute to warmer ocean temperatures due to increasing global temperatures.

In Montana, we're seeing milder winters and record wildfire seasons. Outbreaks of pine beetles in our forests are thought to be partly due to more of the insects surviving the warmer winters which increases their populations and, thus, their ability to kill more trees.

Figure 2 nicely summarizes all we've discussed thus far. At the far left (pink line), we have temperature (°C) changes surging up in the last 200 years. In the center (brown 3-D graph) we have atmospheric CO_2 levels in parts per million staying fairly constant until the 1800s when they begin to spike upward. Finally, we have the presumed driver of the other two: CO_2 emissions in tons of carbon (yellow and pink 3-D graph). The yellow portion of this graph shows the contributions of land use change on CO_2 concentrations while the pink portion shows the contributions of burning fossil fuels.

Recall that some land use changes result in losses of sinks (areas that absorb CO_2) while the burning of fossil fuels increases the release of GHGs. So we have our two primary suspects driving climate change: 1) loss of carbon sinks, and 2) fossil fuel emissions due to petroleum-based activities. Now, how to address these issues?

Market-Based Solutions to Climate Change

Klaus Lackner, a Columbia University geophysicist said, "We sort of vaguely see in the headlights a sharp turn. There are two possibilities. You can say 'I'm going to ignore that and keep going at 90 miles per hour because you cannot prove to me that the curve is not banked and therefore I might make it'…or you can put on the brakes" (Hawn, 2004).

While the scientific community has been documenting and predicting the dire consequences of climate change (IPCC 2001; Karl and Trenbeth 2003), much of the world has opted to apply the

brakes to climate change before things go from bad to worse. As with any crisis, there is the possibility of real danger, but also the opportunity to develop new and creative ways of dealing with the problem. This section will provide a brief overview of efforts designed to reduce net emissions of greenhouse gases.

As you can imagine, there are any number of ways to reduce atmospheric GHGs. From the information we discussed earlier, it is logical to conclude that you could: 1) reduce GHG emissions (don't allow industrial activities to put them in the atmosphere) or 2) improve the capacity of the Earth's natural systems to take GHGs out of the air through biological processes.

Let's call the first type **emissions reduction projects** and the second **offset or sequestration projects**. Emissions reduction projects seek to reduce the amount of GHGs being released into the atmosphere. They can be controlled through taxes or other penalties imposed by governments or other regulatory agencies. Such programs would make it more expensive for the companies to pollute and thus would force them to develop technologies that limit GHG emission levels (or, in extreme cases, put them out of business altogether). This approach makes intuitive sense: lessen atmospheric GHG levels by not putting them into the air in the first place (clean up the source). However, critics of this approach don't like the heavy amounts of governmental regulation, particularly in free market economies.

On the other hand, developing offset projects is also a promising approach. By developing projects that enhance the ability of land to store CO_2, we also lower GHG levels. But where is the economic incentive? Let's face it – improving CO_2 storage capacity isn't cheap (how much does it cost to replant an entire forest?). There needs to be incentive to change how land is being managed. Barring huge government subsidy programs, any economic system that seeks to reduce GHG levels will need to address this issue.

Fortunately, much of the rest of the world has made considerable progress in developing such a system. In a sense, they've tested a number of different approaches and have had success with them.

The most promising and widely used is called a **cap and trade** system. This approach combines both emissions reductions and offset projects in a market-based approach to GHG reduction. In cap and trade systems (also referred to as emissions trading schemes), a regulatory body such as a government or international agency issues companies or entire countries a certain amount of pollution allowances or credits.

Cap and Trade (Emissions Trading)

An administrative approach used to control pollution by providing economic incentives for achieving reductions in the emissions of pollutants

For example, let's consider three hypothetical organizations operating under a cap and trade system. Company A is allowed to emit one million tons of CO_2 per year. Company B has the same cap of one million tons. Company C is an offset project that has reforested a piece of ground and has been given 250,000 credits to sell on the trading market.

Company A develops a new way to manufacture their goods that greatly reduces the amount of CO_2 they produce. At the end of the year, they have emitted only 750,000 tons of CO_2. Thus,

they now have 250,000 tons of CO_2 credits they can sell to another company that hasn't met this allowance target.

Company B, on the other hand, has surpassed their allowance and has emitted one and a half million tons. Now they have to make up for an additional 500,000 tons. In a sense they are being penalized to pollute.

Under the cap and trade system, Company A can sell their 250,000 remaining allowances to Company B. Now Company B has another 250,000 tons to offset. Fortunately, Company C (the offset provider) conveniently has 250,000 tons to sell. In this way Company B can meet its allowance cap:

Company B's emissions	1,500,000 tons
Company B's allowance cap	-1,000,000 tons
Company B's allowance cap is exceeded by	500,000 tons
Company B purchases Company A's unused credits	-250,000 tons
Company B purchases Company C's offset credits	-250,000 tons
Company B meets their allowance cap	0 tons

You'll notice from this example that both Companies A and C received rewards (revenue from sales of their credits) from the cap and trade program while the polluter (Company B) had to pay for exceeding their trading cap. Thus, in theory, those who can easily reduce emissions most cheaply will do so, achieving the pollution reduction at the lowest possible cost to society.

That's a brief introduction to cap and trade systems. By now I'm sure you have lots of questions. Who sets allowance levels? How are allowance levels determined? How is the released CO2 measured? What market buys and sells GHGs? How are offset projects created and verified? To answer these questions, let's explore the largest cap and trade system in the U.S.: the Chicago Climate Exchange.

CASE STUDY: THE CHICAGO CLIMATE EXCHANGE (CCX)

There is no legislation in the United States requiring emission reductions yet (although there is in much of the rest of the world and it is expected to be in the U.S. soon). However, corporations and governments in the U.S. are voluntarily meeting emission reduction goals through the purchase and sale of carbon credits to/from each other.

Here in the United States, the **Chicago Climate Exchange**® (CCX®) was developed to broker voluntary, yet legally-binding, transactions between these parties, thereby helping lower the net volume of CCX members' greenhouse gas emissions. This section will focus on CCX as an example or case study of what offset programs and carbon trading mechanisms look like.

Roles of the Chicago Climate Exchange

In order to better understand the components of a cap and trade system, let's explore the services that an organization like CCX offers and how Montana agricultural producers might work with groups like CCX in the future.

In the text box to the right are some terms that illustrate some of the important issues regarding offset programs. Keep these in mind as you evaluate any offset program.

Again, no formal cap and trade system exists in the U.S., but the House of Representatives passed legislation – the Waxman-Markey Bill – on June 26, 2009. It is unclear when and what version of the bill will be adopted by the Senate, but it is likely that the cap and trade legislation that is eventually adopted by Congress will have many of the same components of CCX, and will have to address the issues identified in the text box to the right. It is therefore useful to understand how CCX works so you can ask the right questions of any existing or new system.

The key components we'll explore in this section are: 1) determining baseline targets for emissions reductions; 2) developing offset projects; 3) registering and tracking credits; and 4) providing a trading platform or marketplace to sell approved credits.

Some Useful Terms and Concepts

- **Additionality**: Projects must demonstrate that their carbon benefits are "additional to any that would otherwise occur" without project investments, and "additional to any that would occur in the absence of the certified project activity."
- **Quantification**: Carbon credits must be real and measurable. In order to measure the carbon credits produced by the project, the project must develop a baseline (that predicts what would have happened *without* project activities). The baseline is the standard by which verifiable changes in carbon stocks are measured.
- **Permanence**: Projects must assure the long-term provision of carbon benefits to the buyer of the carbon credits.
- **Leakage**: Project activities must demonstrate that their carbon benefits are not being displaced to other locations through what is called "leakage."
- **Monitoring and verification**: Projects must have monitoring plans to ensure that the carbon credits claimed remain the same throughout the lifetime of the project, or that changes be declared. Furthermore, projects must have a third party verify that the carbon credits claimed are measurable, real, and additional.

Determining Baseline Targets

One of the most important aspects of an emissions reduction program is determining targets or goals that will lead to an overall decrease in atmospheric greenhouse gas levels. CCX works with its members to quantify the amounts they are emitting or releasing currently, and then sets targets for reductions. Conceptually, this is simple enough: if you are currently releasing 100 tons of CO_2, you might try to reduce that level to 75 tons over the course of a few years. In reality, it's a bit more complicated.

First of all, you need to get an accurate quantification of the GHGs being emitted. Secondly, you have to set realistic yet meaningful goals. If you follow the legislative debates, there is a lot of discussion around these targets. Generally, industries will want higher (easier to achieve) target levels so they can stay in business. On the other hand, environmental groups will want much lower levels to achieve faster GHG reductions. Within CCX, members agree to reduce their current emission levels to the average that they produced during the four-year period of 1998 to 2001.

To explain this visually, refer back to the graph in Figure 2. Imagine going from right to left on the graph, back in time. This means that the company/organization agrees to reduce their current emissions (higher levels) to what they produced earlier in time (lower levels). In a federally-controlled cap and trade system, a regulatory body such as the Environmental Protection Agency will function like the CCX and determine acceptable target levels.

Developing Projects

The second critical role that CCX plays is developing offset projects. You will recall that these are projects that result in a decrease in atmospheric GHGs. These projects generate credits that can be bought by other CCX members to meet their target emission rates. There is a lot that goes into developing such projects. Here is a brief description of the key components:

- **Protocols** – CCX provides guidelines on exactly which practices must be in place to develop "real and additional" credits (more on this later).

- **Quantification** – CCX determines the methods used to quantify how many credits will be generated by a specific project activity. Obviously, quantification methods should be accurate, but are always a subject of much debate.

- **Verification** – CCX sets requirements for verifiers. Verifiers are third-party (independent) groups that "audit" the sequestration activity. Since they are independent, they do not have an incentive to nudge or fudge the numbers in any particular direction. CCX determines the type of expertise required to perform verifications, as well as other requirements like financial capacity, appropriate levels of insurance, etc. Verification is an important safety mechanism in any offset program in order to ensure that the emission reduction activities are actually taking place.

Registering and Tracking Credits

Obviously, it will be important to keep track of credits that are generated and sold as offsets. A registry keeps track of all credits and permanently retires those that have been issued as offsets so they cannot be double counted or sold again. Think of it like a brand inspector: they guarantee that a credit ends up in the right place and cannot end up in the wrong hands. Any new or existing offset program should have a well-developed registry as an important check mechanism. CCX is one of the leading registries in the country, although there are others, such as the California Climate Action Registry and the National Voluntary Reporting Greenhouse Gasses program run by the U.S. Department of Energy.

Trading Platform

Finally, CCX provides a trading platform for credit trading. This creates a marketplace, analogous to a cattle auction or market. It is the place where credits can be bought and sold and where consumers can be sure (or pretty sure) what they are getting for their money.

Types of Offsets offered by CCX

CCX has led the field in **biosequestration** projects in North America through their *Agricultural Soil Offset Projects* (primarily no-till agriculture) and *Forestry Offset Projects*. Biosequestration will not solve all of the problems contributing to global warming. However, combined with increased energy efficiency and decreased industrial emissions, projects that enhance greenhouse gas sequestration will play a key role in mitigating the effects of climate change.

Biosequestration

The conversion of a compound through biological processes to a form that is chemically or physically isolated

Remember the role of land use change we discussed earlier? Specifically, we discussed restoring carbon sinks as one key part of lowering GHG levels. Biosequestration projects seek to do just that. Let's look at several of the current offset projects developed by CCX and then we'll focus on one biosequestration program that might be a good opportunity for Montana producers: rangeland carbon sequestration.

Forestry

Forestry projects create GHG sinks by expanding or maintaining forested landscapes. As you might imagine, a growing forest stores a lot of carbon over the course of many hundreds of years (even old-growth forests are carbon sinks). You might also see these projects referred to as **aforestation** or **reforestation** projects.

No-till

CCX has also developed projects that provide incentives for farmers to switch to continuous **no-till** agricultural practices. Annual plowing and disking associated with agriculture leads to loss of carbon from the soil (the previously-stored CO_2 is released back into the atmosphere before it can be more permanently incorporated into the soil).

By switching to no-till, strip till, or ridge till soil management practices, farmers can work within this CCX program to switch practices and then sell the credits on the CCX. In certain counties, farmers and ranchers can also develop offset projects through grass plantings.

Methane

Methane is an important GHG. Notice that it is listed in the first text box in this paper (on page 4, along with the definition of GHGs). While it comprises only 4-9% of the atmosphere, its impact is nearly four times that of CO_2. In other words, one ton of methane in the atmosphere has the same effect as four tons of CO_2!

Methane is a natural byproduct of decomposition and digestion. As you may be aware, many farms – especially places with large concentrations of livestock (chicken farms, cattle feed lots, etc.) – have begun collecting methane and using it to produce electricity for their operation. This not only reduces methane emissions, but may also result in carbon credits for the farm or ranch.

Renewable Energies

Finally, CCX has developed offsets that involve alternative methods of energy production (primarily electricity). Rapidly-developing technologies such as wind and solar generate electricity without the GHGs associated with traditional energy development (coal, natural gas, oil).

Rangeland

Rangeland offset projects have recently been approved as eligible for CCX sequestration programs. CCX aggregators (entities that enroll offset projects, see page 16) are working with ranchers to help them generate carbon credits by enhancing the rate at which their land sequesters carbons. Such transactions will make it possible for ranchers to receive incentive payments for improving their grazing practices, resulting in a benefit not only to the atmosphere, but also to rangeland health and to ranch revenues.

All of these projects are excellent examples of offset projects. They have well-developed protocols, quantification methods, and verification procedures, and can generate credits through CCX.

Let's explore one of these offset types that is particularly interesting for Montana's ranchers: the rangeland carbon sequestration program mentioned above. Understanding this offset program will give you a good sense for how these types of programs are structured in general.

RANGELAND CARBON SEQUESTRATION PROGRAMS

This section will give you a general overview of one type of offset program offered by CCX that may be of interest to ranchers in Montana. As with any program, there are a number of details about which you should be fully informed before committing to any program – CCX or otherwise. Full details can be downloaded from the CCX website (www.chicagoclimatex.com).

Scientific Background

While many ecosystems have the capacity to sequester carbon, rangelands – including grasslands, shrublands, deserts, and tundra – have the capacity to store a massive amount of carbon: estimated at approximately 19 million metric tons in the United States alone (Follet et al. 2001). Rangelands make up an estimated one-third of the world's terrestrial organic carbon reserves (Ganjegunte et al. 2005).

There is, however, a lot of rangeland in the U.S. that is degraded or poorly managed. USDA surveys have shown that there is potential to improve carbon sequestration on 90% of rangeland in the U.S. (Mitchell 2000). This trend has led CCX and others to conclude that the baseline condition, or "business as usual," for most rangeland (90%) results in either soil carbon loss or no net gain.

Research shows that grazing management practices have a significant impact, either positive or negative, on the overall productivity of rangeland (Derner et al. 1997; Conant et al. 2003). Other studies show that certain grazing management practices, such as rotational grazing, moderate stocking rates, etc., can greatly improve rangeland's ability to effectively sequester carbon (Conant et al. 2001; Schuman et al. 2001).

Therefore, providing incentives to sustainably manage rangelands as carbon sinks offers large-scale carbon sequestration opportunities.

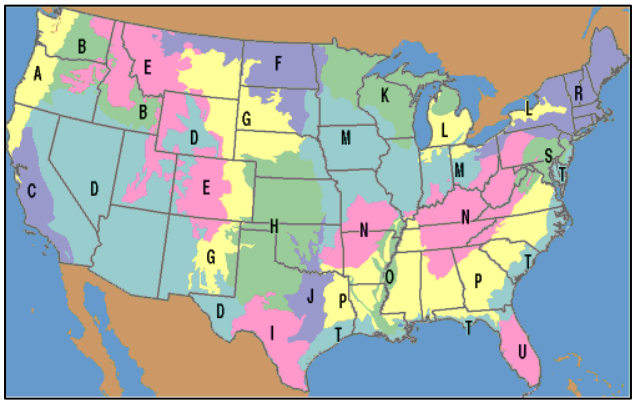

Figure 3. Map showing Land Resource Regions.

Crediting Rates and Quantification

As stated earlier, one of the important steps in developing offset projects is to determine quantification rates (the amount of carbon credits generated by a project).

To determine these rates, CCX convened a technical advisory panel comprised of range and soil scientists, grazing experts, and other agricultural researchers and specialists. They decided to set fixed rates for various regions of the country based on similarities in soil types and precipitation, both of which are key factors in determining a land's potential productivity. These large areas are referred to as **Land Resource Regions (LRRs)**. Figure 3 shows a map of LRRs around the country.

Advisory members of the CCX Research Technical Advisory Committee (soil scientists and other range experts) calculated the estimated gains in CO_2 uptake based on rangeland management changes using a tool called the **V**oluntary **R**eporting of Greenhouse Gases-**C**arb**O**n **M**anagement **E**valuation **T**ool, or **COMET-VR** (details at http://www.cometvr.colostate.edu/).

Baseline calculations were made for each LRR to estimate the amount of carbon dioxide being stored under "business as usual" baseline conditions (Figure 4, red line). Recall from earlier that "business as usual" refers to normal agricultural practices that result in either a loss of soil carbon or no additional carbon uptake.

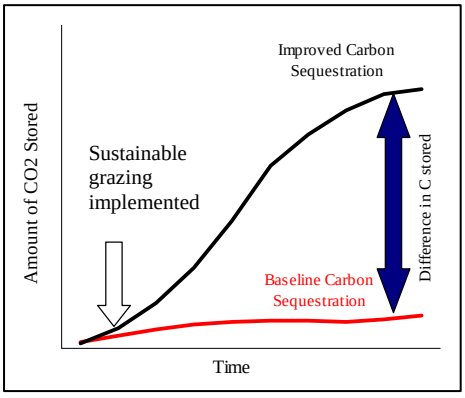

Figure 4. Conceptual overview of the offset process.

They then changed the parameter of the models to reflect more sustainable grazing management practices to obtain a new model rate of soil CO_2 sequestration (Figure 4, black line). They then estimated a conservative value for the improved rate of sequestration (Figure 4, blue arrow). These improved sequestration rates are then used to calculate the credits generated, calculated in metric tons of carbon per acre per year (mTons CO_2/acre/year). A complete list of carbon sequestration rates for each LRR is available from CCX (www.chicagoclimatex.com). Carbon credits thus represent the amount of carbon that is stored beyond what would have happened without implementing sustainable grazing practices.

So let's pencil out a hypothetical carbon sequestration project on a ranch in southeastern Montana. As you can see from Figure 3, this area lies in LRR G, which is the Western Great Plains Range and Irrigated Region. Let's say the ranch has 5,000 acres of rangeland that is being sustainably managed and meets all of the program requirements (more on these details later). LRR G has a crediting rate of 0.27 $mTCO_2$/ac/yr. The math here is pretty simple: you just multiply the enrolled acres by the crediting rate to come up with the number credits that are generated each year. In our case, you'll come up with 1,350 tons each year. That means the ranch can sell 1,350 credits (one credit equals one ton) and can add that revenue to their bottom line. CCX requires a five year commitment/contract period so that means that our ranch would have a total of 6,750 credits to sell over the life of the contract.

Protocols

CCX and their advisory panel also developed the standards and protocols a rancher has to meet to qualify for the program. Project qualifications include: 1) the project takes place on rangeland; 2) the project is in a geographic area for which rangeland soil sequestration rates have been determined (LRR); and 3) the project must adopt and demonstrate conformance with a formal grazing and monitoring plan that must contain the following elements for each pasture within the ranch:

1. **Forage-animal balance** – ensuring that the forage produced meets the demand of the livestock and/or wildlife (e.g., stocking rates designated). Planned utilization should not exceed 50% of current year's growth measured near the end of the grazing season.

2. **Prescribed grazing schedule** – addressing periods of grazing, distribution within a pasture and ranch, and management units sensitive to overgrazing or erosion.

3. **Contingency plan** – rangelands enrolled must have a contingency pan for unpredictable events as a part of their formal grazing plan, inclusive of management responses.

Let's look at each of these in more detail since they are the "nuts and bolts" of the program.

This section, reproduced with permission from CCX, is adapted from a document entitled "Sustainably Managed Rangeland Soil Carbon Sequestration Project Offset Protocol."

Forage-Animal Balance

The forage-animal balance ensures that pasture forage production meets the demand of livestock and/or wildlife (e.g., stocking rates designated) on a pasture or management unit basis.

1. Estimates of forage production must be documented based on soil type or ecological site and the forage production values should be documented from a reputable source (e.g., ecological site description from the NRCS, college or university, extension, primary literature, etc.).

2. Forage production is required for each management unit. Where multiple soil types or ecological sites are present within a management unit and constitute multiple forage production values, either an average forage production or the forage production based on the majority of acres should be used.

3. Provision for supplemental feed to meet livestock demands is required if demand exceeds production.

Prescribed Grazing Schedule

Prescribed grazing schedule indicates the planned number and duration of livestock within a management unit. Development of the prescribed grazing schedule should consider periods of grazing, distribution within a pasture and ranch, and management units sensitive to overgrazing or erosion.

1. All enrolled acres must be included within a management unit of the prescribed grazing schedule.

2. Each management unit must have a planned stocking rate based on the forage-animal balance (above) and include the planned dates for periods of grazing (turn in/out) in which livestock will use the management unit. Significant variations in head numbers or dates, as determined by the Verifier, from the planned stocking rate or dates constitute non-conformance. The ranch must document and justify changes to the prescribed grazing schedule based on forage production, climatic factors, changes to ranch operation, or changes to ranch goals and objectives so long as sustainable grazing practices are consistent with best-in class rangeland management. Planned utilization should not exceed 50% of current year's growth measured near the end of the grazing

season.

3. Distribution of livestock utilization is another key element that must be verified within the prescribed grazing schedule, regardless of a grazing system. Distribution will be assessed on a pasture basis by examining the utilization of key species as identified in the ecological site description for defined key areas of the pastures. Evidence of practices and methods to facilitate spatial and temporal distribution of livestock will assist in verifying this requirement. Examples of practices and methods include: patch burning, herding, salt/water/supplemental feed placement, alteration of grazing seasons, etc.

Contingency Plan

The contingency plan is a planning document for unpredictable events such as flood, fire, drought, hail, insects, and disease which minimizes potential damages and carbon loss to grazing lands.

1. Contingency plans aim to mitigate the effects of drought events by providing adjustments to stocking rate and/or grazing schedule to prevent resource degradation and carbon loss.

2. Drought contingency plans must establish a trigger for implementation of the drought contingency plan. Upon verification, if the established trigger has been met, the Verifier will document the implementation of the drought contingency plan.

3. Documentation of adherence to the drought contingency plan is required.

There are a number of other considerations issued by CCX, such as allowing for the removal of brush (which is okay as long as the project doesn't create too much bare ground), forested areas (which is okay if the areas are grazed), haying (any field hayed more than once per three years is considered hayland and thus is not eligible as a rangeland grazing offset), and additional inputs (no fertilizers, etc., since the land is then considered a cropping system and is therefore not rangeland).

Aggregators and Contracts

Okay, so you think you might be interested in enrolling your ranch into the CCX program, or one like it. Where do you start?

Most ranches will have to be enrolled through an intermediary organization known as an aggregator. **Aggregators** are organizations approved by CCX that serve as administrative representatives for a ranch or, more typically, pools of ranches. They take care of the enrollment paperwork, work with the producer on developing or ensuring that management plans conform to CCX protocols, schedule verifications, maintain the monitoring documentation required, and manage and sell the credit portfolio. In general, they take care of all the paperwork for the program.

All participating ranches that produce less than 10,000 mT/year of carbon emissions must be enrolled in a pool of other smaller ranches through an aggregator. In Montana, that means ranches less than 120,000 acres. Even if your ranch (or leased ground) is bigger than this, you may still want to consider working with an aggregator to save yourself the hassle of completing the paperwork, developing contracts, and selling credits on the exchange; it's usually worth the 10-15% commission rates. Also, you should know that these rates are negotiable; if there are multiple aggregators in your area, you may want to shop around for the best rate and reputation.

The aggregator will provide you with a contract that outlines the terms of the program. CCX has developed a comprehensive list of all the items and declarations that must be included in a contract and monitoring plans (see the Appendix for a list of the monitoring plan requirements). These include, among others, a five-year commitment to the practices outlined above, a declaration that the Project Owner has ownership or operational control of the land enrolled, and a declaration by the Project Owner that they have read and understood the project protocols and will accurately report the required information.

A leading Montana-based aggregator is the National Carbon Offset Coalition (www.ncoc.us). A complete list of all aggregators can also be found on the CCX website (www.chicagoclimatex.com).

Verification

Each ranch enrolled in the program must be verified to ensure that the management practices are in line with the protocols outlined above. **Verifiers** are organizations approved by the CCX to make sure the protocol is being followed. If you are working through an aggregator, they will find the verifier with the best rates (saving you some money) and will arrange for the verification.

Typically, a ranch will be verified annually during the five-year contract to ensure the protocols are being followed. Depending on the size of your ranch and whether it is part of a pool, you may have a "field verification," where the verifier is on-site determining protocol conformance or a "desk verification," that ensures the plans and monitoring form meet protocol standards.

Once an independent third-party verifier determines that program requirements have been met, verified credits can be sold on the Chicago Climate Exchange to other CCX member companies. The purchasing companies buy the credits in order to offset their emissions in compliance with the voluntary emission reduction commitments they made when they joined CCX.

Credit Reserves and Sales

One other piece of information you should know about CCX offset programs is that, typically, 20% of the credits are reserved in a separate account each year.

These credits act as a reserve buffer in case something goes wrong with the project such as nonconformance (not following the rules) or long-term drought. Any inconsistencies that are discovered over the five-year project period can be settled from the reserve account. In the case of a long-term drought (defined as three consecutive years), the loss of carbon storage will be taken from the reserve account.

Another case might be if a participating rancher makes a short-term increase in stocking rates that does not conform with program protocols. The change in carbon storage will be removed from the reserve pool at the end of the contract period.

The reserve account can be thought of as an insurance policy that protects both the rancher and the offset market. In the case of the rancher, minor discrepancies, errors, etc. can be made up from the reserve account rather than having to pay money back. CCX is protected from major non-compliance by withholding a portion of the overall credits to lessen the risk of a major default. Reserve credits remain the property of the rancher and can be sold at the end of the contract period. If all goes well, in the final year of your contract, you'll be able to sell the final years' credits along with the entire reserve pool.

So the final step: selling the credits you've developed. Typically the aggregator will manage the credits (they'll be held in an account within the CCX registry). Credits are bought and sold on a trading platform, much like stocks. There will be negotiations over the price between the aggregator and the buying party until a mutually-agreeable price is reached.

CCX charges a small fee for the credit registration and final sales transaction. These are taken out at this time, as well as the aggregator's fee. The remainder goes to you as additional revenue for your operation. The following table show how a hypothetical project might pencil out. Again, your numbers will vary depending on your ranch size, the crediting rates based on your location, the trading price of carbon, and the fees you negotiate.

The following payments have been calculated for a 25,000 acre ranch in LRR E with a crediting rate of 0.12 $mTCO_2$/ac/yr. You can see that our hypothetical rancher will receive $5,880 per year when he sells each year's credits. In addition, he will receive a lump sum payment of $7,350 when the reserve credits are sold at the end of the contract in Year Five (assuming there was no drought or general program default). Thus, over the five-year period, the rancher nets about $36,750 (not including verification and implementation costs).

Year	Total Credits Generated	Reserved Credits	Total Available for Sale	Revenue @ $3/ton	Aggregator Fee @ 10%	CCX Fees @ $0.25/ton	Rancher Net
1	3,000	-600	2,400	$7,200	-$720	-$600	= $5,880
2	3,000	-600	2,400	$7,200	-$720	-$600	= $5,880
3	3,000	-600	2,400	$7,200	-$720	-$600	= $5,880
4	3,000	-600	2,400	$7,200	-$720	-$600	= $5,880
5	3,000	-600	2,400	$7,200	-$720	-$600	= $5,880
Reserve*		3,000	3,000	$9,000	-$900	-$750	= $7,350
Totals	**15,000**	**-**	**15,000**	**$45,000**	**-$4,500**	**-$3,750**	**= $36,750**

*Reserve credits are sold at the end of Year Five, at the same time as the regular Year Five credits.

Potential Challenges for Producer Participation

There are a number of challenges regarding the emerging carbon markets in the U.S. Two of the primary concerns are: 1) the current low trading price of carbon, and 2) uncertainty around legislation and the future of the program.

As we have discussed already, CCX is part of a *voluntary* carbon trading system. This means that all members are reducing their emissions voluntarily as opposed to being required to do so through law or policy. Thus, the program has remained small. And, because demand is low, the trading price of carbon has been low – ranging from roughly $0.15 to $7.00 per metric ton during the period 2006-2009.

The recent economic downturn has also significantly affected carbon markets. Remember from earlier in this paper where we discussed allowance trading? That's where a company can sell any surplus credits generated when their actual emissions end up lower than their emissions-reduction targets. In 2009, because of the economic downturn, many companies had to cut way back on their production, making it much easier for them to achieve their reduced emissions (obviously, if you close a manufacturing plant or two, you'll greatly reduce emissions – not to mention income). Therefore, carbon trading prices declined along with the general economy as credits flooded the market, increasing supply.

As of November 18, 2009, carbon closed at a mere 15¢. Obviously, at that rate, there is little incentive to create offset projects! However, this is likely a temporary setback. A much more important trend to track will be pending cap and trade legislation.

As mentioned earlier in this paper, the U.S. House of Representatives passed the Waxman-Markey Bill on June 26, 2009. This bill outlines a mandatory cap and trade system for the U.S. Obviously, this will greatly increase demand for carbon credits.

The bill that was passed by the House contains considerations for agricultural offsets, such as no-till and rangeland. The U.S. Senate is expected to explore similar legislation, although it is unclear at this time when or if they will pass their version of the bill. Regardless, if legislation is passed, the trading price of carbon can be expected to rise significantly.

In the European Union, where there is a mandatory multinational cap and trade system, the price of carbon is significantly higher. Their closing price for carbon as of November 18, 2009 was about $20/ton. That changes things considerably! If carbon prices reach that level in the United States, significant incentives will arise for Montana agricultural producers to develop offset projects. Doing so will not only assist in reducing atmospheric GHG levels, but will add to producers' bottom lines.

It also should be noted that, when cap and trade legislation is passed in the U.S., it is likely that energy-related costs will increase for all consumers, including agricultural producers, whether or not they choose to participate in the offset markets. However, revenue from the sale of carbon

credits can help offset those expected price increases, which adds another incentive to participate.

Criticisms of Offset Markets

While offset projects as part of cap and trade systems are becoming increasingly common, there is still criticism. One argument is that offsets are an *indirect* way to confront the issue of GHG levels. Proponents of this argument say that efforts should be primarily focused on reducing emissions rather than developing projects that allow them to "pay to pollute."

This is a valid argument. In reality, however, offsets play a small but vital role in overall emission reduction programs. While they might be more indirect, they do produce useful co-benefits – improved habitat for wildlife, improved management of other important ecosystem services such as erosion control, soil conservation, improved water retention, etc. – while helping provide economic development opportunities in rural areas.

Stephen Porder, a soil carbon expert at Brown University, says he is optimistic that rangeland offsets will promote better land management in the West. He continues, "Will sequestration be a solution? Absolutely. Is it a panacea [solution to all our problems]? Absolutely not." (Ahearn 2009). While criticism of offset projects will undoubtedly remain, such projects will likely play a key role in a cap and trade system should one be established in the U.S. – provided, of course, that the projects are rigorous and meet regulatory standards.

This paper provides many of the tools to help determine the quality and reliability of an offset program. You have been exposed to the core principles of creating offset projects. Recall from the text box on Page 9 our list of "helpful terms and concepts." These are many of the key points of criticism that a good offset project must address: additionality, quantification, permanence, leakage, monitoring, and verification.

You have also seen how one CCX program has addressed these issues in its protocols for rangeland carbon sequestration. Hopefully, such exposure will allow you to critically assess any program in which you might wish to participate, whether it is offered by CCX or another entity. Keep these principles in mind and ask questions related to these topics, such as:

- How do you establish additionality in your offset projects?
- How do you measure (quantify) the credits in your program?
- How do you ensure the carbon is being sequestered permanently (or, at the very least, over the term of the contract)?
- How do you ensure that negative activities are not being displaced outside the project boundaries (leakage)?
- What are your monitoring and verification protocols?
- How are emissions baselines calculated? And who sets targets levels for emission reductions?

- Can I be sure my credits will not be double counted? Is there a registry involved?
- What fees are associated with the program (registration, trading, verification, aggregators, etc.)? Don't forget that many of these may be negotiable!
- What is the trading price history for a carbon credit? What net annual payment amount should I expect to receive given the current trading price?

Undoubtedly, you'll have many other questions, but these should give you a good starting point.

Now let's look at the potential opportunities for Montana ranchers.

Opportunities for Montana Ranchers

So, assuming there will be a cap and trade system in the U.S. that allows for offset project development, what opportunities are there for Montana producers? What benefits can we expect from a robust GHG trading market that might help Montana agricultural producers?

There are a number of benefits worth mentioning, a few of which we will discuss here in detail: 1) a revenue stream that rewards sustainable agricultural practices and good land stewardship; 2) the possibility of participating in a potentially lucrative incentive program that is NOT a subsidy program; 3) marketing opportunities; and 4) developing rural/urban connections.

Revenue to Support Sustainable Agriculture and Stewardship

Obviously, a great opportunity for ranchers lies in the economic potential of offset projects within a cap and trade program. By now, you should have a clear grasp of the unique role Montana producers can play in a national cap and trade system. By implementing sustainable grazing practices, we can enhance our ranches' capacity to sequester CO_2 from the atmosphere. This land management system will improve rangeland carbon sinks throughout the West, thereby decreasing atmospheric CO_2 levels. Participating in such a program will yield direct economic benefits to the ranches involved, as well as assist corporations and organizations to reach their emission reduction targets.

Many other benefits result from good stewardship, including better wildlife habitat, cleaner air and water, open spaces and other public benefits. In addition, such incentives, if large enough, might help some ranches or agricultural operations stay in business, thereby reducing the number that get sold to developers.

Ted Dodge, executive director of the National Carbon Offset Coalition, summarizes it nicely, "We're talking about soil-quality improvement, water-quality improvement, wildlife habitat improvement. What we're really talking about is applying good conservation practices here, and now we can put a carbon number on it and pay people for that. I believe that with this market we have the potential to impact land use in this country like we've never done before" (Ahearn 2009).

Incentive, Not Subsidy!

An important thing to keep in mind is that the cap and trade framework is a new approach to conservation: an incentive-based, free-market approach that is inherently different from subsidy programs. You are probably familiar with many of the subsidy programs available through the Farm Bill (e.g., CSP, CRP, etc.) that offer government subsidies to producers for implementing conservation practices. While there is nothing wrong with such programs, many producers may feel uncomfortable with the notion of "taking handouts" from the government.

But with an offset program, the ultimate source of the revenue is from corporations that are paying fluctuating market rates to help them meet their emission reduction targets. Even the emitting entities have options to find the lowest prices to meet their targets within a regulatory framework. That is one of the beauties of market-based approaches to conservation: they allow freedom within a regulatory framework to find the most efficient (cheapest) way to meet target emission reduction levels, thus reducing pollution with the lowest cost to society.

Marketing Sustainable Agricultural Products

Producers who are implementing offset projects may have interesting marketing possibilities for their products. Many producers are able to demand premium pricing for selected high-quality products, such as organic or all natural beef. Others have found that locally-grown products can command higher prices as well. The Undaunted Stewardship® program in Montana provides another marketing tool to potentially command higher prices, particularly among markets that value the conservation requirements of the program. Marketing beef that is sustainably-managed to reduce greenhouse gas levels could offer a similar marketing opportunity.

Climate change is now an everyday word, particularly in urban areas. Many industries are now marketing "green" products to urban consumers, with great success. It is very possible that marketing beef as "green" could command a premium price. For example, at a 2009 beef auction, the Mayfield Ranch of Hidalgo, New Mexico, sold their cattle for a price that also included the carbon credits resulting from the ranch's sustainable activities. Other creative marketing strategies such as this should be explored.

Rural/Urban Connections

Urban populations are very aware of the climate change issue and efforts to mitigate its impacts. An increasing number of them value, and are willing to pay more for, "green" products. This could be an interesting opportunity to help bridge the widening gap between rural and urban areas.

There seems to be a lack of understanding in urban areas about where and how their food is produced. As country-of-origin labeling becomes more common, people will have more opportunities to know and choose *where* their agricultural products come from. For example, beef from South America may be cheaper, but its carbon footprint (amount of CO_2 associated with raising and transporting a product) might be much higher than local beef.

As large populations of urban consumers become aware that they have a choice in choosing beef produced by nearby rural producers, they might be willing to pay more for that product since it

may have a lower environmental cost. Add to that the fact that the cows were managed in a way that improves carbon sequestration, and you can see that there might be a real possibility for both marketing and education.

Given “green” products, targeted marketing, and a clearer understanding of the interrelationship between urban and rural, urban populations can gain a better perspective on how their agricultural goods are produced, as well as an appreciation for good stewardship. This should help mitigate some of the misconceptions surrounding agricultural production: ideas that all grazing is bad, or that all food production is part of the climate change problem rather than a potential part of the solution.

SUMMARY

We sure have covered a lot of ground – from climate change to market-based solutions to offset markets and the Chicago Climate Exchange. We have also identified potential opportunities such programs might offer to Montana agricultural producers, especially ranchers.

In short, Montana producers might have a vital role to play in addressing the global issue of human-caused climate change. Emerging markets that offer incentives for maintaining healthy working landscapes could provide another source of revenue for participating producers. Such programs also have the added benefit of rewarding good stewardship, contributing to rural economies, and sustaining important habitat. We have also briefly discussed ways that participation in carbon offset markets might be used by entrepreneurially-minded producers seeking additional marketing strategies for their products.

Most importantly, this paper should give you the background you need to ask the tough questions of any offset program so you can be sure that you are joining a reputable solution to climate change problems. It should also provide the information necessary for you to determine if a program is right for your operation.

But it is important to emphasize that there is considerable uncertainty surrounding the future of offset programs in the U.S. right now. Until this uncertainty is resolved, it is unlikely that carbon prices will change much. As such, you can choose one of two paths. You might want to sign up now to take advantage of existing markets and programs; this paper should provide you with enough information to have an informed conversation with an aggregator. On the other hand, you might decide to wait until the future of the markets is more certain and you can be sure of a higher price and a longer-term program. Ultimately, the choice will come down what is best for you, your family, and your operation.

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APPENDIX: CCX MONITORING PLAN REQUIREMENTS

This information, reproduced with permission from CCX, is a subsection of a document entitled "Sustainably Managed Rangeland Soil Carbon Sequestration: Offset Project Protocol" available at:
http://www.chicagoclimatex.com/docs/offsets/CCX_Sustainably_Managed_Rangeland_Soil_Carbon_Sequestration_Final.pdf

Monitoring Requirements

Each project shall have and follow a documented monitoring plan. The Aggregator or Owner shall maintain procedures for obtaining, recording, compiling and analyzing data and information required for quantifying and reporting GHG emissions reductions. At a minimum, the following items must be included in the monitoring plan:

1. Contract number
2. Contract name (if applicable)
3. Project Owner name
4. Project Owner contact person name
5. Farm/ranch name
6. County
7. State
8. Zip code
9. Project Owner contact phone number
10. Project Owner contact email
11. Start year of contract
12. Gross farm/ranch acreage
13. Enrolled acres
14. Crediting rate
15. Offsets claimed for the farm/ranch by vintage
16. Offsets issued for the farm/ranch by vintage
17. Project type (conservation tillage, grassland, rangeland, etc.)
18. Offsets claimed for the project for the contract years(s) by vintage
19. Indication of whether the project was field verified in any year
20. Indication of the compliance status of the contract (compliant, non-compliant or corrected)
21. Indication of adjustments made (to be made) in the Soil Carbon Reserve Pool for historic years based on current year discovery of error or non-compliance
22. Annual self reporting compliance statement

23. Loss/acquisition of land
24. Changes to formal grazing plan
25. Changes in voluntary execution of project
26. Forage/animal balance
27. Grazing schedule
28. Stocking rates by management unit and adjustments
29. Planned and actual turn in/ turn out dates
30. Variations in grazing schedule
31. Grazing distribution plan
32. Recording of drought triggers
33. Execution of documentation of drought contingency plan
34. Removal of brush and % disturbance
35. 12-month Standardized Precipitation Index (SPI) from November to October
36. Other elements to ensure conformance with this protocol.