Policy Options for the Conservation Reserve Program in a Low-Carbon Economy

WORKING PAPER

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1. Executive Summary

Emerging markets and a rapidly evolving agricultural industry will strongly impact the implementation of conservation programs in the United States. The Conservation Reserve Program (CRP) is the nation's largest and most successful land conservation program, making it a good test case to evaluate current drivers of landowner behavior and future policy options. Furthermore, the lessons learned in the case of the CRP can be applied to other land-based incentive programs that could emerge through policies aimed at creating a low-carbon economy.

Commodity prices and land rents rapidly increased in 2007 and 2008. While prices have stabilized to an extent, emerging policy-driven pressures on agricultural markets signal future commodity market volatility and a concern that higher price regimes will pressure agricultural development on ecologically sensitive lands. Rental payments under the CRP that once provided the benefits of certainty and steady income now come with greater opportunity cost. Withdrawal of lands from the CRP for recultivation could have significant effects on water quality, wildlife habitat, and carbon storage. To guard against widespread CRP reversion and to preserve its environmental benefits, we propose several policy options that can simultaneously stem the loss of CRP acreage while staying true to the program's conservation mission. These options include 1) allowing selected perennial biofuel feedstocks to be produced on CRP land, 2) the incorporation of carbon offset value into CRP rental payments and bid acceptance criteria, and 3) authorizing landowners to sell carbon offsets generated on CRP lands. Consistent with each of these policy options is an effort to make conservation program participation complementary to other landowner objectives.

The policy options are covered in detail, with discussions of the various economic, environmental, and institutional issues each presents. While restructuring the CRP could prove cumbersome, avoiding mass recultivation of CRP land is an important policy consideration. We focus primarily on policies designed to enhance the terrestrial carbon storage potential of CRP land by providing incentives to keep land in conservation, directly targeting lands with high sequestration potential, and allowing for biomass production on CRP lands. It is currently unclear how public conservation programs like the CRP will interact with emerging greenhouse gas (GHG) compliance offset markets. How this issue is resolved could have wide-ranging implications on future landowner participation in both carbon markets and traditional land conservation programs.

2. Introduction

Increasing land rents, rising commodity prices, biofuel mandates and incentives, and evolving ecosystem service markets all increase land returns (rents) and can strongly impact the implementation of land conservation programs nationwide. To shed light on the possible options for future implementation of public conservation programs, this paper discusses how the Conservation Reserve Program (CRP) can operate in an environment characterized by expanding bioenergy demand and land-based activities tied to greenhouse gas (GHG) mitigation efforts.

The CRP is the nation's largest and most successful land conservation program, making it a good test case to evaluate current drivers of landowner behavior and future policy options. Historically, the CRP's success in transitioning land from intense agricultural practices to resource-conserving land uses is attributed to the use of economic incentives, i.e., annual rental payments, to provide a predictable source of income. For an extended period of time between late 2006 and 2008, agricultural commodity prices soared while CRP land rents remained steady for the most part. As a result, incentives existed for CRP contract holders to consider abandoning the program and re-cultivating their lands back into active agricultural production. CRP enrollment is currently at 33.6 million acres, down from approximately 36.8 million acres in 2007, giving rise to the concern that periods of inflated commodity prices can lead to a loss in conservation lands (USDA – FSA 2009).

Mass withdrawal of lands from the CRP and subsequent recultivation could have significant effects on water quality, wildlife habitat, and carbon storage (as discussed in subsequent sections). It is therefore important to understand how shifting drivers will impact landowners' decisions to participate in the CRP and the available policy options that can influence these decisions. The analysis that follows first examines these drivers, drawing from the literature and current trends in CRP and agricultural land use. We then review several policy options for operation of the CRP in an agricultural environment characterized by new markets, rising commodity prices, and higher land rents. Finally, we suggest how the lessons learned in the case of the CRP can be applied to other public conservation programs operating in a low-carbon economy.

2.1. CRP objectives and benefits

The CRP is the largest voluntary federal conservation program, covering nearly 34 million acres (USDA – FSA 2009). The 764,017 current CRP contracts with landowners are managed by the Farm Service Agency (FSA) under the U.S. Department of Agriculture (USDA) (USDA – FSA 2008b). The CRP was established in Title XII Subtitle D of the 1985 Farm Bill (P.L. 99 - 198, Sec. 1231-1236) after growing concerns of soil erosion led to federal measures to promote agricultural land conservation. The program is bound by a nationwide acreage limit set by Congress. In addition to the aggregate cap, no more than 25% of total cropland can be enrolled in CRP in any given county. There are a variety of activities landowners can choose to participate in, including grassland, established trees, or afforested stands. Established and planted trees only account for roughly 6% of current CRP acreage, with the majority accounted for by grassland.

The CRP has been highly successful in its mission to curb soil erosion. Numerous studies have found a significant reduction in soil erosion when comparing CRP land to cultivated land (Davie and Lant 1994; Ervin and Lee 1994; Gilley et al. 1997; Wu et al. 1997; Huang et al. 2002). Additional studies have found that CRP lands have reduced soil acidification (Huang et al. 2002), decreased compaction, and improved soil structure (Lindstrom et al. 1994; Staben et al. 1997; Karlen et al. 1999; Huang et al. 2002). Additionally, the CRP has led to increased soil organic matter (Gebhart et al. 1994; Staben et al. 1997; Piñeiro et al. 2009), microbial biomass (Karlen 1996; Staben et al. 1997) and overall soil fertility (Wu et al. 1997).

Although the CRP was not designed for carbon storage and sequestration, CRP contracts include land cover maintenance and restricted biomass removal, which enhances above- and below-ground carbon sequestration (FAPRI 2007). In particular, organic carbon levels in CRP lands can be significantly greater than in cropland; studies have shown that only five years after restoration of a perennial grass cover, 21% of the soil carbon lost during decades of intensive tillage had been replaced (Gebhart et al. 1994). A recent comprehensive review of soil carbon with the CRP estimates that soil organic carbon increases at the rate of 570 kg C (2.1 metric ton CO_2 equivalents) per hectare per year (Piñeiro et al. 2009). These increases in soil carbon storage can be negated by recultivation; a global review of numerous soil types found there is an average loss of 30% soil carbon from soil layers of less than 150cm deep (Davidson and Ackerman 1993).

The CRP can likewise benefit water quality. Research indicates that CRP lands reduce erosion and sedimentation (Davie and Lant 1994). CRP lands are also characterized by lower rates of nutrient leaching (Randall et al. 1997). In addition to fertilizer needs, cultivation typically requires irrigation and pesticides; land converted to CRP can therefore reduce the use of these agricultural inputs as well.

Wildlife habitat conservation and subsequent recreation benefits are also provided by the CRP. Studies suggest that at least 92 species of birds make use of CRP lands in the central United States (Ryan et al. 1998), and small, medium, and large mammals, snakes, and other invertebrates have all been recorded in previous CRP studies (Ferrand 2005). CRP lands may also host unique or increased abundance of species as compared to nearby row-crops (Best et al. 1997). Studies in the Prairie Pothole region of North Dakota, South Dakota, and Northeastern Montana found that the CRP land is vital in maintaining a vibrant waterfowl population (Kantrud 1993; Reynolds et al. 2001; Niemuth et al. 2007). CRP lands can also lead to increased acreage of viable habitat and help to connect previously disparate habitat patches, thus aiding species with large habitat range requirements (Egbert et al. 2002).

2.2. CRP enrollment and rental rates

There are two types of CRP contracts: General and Continuous Signups. Here, we focus on whole-field cropland retirement program known as the General Signup CRP, which accounts for 88% of all acres enrolled in CRP (USDA – FSA 2008c). The General Signup CRP is of particular concern for two reasons. First, General Signup contracts typically involve larger tracts of land, averaging 79 acres as compared to 11 acres for Continuous Signup. Tract size is important because some ecological functions are inherently scale-dependent (e.g., habitat diversity, hydrologic functions, nutrient transport). That is, larger tracts of conservation land can provide greater net benefits per unit of land than small tracts. Second, the average rental payments are much lower in General Signup ($44/acre) compared to Continuous Signup ($89/acre) for a given soil type and location (USDA – FSA 2008d). This is because extra incentive payments are provided to landowners in Continuous Signup CRP.[1] Lands enrolled in General Signup therefore have a higher opportunity cost of opting out of crop production, especially when commodity prices are high.

Agricultural landowners can offer their crop land for CRP General Signup enrollment only during designated sign-up periods as announced by the Secretary of Agriculture. These signups have historically occurred at different intervals, ranging from a few times a year to once every few years. If an offer is accepted by the USDA, landowners enter into a 10- to 15-year contract with the agency.[2] Landowners are guaranteed an annual rental payment (and cost-share assistance, if requested and approved) in exchange for ceasing crop production and establishing resource-conserving coverage on that land.

[1] Rental rates in Continuous Signup are based on the same soil rental rates as those in the General Signup, but potentially include additional financial measures such as practice incentives (up to 20% in addition to base rental rates) and maintenances incentive (up to $9/acre) (See USDA - FSA, 2008f).

[2] The length of contract is based on the dominant conservation activities that will be practiced (See USDA - FSA, 2008f).

Offers by landowners to enroll in the CRP are ranked according to the Environmental Benefits Index (EBI), which values the potential environmental benefits of retiring the offered land. Aside from the amount of acreage offered, producers also specify the types of conservation practices they are willing to undertake, any cost-share assistance they would need for those practices, and the minimum rental rate (in $/acre/year) they are willing to accept for this offer. The EBI has traditionally relied on measures of soil erosion, wildlife protection potential, water and air quality improvements, and the enduring benefits factor.[3] Recently, the Department of Agriculture incorporated carbon sequestration into the EBI as part of air quality improvements, but this factor still comprises a small portion of total EBI scoring.

The EBI scoring system favors lands that are cheap to rent. By definition, "cheap land rent" is synonymous with marginal lands with low agricultural production value. In this system, the most marginal and erodible lands receive high scores. For two identical parcels of land with the same EBI score and bids that are equal in every respect but the bid price, the agency can accept the lower-cost bid of the two, and the winning landowner will receive a rental payment equal to their bid. Landowners can also offer discounts, i.e., rental prices less than this maximum rate, potentially increasing the chance of an offer being accepted. However, landowners who are confident that their offers will be accepted—e.g., those offering land in priority conservation areas—rarely offer discounts (Kirwan et al. 2005).

While under contract, landowners are required to maintain approved land management practices. Landowners also face penalties for breaking the contract, including repayment of all CRP-related income plus interest and liquidated damages[4] (USDA – FSA 2008f). Once the contract expires, however, landowners can choose to re-offer their land for a second CRP term, or put it to an alternative use such as recultivated agricultural production. Even while under contract, the returns from high commodity prices may outweigh the costs of breaking a CRP contract. Furthermore, pressure has been exerted recently to allow farmers to convert their CRP land without paying penalties (The National Grain and Feed Association 2007; Baxter 2007; MacPherson 2008).

The FSA sets the maximum per-acre rental payment given to the landowner for entering into a CRP contract. The per-acre rate is based on the Soil Rental Rate (SRR), which differs by soil type and county, as well as the productivity of the land in agricultural production. The Maximum Rental Rate (MRR) for each parcel is the weighted average of the SRRs of the three dominant soil types on the land. Although the SRRs can be set as high as $204 per acre (USDA – FSA 2008f), average state rental rates range from $27 to $94/acre (USDA – FSA 2007a).

In general, the rental rate is set to "the amount necessary to encourage owners or operators of highly erodible cropland to participate in the program" (P.L. 99 - 198, Sec. 1234(c)(1)). At the same time, CRP rental payments must also protect the interests of tenants and sharecroppers, who are disadvantaged when high CRP rental rates increase local land rents. Therefore, each county carefully reviews the SRR to ensure the right balance between providing conservation incentives and avoiding competition with sharecroppers and land renters. Because the SRR captures land values based on agricultural productivity, increasing real estate prices and other non-agricultural land-use options may throw this delicate calculation off-balance.

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[3] The enduring benefits factor measures the likelihood that the practice established will persist and be maintained beyond the contract period (USDA - FSA, 2008f).
[4] Administrative fines and fines for preventing other landowners from participating in the program are equal to 25% of one year's rental payment.

3. CRP Enrollment Trends

The current distribution of CRP contracts reflects the origins of the program. Farmers who suffered the most from falling commodity prices and the appreciating dollar during the early- to mid- 1980s were those who had heavy debt loads and relied on export-sensitive crops, such as corn and wheat. Thus, the current distribution of CRP contracts continues to be skewed towards corn and wheat-producing states; Corn Belt states[5] occupy 19% of the U.S. land base but have 47% of all CRP acres (Figure 1).

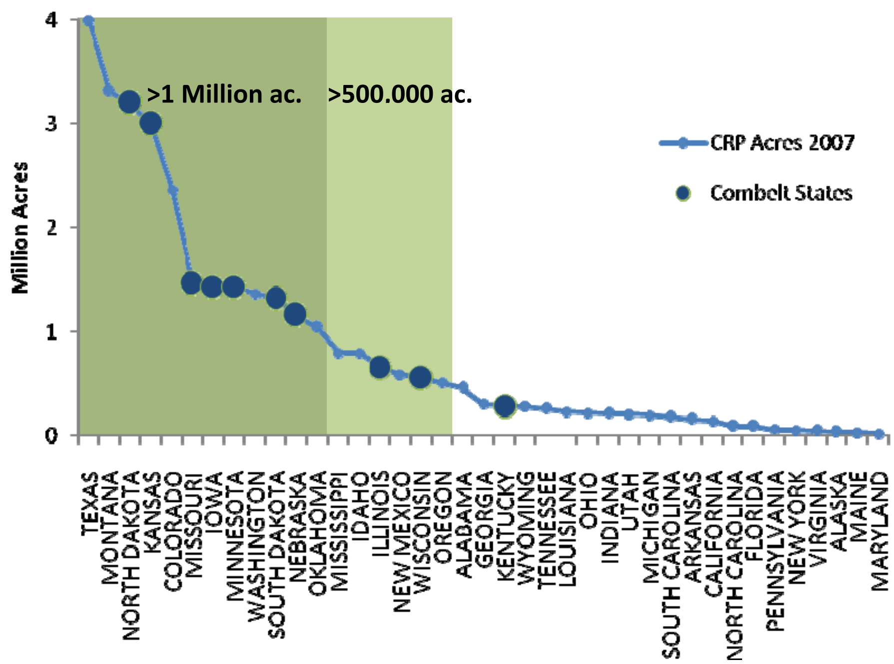

Figure 1. CRP enrollment by state. (Source: USDA – FSA 2008a)

The first CRP general sign-up was in 1986, but the sign-up that brought the largest block of acreage into the program occurred in 1987. At the time, low commodity prices due to oversupply and a weak export market led many farmers to enroll their croplands into the CRP. Most of the contracts for lands enrolled in 1987 expired in 1997, leading to a second spike of enrollments in that year (Figure 2).

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[5] The Corn Belt includes the states of Illinois, Indiana, Iowa, Kansas, Kentucky, Michigan, Minnesota, Missouri, Nebraska, Ohio, South Dakota, and Wisconsin.

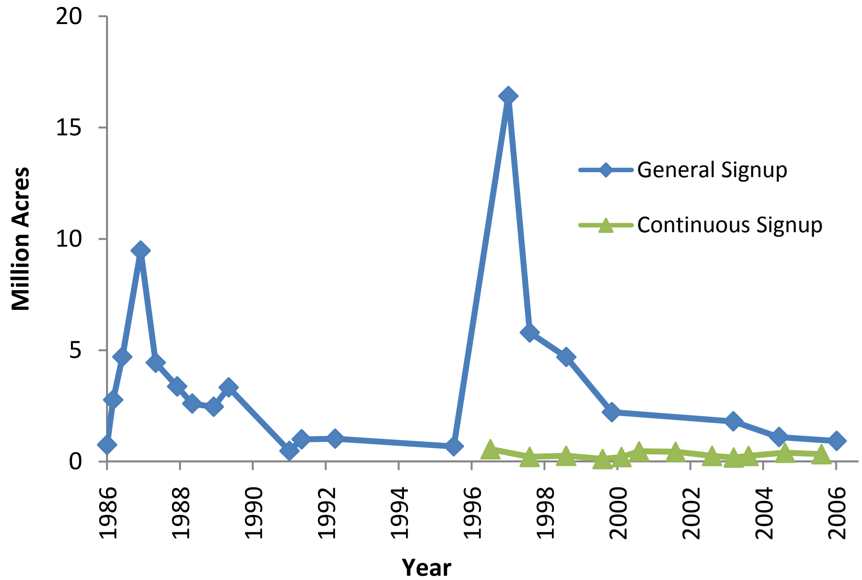

Figure 2. Enrolled CRP acres by signup type. (Source: USDA – FSA 2007a)

As 2007 approached, the USDA introduced the Re-Enrollment and Extension (REX) program to reduce the workload from processing the nearly 16 million acres enrolled in 1997. This program effectively spreads the contract expiration across a longer period (Figure 3). Under REX, CRP lands were ranked according to their EBIs (as calculated when they enrolled in 1997). The FSA offered to re-enroll the top quintile into another 10-year contract, and offered the middle quintiles a 2-to-5-year extension. No extension offers were made to the bottom quintile.

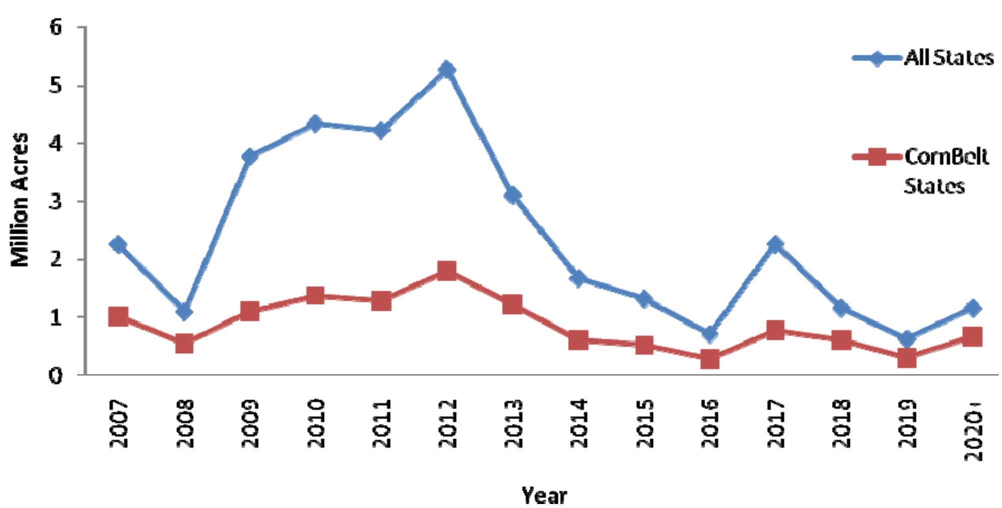

Figure 3. CRP acres expiring by year and region, including the results of 2006 re-enrollment and extension offers. (Source: USDA – FSA 2007b)

Landowners of 24 million acres, or approximately 85% of total CRP acres set to expire between 2007 and 2010, accepted re-enrollment and extension offers. Assuming that acres enrolled in the REX program will stay in CRP for the full contract term, 12 million acres of CRP land will be released between 2007 and

2010 (USDA – FSA 2007b) out of 28 million acres that would have been released in that period without the REX program. It is important to highlight that REX was implemented before commodity prices started to increase at an accelerated pace. Since that time, corn and other agricultural commodity prices spiked to more than twice 2006 levels (Figure 4). As of January 2009, prices have stabilized, though they remain well above historical trends. As policy-driven biofuel expansion continues, increased market volatility and higher price regimes are likely as producers respond to emerging market needs (Trostle 2008).

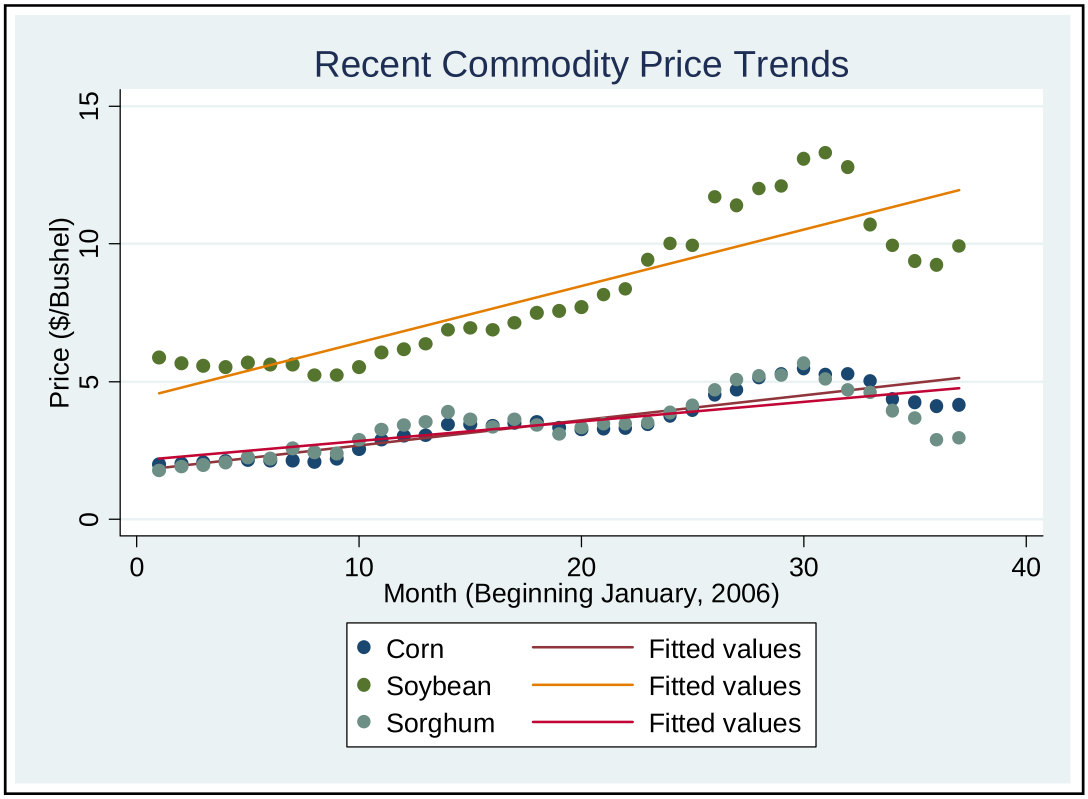

Figure 4. U.S. commodity prices ($/bushel). (Source: USDA – FSA 2008e)

4. Drivers of CRP Conversion

The main drivers of potential CRP conversion are opportunity costs. Landowners nearing the end of their contracts are facing an entirely different level of opportunity cost than when they were enrolled. The full suite of opportunity costs, including the role of agricultural commodity prices, farming costs, yields, and CRP rental rates, must all be examined to better understand the incentives that landowners have to leave the CRP in favor of recultivation.

4.1. Bioenergy expansion and commodity prices

Research suggests that historically high corn prices would make profitable the recultivation of up to 70% of expiring CRP contracted land in some states (Secchi and Babcock 2007), thereby putting program acreages at risk. In fact, corn acreages in the United States increased by 15.3 million acres (19%) between 2006 and 2007 (USDA – NASS 2008a). Much of this additional acreage came from farmers continuously planting corn instead of rotating with other crops such as soybeans and from conversion of CRP, hay, and pasture lands (USDA – NASS 2007b, cited in Simpson et al. 2008). This shift in acreage can be tied to surges in commodity prices; food grain prices received by farmers in February 2008 were approximately 93% greater than 2007 prices (USDA – ERS 2008).

Some argue that biofuel expansion is one of the many drivers that led to the 2006 and 2007 surge in commodity prices (Mitchell 2008; Trostle 2008). Indeed, corn production and ethanol production have trended similarly in recent years. As of January 1, 2005, producers have been eligible to claim a Volumetric Ethanol Excise Tax Credit (VEETC), of $0.51/gallon for corn ethanol. The Energy Policy Act of 2005 (P.L. 109-058) mandated the increased production of primarily corn-based ethanol to 4 billion gallons by 2006, 6.1 billion gallons by 2009, and 7.5 billion gallons by 2012. This led to a sharp increase in demand for corn, the primary feedstock for ethanol in the United States (Hart 2006). The Energy Security and Independence Act of 2007 (P.L. 110-140) imposed an even higher biofuels mandate of 36 billion gallons by 2022.

4.2. Production costs and yield

Agricultural revenues have increased due to higher crop prices, leading to more production. This brings about high demand in agricultural inputs such as fertilizer, seed, farming labor, agricultural chemicals, and fuel, which in turn increases overall production costs. Additionally, many of these input prices are affected by the price of petroleum. While the future of energy and agricultural input costs is highly uncertain, as demonstrated by the sharp drop in oil prices in October-November 2008, the net effect is that future profit margins on marginally productive lands may not be as high as anticipated.

The 2008 projected production cost estimates for continuous corn in Iowa was $4.17 per bushel at 145 bushels/acre (Duffy and Smith 2008), up from $3.10 in 2007 at 156 bushels/acre (Duffy and Smith 2008). From 1981 until 2007, farm labor wage rates have increased at a faster rate (3.8%) compared to non-farm wages (3.4%) (USDA – NASS 2007a). Between February 2007 and February 2008, real fuel and fertilizer prices increased dramatically by more than 35% and general production item prices increased by 13% (USDA – ERS 2008). Much of the increase is attributed to the rising price of oil, which determines the price of fuel and fertilizers (15% of average farming expenditures), and influences the cost of farm services (another 15% of expenditures). However, production costs have lowered significantly since late 2008, as fuel prices have decreased in light of decreased global demand for oil.

Technological improvements in crop production have also allowed more crops to be produced per acre of land. In 2000, the average corn yield in the United States was 136.9 bushels per acre; by 2007 it had increased 10% to 151.1 bushels per acre. Soy yields increased 8% from 38.1 bushels/acre to 41.2 bushels per acre during the same period. With increased farming efficiency and higher crop prices, lands deemed too marginal to cultivate ten years ago can now become economical. This is pertinent to CRP because the program tends to target marginal land (Secchi and Babcock 2007).

4.3. Rental rates

Historically, enrollment in the CRP provided an attractive alternative to owners of marginal or highly degraded land; the certain income provided by CRP rental rates provided an excellent incentive for landowners to keep their land out of production. However, as expectations of future returns to agriculture rise, the risk of forgoing future production may be too great to convince new or existing CRP contract holders to accept a certain but likely smaller CRP rental payment.

Given the strong role of opportunity costs in driving CRP reversion, landowners will be more likely to recultivate their land if CRP rental rates cannot adjust to the agricultural commodity market. Unfortunately, the frequency of updating CRP rental rates cannot keep up with the rapidly changing crop prices; the process itself is cumbersome and time consuming, and was designed to limit rapid rental rate changes. The slow pace of change is corroborated in a recent empirical study that found CRP rental rates in Iowa are not sensitive to differences in CSR (Corn Suitability Rating), which is a good proxy for the opportunity cost of agricultural land in the study area (Secchi and Babcock 2007). However, current CRP guidelines do not allow for rapid updating of rental rates (Box 4.1). The long-term nature of CRP contracts also precludes the re-negotiation of a rental rate.

Box 4.1. USDA guidance on rental rate adjustment

"**Important**: Because County Offices have been directed to review and recommend rental rate changes before each of the last 5 general signups, all future changes necessary should be relatively minor. Changes in rental rates shall only be made for particular soils. Extensive or "across-the-board" increases will **not** be approved. Rental rate increases greater than 1 soil productivity group will generally not be approved."
(USDA - FSA, 2008f, p.7.15, Emphasis in original)

5. Policy Options for the CRP in a Low-Carbon Economy

Increased focus on the production of biofuels and increasingly high commodity prices could pressure current CRP contract holders to leave the program. At the same time, increased awareness and concern over large-scale environmental issues such as global climate change and the role that agriculture can play in mitigating climate change may present new opportunities for landowners enrolled in the CRP. This section discusses policy options for leveraging this new suite of CRP deliverables, including carbon sequestration and the production of dedicated perennial energy crops. In particular, we examine the following options: 1) allowing selected perennial biofuel feedstock to be produced on CRP land, 2) raising the CRP rental payments or likelihood of bid acceptance, and 3) authorizing landowners to sell carbon offsets generated on CRP lands.

In each of the policy options explored here, we assume that land conservation and protection against soil erosion remain the primary foci of the CRP. We discuss how the CRP can draw upon other markets, commodities, or environmental services in order to minimize the number of farmers leaving the program, but do not consider a wholesale revamping of the program. Under each policy option, we first review the policy basis or precedent, and then provide an overview of the potential environmental, economic, and other impacts that could result from implementation of the policy.

5.1. Production of bioenergy crops on CRP land

A significant portion of the total Renewable Fuels Standards mandate must be met by cellulosic ethanol beginning in 2015 (P.L. 110-140, Sec. 202). Cellulosic ethanol may be produced from a number of feedstocks, including agricultural residues, perennial grasses, and woody biomass (Schubert 2006; Sims et al. 2006). Allowing CRP lands to produce and harvest these or other cellulosic feedstocks could help meet bioenergy mandates while providing incentives to keep lands under CRP contract.

Permitting growth and harvest of perennial biomass on CRP lands would permit farmers to take advantage of increasing demands for renewable energy, while still participating in a land conservation management plan that prioritizes environmental services. A primary concern is that allowing biomass production on CRP lands may compromise the conservation mission of the CRP by effectively allowing for commodity production on enrolled lands.

Landowners could manage perennials such as switchgrass (*Panicum virgatum*), and possibly woody biomass species such as hybrid poplar (*Populus sp.*) and willow (*Salix sp.*), similar to current CRP cover crops. Switchgrass, for example, can be harvested up to twice a year, has a flexible harvesting schedule which is compatible with the production of other Midwestern crops such as corn and soybean, and can be planted, harvested, and stored using conventional infrastructure and equipment (Vogel et al. 2002; Murray et al. 2003; Sanderson and Adler 2008).

The concept of producing bioenergy feedstock on CRP lands is not new (see, e.g., Downing et al. 1995; Walsh et al. 1996). In fact, it is already permissible to harvest perennial biomass on CRP lands under current regulations. Section 2101 of the Farm Security and Rural Investment Act of 2002 (P.L. 107-171) amended the CRP to allow for managed harvesting and grazing, including the managed harvesting of biomass, on CRP contract lands. Generally, harvesting activities must be consistent with the soil, water, and wildlife conservation purposes of the CRP. Specifically, harvest activities must occur no more than once every three years, be accompanied by a payment reduction, and take place outside nesting and brood rearing seasons (7 CFR 1410.63(c)).

The administration of biofuel feedstock production on CRP lands could approximate how haying practices are currently administered under the program. Under current CRP guidelines, CRP payments are reduced by 25% in the year of haying and management plans must be modified to reflect site-specific wildlife concerns (USDA – FSA 2008f). Haying and grazing are permitted only on CRP lands undertaking a limited number of grassland, wildlife habitat, and salinity reduction practices (practices CP1, CP2, CP4B, CP4D, CP10, CP18B, and CP18C). Accordingly, we focus only on the production of switchgrass and other perennial biomass on CRP grasslands. It is also possible that other biomass, such as hybrid willow or poplar, may be produced on CRP lands, but care is necessary to ensure that these crops are paired with appropriate practices.

Production of switchgrass and other perennial biomass on CRP lands can be accomplished while still meeting conservation objectives (De La Torre Ugarte et al. 2003; Mapemba et al. 2007). Switchgrass is native to North America, and has been cultivated for the past 50 years as fodder (Parrish and Fike 2005). Switchgrass is an efficient user of nutrients and does not require large applications of fertilizers, especially when grown as biomass (Parrish and Fike 2005). Partial harvest of switchgrass can increase the variety of habitats for birds by varying the grass heights (Rotha et al. 2005). Grassland bird species that favor short vegetation structures and low to moderate density have been found in harvested areas, while unharvested grasses serve as habitat for other species that favor tall grasses (Murray et al. 2003). The sustainability of feedstock production is, however, dependent upon institution of proper management practices (Robertson et al. 2008).

The use of biomass for biofuel production also has potential GHG mitigation benefits. Research suggests that ethanol produced from switchgrass has greater greenhouse gas benefits than corn-derived ethanol (Tilman et al. 2006; Adler et al. 2007). The production of perennial biomass can also help increase soil carbon sequestration (Jobbágy and Jackson 2000), but sequestration rates vary by cropping system (Sanderson and Adler 2008). Recent literature suggests that producing cellulosic ethanol on lands currently enrolled in CRP provides more carbon benefits than cultivating that land for corn ethanol, or simply keeping the land idle for sequestration purposes (Piñeiro et al. 2009). The production of biomass on CRP and other lands that are not currently being cultivated also potentially reduces competition between food and fuel crops, diminishing the conversion of other lands to agricultural production (Tilman et al. 2006; Fargione et al. 2008).

A primary consideration is whether feedstock can be produced on CRP lands in amounts and concentrations sufficient to sustain a biomass facility. At the national level, De La Torre Ugarte et al. (2003) estimate that 16.9 million acres of CRP land are available for biomass production; assuming that that over 55 million acres of cropland, idle cropland, and pasture will be necessary to meet year 2030 biomass demand (Sanderson and Adler 2008), 16.9 million acres satisfies approximately 30% of projected production demand. Walsh et al. (1996) claim even higher estimates of CRP land availability, assuming that 17.4 million acres are available for switchgrass production and 14.2 million acres are available for willow and poplar. Using experience with the CRP haying program as yet another benchmark of potential supply, a 2003 statement by the USDA suggested that managed haying could occur on roughly 25% of CRP grasslands (68 Fed. Reg. 24830; May 8, 2003). In 2003, this translated to between 6.3 and 6.9 million acres of grassland, implying an annual harvest availability of approximately 2.1–2.3 million acres, or roughly 4% of year 2030 biomass acreage demand.

Even with large supplies of biomass at the national level, sufficient biomass feedstocks must exist in high enough concentrations in the vicinity of the end-use facility in order to be economically viable. In some areas of the U.S., CRP-derived feedstock may exist in concentrations capable of supplying a several-thousand-ton/day facility (Mapemba et al. 2007). Others suggest, however, that insufficient concentrations of perennial grass and woody biomass acreage exist to support facilities in excess of 50 million gallon/year of output (Simpson et al. 2008).[6] Importantly, facility size can also have direct impacts on the average price of feedstock, as the cost to transport the required volume of biomass increases with larger facilities (Mapemba et al. 2007).

Increasing feedstock prices may be offset somewhat by the built-in production subsidy provided to switchgrass and other perennial biomass produced on CRP lands (Walsh et al. 1996). The inherent subsidy could potentially be viewed as unfair by non-CRP producers nearby. But unlike non-CRP biomass producers, CRP holders will likely be bound to strict production requirements. Regulations limiting the size and timing of potential biomass harvests can influence the cost of biomass feedstock production on CRP lands (Mapemba et al. 2007).

A larger issue is the reliance on CRP lands for the production of a commodity. Currently, no crops of any kind may be harvested from the designated CRP acreage during the contract period. If private production of biomass becomes a significant component of domestic supply, there will be pressure to acknowledge feedstock species as crops. In such a situation, the USDA must be prepared to make exceptions for these biomass feedstock species, and carefully distinguish between "conservation land cover" and "agricultural crop." In light of research showing that the type and amount of a given feedstock produced is strongly influenced by management objectives—cropping systems placing an emphasis on wildlife management will result in a different solution set than those maximized for biomass production (De La Torre Ugarte et al. 2003)—clear guidelines on the production of biomass of CRP lands are absolutely necessary.

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[6] Assuming a conversion rate of 65 gallons ethanol per ton of feedstock and 365 operating days per year, an output of 50 million gallons per year equates to a biomass demand of approximately 2,100 tons per day.

Regardless of management guidelines or harvest restrictions, allowing for large-scale biomass production on CRP lands can lower government outlays as rental payments are reduced in years of harvest. Tying production of biomass on CRP lands to some sort of rental rate reduction can reduce program implementation costs by several hundred million dollars per year (Walsh et al 1996). These savings could be offset to some extent by increased monitoring and enforcement costs, as landowners may be tempted to harvest more than the allowed frequency or outside of the allowed harvesting periods. Under current guidelines, 25% of haying and grazing contracts are subject to direct spot-check and inspection (USDA – FSA 2008f). Even if this percentage is to remain the same, increased landowner involvement in biomass production will increase the number of spot-checks required.

5.2. Increase rental rate commensurate with higher commodity or GHG prices

The current manner in which CRP rental rates are determined gives significant power to landowners, ultimately affecting the total cost of the program. If a parcel of land scores highly on the EBI, then it is possible for landowners to bid above their reservation rents and receive a premium (Kirwan et al. 2005). An anticipated result of the recent surge in commodity markets is that landowners will begin to increase their bids with higher expectations regarding future profits and a greater chance of bid acceptance (as the opportunity costs of idling land increase, a smaller pool of bids is probable).

Furthermore, the 2008 Farm Bill (P.L. 110-246) reduced the targeted CRP acreage to a target rate of 32 million acres. If the CRP is appropriated similar funding as in the past, this move sends a market signal that the FSA is willing to pay higher rental rates and accept reduced conservation acreage. Thus, changes in policy and landowner bidding behavior may drive up CRP rental rates. Such increases in rental rates are in line with recent recommendations that the CRP focus less on maintaining acreage totals and shift limited resources to high-priority areas (Babcock and Hart 2008).

If rental rates increase slightly, the allocated funds are likely to be insufficient to maintain a stock of 32 million acres in the program and protect against mass reversion. In order to minimize the expected loss in soil carbon and ecosystem services from CRP reversion, the CRP rental rate could be increased significantly via two mechanisms: 1) additional subsidization consistent with higher commodity price regimes and more flexible contract schedules, or 2) a direct increase in soil rental rates or contract acceptance determined by the carbon sequestration potential of the land. It is noted that each of these options could require significantly increased costs of maintaining the CRP. This could make each policy option unpalatable for policymakers, but it is important to consider that the opportunity cost of CRP recultivation is potentially greater in a low-carbon economy.

Option 1: Higher payments consistent with higher net returns

Raising soil rental rates to be more consistent with contemporary agricultural land values may be the only sure way to minimize damages from recultivation. While straightforward in concept, implementation is somewhat more complicated. Raising CRP rental payments to be commensurate with contemporary agricultural land values would significantly increase the costs of the CRP program. Currently, the program supports mean rental rates that range from $24-$97/acre/year. If the CRP is to compete with high profit potential from commodity production, rental rates will have to increase significantly.

It is difficult to say how rental rates should be augmented to account for higher opportunity costs of conversion. One approach is to simply raise the mean rates by the same proportion that price indices and land values increase. For example, considering a 10% long term increase in agricultural rents on marginal lands, which is a very modest increase, the additional costs per-acre would be $2.40-9.70/acre/year. In addition to overall program cost increases, the USDA/FSA could be taking on considerable risk if commodity prices stabilize to levels consistent with historical trends. If landowners were to "bid up" new or extended contracts with high expectations of future market conditions and prices return to historical trends, then the FSA would be locked into paying arbitrarily high contract rates. While biofuels and other competing demands for feed grains are expected to keep prices high for the foreseeable future, there is no doubt that commodity markets and agricultural land values are highly volatile. Policy and rental rates agreed on during a period of inflated commodity prices could lead to over-subsidized conservation practices.

An alternative approach would be to have a variable rental rate. The FSA could presumably allow the CRP rental rate to vary annually with agricultural returns. Here, bids would be accepted and baseline soil rental rates determined in exactly the same manner as they are now. The only difference is that the actual rate received by the landowner would vary in a predefined manner from year to year, depending on commodity prices and land rents.

The idea of a flexible rental payment would be to compensate landowners on an annual basis at a rate consistent with commodity price indices or cash rents for agricultural land. Data on annual cash rents (paid to landlords for agricultural land) can serve as a proxy for the overall value of agricultural land in a given time period for a particular region.[7] A flexible CRP contract could follow fluctuations in cash rents (or an alternative indicator, such as a price index or agricultural real estate values). Thus, after a base rental rate is determined, the actual rental payment will depend on movements in commodity/land markets. As an example, a 10% increase in cash rents in one time period could correspond to a 10% increase in soil rental rates the following year to adequately compensate the landowner for forgone profits.

There are at least two difficulties with this approach. First, it is possible that land values could dip below the bid CRP rental rate at some point during the contract period, at which point the landowner would receive less than the negotiated rate. This prospect is likely not palatable to landowners, and could create incentives to alter bidding behavior. Second, from the agency's perspective, this approach could increase costs of CRP substantially as cash rents will likely continue to rise. From 2000 to 2006, U.S. cash rents rose a somewhat modest 13.6% ($70-79.50/acre). However, between 2006 and 2008, rents have ballooned an additional 21% ($79.50-96/acre) (USDA-NASS 2008b). While this trend is unlikely to continue at such an accelerated pace, the prospect of paying continuously higher CRP contract rents presents policy uncertainty to the FSA in terms of the overall costs of land conservation per acre, and in terms of the number of contracts the FSA can potentially support in a given time period.

Yet another alternative is to only provide additional compensation in extremely profitable years in which commodity prices are high. First, a baseline CRP rental rate is determined according to the usual bid process. This would be the base rate that a landowner receives during the lifetime of the contract. Next, according to baseline agricultural land values by county, a new payment mechanism could be triggered if annual farm earnings or cash rents exceed some negotiated trigger point. The beginning of the next

[7] These values are available through USDA/NASS.

contract could return to the baseline rental rate unless higher prices were sustained for an additional time period.

The advantage of a profit-indexed approach is that it reduces risk for both the landowner and the FSA. For a landowner bidding to enter/re-enroll into a contract, this alleviates concerns of forgoing substantial short-term gains to production when prices are high, thereby decreasing the opportunity costs of idling their land. For the agency, this approach reduces the risk of raising rental rates during a short-lived period of high agricultural returns and then being locked into paying a higher contract for the full length of the term. The model here is consistent with past farm support programs that guarantee a certain return to agricultural producers.[8]

An important issue to consider is that the implementing agency would likely have to budget according to a worst case scenario every year to ensure all contract rents are payable. This is where the trigger mechanism is so important. The FSA can reduce overall project costs relative to a strictly variable rental payment by choosing a trigger point that is sufficiently high with a low probability of occurrence. The choice of an appropriate trigger price would be critical here, as it would need to be high enough to adequately compensate farmers for forgone profits.

Option 2: Including carbon payments directly into rental rates

If protecting against soil carbon loss is a primary objective, it is important to consider the inherent competition that could develop between the CRP and GHG markets. If participation in either is mutually exclusive, high carbon prices could encourage landowners to abandon the CRP in favor of offset project implementation. Altering CRP implementation to place increasing emphasis on carbon storage in the EBI or providing direct payment for soil carbon accumulation into the formal CRP contract could help combat this potential disincentive to CRP participation.

2.a. Altering the EBI scoring index

The CRP has traditionally promoted efforts to improve water quality and provide wildlife habitat, but implementation of the program could easily be modified to promote increased carbon sequestration as well. Currently, soil carbon plays a very minor role in the EBI scoring system used to rank CRP bids. Placing a greater weight on carbon storage is one way to both directly target soil carbon in CRP soils and to prioritize current CRP contracts for re-enrollment. While this may not affect rental rates directly, it does increase the likelihood of acceptance for contract bids with high sequestration or carbon storage potential.

Carbon storage accounts for a maximum of 10 points out of a possible 395 points in the EBI system (USDA – FSA 2008f). Augmenting the EBI to increase the weighting of carbon benefits would prioritize those offers with greater sequestration potential. Placing a higher weight on carbon could help the FSA target counties with high sequestration potential, thereby maximizing the carbon benefits of the CRP. In addition to placing a higher weight on soil carbon for new contract bids, the EBI could also account for previously stored carbon, giving an advantage to re-enrollees. Indeed, one way to maximize the carbon benefits of the CRP is to maintain the existing carbon stock and protect against land conversion. By

[8] Price support and loan deficiency programs follow a similar format. Information on these programs is provided by the Farm Service Agency of the USDA (http://ww.w.fsa.usda.gov/FSA/webapp?area=home&subject=prsu&topic=landing; last accessed June 12, 2009).

emphasizing existing carbon stocks in soils, there is a higher likelihood that landowners seeking to re-enroll will have their bids accepted.

2.b. Direct payments for soil carbon

Alternatively, carbon stored in CRP soils can be directly subsidized. Targeting soil carbon explicitly as a primary benefit of the CRP can be an effective way to increase the carbon sequestration potential of the program (Feng and Kling 2005, Feng et al. 2005, Feng et al. 2007). Existing carbon markets already provide a pricing mechanism for carbon storage. For example, the value of carbon dioxide traded on the Chicago Climate Exchange (CCX), a voluntary U.S. carbon market, was $7.40 per metric ton in May 2008 but fell to $1.45 by March of 2009.[9] If establishment of perennial grass cover sequesters an additional 0.8 metric tons of soil organic carbon per hectare as compared to croplands (Gebhart et al. 1994), the net sequestration value is 1.19 metric tons of CO_2e/acre or $1.73-$8.81 per acre per year. Higher carbon prices are expected under a mandatory U.S. carbon market, increasing per-hectare value of carbon storage significantly.

In terms of contracting, the Department of Agriculture can set rental rates independent of carbon payments, which could then be included as additional compensation. The advantage of this approach is that the targeted environmental benefit is funded directly. There is a great deal of heterogeneity in soil carbon accumulation rates, based on soil type, topography, climate, and a host of other factors, so accounting could be cumbersome (Post and Kwon 2008; Antle et al. 2003). However, as the overall understanding of the soil carbon cycle continues to improve and more data becomes available, accounting for regional soil carbon balances and targeting conservation policies or practices that enhance this benefit is entirely possible.

With the inclusion of carbon sequestration in the calculation of rental rates, forest cover can become a more attractive option in areas where multiple types of land cover are feasible. Grasslands currently compose more than 90% of CRP lands (USDA – FSA 2009). Carbon sequestration considerations may shift this balance in favor of more tree-planting, since trees can sequester high levels of carbon per acre relative to grasslands. Research suggests that forests can sequester 0.9–4.6 tons of carbon/ac/yr (3.3–16.9 tons CO_2e/ac/yr), depending on stand age and timber species (Stavins and Richards 2005). This far exceeds the per acre soil organic carbon sequestration reported above. Even with additional payments for carbon sequestration, it is unlikely that vast portions of the CRP will be converted from grassland to forest. In particular, landowners may be reluctant to plant forests if they are forced to sacrifice flexibility over future land use decisions unless compensation is high enough to induce this land conversion (Richards et al. 2006).

An important drawback to attaching soil sequestration payments to CRP contracts is the price volatility in carbon markets. The cost of incorporating a carbon payment into CRP rental rates varies depending on the net sequestration expected on CRP lands and on the size of the carbon payment. If all 32 million acres of CRP land are converted to grassland and achieve a carbon storage rate of 1.19 tons CO_2e/acre, CRP program expenditures increase by $380 million per year at $10/ton CO_2e. Assuming that all 32 million acres of CRP land are converted to forests and achieve a net rate of sequestration between 0.9 and 4.6 tons of carbon/ac/yr, CRP rental rate expenditures would increase by $1B to $5.4B at $10/ton CO_2e. For comparison, current annual CRP expenditures are approximately $1.8 billion (USDA – FSA

[9] Retrieved May 31, 2008 and March 19, 2009, from http://www.chicagoclimatex.com/.

2008c). Whether the USDA/FSA has sufficient funding to cover these additional costs is an important policy concern.

If the objective is to maximize carbon sequestration, linking payment directly to the amount of sequestered carbon is more efficient than simply providing payment for implementing a certain practice (Paustian et al. 2006). For example, the marginal cost of sequestering carbon by retiring Highly Erodible Lands (HEL) such as those in the CRP depends on the carbon sequestration capacity of the soil and the value of the crop displaced by the CRP. Replacing soybeans grown on sandy soils is very costly (\$1,224/metric ton CO_2e) because the land rental rate is high but carbon accumulation is low, while on some cotton lands the marginal cost of soil carbon storage can be as low as \$3/metric ton CO_2e (Sperow 2007).

Simply providing payment for carbon may be insufficient in itself to prevent mass conversion of CRP lands. Estimates by Secchi and Babcock (2007) indicate that even doubling current rental rates will only retain one-third of current acreage in Iowa. With low per-acre rates of sequestration and at low carbon prices, it is difficult to imagine how additional rental payments would be large enough to compete with high commodity or land prices. Also, terrestrial offsets could face steep discounts due to permanence, leakage,[10] and additionality concerns, so even higher carbon prices may not offer enough incentive to keep agricultural land idle.

Providing direct payment for carbon sequestration requires attention to the permanence of carbon storage benefits. For example, grasslands compose a large majority of CRP lands but are easily converted into cropland upon contract expiration, so there is no guarantee that soil carbon benefits will last indefinitely. If the goal of incorporating a carbon payment into CRP rental rates is to achieve long-term GHG benefits, the issue of permanence must be addressed through regulatory or contractual means. If the goal is simply to stem the loss of CRP acreage and provide an incentive to undertake activities that can store carbon in the short-term, permanence becomes less of an issue.

Providing direct payments also requires calculation of the actual amount of carbon that was stored by the activity. This is an important consideration because carbon storage benefits may accrue simply as a result of a landowner implementing an agreed-upon CRP contract. If a landowner is already being paid a per-acre rent to restore his/her land, providing a payment for the carbon benefits that accrue from this action would be providing double compensation for a single management action. While less an issue here than under a federal GHG compliance market (explored below), it is still important to acknowledge the potential fairness and efficiency issues that emerge when providing payment for carbon storage benefits that accrue simply through CRP contract implementation.

5.3. Allow CRP lands to join federal offset programs

While the two policy options discussed above hinge on a revision or slight alteration of the CRP itself, the feasibility of CRP participation in a federal GHG offsets program will largely depend on the construction of the offsets program. Furthermore, the interaction between conservation programs like the CRP and a mandatory GHG cap-and-trade program remain unresolved. An offsets market–induced shift out of the CRP is unlikely on lands and under practices characterized by low rates of carbon

[10] It is unlikely, however, that those management decisions that increase soil carbon storage on CRP lands will result in significant emissions on non-CRP lands (EPA 2005).

sequestration. This is a very different situation for activities characterized by high rates of carbon sequestration (e.g., afforestation and reforestation), where a carbon price as low as of $5.56 per ton CO_2e can result in per-acre carbon payments that are greater than the range of current CRP rental rates.[11] As explored below, the issue of additionality will be a key factor in whether carbon prices of this magnitude or greater will actually induce a shift out of CRP.

Policy precedent exists for CRP land participation in offset markets. Beginning with the 2003 CRP interim regulations, CRP contract holders can sell carbon and other ecosystem services (7 CFR 1410.63(c)(6)). The creation of a mandatory carbon market in the United States continues to receive considerable attention, but the exact interaction between the CRP and any eventual cap-and-trade program remains hypothetical. In the absence of a federal program, state and regional registries and markets have been established (e.g., Regional Greenhouse Gas Initiative [RGGI]; California's Climate Action Registry [CAR]), as have voluntary carbon markets and registries (e.g., Chicago Climate Exchange (CCX); U.S. Department of Energy 1605(b)). Even in these existing registries and markets, however, conflicts between conservation program and carbon market participation have been largely absent. This could be due to the voluntary, non-compliance nature of some of the existing markets or programs, or alternatively to minimal overlap with conservation program lands.

It is still uncertain whether or how CRP contract holders will be able to participate in an eventual federal offsets market. As introduced in the Senate in 2007, Section 2403(c) of S. 2191, America's Climate Security Act, originally prohibited offsets from being generated from any "project participating in Federal, State, or local cost-sharing, competitive grant, or technical assistance program." This provision was removed before the bill was passed out of the Senate Committee on Environment and Public Works, suggesting that the potential participation of CRP and other conservation payment programs in a GHG offsets market is an issue that is of concern to some stakeholders. While the issue is not directly addressed in legislation recently introduced in the U.S. House of Representatives (H.R. 2454, The American Clean Energy and Security Act of 2009), the bill does limit eligibility based on when an activity was initiated (Sec. 734). These timing restrictions in themselves could limit the participation of certain existing CRP contract holders. Of course, the same would also hold true for all landowners implementing activities as of these benchmark dates, not just participants in the CRP.

Despite this uncertainty, several potential approaches exist that could allow programs like the CRP to be incorporated into a federal offsets program. The first option for allowing CRP participants to also participate in a national GHG market is to permit landowners to offer as offsets only that portion of carbon storage that is above and beyond what is accrued through simple compliance with the CRP contract. This option treats carbon sequestration achieved as a result of CRP participation as a baseline. If a landowner can undertake additional actions that are still in line with the conservation agreement but that result in additional carbon storage, the difference may be sold on the market. A key drawback to this approach is administration, especially as it pertains to establishing and verifying the amount of carbon that is eligible for sale. Contract or CRP program requirements may also limit the activities a landowner may undertake, restricting the amount of additional carbon that can be sequestered.

The second option is to apply a discount equal to the share of public funding that was used to implement the project. This approach assumes that the CRP rental payment is not enough to fully fund a shift in management practices or cover the opportunity cost of forgone harvests. Under this option, the

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[11] Assumes maximum sequestration potential of 16.9 metric ton CO_2e/ac/yr (Stavins and Richards 2005) and CRP rental payments of $27 to $94/ac/yr (USDA - FSA, 2007a)

landowner may market that percentage of stored carbon that is both above the baseline[12] and attributable to private funding. Of course, this assumes that participating landowners receive less in CRP rental payments than forgone revenue. Research suggests that this may not necessarily be the case (Kirwan et al. 2005). Even if the rental rate a landowner receives is below their reservation rent, establishing and verifying the exact amount of carbon eligible for sale may be a complicated undertaking.

The third option is to allow simultaneous participation in the CRP and federal offsets market, but only if the CRP contract is sought after sale of carbon has already begun. Under this approach, landowners already selling offsets to the carbon market may apply for participation in the CRP, but not vice-versa. This ensures that the sequestration of carbon is a primary motivation for undertaking a particular land use decision. Project eligibility could be easily determined, making administration of this approach simpler than the previous two options. Landowners pursuing this approach may have difficulty securing new CRP contracts, however, as the current EBI scoring system favors degraded lands. Current CRP participants could be presented with an option for GHG market participation when seeking re-enrollment, but, as above, it is important to carefully evaluate landowner motivations to avoid double-payment for any carbon benefits that accrue. That said, limiting GHG market participation to new actors is likely to be politically difficult (Richards et al. 2006). It also increases the risk that current CRP contract holders will abandon the program to either recultivate their fields or to participate unencumbered in the offsets market.

The fourth option is to provide some reward for landowners already participating in the CRP, but not necessarily allow them to sell offsets. Funding could be generated through a climate policy whereby allowances are auctioned and some portion of the proceeds is used to reward CRP contract holders for their additional or continued carbon benefits. Using auction proceeds rather than allowing CRP lands to participate in an offsets avoids potentially undermining cap integrity by allowing non-additional carbon sequestration into the market, but it can be politically more contentious. Examples of potential mechanisms to accomplish this include the allowance allocation process under Subtitle G of S. 3036, the Lieberman-Warner Climate Security Act of 2008, or possibly the mitigation financing program as suggested by Olander (2008).

Regardless of the approach, the central hurdle in allowing CRP lands to participate in a federal GHG offsets market is the concern over additionality. As noted above, a landowner receiving a payment for carbon storage benefits that accrue as part of CRP contract implementation is potentially being paid twice for a singular contribution. In the case of a federal GHG compliance market, such a situation would allow non-additional carbon into the compliance market. In order to be additional, the amount of carbon sequestered must be in addition to or on top of what would have been sequestered in the absence of the project. If the land was to be planted to native grassland as part of participation in the CRP program, the accrued soil carbon would be incidental, not additional.

Alternatively, prohibiting CRP participation in GHG markets could increase the likelihood that landowners will abandon the CRP to pursue offset opportunities. Whether or not a landowner will participate in a federal offsets program in lieu of the CRP depends on the relative payoff of each option. As an example, we compare an average per-acre carbon sequestration rate multiplied by a range of carbon prices to the national average CRP rental rate. Several field studies have measured the carbon

[12] In this situation, baseline may be determined separately using a project-specific or regional performance standard, or may be simply assumed to be the share of carbon that is attributable to out-of-pocket expenditures.

sequestration rates of CRP soils in the United States. While these estimates vary significantly by region and soil type, a recent study by Piñeiro et al. (2009) summarizes the results of numerous field studies, estimating an average soil carbon accumulation rate of 0.845 metric tons CO_2e/acre/year. Recall that the average rental rate for General CRP Signup is $44/acre/year, and $89 for Continuous Signup, implying that carbon prices would need to exceed $52 per metric ton CO_2e for offsets to compete with General signup, and $105 for Continuous Signup.

As explored above, reversion of land out of the CRP has numerous environmental drawbacks. If a landowner is removing land from the CRP in order to produce offsets, however, chances are that the new land use will provide at least some environmental benefits, depending on the practice. Requiring landowners to pursue a particular management strategy such as no-till in exchange for exiting the program early with little or no penalty could present yet another policy option to minimize the impacts of CRP reversion. A policy emphasis on no-till production methods on reverted CRP soils could reduce losses in soil carbon and militate against soil erosion risks. Unfortunately, such a requirement could also complicate determination of additionality.

Despite these potential difficulties, allowing CRP lands to join a federal offsets program has similar advantages to the second policy option explored above (paying landowners commensurate to the carbon sequestered by their land). Tapping into a market mechanism, however, offers a significant financial advantage that links buyers of carbon offsets with sellers (landowners). The taxpayer does not have to make additional payments to CRP contract holders, potentially alleviating budget concerns over carbon or commodity price volatility.

6. Conclusion

The emergence of new markets, rising commodity prices, and higher land rents will all impact implementation of the CRP. To avoid the loss of significant environmental benefits secured since the program's inception over 20 years ago, it is critical to assess how the CRP can function under shifting economic conditions. A first step in this process is to assess the current drivers of landowner participation in the program and how these drivers are likely to shift in a low-carbon economy that places increased value of the production of biomass and the management and storage of terrestrial carbon.

Commodity prices increased rapidly between late 2006 and 2008. While prices have somewhat stabilized, they remain above historical trends. CRP rental payments that once provided the benefits of certainty and steady income now come with greater opportunity cost. As a result, participation in the CRP may become less attractive. In order to preserve the water quality, wildlife habitat, and carbon storage benefits that have been achieved thus far, it will likely be necessary to modify the way the CRP is implemented.

Several policy options exist that can simultaneously buttress against a loss of CRP acreage while still staying true to the program's conservation mission. Increasing rental payments to better capture the opportunity costs of forgone agricultural production or the benefits of carbon storage can make participation in the CRP a more competitive option. But large increases in rental pay-outs can place enormous burdens on agency budgets, and in themselves may be insufficient to stem the loss of significant CRP acreage. Allowing the production of bioenergy feedstock on CRP lands or allowing CRP contract holders to participate in a federal carbon offset program rely on the market to provide payment for services rendered. This addresses federal agency budget concerns, but it can undermine environmental or GHG mitigation objectives if adequate guidelines and oversight are not put in place.

In the distinct case of the CRP, alteration of rental rates to be commensurate with carbon storage benefits holds particular promise, as does alteration of the EBI scoring system to better recognize carbon storage potential. Under both mechanisms, the underlying structure of the CRP is maintained, and additional flexibility is granted the program to respond both to emerging carbon markets and to shifting commodity markets. Obviously, an increase in rental payments could increase total program cost if CRP acreage remains constant. It is important to recognize, however, that the opportunity cost of CRP recultivation is also greater in a carbon-constrained era. If CRP acreage is allowed to decrease, alteration of the EBI could help to shift limited resources to high-priority areas.

Alternatively, use of the CRP to produce biomass as biofuel feedstock has precedent in current haying practices, but may fail to produce feedstock in sufficient concentrations to support widespread large-scale biofuel facilities on their own. Potential may exist, however, for a smaller subset of CRP lands to serve as a sort of "biomass reserve," where biomass harvesting is used to supplement feedstock coming from other non-reserved lands in times of severe weather or market conditions (see, e.g., American Corn Growers Association 2007; Hart and Babcock 2007). Such an approach would also approximate current emergency haying provisions in place for CRP lands.

While the sale of carbon storage benefits to voluntary markets is currently allowed on CRP lands, the sale of carbon credits to a federal GHG compliance market is likely to be a complicated undertaking. As with countless other existing activities and programs, issues of baseline and additionality need to be fully examined and satisfied. How these issues are to be resolved in, by, or through climate legislation remains unclear at the present time, but multiple policy options exist that could be used to recognize incremental GHG mitigation benefits achieved on CRP lands.

Continued work is necessary to better evaluate the role of the CRP and other conservation programs in emerging GHG compliance markets, as this may be a driver of landowner participation in both carbon markets and traditional land conservation programs for decades to come. Larger issues of agency budget restrictions, program oversight, and the establishment of guidelines to address new activities are not unique to the CRP. Indeed, they will likely apply to countless other public conservation programs operating in a low-carbon economy. Key to maintaining the environmental successes achieved by these programs thus far is a comprehensive re-evaluation to ensure that they remain complementary to landowner objectives, especially in an era characterized by emerging markets and increasing commodity prices.

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