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An Economic Evaluation of the U.S. Conservation Reserve Program

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AAA	Agricultural Adjustment Act
CCC	Commodity Credit Corporation
CH_4	Methane
CO_2	Carbon Dioxide
Con	Continuous Signup
CP	Cover Practice
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
DEFRA	Department for Environment, Food and Rural Affairs, United Kingdom
DRL	Deutscher Rat für Landespflege
EBI	Environmental Benefits Index
EI	Erodibility Index
FACT	Food, Agriculture, Conservation, and Trade Act
FAIR	Federal Agricultural Improvement and Reform Act
FSA	Farm Service Agency
Gen	General Signup
LCC	Land Capability Classes
MARR	Maximum Acceptable Rental Rate
N_2O	Nitrous Oxide
NRCS	Natural Resources Conservation Service
OECD	Organization for Economic Cooperation and Development
SSSI	Sites of Special Scientific Interest
T	Soil Tolerance Level
U.S.	United States
USDA	United States Department of Agriculture
USGAO	United States General Accounting Office
WRP	Wetland Reserve Program

1 Introduction

U.S. agriculture is one of the most productive in the world. Energy, machinery, agrochemicals, and irrigation have propelled American agriculture from pioneering conversion of the landscape to intensive, high-yield, monocultural production. Simultaneously, the structure of the agricultural sector has changed dramatically. Larger, more economically efficient producers have increasingly replaced smaller, less successful farms (Allen 1995).

However, these developments have had a large impact on the quality of environmental resources. [1] Intensive cropping practices leave the soil bare for extended periods of time, and thereby expose acres to wind and water erosion. Annual agriculture-induced erosion amounts to 1.89 billion tons (Claassen et al. 2001, p. 3). Soil erosion diminishes the productivity of cropland. Moreover, wind-borne soil particles reduce air quality and cause property and health damages (Ribaudo et al. 1989, p. 421). The application of agrochemicals has direct effects on the quality of groundwater resources. At the end of the eighties, researches found nitrate in more than half of the 94,600 community water system wells. In addition, water erosion carries agricultural residues, e.g. pesticides, into surface waterways endangering aquatic wildlife habitats and decreasing the quality of drinking water resources. For example, agricultural resources are suspected to contribute about 65 percent to the nitrogen loads entering the Gulf of Mexico from the Mississippi Basin (Claassen et al. 2001, p. 2). The conversion of grassland and remnant habitats, such as hedgerows, woodlots, and wetlands, to crop production has brought about dramatic reductions in many wildlife species, e.g. cottontail rabbits and ringneck pheasants. In general, agricultural activities have been a factor in the decline of 380 of the 663 species federally listed as threatened or endangered in the United States (Feather et al. 1999, p. 3).

An important means to cope with environmental problems of agricultural activities are agri-environmental policies which compensate farmers for adopting ecologically beneficial practices (see, for example, Claassen et al. 2001). The United States Department of Agriculture (USDA) has established a variety of such compensation payment instruments to address conservation problems of rural land management. The largest and most important USDA conservation initiative is the Conservation Reserve Program (CRP), which was implemented in 1985 (Heimlich 2003). The CRP is a voluntary long-term land retirement program aimed at reducing water and wind erosion, protecting soil productivity, improving water quality, and enhancing wildlife habitat. Farmers sign contracts for 10 to 15 years and have to establish long-term, resource conserving covers. In return, they receive annual rental payments and cost-share payments (USDA 2003c).

The aim of this work is to evaluate the CRP economically. Findings are of particular interest since the CRP has been the first large-scale compensation payment tool to apply an auction in order to assess payments and allocate conservation resources, whereas traditional compensation payment approaches rely on posted payments (Hamsvoort and Latacz-Lohmann 1996, p. 10). To assess whether the USDA has designed the CRP appropriatly, the work focuses on two criteria: ecological effectiveness and cost-effectiveness. However, it has to be mentioned that this work neither researches the suitability of compensation payment policies in general, nor that of practice-based compensation approaches in particular. Furthermore, the discussion on possible advantages and disadvantages of land retirement tools will not be reflected. On the contrary, any discussion on the CRP design considers these conditions ceteris paribus.

This work is divided into five parts. Chapter two discusses generally why compensation payments to farmers should be made, and which options decision makers have when designing such instruments. The objective of chapter three is to develop the criteria that should be included in an evaluation of compensation payment policies to answer the above questions. The next section provides insights into the design of the CRP and numerical information about the

[1] For a general overview of impacts of agricultural activities see Babcock et al. (2001).

program. Chapter five applies the criteria developed in section three to the CRP. Subchapters will be devoted to issues of ecological effectiveness and cost effectiveness (in terms of production costs, transaction costs, and deadweight losses). The final section summarizes the findings made in this work and states directions of further research.

2 Compensation Payments as a Tool of Agri-Environmental Policy

2.1 Background

The introduction has shown that agricultural activities have a large impact on the quality of environmental resources. These resources are examples of public goods. Public goods are available for free because no one can be excluded from using them and the consumption of one party does not diminish that of another. These characteristics impede the trading of public goods in the market and the setting of prices to indicate scarcities (Babcock et al. 2001, p. 3). The free availability of public goods causes side-effects, the so-called externalities. Externalities are produced when actions of an individual or group improve (positive externalities) or diminish (negative externalities) the well being of another individual or group. Thereby, the latter may gain savings or incur costs which are typically not reflected in market transactions (Babcock et al. 2001, p. 2). Thus, the private costs of activities do not correspond to the social costs (Hofmann et al. 1995, p. 10). The problem of public goods and the necessity of reducing externalities are therefore seen to sufficiently justify government action in agriculture (Babcock et al. 2001, p. 3).

But does a farmer who, for example, applies fewer pesticides and thus improves the quality of streams and lakes produce a positive or reduce a negative externality? This question is of high political and practical relevance as it determines the justification or nonjustification of compensation payments to farmers. Bromley (1997) relates this question to the distribution of property rights, that is, "the socially sanctioned and enforced normative elements of civil society" with regard to "the realm of objects and benefit streams" (Bromley 1997, p. 5).[2]

If farmers are supposed to hold the complete property rights on land and resources, they have the right to carry out any profit-maximizing activity, irrespective of possible external costs or benefits (Hanley and Oglethorpe 1999, p. 1222). Consequently, if a farmer gives up the use of pesticides (and thereby a part of his profit) to improve water quality, he will provide external benefits (Hampicke 1996, p. 73). This implies that any government regulation requiring such changes of farming activities, and thereby, transferring property rights from farmers to society, will have to compensate farmers for their foregone profits (Hanley and Oglethorpe 1999, p. 1222, Bonnieux and Weaver 1996, p. 213). Such payments apply the "Provider Gets Principle" according to which suppliers of public goods – such as water quality – should receive support from public funds at the amount of their marginal opportunity costs of supply (Hanley et al. 1998, p. 104). Since farmers hold the property rights, they should be the ones to decide how to cultivate their land. Consequently, government agri-environmental schemes providing compensation payments are typically voluntary (see for example Whitby 2000b, p. 318, Hanley et al. 1999, p.73).

On the other hand, if the property rights are considered to reside completely with society or the state, farmers do not own land and resources but only receive an allowance to use them according to the wishes of society (Bromley 1997, p. 5). As pollution or the destruction of resources usually do not correspond to these wishes, reducing the use of pesticides is seen as an explicit duty when farming land that belongs to society as a whole. Thus, farmers who reduce environmental pollution do not produce positive externalities but decrease negative external effects (Hampicke 1996, p. 73). Following the "Polluter Pays Principle" the financing of such

[2] Property rights include the rights to use an asset, to change its form and substance, and to transfer all rights in the asset, or some rights, as desired. (Furubotn and Richter 1997, p. 72)

protection has to be carried out at the farmers' expense and may be imposed on them via Pigovian taxes (Hanley et al. 1998, p. 102, Hampicke 1996, pp. 40-41).

From an economic perspective, both property regimes may deliver efficient solutions under certain conditions (Bromley 1997). Decisions on which principle to apply are therefore mainly politically influenced, and could, theoretically, go either way (Hampicke 1996, p. 44). Nevertheless, experience from agricultural practice has led to farmers being considered to hold the property rights, and nowadays the "Provider Gets Principle" is applied in many OECD countries (Hanley et al. 1998, p. 104). One reason can be seen in the problematic economic situation of many agricultural enterprises. Tobey and Smets (1996, p. 72) emphasize that small family farms, which still account for the majority of agricultural enterprises, may face particular difficulties in adapting to changing environmental requirements and financing pollution control practices. Under these conditions, Heißenhuber (1995, p. 126) expects that farmers may give up their enterprises rather than adopting ecologically beneficial practices. Moreover, powerful farm lobbies in most industrial countries have prevented the implementation of policies that impose costs on agriculture which might adversely affect farmers' income, the level of production and the agricultural workforce (Tobey and Smets 1996, p. 73, Hanley et al. 1998, p., 102). Hampicke (1996, pp. 81-82) points out that overcoming such reluctances is of particular importance in the presence of urgent environmental problems which require solutions in the short term. Consequently, governments may have to provide financial incentives.

Usually, property rights are attributed to farmers to a certain extent only. Governments usually establish a baseline to distinguish between practices farmers should be paid for, and uncompensated activities (Babcock et al. 2001, pp. 11-12). One approach for determining this baseline is Bromley and Hodge's (1990) reference point of environmental quality.[3] This reference point represents a level of environmental quality desired by society. Any farming activities that "only" meet this standard should be considered mandatory, and those practices that do not meet them as generating external costs. On the other hand, practices that exceed the determined standard should be seen as producing external effects, and should, therefore, be compensated by society. Because of differences in local environmental quality, innovations and changing preferences, the choice of reference point may vary spatially and temporally. Such reference points are constituted through laws and agreements (Scheele and Isermeyer 1989, pp. 100-103). One example of how to realize such divided property regimes is the legislation on "Good Agricultural Practice" introduced by the European Community.[4] Based on this idea several authors have developed catalogues of practices that may improve the quality of abiotic (soil, water, air), biotic (biodiversity) and aesthetic (landscape) resources, and for which farmers should be paid (DRL 2000, Schumacher 2000, Hofmann et al. 1995, p. 11, Heißenhuber 1995, p. 127).

2.2 Design

2.2.1 General Characteristics

The provision of compensation payments is typically aimed at encouraging the production of environmental goods and reducing the production of environmental bads. Corresponding measures usually relate to the extensification of input use, e.g. significant reductions in the use of fertilizers, pesticides and herbicides and the reduction of livestock density. Other measures may involve the ecologically beneficial management of farm land, such as fixed deadlines for mowing and grazing or the planting of hedges to conserve or re-establish flora, fauna and scenic features of cultivated landscapes. Furthermore, payments can be made to farmers for the upkeep abandoned farmland in rural areas and for providing land for public access and leisure activities, or they can be paid to set-aside tracts of land for several years (Scheele 1996, pp. 4-5).

[3] Other approaches to determine the baseline use time (compensating only newly adopted practices) (Babcock et al. 2001, p. 12) or with-or-without comparison (compensating only practices that if absent would diminish benefits to third parties) (Hanley et al. 1998, p. 103).

[4] For further details and problems see, for example, Hampicke (1996), DRL (2000), Schumacher (2000), Scheele and Isermeyer (1989), and Junghülsing (2000).

Compensation payments are usually funded from agricultural support budgets and administered by a farm agency or ministry (Hanley and Oglethorpe 1999). Farmers receive these payments, if they sign voluntary agency-farmer contracts and, thereby, agree to adopt certain management practices on their land. These so-called management agreements define the objectives of the contract, the area of land covered, the types of activities prescribed, the contract duration and the level of incentive offered to the farmer (Whitby 2000b, p. 318). The payments are supposed to compensate farmers for foregone profits which may result, on the one hand, from higher costs incurred when fulfilling the prescribed activities and, on the other hand, from lower revenues due to less intensive cultivation (Schumacher 2000, p. 22).

Basically, compensation payment policies can be differentiated with respect to the pricing mechanism to determine the appropriate amount of payment.

2.2.2 Payment Mechanisms

Latacz-Lohmann (1998) lists three important mechanisms to determine payments: posted prices, auctions and negotiations.

2.2.2.1 Posted Prices

Posted prices (fixed-rate payments) are the most wide-spread mechanism. The government centrally estimates prices for public goods. In terms of incentive payments, these are transferred to farmers who supply such goods by adopting adequate management practices (Latacz-Lohmann 1998, p. 174). These fixed prices may be uniform across the entire country, but differing from practice to practice, or only uniform within certain areas, but varying across these areas (Hanley et al. 1999, p. 71). The estimation of prices, and thus, of the necessary payments is usually based on average opportunity costs, that is the farmer's average profit foregone by applying a particular management practice. Land managers have no influence on the level of compensation payments, they can merely decide whether to participate or not, and which of the practices offered by the government to choose (Latacz-Lohmann 1998, p. 174). Under these conditions, farmers enroll in a management scheme if the payment offered at least covers their opportunity costs (Latacz-Lohmann 1998, p. 177).

2.2.2.2 Auctions

Public funds may also be distributed to farmers by auctions. "An auction is a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from market participants" (McAfee and McMillan 1987, p. 701 in Hamsvoort and Latacz-Lohmann 1996, p. 12). When applying such mechanism to conservation policies, the responsible agency first of all has to set up multiple similar conservation contracts for tender. These contracts clearly define which management requirements will be imposed on participating farmers. Subsequently, farmers submit bids to the agency indicating the amount of compensation they require to enroll in the management scheme (Latacz-Lohmann 1998, p. 174). Thus, potential participants are forced to compete for a limited number of contracts (Holm-Müller et al. 2002, p. 112).

In contrast to conventional auctions, conservation auctions are often held as reverse auctions rewarding the lowest bidders (Latacz-Lohmann 1998, p. 175).[5] However, costs may be converted into an index that results in high scores for low cost bidders and vice versa (as applied by the CRP). Therefore, aspects discussed in the remainder of this chapter will refer to initially presented type of auctions. In both cases, the number of bidders accepted mainly depends on the government's budget and the type of auction applied.

The process of bidding may be organized in several ways. First of all, one can distinguish between static and dynamic auctions. Static, or sealed-bid, auctions allow only one round of

[5] For a more theoretical analysis of auctions see van der Hamsvoort and Latacz-Lohmann (1996) and Latacz-Lohmann and van der Hamsvoort (1997).

bidding (DEFRA 2003). By a pre-set deadline, bidders hand in both their supply schedules, which include the amount of land they are willing to enroll for certain practices, and the corresponding payments required. Using these schedules the agency forms an aggregated supply curve which is then matched with the demand, that is, the government's environmental aims and budget, to determine the clearing price. Bids at the clearing price, or better clearing index, and above will be accepted (Cramton and Kerr 1998, p. 5).

On the other hand, dynamic auctions can be held allowing more than one round of bidding. This enables farmers to revise their bids with respect to the previous round of bidding, if they realize, for example, that their offer is below the clearing price (DEFRA 2003).[6] Dynamic auctions can be conducted in two basic ways: with supply schedules or with ascending clock. The supply schedule approach is very similar to the sealed-bid auction, except that bidders repeatly submit their offer in several rounds. This process ends when no bidder is willing to improve his bid. All offers at or above the clearing price are accepted (Cramton and Kerr 1998, p. 7). Ascending-clock auctions differ from supply-schedule approaches in that the auctioning agency states an index (and implicitly a price). Thus, bidders are no longer able to determine the price they desire in their bid, but only the quantity of land they are willing to enroll, given the above index. If the amount of enrollments offered at a certain price is higher than what can be funded from the agency's budget, the auctioneer may raise the index. The bidding continues until the quantity supplied is less than the quantity that can be funded (DEFRA 2003).[7]

Auctions may also differ in how the accepted suppliers of public goods are paid. In uniform-price auctions, every bidder receives the same amount of compensation (usually the clearing price) per unit of public good provided. Alternatively, bidders may be paid according to the "pay-as-bid" approach, and thus, get compensation only at the amount submitted in their offer. Both payment mechanisms can be applied equally well for static and dynamic auctions.[8] In practice, large scale auctions have only been implemented in the United States, using a static "pay-as-bid" mechanism (Hamsvoort and Latacz-Lohmann 1996, p. 10, Latacz-Lohmann 1998, p. 175).

2.2.2.3 Negotiations

Negotiation solutions have been applied in a few cases only.[9] Following this mechanism, compensation payments are individually bargained between the farmer and the government for every single management agreement. This approach corresponds to the Coasean bargaining solution, except for the facts that the negotiating parties in reality may face information asymmetries (an aspect that will be particularly focused on in chapter 3.2.2) and that the environmental agency or government may have significant powers of compulsion (Latacz-Lohmann 1998, p. 179). Negotiation usually starts with an offer from the agency which the land manager may accept or reject. Reasons for turning an offer down may be that it does not cover

[6] Actually, the DEFRA (2003) considers auctions which reward the lowest bidders. Thus, the implications are reversed to be applied to conventional auctions.
[7] There are many other auction forms such as fixed price or fixed quantity auctions, ausubel auctions, etc. See, for example, DEFRA (2003) and van der Hamsvoort and Latacz-Lohmann (1996).
[8] Uniform and "pay-as-bid" are the most common pricing methods. A third pricing rule is the Vickrey auction (see Cramton and Kerr 1998, p. 6).
[9] Management agreements for Sites of Special Scientific Interest (SSSI) in the United Kingdom are one example (see Whitby and Saunders 1996).

the farmer's opportunity costs or that the farmer is hoping for higher payments. This process may be continued for several rounds until either the agency is not willing to improve its offer any more, in which case no agreement is reached, or the farmer is satisfied with the payment and a contract is signed (Latacz-Lohmann 1998, pp. 182-184).[10]

However, negotiations are only mentioned for the sake of completeness and are not further disucussed in the remainder of this work.

3 Criteria for the Evaluation of Compensation Payments

Literature offers a variety of criteria for the evaluation of environmental instruments (see, for example, Cansier 1996, Endres 2000, Feess 1998). Nevertheless, it is lacking an overview of criteria that are of importance in the context of compensation payments. Thus, this chapter introduces the criteria that are considered in this work and highlights their importance in the context of compensation payment policies. Ecological effectiveness and cost-effectivenes are the criteria that are best researched for such policies – in theory as well as in the CRP's practice. Consequently, the evaluation will focus mainly on these two criteria. Other criteria, such as impacts on innovation, competition and distribution, structural flexibility, or political acceptance cannot be taken into account due to a lack of research with respect to compensation payments.

3.1 Ecological Effectiveness

The amount and the quality of public goods supplied by compensation payment instruments may differ widely. Therefore, it is important to evaluate whether the instrument applied can guarantee the achievement of environmental goals (Endres 2000, p. 121, Feess 1998, p. 50). The evaluation of environmental success does not only refer to the extent to which these goals have been reached, but also how much time it has taken. The latter aspect is of special interest if urgent environmental problems have to be solved (Weingarten and Schleef 2000, p. 55). If positive results are detected, research on whether these would not have occurred in the absence of the program is necessary. Such estimation requires a reference scenario to predict the development of the quality of the public good without the compensation payments made to farmers (Bergschmidt and Plankl 1999, p. 572-573).

[10] In the last round, accepting the agency's offer is the dominant strategy for the farmer if his opportunity costs are covered. Reasons for accepting an offer in an earlier round may be impatience or costs of continuing the negotiation (Latacz-Lohmann 1998, pp. 183-184).

The assessment of environmental results and reference scenarios depends mainly on the means that have been built into the program to enable an adequate monitoring and evaluation of its effectiveness (see, for example, Kleijn et al 2001, Bergschmidt/Plankl 1999). However, these systems are subject to certain difficulties and limitations. First of all, the success of agri-environmental policies is subject to ecological conditions and processes. Hanley et al. (1999, p. 75) point out that the production of public goods always involves uncertainty and time lags.[11] For example, the effects of reducing fertilizer application may both be uncertain and take several years to reach significant levels. Uncertainty may result from the heterogeneity in underlying conditions (e.g. soil type, geology, hydrology) and the unpredictability of natural events (e.g. weather) (Claassen and Horan 2000, p. 16). Second, the nature of agricultural environmental problems complicates the measurability of ecological outcomes. Most agricultural pollution results from nonpoint sources and has multiple contributors. Thus, it is difficult to determine precisely who and what activities are responsible for which proportion of the total pollution load. Measures applied in only one area may have disappointing results, and improvements detected may actually be put down to practices adopted on other lands. Disentangling such effects is complicated and becomes even more difficult when areas are affected by more than only one policy instrument (Claassen and Horan 2000, p. 15, Tobey and Smets 1996, p. 71, Hanley et al. 1999, p. 76). Furthermore, evaluators are faced with problems in knowing whether farmers are able to meet the contract's requirements, whether they will meet these requirements (due to asymmetric information) and if the practices contracted will produce the desired goods (Hanley et al. 1999, p. 75). In fact, the effectiveness of policies may not be hampered by inappropriate design but by farmers who are unable or unwilling to adopt the prescribed measures. Consequently, it may be interesting to investigate how these problems are addressed in the design of compensation payments.

3.2 Cost-Effectiveness

Cost-effectiveness considerations refer to the economic costs the society incurs when a compensation payment policy is implemented. The cost-effectiveness analysis of this work includes three categories of economic costs: production costs (chapter 3.2.1), transaction costs (chapter 3.2.2) and deadweight losses (chapter 3.2.3).

Generally, two definitions of cost-effectiveness may be distinguished. On the one hand, a conservation policy can be considered more cost-effective than another if it produces a determined ecological outcome at a lower sum of production costs, transaction costs and deadweight losses. On the other hand, a conservation policy is superior to another if it at the same preset economic costs generates higher conservation benefits (Wätzold and Schwerdtner 2004). Both definitions lead to the conclusion that cost-effective compensation payment policies have to maximize the total amount of environmental benefits received per dollar expended (Wu and Skelton-Groth 2002, p. 313).

3.2.1 Production Costs

The production costs resulting from compensation payment instruments refer to the costs incurred when the required practices are actually applied. Usually, these costs are not uniformly spread over an area and time and amongst farmers adopting given practices, but subject to spatial and temporal variation. Furthermore, compensation payments are not typically paid for all agricultural lands or to all farmers but only to selected ones. Thus, environmental aims can be achieved at different costs depending on which land and which farmers are enrolled in a management scheme at a given time.

Spatial variation of costs may result from differing conditions under which practices are applied on farms. Differences may occur with respect to the opportunity costs of land if, for example,

[11] For an insightful analysis of uncertainty in the context of environmental instruments see Sterner (2003, pp. 150-166).

the suitability of land for economic purposes differs, resulting in different amounts of economic benefits foregone. Other reasons include variations in opportunity costs for labour or technical equipment, because larger firms, for instance, are able to realize economies of scale (Wätzold and Schwerdtner 2004, pp. 6-7). Moreover, benefits may differ between types of land. Assuming constant production costs, different amounts of benefits will result in different costs per unit of benefit. Schumacher (2000, pp. 21-22), for example, notes, that management agreements will produce higher benefits on meadows and pastures than on cropland. Hofmann et al. (1995, p. 33) conclude that measures applied on highly fertile sites will be less effective because most endangered species require soils that are low in nutrients. In addition, benefits may be affected by non-ecological aspects if they are considered in monetary terms. If such estimates are based on the demand for conservation benefits, these, for example, will be more highly valued in more densely populated areas (Ribaudo 1989a).[12]

Similarly, cost-effectiveness may be affected by temporal variations in costs and benefits. For example, the survival of storck nestlings depends on whether meadows around the nest have been mowed by the time they hatch out and, thus, the likelihood of the parents finding an appropriate amount of food. This implies that mowing is likely to provide greater benefits during the breeding period than before or afterwards (Johst et al. 2002). Costs may vary due to changing opportunity costs of land, e.g. foregone economic benefits arising when land is not cultivated in a profit-maximizing way, temporal variations of labour costs and possible additional economic benefits of conservation practices (such as improved quality of hay) (Wätzold and Schwerdtner 2004, pp. 6-7).

Consequently, these spatial and temporal variations have to be taken into account if compensation payments are to be implemented in a cost-effective manner. Programs have to be designed in such a way that they allocate resources to those farmers and acres that provide the greatest environmental benefit per dollar expended.

3.2.2 Transaction Costs

As a second cost component, conservation policies typically involve transaction costs. The consideration of transaction costs in the context of policy tools refers to findings made for production activities in the private sector. Coase (1960) stated that in order to carry out market transactions, additional costly operations are necessary, such as selecting transaction partners, negotiating, and observing fulfilment of the contract by the partner. Transaction costs of conservation policies are incurred by both the state and the farmer. For most compensation payment policies, the state bears the majority of the transaction costs (Whitby et al. 1998, p. 98). Nevertheless, Falconer (2000) emphasizes that agri-environmental schemes may produce significant private transaction costs as well. In both categories of costs, one can distinguish between ex ante and ex post transactions costs (Häder 1997, p. 70), or rather between costs of decision making and costs of implementation (Birner and Wittmer 2004).

Decision-making costs relate above all to the costs of acquiring information (Birner and Wittmer 2004, p. 4). From a private, that is the farmer’s point of view, these may arise from seeking information about the policies offered and analyzing their implications for one’s own enterprise (Whitby et al. 1998, p. 98). The government, on the other hand, has to seek information on which conservation policies to offer, including scientific knowledge on natural resources, where to apply these policies, and which requirements and payments these policies should include (Whitby et al. 1998, p. 98, Birner and Wittmer 2004, p. 4). A particular problem which arises in the context of public information costs is that of asymmetric information. This results from the fact that the state-farmer-contracts to constitute compensation payments can be described as principal-agent relationships (see for example Moxey et al. 1999). If principals are not able to cope with a problem on their own, they may see themselves forced to rely on agents.

[12] Undoubtedly, these estimates also depend on the valuation method used. For an overview see Bateman (1995) and Bonnieux and Weaver (1996).

In the case of compensation payments, the government (principal) is not able to improve the environmental quality on its own and offers therefore contracts to a large number of farmers (agents) (Whitby et al. 1998, p. 100). Such principal-agent relationships are typically characterized by information asymmetries in favour of the agent, that is, the farmer. Under these conditions, the agent is able to pursue not only the principal’s aims but also his private (contradictory) ones. One problem faced by the principal given asymmetric information is the existence of so-called hidden characteristics (Häder 1997, p. 66). In the case of compensation payments, the government may not be able to determine the true abatement costs incurred by farmers. On the other hand, farmers may be interested in receiving higher payments than strictly necessary and therefore indicate higher costs to the government, a problem that is called moral hazard (Whitby et al. 1998, p. 100).

A second element of ex ante costs is the cost of co-ordinating decision making if different individuals or groups are involved. It affects both private and public contractees and includes, for example, the resources used for meetings and solving conflicts and costs arising from delayed decisions (Birner and Wittmer 2004, p. 5).

Ex post, or implementation costs arise when environmental legislation is monitored and enforced. Becker (1968) explained monitoring and enforcement needs on the basis of economic cost-benefit considerations. He stated that individuals will violate laws and regulations if it maximizes their utility, that is, if the expected utility of an offense exceeds that of alternative legal actions. The utility of a violation is mainly determined by the probability of conviction and the punishment. Thus, governments may try to prevent offenses by expanding monitoring activities and/or increasing fines. From a cost-effectiveness point of view, governments should prefer the latter option since monitoring is usually costly for society.

Monitoring in the context of compensation policies is complicated due to information asymmetries, which result from the already mentioned principal-agent structure. Apart from the above cited hidden characteristics, hidden actions may exist. In these cases, the principal, that is the agency, cannot supervise the farmer’s actions but only the results. However, relating results to actions is difficult and costly, particularly since outcomes may not only be influenced by farmers’ activities but by a variety of other exogenic factors as well. This problem does not only increase public implementation costs but private costs as well, because farmers may incur costs from providing evidence that they really fulfill the contract (Häder 1997, p. 66).

The monitoring results may require enforcement efforts and thus cause additional costs, e.g. when farmers have to be sanctioned for not implementing contracted prescriptions. Moreover, monitorings may find that contracts are not appropriate anymore to achieve the intended goals because environmental conditions have changed or aspects have appeared to be important that were not considered in the contract (Häder 1997, p. 69). Consequently, agencies may be forced to renegotiate contracts or even to reselect target groups (Moxey et al. 1999, p. 189).

3.2.3 Deadweight Losses

Compensation payment policies are usually funded from agricultural support budgets (see chapter 2.2.1). Governments procure these budgets by taxing the economy. Taxes, however, are non-neutral with respect to economic costs. On the one hand, costs may arise directly due to administrative costs of tax collection. On the other hand, economic losses may be caused indirectly by labor/leisure distortions from income taxes, investment distortions from capital taxes, and consumption distortions from sales taxes. Both effects are refered to as deadweight losses in economic literature (Oskam and Slangen 1998, Innes 2000). Such economic losses may reach up to 50 percent of the dollar expended. Consequently, cost-effectiveness considerations call for compensation payment policies that minimize budgetary costs.

Budgetary costs in the context of compensation payments consist of public transaction costs of program administration and compensation costs. Compensation costs amount to the sum of payments made to farmers and reflect production costs and private transaction costs from program adoption (Whitby 2000b). In reality, however, compensation expenditures often exceed pure production and transaction costs. The most important reason for such overcompensation are information asymmetries, which impede the assessment of exact abatement costs by paying agencies (see chapter 3.2.2). Thereby, compensation payments will include a so-called information rent (Whitby et al. 1998, p. 100). Moreover, Ahrens et al. (2001) stated that governments may even have an interest in paying more than what is necessary to provide income support for farmers in order to compensate them for economic hardships. However, such overcompensation should be diminished to reduce deadweight losses.

4 The U.S. Conservation Reserve Program

4.1 History

The United States Department of Agriculture (USDA) established the CRP in the Conservation Title (Title XII) of the Food Security Act of 1985 as a voluntary land retirement program in response to concerns about soil erosion (USDA 2003c, Anderson 1995, p. 4). Under this program, farmers receive annual rental payments and cost-share assistance to establish long-term, resource conserving covers on cropland using approved conservation practices. Potential participants apply during periodic signups and are selected in a competitive bidding. If accepted, they have to sign CRP contracts for 10 to 15 years (Heimlich 2003, p. 13, USDA 2003a).

The idea of setting land aside was not new. Land retirement has been a tool of agricultural policy since the 1930s, when the Agricultural Adjustment Act (AAA) was enhanced to allow supply control in form of acreage reduction. Later, the AAA was transformed to the Agricultural Conservation Program. When stocks began to grow again after World War II, the Agricultural Act of 1956 created a new program – the so-called Soil Bank – that combined surplus reduction with conservation objectives. By 1972, when the last long-term contracts of the Soil Bank expired, the program had idled up to 29 million acres. Nevertheless, it was not until the establishment of the CRP in 1985 that another comparable government program was launched (Smith 2003, USGAO 1993, p. 2).

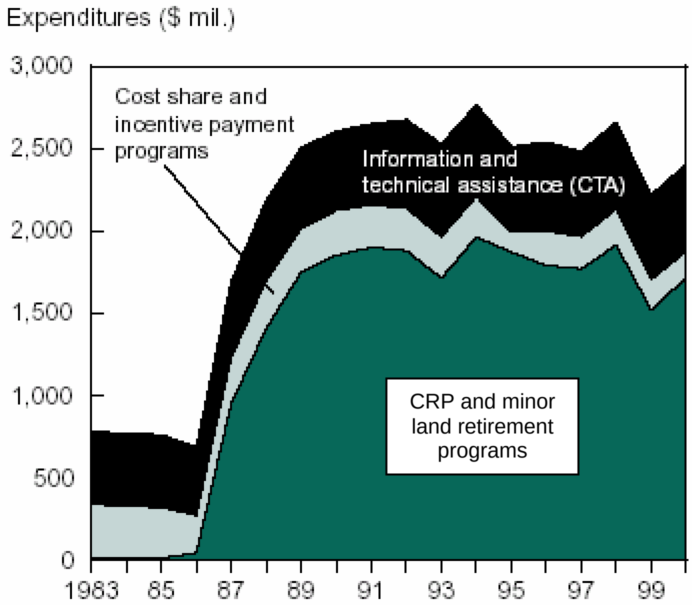
Since 1985, the CRP has been re-authorized by subsequent Farm Bills – the 1990 Food, Agriculture, Conservation, and Trade (FACT) Act, the 1996 Federal Agricultural Improvement and Reform (FAIR) Act, and, recently, the 2002 Farm Security and Rural Investment Act (Smith 2003, p. 2, USDA 2003b). The latter authorized the CRP through the year 2007.[13] Although land retirement has always been the basic feature of the CRP, objectives, practices and procedures have changed substantially over the years. In this respect, the 1990 Farm Bill has been of particular importance as it shifted the goals of the CRP from reducing soil erosion to achieving broader environmental objectives and, consequently, introduced new eligibility criteria and enrollment procedures (Osborn 1993, p. 275). Furthermore, in 1996, the USDA established a "continuous" signup for specific conservation practices and areas. In contrast to the existing "general" signup, land can be enrolled at any time of the year, and a competitive bidding mechanism is not used. In 1997, the Conservation Reserve Enhancement Program (CREP) was implemented. This joint Federal-State land retirement program supplements CRP incentives in order to address more State-specific goals.[14] Additionally, some programs introduced new eligible practices to the CRP. In 1997, the CRP became a part of the USDA's National Conservation Buffer Initiative, and corresponding practices were added (Smith 2003). The last significant modification was undertaken in 2001 when the Farmable Wetland Program enhanced the CRP's focus (USDA 2002a). The effects of these changes on the features of the CRP will be discussed in detail in the following chapters, with the main emphasis on the general signup.

Apart from the CRP, the USDA has implemented several other conservation programs: additional land retirement programs such as the much smaller Wetlands Reserve Program

[13] For the complete Farm Security and Rural Investment Act see USDA 2002b.
[14] Until 2000, thirteen States had implemented a CREP (Maryland, Illinois, North Carolina, New York, Delaware, Minnesota, Ohio, Oregon, Pennsylvania, Washington, Virginia, Michigan, and Missouri, by order of acceptance) (Smith 2003).

(WRP), programs to keep farmland in production and offering cost-sharing and incentives, such as the Environmental Quality Incentives Program, and initiatives granting technical assistance and information (Heimlich 2003, Claassen et al. 2001). Nevertheless, the CRP is the largest conservation program ever in U.S. history and accounts for the majority of government conservation expenditures (see figure 1) (Heimlich 2003, p. 9).

Figure 1: U.S. conservation expenditures 1983-2000



Source: Claassen et al. 2001, p. 8 [15]

4.2 Design

4.2.1 Goals

When the CRP was implemented in 1985 the reduction of soil erosion on highly erodible cropland was determined as primary goal. Secondary objectives were the protection of soil productivity, the reduction of sedimentation, the improvement of water quality, as well as of fish and wildlife habitat, the reduction of the production of surplus commodities and the provision of income support to farmers (Feather et al. 1999, p. 5, Ribaudo et al. 2001, p. 12). As noted above, the 1990 Farm Bill redirected the CRP as to better address environmental issues. Consequently, the USDA's (2003b) Interim Rule to the 2002 Farm Bill which is the most recent regulation relating to the CRP's goals declares that "the objectives of the CRP are to cost-effectively reduce water and wind erosion, protect the Nation's capability to produce food and fiber, reduce sedimentation, improve water quality, create and enhance wildlife habitat, and other objectives including encouraging more permanent conservation practices and tree planting."

Neither this implementation rule nor the Farm Bill stipulate quantitative levels for achieving these goals (USDA 2002b, USDA 2003b). The only number that may be interpreted as a quantitative objective is the so-called enrollment cap. This cap determines the maximum number of acres of cropland that should be enrolled in the CRP annually or by a certain deadline. The 1985 Farm Bill determined a maximum of 40 to 45 million acres to be entered into the CRP by 1990.[16] It further prescribed the enrolled acres not be less than five million in 1986, ten million acres in each of the years 1987 to 1989, and five million acres in 1990.

[15] The CRP accounts for roughly 90 percent of the USDA's land retirement expenditures. The most important minor land retirement program is the Wetland Reserve Program (WRP) (Heimlich 2003).
[16] An acre equals 0.4047 hectares.

Additionally, at least 12.5 percent of this acreage was to be planted with trees, a target that did not appear again in later regulations (USGAO 1989). In 1990, the FACT Act mandated the same enrollment goals for the period up to 1996, but later legislation revised this cap to 38 million acres (Osborn et al. 1995, p. 4). It is unclear until which year the USDA continued to set minimum annual enrollment goals. At least in 1991, a 1.1-million-enrollment target was mandated (USGAO 1993, p. 6). The 1996 FAIR act further decreased the enrollment rate, capping it at 36.4 million aces through the year 2002 (Osborn 1997a, p.15). The recent 2002 Farm Bill returned to an increased cap of 39.2 million acres. To put this enrollment target in perspective, in 1997, the area of cropland in the U.S. was approximately 455 million acres (Vesterby 2003, p. 4). Similar enrollment targets have also been established for the CREP and the Farmable Wetlands Program capping them at 1.62 and 1 million acres respectively (Loftus and Kraft 2003, p. 74, USDA 2003b).

4.2.2 Administration

In general, the CRP falls within the authority of the Commodity Credit Corporation (CCC), a Government-owned and operated entity within the USDA that was created to stabilize and support farm income and prices (USDA 1999). To finance the CRP the CCC borrows funds from the Department of Treasury which later have to be returned with appropriated funds (USGAO 1999, p. 4).

In practice, the CRP is actually administered by the USDA’s Farm Service Agency (FSA) on behalf of the CCC. The responsibilities of the FSA include issuing federal regulations and other announcements, such as notices of future signup periods. Furthermore, it assesses which parcels of land should be enrolled in the program and which amount of rental and cost-share payments should be made to individual farmers, and, finally, makes these payments to the participants (USGAO 1999, p. 3)

However, the FSA staff lack the specific knowledge necessary to assess the ecological features of potential CRP land. Thus, the FSA receives technical support from the Natural Resources Conservation Service (NRCS), another USDA entity. During the enrollment process, the NRCS determines the eligibility of land offered and the potential environmental and conservation benefits of its enrollment (see chapter 4.2.5). Furthermore, the NRCS assists farmers in developing, implementing and maintaining a conservation plan for their lands (USGAO 1999, p. 5) (see chapter 4.2.4). Additionally, the FSA and farmers may collect information from the USDA’s Co-operative State Research, Education, and Extension Service, State forestry agencies, local soil and water conservation districts and private sector providers of technical assistance (USDA 2003c).

4.2.3 Eligibility

4.2.3.1 Eligible Producers

To be eligibile for the CRP, producers must have been the owner, operator, or tenant of the land for at least twelve months prior to the close of the CRP signup period. Farmers may be excluded from this regulation if they acquired the land by succession as a result of the previous owner’s death or due to foreclosure in which case the owner exercises a timely right of redemption in accordance with state law. Furthermore, even if the farmers have not owned the land for the previous 12 months, they may enroll if they are able to prove that they did not obtain the land for the purpose of placing it in the CRP. Finally, potential participants have to provide evidence that they will be in control of the land for the entire contract period of the CRP (USDA 2003b, USDA 2003c).

4.2.3.2 Eligible Land

During the first years after the implementation of the CRP in 1985, land was only deemed eligible if it was highly erodible. This criterion remains an important part of today’s regulation.

Initially, erodibility was measured by Land Capability Classes (LCC) (see Appendix II). Acreages were mainly defined highly erodible if two-thirds of the field belonged to a) LCC VI-VIII, b) to LCC II-V, with an actual erosion greater than three times the soil loss tolerance value (3T) (see Appendix II), or c) to LCC II-V with an actual erosion of 2T and with serious gully problems or with tree plantings (Ribaudo et al. 1989, p. 421). In 1987, the USDA additionally introduced the Erodibility Index (EI) qualifying lands with an EI greater than 8 (see Appendix II) (Osborn et al. 1995, p. 3). Since 1995, the EI has been the only criterion of erodibility used (Heimlich 1997, p. 289).

The shift of the CRP goals outlined above, naturally affected the program's eligibility requirements. Thus, several additional criteria have been added to better address conservation targets irrespective of the level of erosion. As soon as 1988, the program was extended to cropland bordering waterways, the so-called filter strips. Only one year later, the USDA started to consider cropped wetland and fields that are subject to scour erosion due to periodical floodings eligible. The 1990 Farm Bill expanded the focus of the CRP to cropland that was not highly erodible. From then on, cropland located in national and State conservation priority areas, which had been established under this law, cropland in identified State water quality areas and within public wellhead protection areas determined by the Environmental Protection Agency could be enrolled in the CRP.[17] Furthermore, cropped acreages suitable for filter strips, waterways, contour grass strips, permanent wildlife habitat, field wind breaks, shelterbelts, living snow fences, salt tolerant vegetation, or terraces were mandated to be eligible (Osborn et al. 1995). In 1997, the FSA estimated that on the basis of these eligibility criteria more than 240 million acres qualified for the CRP, compared with only about 100 million in 1985, when the program was authorized for the first time (Osborn 1997a, p. 15). Thus, in 1997, more than 50 percent of the total of 455 million acres of cropland was eligible for enrollment in the CRP (Vesterby 2003). Table 1 shows the eligible acres in correspondance with their eligibility criteria.

Table 1: Eligible CRP land by land category as of 1997

Land category	Eligible acres (million acres)
Highly erodible cropland	142
Cropland in national priority areas	86
Cropland in state priority areas	24
Cropland adjacent to water bodies	13
Cropped wetland and adjacent upland	8
Pastureland adjacent to water bodies	not available
Total CRP land eligibility	240

Source: Osborn 1997a.[18]

These numbers should not have changed substantially as later regulations have only implemented slight revisions. To mention the most important change, the 2002 Farm Bill mandated that once enrolled in the CRP land will automatically qualify for further enrollment when the existing contracts expire (USDA 2002c).

Apart from the above physical criteria, land has to meet some additional basic requirements to be eligible. Until 2002, highly erodible acreages were only accepted if they had been cropped in two of the past five years before enrollment. The 2002 Farm Bill tightened this regulation requiring that cropland must have been cultivated in four of the previous six years (USDA 2002c). Of course, this regulation does not apply to the non-erodible lands introduced into the CRP later. However, in all signup periods non-erodible land like highly erodible land has been subject to the restriction that only a maximum of 25 percent of any county may be enrolled in

[17] Wellhead protection areas have been established to protect the area surrounding a well from which groundwater is drawn.
[18] Minor categories of eligible land and double-counting of land that qualified for more than one category were excluded.

the CRP (USDA 2003b). This maximum county acreage was introduced to avoid the adverse effects on agriculture-dependent economies experienced with earlier conservation programs (USGAO 1989, p. 21). The FSA may allow this limit to be exceeded on a county basis if negative impacts on local economies are not to be expected (USDA 2003b).

4.2.4 Conservation Plan

Before farmers who meet the above eligibility criteria can participate in a CRP signup, they have to draw up a conservation plan for the land to be enrolled. This plan determines the measures the farmer is willing to adopt in return for annual rental payments received. Thus, the CRP can be described as a practice-based instrument. Contents of this plan are typically a schedule of operations, activities, and estimated expenditures incurred to adopt these measures. Local NRCS offices farmers in designing their conservation plan (USGAO 1999, p. 5).

For approval by the NRCS, practices included in the conservation plan must help to meet the CRP's goals (USDA 2003b). Typically, a variety of herbaceous or woody covers is planted under the CRP to establish or maintain a permanent cover for the contract period (Stauffer et al. 1990, p. 57). The establishment of such covers is of particular importance for highly erodible lands, whereas maintenance is in focus for existing environmentally sensitive lands (Plankl 1999, p. 167). The number of practices that can be enrolled in the CRP has changed as the eligibility of the program has done. By the end of 2003, the FSA had found eligible and adopted 31 cover practices (CP) (see Appendix I) (USDA 2003g).

4.2.5 Enrollment Process

4.2.5.1 Bidding

The Food Security Act of 1985, that implemented the CRP, explicitly required a competitive bid system to be established for the enrollment of CRP lands (USGAO 1989, p. 35). Consequently, the USDA periodically holds signups, the so-called general signups, within which farmers can bid for CRP contracts. Their offers have to indicate the number of acres they wish to enroll, the practices they are willing to adopt and the annual rental rate they desire. Subsequently, the FSA ranks and accepts these offers according to its bidding criteria (USGAO 1989, p. 11). However, since 1985 these criteria have been subject to remarkable changes.

From 1985 to 1990, the USDA applied a bid acceptance process that could be described as a reverse static pay-as-bid auction. After each signup, the Secretary of Agriculture calculated maximum acceptable rental rates (MARR) for multi-county areas. These areas, called bid pools, were aggregated on the basis of similar soil erosion rates, crop production levels, and other agricultural criteria. The local FSA offices then compared all submitted offers were compared to these MARR.[19] Bids that did not exceed this MARR and additionally fulfilled the eligibility requirements (see chapter 4.2.3) were accepted (Osborn et al. 1995, p. 2). This approach was rather an offer system than an auction and was used to achieve the mandatory minimum annual enrollment levels established by the 1985 Farm Bill (see chapter 4.2.1) (Smith 2003, p. 6).

As for other design issues, the 1990 Farm Bill made substantial changes to the enrollment process. Generally, a three-step process was authorized. First, local FSA offices reviewed whether each bid received met the basic eligibility criteria and whether or not it exceeded the prevailing local rental rates. Secondly, offers accepted on a local basis were then transmitted to the national FSA office. There, a bid cap was determined for every single bid taking into consideration the relative productivity of the predominant soil on the offered land (assessed by the NRCS), the prevailing local rental rate, the cost to participants of establishing and maintaining the permanent cover, the rate of inflation, and the cost of idling farm resources (such as equipment). All bids exceeding this bid cap were rejected. Finally, for each bid that had survived this step an environmental benefits index (EBI) was determined (see chapter 4.2.5.2).

[19] In fact, theAgricultural Stabilization and Conservation Service had managed the CRP until 1994, when its responsibilities were passed on to the newly established FSA (USDA 2004).

Offers were ranked for acceptance with respect to the ratio of the EBI to the government cost of the contract (annual rental rate plus cost-share payments).[20] Bids were accepted in rank order until the predetermined enrollment goal was achieved (USGAO 1993).

When submitting their bids, farmers were neither informed of the rental rate nor of how the EBI was assessed (Osborn 1997b, p. 296). Since farmers received the payments as stated in their offers the bidding mechanism may be described as a static pay-as-bid auction (see chapter 2.2.3.2) (Latacz-Lohmann 1998, p. 175). However, some practices and acreages were excluded from this competitive selection. Measures that required useful-life easements, particularly filter strips, and land within wellhead areas were automatically accepted for enrollment if they met the basic criteria of step one (Osborn et al. 1995, p. 5).

In 1995, the USDA again undertook some revisions. The above three-step model was maintained but changes in the bidding process were implemented. The cost factor that the EBI had previously been related to now became part of the EBI. Thus, from this time on, bids have been solely ranked with regard to this index. If two offers achieved the same score, the bid of the lower costs per acre was to be accepted first. Furthermore, the local FSA offices were instructed to inform each applicant during the signup of the maximum annual per-acre rental payments the USDA would accept for the lands offered by him, and how the EBI was calculated. Farmers were still free to bid whatever they liked, but bids exceeding the announced bid caps would be rejected whilst bids below this level would enhance the probability of being accepted (Osborn 1997b, pp. 289-290). This is the bidding mechanism applied by the USDA up to the most recent general signup held from May to June in 2003.

Since the 1996 Farm Bill, the USDA has offered an additional option to enroll in the CRP: the continuous signup. This possibility is open to a group of practices that are considered to involve little costs, but contribute substantially to environmental improvements (Osborn 1997b, p. 291). Eligible practices are riparian, wildlife habitat, and wetland buffers, filter strips, wetland restoration, grass waterways, shelterbelts, living snow fences, contour grass strips, salt-tolerant vegetation, shallow water areas for wildlife, and lands within wellhead protection areas. Such acreages may be entered into the CRP at any time of the year and will be accepted without competitive bidding providing that the eligibility criteria are met (USDA 2003f). Thus, the rental rates producers receive equals the above mentioned bid cap (USDA 2003b). The CREP also applies a continuous signup with the only difference that this is held on the State instead of the national level (USDA 2003g).

4.2.5.2 Environmental Benefits Index

Since its introduction in 1990, the EBI has always been a dynamic process with periodical adjustments and improvements of factors and weights (Feather et al. 1998, p. 21). When first applied, the EBI was calculated on the basis of improvements in seven equally weighted conservation and environmental areas: surface water quality, ground water quality, soil productivity, conservation compliance assistance, tree planting, assistance to designated state water quality areas, and conservation priority areas (USGAO 1993, pp. 12-13). However, the exact construction of an individual EBI was always unclear to the farmers (Szentandrasi et al. 1995, p. 387).

In 1995, only three signups later, the structure of the EBI was made public and replaced by four weighted factors referring to environmental improvements and the newly included cost factor. The environmental factors incorporated the protection of water quality (including both groundwater and surface water), the creation of wildlife habitat, the control of soil erodibility (a maximum of 20 points each), and tree planting (a maximum of 10 points). The cost factor depended on the annual rental rate required by the farmer (Osborn 1997b, p. 290). In addition, some environmentally sensitive acreages and practices, such as filter strips, shallow water areas

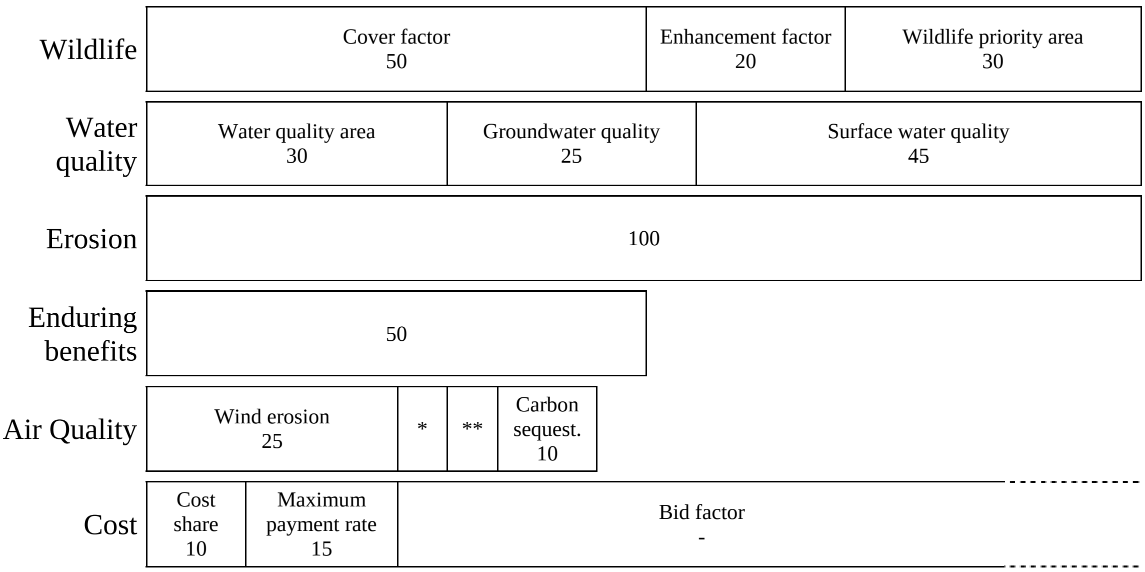
[20] The EBI is determined by the NRCS, whereas government cost are assessed by the FSA (Mello et al. 2002, p. 87).

for wildlife, field windbreaks, or shelterbelts, automatically received maximum scores for the environmental factors (Ribaudo et al. 2001, p. 15).

In 1997, another fundamental recomposition of the EBI took place. The index now included six environmental factors and a cost factor. Wildlife habitat benefits, water quality benefits resulting from reduced water erosion, runoff and leaching, and on-farm benefits due to reduced wind or water erosion accounted for a maximum of 100 points each. Up to 50 points were granted for long-term benefits resulting from cover beyond the contract period, and up to 25 points for air quality benefits resulting from reduced wind erosion and benefits due to enrollment in conservation priority areas (Osborn 1997b, p. 292). The cost factor was to be determined after each signup period (e.g., 200 and 150 for the two signups hold in 1997, 150 for the 1998 signup) (Smith 2003, p. 4, Mello et al., p. 88).

Since then, the EBI has evolved only slightly. Some minor adaptations have been made within the benefit categories. The air quality factor was increased to 35 points for the second signup in 1997, and once more, to 45 points in 2003. For the latter signup, the USDA removed the factor for benefits from the enrollment in conservation priority areas (Smith 2003, p. 4, USDA 2003e). Thus, the EBI for the 26th signup in 2003, the most recentgeneral signup, was designed as follows (USDA 2003e, figure 2):

Figure 2: Environmental Benefits Index as of the 2003 signup (26th Signup)



Source: Feather et al. 1998, updated with USDA 2003e (* Wind erosion soils list 5 points, ** Air quality zones 5 points).

The wildlife factor (maximum of 100 points) contained three subfactors. The cover factor (maximum of 50 points) evaluated the quality of the covers established with respect to their wildlife benefits (see Appendix III). Additionally, up to 20 points were given for practices that aim to enhance wildlife (see Appendix III). For example, 20 points could be granted for water development if water quality limited potential wildlife benefits. Finally, farmers could receive additional 30 points if at least 51 percent of the acreage offered by them lay within a high-priority wildlife area.[21]

Similarly, the water quality factor (maximum of 100 points) evaluated the potential of the land to improve surface and groundwater quality. Generally, acreages located in State water quality areas obtained 30 points. A second factor (up to 25 points) determined the contribution of the offer to groundwater quality. The evaluation of this was mainly based on the three predominate

[21] High-priority areas had been developed before the 26th signup period by the FSA in consultation with farm, commodity, wildlife, and environmental groups (USDA 2003e).

soils, the weighted average leach index, and the population that utilized groundwater for drinking. The score of the third, i.e. the surface water quality factor could be up to 45 points, and depended on the potential water-induced erosion, the distance to the water, and the watershed population.

The erosion factor assessed the on-farm benefits of reduced water and wind erosion, e.g. the impacts on soil productivity. This factor was proportional to the Erodibility Index (EI) of the land, as benefits from retirement would be higher on highly erodible acreages (see Appendix III, for the definition of the EI see Appendix II).

The enduring benefits factor recognized that certain practices were more likely to be maintained after contract expiry than others. Thus, up to 50 points were awarded to those measures that were considered to be most enduring, such as planting hardwood trees (see Appendix III).

The fifth environmental factor (maximum of 45 points) reflected potential air quality improvements that could be gained from reducing airborne cropland dust and particulates caused by wind erosion. Thus, one subfactor (up to 25 points) evaluated the impacts of wind erosion on the basis of climatic aspects (wind speed, wind direction, and duration of wind events), soil erodibility and the size of the potentially affected population. Furthermore, a list of soil types that were particularly subject to wind erosion was developed. Land where more than 51 percent of the soil belonged to types included on this list received another five points. Similarly, acreages located with more than 51 percent in air quality zones were awarded an additional five points. Finally, up to ten points were granted for practices that provided benefits from sequestering greenhouse gases.

The cost factor accounts for the largest share of the EBI. However, the exact number of points awarded, in particular that of the bid factor, may vary and is not announced before the signup is closed. Generally, offers with lower per acre rental rates will receive a higher bid factor. For example, after the 1998 signup this bid factor was set at a maximum of 125 points (Mello et al., p. 88). Apart from the bid factor, two more aspects could increase the total cost factor. Farmers that refrained from cost-share payments were rewarded with additional ten points. Offers below the maximum payment rate received 15 points, in contrast to zero points for offers equal to this rate.

4.2.6 Contracting

Once farmers have been accepted on the CRP scheme, they enter into contracts with the FSA, on behalf of the CCC. Apart from the conservation plans mentioned in chapter 4.2.4, the contracts set out the terms and conditions for participation in the CRP. Highly erodible lands are contracted for ten years, whereas contracts for other, environmentally sensitive acreages may be agreed for 10 to 15 years (USDA 2003b). However, the USDA occasionally allows one-year extensions of contracts expiring, as it did in the years 1995, 1996 and 2002 (Osborn 1997b, USDA 2002b).

Basically, no activities is allowed on retired land, except the establishment of the required cover (USDA 2003b). Until 2002 haying and grazing could be permitted on CRP lands during drought emergencies (USDA 2002c). However, this was changed with the 2002 Farm Bill which permitted grazing and haying once every three years, as long as such management is determined in the conservation plan and corresponds to conservation purposes. Furthermore, the placement of wind turbines on CRP land was authorized (USDA 2003b).

Regulations may be modified during the contract period if the CCC agrees. For example, the acreage enrolled may be decreased or the management practice changed if they are found inappropriate to the requirements of the land. Any violation of the terms and conditions of the CRP contract results in the CCC terminating the contract, and the farmer having to refund all previously received rental payments plus interest, liquidated damages, and in many cases, cost-share payments granted. Similarly, farmers who transfer all or part of the right and interest in or right of occupancy of the land have to reimburse all payments that have been paid to them for this share of land if the new owner terminates the CRP contract (USDA 2003b). However, the USDA offers possibilities to avoid such sanctions. For the years 1995 and 1996, the Secretary of Agriculture announced one early-out opportunity respectively, for which farmers had to register in advance. Land with an Erodibility Index greater than 15 as well as certain environmentally sensitive land, such as acreages within 100 feet of waterbodies, grass waterways, filter strips, shallow water areas for wildlife, bottomland timber on wetland, field windbreaks, and shelterbelts could not be withdrawn from the CRP. The main reason for the granting of early-out opportunities by the USDA is to bring more environmentally sensitive lands into the program that could not be enrolled previously because of the enrollment cap. Furthermore, the production of additional grains should be induced, given the fact that stocks were low. The 1996 Farm Bill later relaxed this regulation stipulating that farmers may withdraw their lands from the CRP at any time subject to a 60-day notice period (Osborn 1997b).

4.2.7 Payments

Generally, the FSA provides two basic kinds of payments to participating farmers: annual rental payments and cost-share payments. The rental payments are determined by the offers that farmers have submitted during signups and, at most, may amount to the bid cap that has been assessed for the land offered (see chapter 4.2.5.1). Rental payments should not exceed $50,000 per farmer and year (USDA 2003b). These rental payments may be supplemented by $5 per acre per year to reward farmers who perform certain maintenance obligations (USDA 2003c). From 1985 to 1990 special incentives were offered for certain types of land: a $2 per bushel per acre bonus for enrolling corn acreage, and higher bid caps were allowed in some tree growing areas (USGAO 1989, p. 16). In addition, cost-share assistance is granted for up to 50 percent of the costs the farmer has to incur to establish the required covers (USDA 2003c).

Apart from these payments, additional incentives are available for land enrolled under the continuous signup. The FSA pays a 20-percent incentive over the maximum rental rate for field windbreaks, grass waterways, filter strips, and riparian buffers, and a ten-percent incentive for wellhead protection areas. In addition, since 2000, an one-off signing incentive payment of $100 to $150 (depending on the duration of the contract) has been mandated for certain practices, as well as a practice incentive payment, which covers 40 percent of the cost of installing practices to all continuous signup practices (USDA 2003f). Similar payments are granted for the CREP on a State basis (Smith 2003, p. 5).

4.3 The CRP in Numbers

4.3.1 Enrollment and Signup Statistics

By the end of 2003, almost 34.5 million acres were enrolled in the CRP (USDA 2003g). Thus, 7.6 percent of the total 455 million acres of cropland in the U.S. were idled under CRP management (Vesterby 2003).[22] More than 260,000 farms, that is 12 percent of all farms, had entered into over 390,000 contracts with their local FSA offices (USDA 2003g, Hoppe and Wiebe 2003). The majority of lands had been enrolled during general signups (USDA 2003g, see table 2).

Since 1991, when the initial growth period ended, the total amount of land enrolled in the CRP has changed only marginally (figure 3). From 1992 to 1995, the amount of acres enrolled in the CRP remained relatively stable indicating that the CRP's potential was somehow depleted. Once the first 10-year contracts started to expire from 1996 onwards, the total amount of land enrolled declined, especially in the years 1996 and 1999. However, these decreases were not dramatic. In 1997, when the contracts on some 21 million acres expired, enrollments even increased slightly. This implies that a large share of expired land was re-enrolled in the same

[22] Vesterby (2003) provides 1997 cropland data. However, this data seems to be the most recent available.

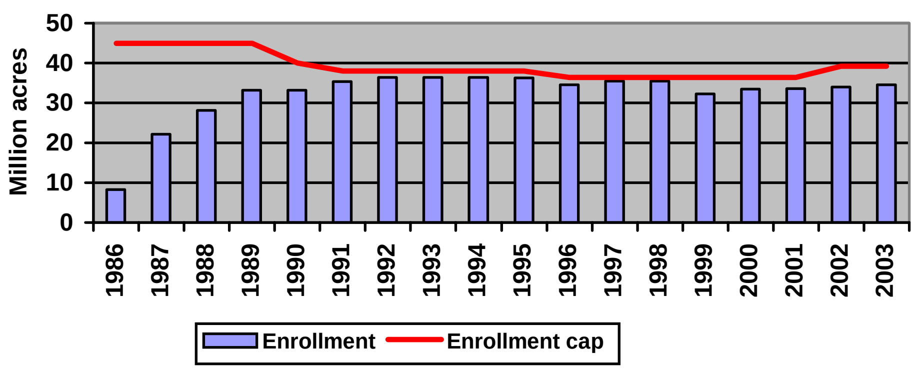
year. The expiry wave had more or less passed in 1999 and since then enrollment rates have started to rise again (Smith 2003).

Table 2: Enrollment by the end of 2003 by signup type

Signup Type	Contracts	Farms	Acres
General	392,172	260,380	31,779,301
Continuous			
Non-CREP	211,157	143,434	2,057,386
CREP	34,617	23,192	548,393
Subtotal	245,774	154171	2,605,779
Farmable Wetland	6,449	5,295	99,858
Total	644,395	381,967	34,484,938

Source: USDA 2003g.

Figure 3: Enrollment by year and corresponding enrollment caps



Source: Smith 2003, USDA 2002a, USDA 2003g.

A more precise view on CRP data is obtained if signup statistics are considered instead of the total number of acres enrolled. Since 1986, the FSA has conducted 27 signups (table 3). 18 of these were general signups, the most recent was held from May 5 to June 13, 2003. Although continuous signups are not realized within certain periods, they have been numbered as well to reflect their annual development. The first continuous signup was assigned number 14, the most recent continuous signup of 2003 number 27 (Smith 2003, USDA 2003d, USDA 2003g, USDA 2003h).

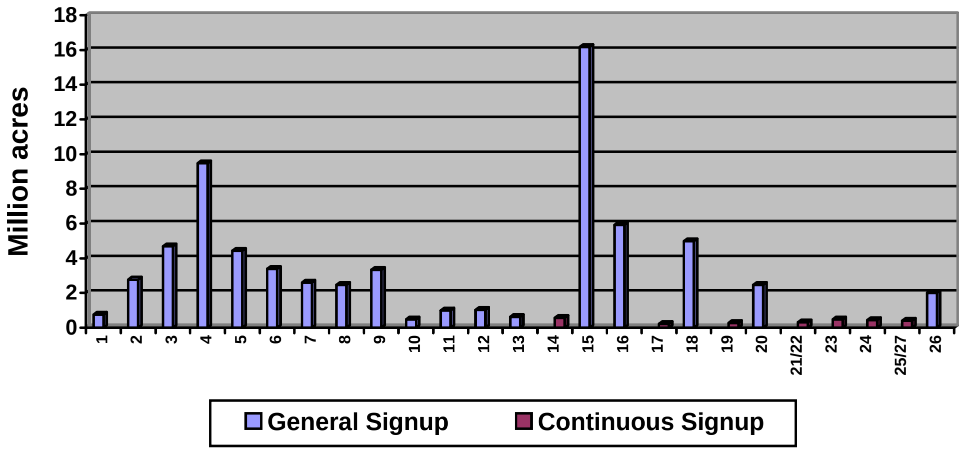
Table 3: Signups 1986-2003

No.	1	2	3	4	5	6	7	8	9	10	11	12	13
Type	Gen	Gen	Gen	Gen	Gen	Gen	Gen	Gen	Gen	Gen	Gen	Gen	Gen
Year	1986	1986	1986	1987	1987	1988	1988	1989	1989	1991	1991	1992	1995
14	15	16	17	18	19	20	21	22	23	24	25	26	27
Con	Gen	Gen	Con	Gen	Con	Gen	Con	Con	Con	Con	Con	Gen	Con
1997	1997	1997	1998	1998	1999	2000	2000	2000	2001	2002	2003	2003	2003

Source: Smith 2003, USDA 2003g, USDA 2003h (Gen = General Signup, Con = continuous Signup).

Figure 4 demonstrates that the enrollment process has been much more dynamic than it appears in figure 3. CRP statistics recorded booming signup rates in the three initial years, particularly in 1987 when more than 13 million acres were newly enrolled during the fourth and fifth signup. Subsequently, the numbers of acres accepted declined until 1997. A remarkable drop occurred with the tenth signup. This was the first opportunity to enroll land after the 1990 Farm Bill revision, and therefore, the decline may have been due to the more competitive bidding system, which restricted enrollment more tightly than before (see chapter 4.2.5.1). Participation remained low and no signups were held at all in 1993, 1994, and 1996. The renewed peak with the 15th signup in 1997 more or less reflected the expiry schedule. As the majority of CRP contracts were initiated in 1987 they had, consequently, expired by the end of 1996 and the land were available for re-enrollment. Therefore, re-enrolled lands accounted for roughly 70 percent of the 16 million acres accepted during the 15th signup. As the number of expiring acres decreased in subsequent years, signup enrollments declined as well, and the share of land that had not been enrolled before increased. With respect to the initial contract year of land currently enrolled in the CRP, it can be assumed that the above pattern will be repeated in the future: signup enrollment will remain low for the forthcoming years until 2007 when a bulk of contracts expire again (Smith 2003). During the first continuous signup (14th signup) more than 500,000 acres were enrolled. For the subsequent years, this rate ranged between 200,000 and 300,000 acres per year (USDA 2003g).

Figure 4: Accepted acreages by signup



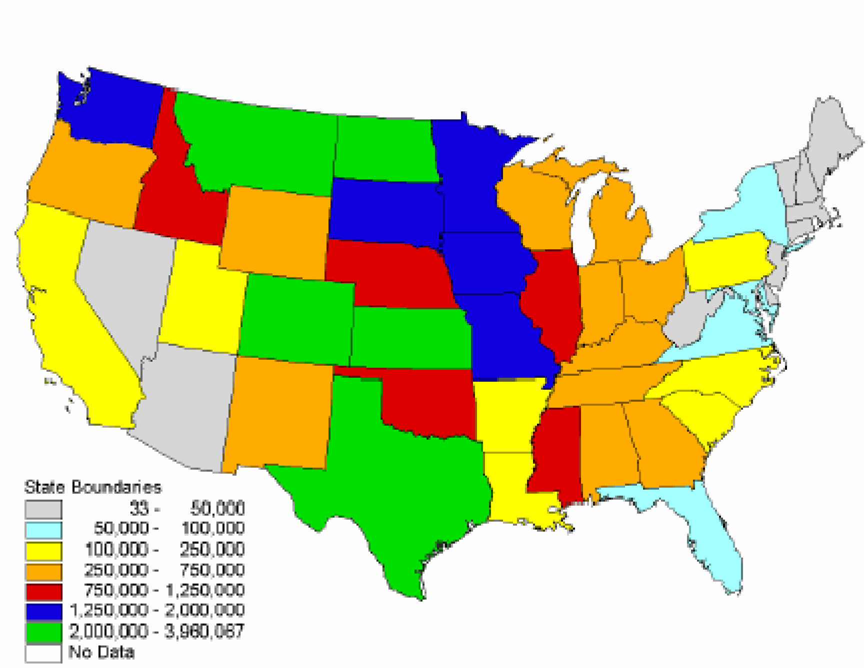
Source: own figure, data from Smith 2003, USDA 2003g, USDA 2003h.

4.3.2 Spatial Distribution of CRP Land

By the end of 2003, roughly two-thirds of the CRP-enrolled land was in the Northern and Southern Plains and the Mountain region (see Appendix IV for the definition of U.S. farm production regions) (see figure 5). Some areas in the Lake States region and the Corn Belt region held significant shares as well (USDA 2003g). To some extent, this concentration may be attributed to the fact that the majority of U.S. cropland is located in these areas (Vesterby 2003).

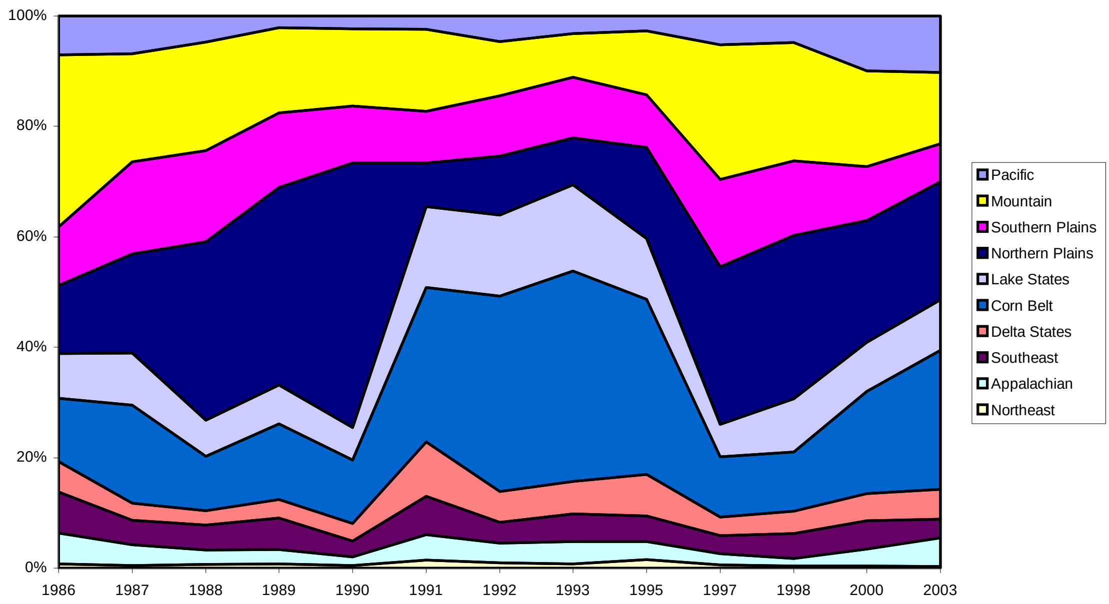
However, distribution has also been affected by other issues, such as opportunity costs and the design of the CRP, especially with respect to the eligibility and enrollment process (Smith 2003, p. 4). The latter factor is very well presented by figure 6, which sheds light on the spatial distribution of acreages accepted during single signups. Initially, CRP enrollment was mainly concentrated to the Plains and the Mountain regions. When the 1990 Farm Bill modified the eligibility criteria to reflect broader environmental aims, and created the EBI as an important part of the enrollment process, the geographical focus of newly enrolled acreages shifted from these areas to the Corn Belt, Delta and Lake States. Only 1997 and 1998 signups interrupted this development, when previously contracted acreages in the Plains and the Mountain regions were re-enrolled. Subsequently, as the amount of re-enrolled acres declined, the Corn Belt region in particular regained its share (Osborn et al. 1995, USDA 1997a, USDA 1997b, USDA 1998a, USDA 1998b, USDA 2000, USDA 2003h).

Figure 5: Enrollment as of October 2003 (in acres)



Source: USDA 2003h.

Figure 6: Distribution of accepted acreages by farm production region and signup year



Source: own figure, data from Osborn et al. 1995, USDA 1997a, USDA 1997b, USDA 1998a, USDA 1998b, USDA 2000, USDA 2003h.[23]

[23] Osborn et al. 1995 provide enrollment data for 1986 to 1993 by initial contract year. Thus, data is available for 1990 and 1993, although no signups were conducted in these years. In contrast USDA 1997a, USDA 1997b, USDA 1998a, USDA 1998b, USDA 2000, and USDA 2003h provide data on 1995, 1997, 1998, 2000, and 2003 signup enrollment. However, contracts for lands enrolled during these signups did not necessarily become effective in the same year but in subsequent years. As figure 6 does not consider total numbers but percentage shares, this inconsistency may be neglected.

4.3.3 Practices and Eligibility

More than three-quarters of the CRP acreages have been planted with grasses. Existing grass covers (CP10) and grass plantlings (CP1 and CP2) accounted for 47 percent and 30 percent of the total CRP acreage respectively, achieving the highest participation rates in the Northern and Southern Plains. Tree related practices (CP3, CP3A, CP3B, and CP11) and specific wildlife habitat planting practices each account for 7 percent of the total acreage, the former occurring mainly in the Delta and Southeast regions and the latter in the Northern Plains and Corn Belt. The 5 percent of the total acreage on which wetland restoration practices (CP23) have been adopted can be found mostly in the Northern Plains (USDA 2003g, Smith 2003, p. 4).

However, another look at the signup statistics reveals more information (table 4). During the first 13 general signups, CRP acres were usually planted with grass. However, this changed with the 15th signup, when most newly enrolled CRP land was devoted to existing grass covers. This resulted from the large share of re-enrolled lands. As the amount of re-enrolled land declined, the structure of accepted acreages started to respond to the incentives that had been set by the EBI revised under the 1996 Farm Bill. Wildlife habitat protection and enduring benefits especially were better addressed, as may have been the result of increasing shares of tree and wildlife habitat plantings (Smith 2003, p. 10).

Table 4: General signup results by conservation practice

Signup	Grass plantings	Existing grass cover	Tree plantings	Existing tree cover	Wildlife habitat plantings	Wetland restoration
	Percent of enrolled acres					
1-13	81.0	6.7	6.7	0.2	4.7	1.1
15	22.8	63.3	1.6	4.9	2.5	4.8
16	39.6	35.5	2.5	2.5	13.8	5.1
17	35.0	23.6	6.5	2.2	18.6	9.1
18	55.8	13.6	9.5	1.7	7.3	6.3

Source: Smith 2003, p. 11.

Little information is available on how acreages are distributed with respect to eligibility criteria. Some data are available for the erosion criterion. By 1990, 40 percent of CRP land had potentially severe soil erosion problems (lands in capability classes IV-VIII). Most of this belonged to classes IV (28 percent of total) and VI (11 percent of total). The remaining 60 percent of CRP lands had less severe problems or was located in filter strips (Dunn et al. 1993). During the most recent 26th signup highly erodible land (EI>8) even accounted for 77 percent of the accepted land. However, some of this land met other additional eligibility criteria, for example, 69 percent of the enrolled acres were located in national or State priority areas (USDA 2003h).

4.3.4 Compensation Payments

In 2003, land that had been enrolled during general signups received annual rental payments of \$43.56 per acre on average.[24] Due to special incentives (see chapter 4.2.7) continuous signup lands received more than twice these payments, averaging \$96.33.[25] The highest payments for general signup land were made to farmers in the Corn Belt (\$78.57/acre), whereas land managers in the Mountains and the Northern and Southern Plains received the lowest rates (\$32.75/acre, \$38.10/acre, and \$34.55/acre, respectively). On average, participants were paid some \$4,300 per farm (USDA 2003g). The USDA (2002a) calculated a total more than \$1.6

[24] This number does not include payment reductions for land enrolled less than a full year, and lands devoted grazing and haying.

[25] However, one-off signing and practice incentive payments are not yet included in this amount. Furthermore, payment reductions are excluded.

billion of rental payment expenditures for CRP.[26] Additionally, some $150 million of cost-share payments were made. The CRP expenditures made by the USDA from 1986 to 2000 totaled to roughly $21 billion (Heimlich 2003).

80 percent of the CRP payments are made to small family farms (see Appendix V) (table 5).[27] In particular, retired farmers, or those whose main occupation is not farming (residential) receive large amounts of compensation payments. This distribution may be explained by the fact that the CRP targets particular types of land that are not devoted to intensive commodity production, and these are usually owned by small farmers. Consequently, small family farms account for roughly 78 percent of the total land enrolled in the CRP. In contrast this category of farms only owns 65 percent of total U.S. cropland (Hoppe and Wiebe 2003).

Table 5: Distribution of CRP lands and payments and total cropland among farmers (in percent)

<table>
<tr><th rowspan="3"></th><th colspan="5">Small family farms</th><th rowspan="3">Large family farms</th><th rowspan="3">Very large family farms</th><th rowspan="3">Non-family farms</th></tr>
<tr><th rowspan="2">Limited-resource</th><th rowspan="2">Retirement</th><th rowspan="2">Residential</th><th colspan="2">Farming occupation</th></tr>
<tr><th>Low-sales</th><th>High-sales</th></tr>
<tr><td>Payments</td><td>3.7</td><td>22.1</td><td>23.5</td><td>18.4</td><td>12.4</td><td>11.3</td><td>3.5</td><td>5.1</td></tr>
<tr><td>Land enrolled</td><td>4.3</td><td>18.2</td><td>21.1</td><td>20.0</td><td>14.2</td><td>13.8</td><td>3.6</td><td>4.8</td></tr>
<tr><td>Total U.S. cropland</td><td>2.1</td><td>5.7</td><td>12.6</td><td>19.1</td><td>25.1</td><td>17.1</td><td>13.8</td><td>4.5</td></tr>
</table>

Source: Hoppe and Wiebe 2003

5 Evaluation of the U.S. Conservation Reserve Program

5.1 Ecological Effectiveness

5.1.1 Enrollment Goals

Comparing the CRP's enrollment goals (chapter 4.2.1) with the actual rates (chapter 4.3.1), it is apparent that the program has not always been able to achieve its quantitative objectives (see figure 3 in chapter 4.3.1). However, the CRP performed quite successfully initially. During the first seven signups, from 1986 through 1988, over 28 million acres were enrolled in the CRP for the first time. Thus, the mandated enrollment of 25 million acres – five million acres in 1986 and ten million in 1987 and 1988 – was exceeded. But only 1.7 million acres, or 6 percent, had been planted with trees by the end of 1988. Consequently, not even half the targeted 12.5 percent had been achieved. Nevertheless, the USGAO study (1989), which provided the above data, notes that the CRP's tree planting initiative represented the largest publicly sponsored tree planting program ever. Yet, the subsequent years of 1989 and 1990 failed to meet the constituted enrollment aims. Although, until 1990, the enrollment process had been designed to accept land as long as it did not exceed the MARR (see chapter 4.2.5.1), only 5.8 million acres (instead of the projected 10 million acres) entered into CRP contracts during the two 1989 signups, and no signup was held at all in 1990. Thus, by the end of 1990, only 33.9 million acres instead of the 40 to 45 million acres mandated had been enrolled. Figure 3 further demonstrates that from 1991 through 1995, the annual enrollment was close to the cap. This may be attributed to the facts that the enrollment cap was reduced to 38 million acres and eligibility expanded after the 1990 Farm Bill. The gap between realized rates and mandated caps

[26] Including one-off signing and practice incentive payments and adjusted for payment reductions.

[27] Hoppe and Wiebe (2003) provide data for enrollment in land retirement programs, but they are aggregated for the CRP and the WRP. Nevertheless, their results allow conclusions for the distribution of CRP land, since the share of WRP lands is neglectibly small, as mentioned in chapter 4.1.

widened when contracts started to expire in 1996 and again in 2002 when the Farm Bill raised the enrollment cap to 39.2 million acres. However, the USDA did so with respect to long-term considerations until 2007. Moreover, enrollment caps give only an indication of the maximum enrollment that the USDA is willing to fund in order to reach environmental goals. Chapters below will show that it may be desirable to enroll less land if this provides the same benefits as higher levels of enrollment. Thus, rather than evaluating quantitative targets, the subsequent chapter will examine the extent to which the CRP's qualitative goals have been met.

5.1.2 Environmental Goals

5.1.2.1 Erosion

Chapter 4.2.1 has shown that the reduction of erosion has been a major objective throughout the existence of the CRP. Although the 1990 Farm Bill enhanced the CRP's focus with respect to other environmental goals, high erodibility remained an important eligibility criterion, and potential impacts on erosion were included in the design of the EBI. Furthermore, Chapter 4.3.3 has shown that highly erodible land has always accounted for a large share of total CRP land. The CRP has the potential to reduce sheet, rill (water driven) soil erosion, and wind erosion (USDA 2003b). Initially, experts from the USDA's Environmental Research Service estimated that the first two signups of 1986 reduced erosion by 26-27 tons per acre per year on average (Ribaudo et al. 1989, p. 421, Young and Osborn 1990a, p. 372). However, this figure fell to 17-18 tons for subsequent signups due to the fact that less highly erodible land was available for enrollment. Given the targeting of highly erodible land, the CRP was expected to reduce erosion by 17 tons per acre or a total of 750 to 780 million tons annually, once all the projected 45 million acres had been enrolled. Thus, the CRP should have prevented more than 7.5 billion tons of erosion from 1986 through 1999. However, it was not possible to discern to which scenario these estimates refer. Still, experts noted that the net erosion reduction success of CRP scenario compared to a non-CRP scenario is lower, since some land might have been set aside under other programs. Furthermore, slippage effects (see chapter 5.2.4) could diminish the success of erosion reduction.

Claassen et al. (2001, p. 16) argue that the total erosion on CRP lands before idling might be used as a proxy for resulting erosion reduction. On the 31.5 million acres enrolled by June 15, 2000, total erosion amounted to 406 million tons per year in 1982, or roughly 13 tons per acre. Thus, the erosion reduction was only half the value indicated by Ribaudo et al. (1989) and Young and Osborn (1990a). Considering Claassen's estimates, the CRP accounted for more than 30 percent of the decline in agriculture-induced erosion from 3.08 to 1.89 billion tons per year from 1982 to 1997. However, Claassen et al. (2001, p. 16) qualified that the actual reduction induced by the CRP was lower due to the fact that even on land set aside erosion could not be reduced to zero and due to negative impacts of slippage effects.

Claassen et al. (2001, p. 17) also provide an estimate of the monetary benefits from erosion reduction. Given 35 million acres enrolled, the CRP would produce benefits of $694 million per year. This value includes impacts on water based recreation, soil productivity, municipal and industrial uses, and household chores, e.g. cleaning. Thus, some of these values reoccur when determining benefits from the CRP that result from reduced erosion levels.[28] [29] Reduced erosion results in on-site benefits (soil productivity) and off-site benefits (water and air quality) that will be addressed in the subsequent chapters.

[28] All estimates of monetary benefit presented in this and subsequent chapters represent non-market use values. Thus, values given to the existence of an environmental resource, although it is currently not used ,are not included (Feather et al. 1999).

[29] Estimates cited in this and subsequent chapters rely on data provided by Feather et al. 1999 (the estimates of Claassen et al. 2001 are based on this data as well). Another attempt to value CRP benefits was undertaken by Ribaudo et al. 1989. They estimated CRP benefits for the period from 1986 to 1999 and assumed a 45-million-acres enrollment. Their results indicated that soil productivity benefits ranged from $0.8 to $2.4 billion, surface water benefits from $1.9 to $5.3 billion, air quality benefits from $0.4 to $1.1 billion, and wildlife benefits from $2.9 billion to $4.7 billion.

5.1.2.2 Soil Productivity

Soil productivity, another goal of the CRP, is directly influenced by erosion and thus did not need to be targeted explicitly via the EBI or eligibility criteria. Excessive soil losses reduce crop yields due to reduced water-retention capacity and water infiltration rates and due to nutrient losses. The application of fertilizers may help to restore nutrient supply but will not prevent yield losses resulting from a lower water-retention capacity (Young and Osborn 1990a, p. 372). Given the erosion level of 1982, soil productivity was expected to decline by 2 to 4 percent over the next century. At that time, about 40 percent of U.S. cropland was eroding at a rate greater than that assumed to result in productivity losses (Ribaudo et al. 1989, p. 421). Thus, erosion reduction through planted covers should improve soil productivity. Generally, the more severe the deterioration of soil structure due to cropping practices, the more significant the effects from CRP management (Uri 2001, p. 328).

Some studies provide evidence that the above assumptions have been realized on CRP land. During a six-year study, Reeder et al. (1998) re-established grass on field plots that had been cropped for the previous 60 years or more. Their results indicated that five years after retirement, the soil organic carbon and nitrogen content of the investigated soils was higher than that of cropland, and equal to or even greater than that observed on adjacent native ranges. This was not only due to lower erosion rates, but also resulted from higher levels of biomass production on these plots. According to their estimates, CRP covers produced 930 to 1,300 kilograms of carbon and nitrogen biomass per acre per year. However, the results were less significant for some types of soil. Similarly, Follett (2001) calculated that the amount of carbon sequestered in CRP covers averaged 240 to 360 kilograms per acre annually. Considering the roughly 32 million acres contracted under the CRP by the end of 1999, CRP covers sequestered 7.6 to 11.5 million metric tons of carbon per year. Based on a slightly lower level of enrollment Uri (2001) calculated that CRP land sequestered 3.8 to 8.8 million tons of carbon.[30] These studies basically assumed that carbon sequestration on retired lands is higher than on cropland, but did not provide data for carbon sequestration on cropland. However, the contribution of carbon sequestration to soil productivity will be higher on retired land than on cropland as biomass is not typically harvested, but rather remains on the field and thus transmits carbon to the soil.

Young and Osborn (1990b, in Feather et al. 1999, p. 28) valued soil productivity gains from erosion reduction monetarily at $227.5 million per year. The effect of carbon sequestration has been valued with respect to air quality benefits (see below), but a monetary benefit is still lacking for soil productivity benefits.

5.1.2.3 Water Quality

When evaluating the results for the water quality objective, two categories need to be distinguished: surface water quality and groundwater quality. Surface water quality is mainly affected by erosion. Soil runoff may carry agricultural residues, e.g. chemical fertilizers, animal manure, pesticides, and sediments into waterways. Fertilizers, animal manure, and pesticides may endanger aquatic plant and animal life, and decrease the quality of drinking water. Sediments washed off can fill reservoirs, block navigation channels, affect aquatic plant life, and degrade recreational resources (Ribaudo et al. 1989, p. 422). Not only has the CRP taken these impacts into account by targeting highly erodible land and prohibiting farming on it, and thus, reducing the discharge of organic and inorganic residuals, but also has the USDA explicitly made lands adjacent to water bodies, e.g. filter strips, eligible for the CRP, and based part of the EBI score on the location of land relative to water protection areas and its contribution to water quality. However, there are few studies which investigate the extent to which the CRP has actually been able to achieve water quality improvements. A USGAO report (1989, p. 18) estimates that the amount of harmful chemicals washed into streams and lakes

[30] Uri (2001) notes that there are different interpretations as to what constitutes carbon sequestration in the context of carbon emissions mitigation policies.

might be reduced by about 5 percent, yet does not give more detailed information. Claassen et al. (2001, p. 16) give an idea of how strongly erosion reduction may influence surface water quality, indicating that more than half the erosion reduction on U.S. cropland was attributed to reduced water erosion between 1982 and 1997.

Groundwater quality is mainly affected by the use of agrichemicals. In contrast to surface water quality, erosion plays an insignificant role here. Any contribution to improved groundwater quality is due to the fact that the CRP prohibits the use of fertilizers or pesticides on enrolled land, and consequently less of these materials can leach into groundwater (Young and Osborn 1990a, p. 373). The CRP addresses groundwater issues by making wellhead protection areas eligible. Moreover, the USDA has included a groundwater factor as part of the water quality factor, which evaluates potential impacts on groundwater quality. Ribaudo et al. (1989, p. 423) identify another interesting benefit in the context of groundwater. If cropland enrolled in the CRP had previously been irrigated, idling would help to conserve groundwater supplies and prolong the life of aquifers. However, the absence of procedures to estimate changes in groundwater quality prevents exact quantification in this respect. Still, Young and Osborn (1990a, p. 373) found that benefits from groundwater quality improvement would be small, especially because slippage effects (e.g. intensification of pesticide and fertilizer use on lands remaining in production) might shatter some of the positive results (see chapter 5.2.4).

According to Ribaudo (1989b, in Feather et al. 1999, p. 28), the benefits to sport fishing due to improved water quality amounted to $21.4 million annually. Feather et al. (1999) supplemented this study with estimates on the benefits of the CRP to freshwater-based recreation, judging these to be worth $39.6 million. However, they claim that total water quality benefits are actually higher, because this figure does not take improvements relating to saltwater-based recreation and groundwater quality into account. Nonetheless, the USGAO (1989, p. 29) stated that the effect of soil erosion on water quality was up to 100 times greater than the estimated benefits to to water quality from the CRP. Studies on the monetary value of groundwater quality benefits from the CRP are still lacking.

5.1.2.4 Air Quality

Air quality was never mentioned as an explicit objective in the wording of Conservation Titles of Farm Bills. Yet, it may be seen as a concealed aim in the erosion reduction target. Since the inclusion of air quality as a subfactor in the EBI in 1997, it can even be considered as a primary objective. The construction of this EBI factor implies that air quality mainly depends on wind erosion and climatic impacts. Wind erosion generally occurs in areas, where low average rainfall, frequent drought and high wind velocities coincide with fine soils, sparse vegetative cover and agricultural activity, as is the case in the western United States. The resulting high particulate air pollution causes maintenance and cleaning costs for households and businesses, damages to machinery, and has a harmful effect on health (Young and Osborn 1990a, p. 373). Thus, idling land and establishing permanent covers provides a number of benefits. The construction of the EBI's air quality factor demonstrates that the USDA has tried to focus CRP measures on problem areas described above. As outlined in Chapter 4.2.5.2, land with highly erodible soils in areas where strong winds are a climatic feature receives higher EBI scores, is more likely to be enrolled. Besides this, some practices encouraged by the CRP, e.g. windbreaks, not only have the potential to fix erodible soils, but also to lower wind velocities and thus may contribute to reducing wind erosion. As with water quality, quantitative evaluations of air quality benefits accruing from the reduction of wind erosion are lacking. Claassen et al. (2001, p. 16) at least indicate possible impacts of reduced erosion on air quality, estimating that wind erosion reductions accounted for roughly 46 percent of total erosion reductions from 1982 through 1997.

The impact of the CRP on climate has been subject to much more detailed investigations. Climate change, particularly through global warming, is influenced by the concentration of various atmospheric gases, the so-called greenhouse gases, of which carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) are among the most important. Agriculture is assumed to contribute significantly to emissions of these gases. Regarding CO_2, tillage and consequent erosion release carbon deposits stored in the soil, and make them available to living soil organisms that respire CO_2 into the atmosphere. The resulting impacts on the climate are significant because soil represents the most important terrestrial carbon store (Follet 2001). Furthermore, devoting land to cropping decreases the supply of plants to sequester atmospheric carbon. Chapter 5.1.2.2 has provided evidence on the extent to which CRP covers may contribute to improved carbon sequestration, and thus diminish atmospheric carbon loads. Moreover, Dunn et al. (1993) and Uri (2001) emphasize the importance of trees for carbon sequestration. The CRP contributes to greater forestation, as it supports several tree planting and tree maintaining practices. Furthermore, the EBI rewards land management that provides enduring benefits, e.g. planting trees. Based on estimates for carbon sequestration, some authors have predicted the CRP's contribution to total carbon reductions. Using estimates cited in chapter 5.1.2.2, Uri (2001) calculated that carbon sequestered in CRP soils may account for an average of 1.2 percent of the U.S. carbon emissions resulting from the burning of fossil fuels. Dunn et al. (1993) draw a more pessimistic picture, stating that CO_2 emissions from fossil fuel use were 300 times the sequestration potential of all CRP acres planted with trees in 1990. Thus, they conclude that the tree planting practices of the CRP can make only a small contribution to reducing atmospheric CO_2, although they are the most important part of the CRP with respect to carbon reductions.

More encouraging findings with respect to emissions of N_2O, another important greenhouse gas, were reported by Mummey et al. (1998). They argue that agricultural soil management increases N_2O emissions by altering soil structures and nitrogen cycles and thus caused about 75 percent of total anthropogenic N_2O emissions. According to their calculations, idling land under the CRP might reduce N_2O emissions by about 8.4 million tons of carbon equivalents per year, that is, 7.7 percent of 108 million tons of carbon equivalents per year that the USA aims to reduce its greenhouse gas emissions by.

In addition, Follet (2001) underlines that greenhouse gas reductions stem not only from re-established covers, but also from reduced emissions due to the use of fewer production inputs. According to his results, retiring land might significantly lower CO_2 emission rates, because less diesel would be consumed by farm machinery and the energy demand for irrigating land would decline. Besides this, less nitrogen fertilizer would be applied, leading to lower N_2O emissions from fertilizer production and from the denitrification of the applied fertilizers. However, Follet (2000) did not undertake specific estimates for the case of the CRP.

Ribaudo et al. (1990, in Feather et al. 1999, p. 28) calculated the monetary air quality benefits from CRP erosion reductions to be $ 51.1 million per year. The monetary evaluation of climate-related benefits appears much more complicated. Parks and Hardie (1996, in Feather et al. 1999, p. 28) valued carbon sequestration benefits at roughly $65 billion, considering the CRP acreage planted with trees. Still, total benefits will be higher as several of the benefits mentioned above have not been subject to monetary evaluations yet.

5.1.2.5 Wildlife Habitat

When the CRP was implemented in 1985, wildlife habitat benefits were only mentioned as a secondary objective. This changed when the 1990 Farm Bill mandated that permanent wildlife habitat covers, rare and declining habitats, and other sensitive lands and practices should be eligible. Thus, the CRP includes several measures that are expected to directly improve wildlife habitat. Most of these, moreover, were excluded from the competitive land selection process by the introduction of the continuous signup in the 1996 Farm Bill. Thus, the support of wildlife habitats is not subject to cost considerations but only to benefit expectations. Since 1995, the wildlife factor has been part of the EBI. Along with water quality and erosion issues, wildlife aspects account for the largest share of the EBI score reflecting the high importance attached to wildlife habitat improvements by the USDA.

The CRP basically contributes to such wildlife habitat improvements by establishing grass and tree covers and by reducing the use of agricultural chemicals, which should particularly improve aquatic habitats (see chapter 5.1.2.3) (USGAO 1989, p. 18). In some areas, the majority of available grassland habitat for wildlife is located on CRP land. In 1994, the area of grassland habitat established under the CRP was twice the size of all national and State wildlife reserves (Osborn 1997b, p. 293). Permanent grass covers are supposed to provide nesting covers, wintering habitats, plant and insect food for numerous wildlife species not indigenous to forestland. Hays et al. (1989), for example, found that the quality of winter cover and winter food supply were higher on CRP fields than on other land in the vicinity. Still, they qualified their results commenting that covers could not guarantee that birds would survive severe winters. Furthermore, they emphasized that the quality of wildlife grass habitat declined significantly when fields had been mowed or grazed. In this context, the 2002 regulations permitting haying and grazing appear problematic. However, as such land management is allowed only every three years and has to be undertaken according to conservation plans elaborated with the NRCS, it can be assumed that wildlife habitat aspects are taken into consideration, and that impacts will not be too severe. Indeed, the USDA (2003b) claims that managed haying and grazing may even increase diversity and quality of vegetative covers.

Dunn et al. (1993) expected that the CRP would also enhance total forest areas, and thus provide important interior habitats (the corresponding CRP measures have been discussed in chapter 5.1.2.4). Further, they found that planting cropland with trees under the CRP would reverse landscape fragmentation and improve habitat connectivity. Resulting lower distances between woodlots would improve the dispersal of fauna species and thus enhance biodiversity. Similar improvements may be assumed to occur due to the greater connectivity of grass plots. However, the EBI used for the 15th signup promoted habitat connectivity better than that of the 26th signup, since it awarded additional points for acreages adjacent to protected wildlife habitat and of larger size than the average amount of land offered in a State (Feather et al. 1999).

Comprehensive estimates of total changes in wildlife populations due to CRP management are not available. However, several studies have investigated the impacts of the CRP on single species. The CRP has been particularly beneficial to grassland dependent birds. Two studies by Johnson and Schwartz (1993a, 1993b) found that many bird species were more common on CRP lands than on cropland. Consistent with this study, Coppedge et al. (2004) ascertained some beneficial relationships between grassland-associated birds and CRP-derived pasture. Increased populations may be explained by greater nesting and breeding success due to better nesting cover and food supply. According to Kantrud (1993), the duck nest success amounted to 23.1 percent on CRP lands compared to 8.2 percent on waterfowl protection areas with similar vegetative covers. Evrard (2000) even calculated a higher rate of duck nest success of 27 percent on CRP lands in Wisconsin but could not confirm this result to be significantly better results than the results in waterfowl protection areas. Moreover, he found that the number of pheasants on CRP lands was up to ten times higher than on surrounding cropland. Results of a study conducted by Berthelsen et al. (1989) in the Southern Plains indicated that pheasant reproduction and density were much higher than the figures given in research on the same land before CRP implementation. Nevertheless, they considered that the level of nest success was still inadequate to meet the pheasants' reproduction needs. Like Hays et al. (1989), Berthelsen et al. (1989) emphasized that haying and grazing can have severe impacts on the nest success, because they can destroy nests. Still, conservation plans can be constructed in such a way that mowing during nesting periods is discouraged. However, information on how CRP conservation plans take such aspects into account was not available.

Some studies even investigated impacts of the separate CRP cover practices on wildlife populations. The results of a study by Stauffer et al. (1990) indicate that improvements in quail habitat due to newly introduced grasses and legumes (CP1) were counteracted by negative effects of tree plantlings (CP3) because the latter offered minimal cover for nesting, and did not provide sufficient food suitable for quail. Similarly, Johnson and Schwartz (1993a) state that certain practices favoured certain bird species. Some species were more common in fields with high coverage of grass, the population of several species were negatively related to legumes coverage, and the populations of a few were positively related to water cover. However, Johnson and Schwartz (1993a) point out that more research is necessary in this field. Allen (1995) found that different cover practices may have differing effects on the quality of wildlife habitat. His results indicated that native grasses provided a higher and denser habitat than tame grasses, although the latter achieved habitat improvements more quickly. Similar results were delivered in a study by McCoy et al. (2001, in Coppedge et al. 2001). They compared different CRP field types and discovered that plantings consisting of more diverse vegetation were more beneficial to bird habitat than single-species plantings. Thus, Coppedge et al. (2001) demanded that future CRP enrollments should offer incentives for planting communities of native vegetation in order to replace monocultures of forage and pasture grasses, as had previously been in place commonly.

Studies on CRP impacts on mammals and water habitat species are still lacking. Still, it is believed that these have also benefited from CRP management practices (Szentandrasi et al. 1995).

Generally, CRP wildlife habitat improvements are considered to provide the greatest benefits in monetary terms. Young and Osborn (1990b, in Feather et al. 1999, p. 28) assessed the benefits for small-game hunting to be worth $443.8 million per year. Waterfowl hunting benefits were estimated by John (1993, in Feather et al. 1999, p. 28) to amount to $175.2 million annually. Feather et al. (1999) calculated that wildlife viewing and pheasant hunting benefits amounted to $347 million per year and $80 million per year, respectively. On the one hand, the total expected wildlife benefits should be higher, because no studies have been conducted yet on benefits from better conditions for big-game hunting for example (Feather et al. 1999, p. 31). On the other hand, actual hunting benefits will be lower as many land owners will not allow hunting on their property (Miller and Bromley 1989). Consequently, monetary valuations are still subject to remarkable uncertainty.

5.1.3 Special Issues of Ecological Effectiveness

The two previous chapters have shown that the CRP has been able to achieve significantly the goals set by the USDA. Factors that may have contributed to meeting single objectives have been mentioned. However, some aspects affect not only a single goal but overall ecological effectiveness. In the remainder of this section, light will be shed on the important issues of the, regulation when contracts expire, information to farmers, and incentives offered. Of course, insufficient monitoring and enforcement systems (see chapter 3.2.2) may also have adverse effects on ecological effectiveness. Farmers which are not monitored may pursue personal goals rather than environmental goals. However, this important issue cannot be discussed in detail in the context of this work because no information was available on the design of the monitoring and enforcement process, or on the problems relating the monitoring and enforcement of the CRP.

5.1.3.1 Regulation When Contracts Expire

Chapter 2.1 indicated that compensation payment instruments typically purchase property rights from farmers. However, property rights are usually transferred only temporarily. In the case of the CRP, farmers are contracted for 10 to 15 years. During this period farmers have to obey the FSA regulations, that is, retire their acreages, in return for the compensation payments received. Once these contracts expire, property rights are returned to farmers and it is not guaranteed that the conservation practices will be continued. Even if re-enrollment is offered, as with the CRP, farmers may prefer to return to cropping if, for example, market prices have risen or new market opportunities have opened up (Hodge 2001, p. 102). However, many ecological processes take decades to reach desired goals and benefits already gained may be lost if farmers return to more intensive land management (Hanley et al 1999, p. 74). With respect to the CRP, Uri (2001, p. 328), for example, states that soil productivity benefits and erosion reductions due to CRP covers might be lost within few years. Mummey et al. (1998, p. 85) expect that part of the N_2O mitigation benefits of the CRP would be lost if land was returned to tillage-based farming systems. Similar negative impacts on erosion, water and wildlife habitat quality may be supposed. Consequently, Whitby (2000a, p. 373) demands that policies must be designed to promote long-term retention of conservation benefits.

Generally, the CRP's 10 to 15-year contracts cannot guarantee conservation in the long term but only during the contract period. Several authors who conducted studies before the large round of expiry in 1997, feared that up to 46 percent of the CRP farmers would return to conventional tillage, mostly for financial reasons (see Osborn 1993, p., Allen 1995, Coppedge 2001, p. 686). These estimates were all based on the assumption that the CRP would not be prolonged, and thus, did not consider the incentives offered after contract expiry. It was not until 1996, that the USDA decided to expand the CRP through 2002. Due to this uncertainty, it was always unclear, whether the CRP would be extended and thus offer possibilities to produce enduring benefits, or whether it would be terminated due to budgetary cuts. However, due to the prolongation of the CRP the above estimates did not come true. Of the 21.61 million acres whose contracts expired in 1997 roughly three quarters were re-enrolled the same year (Smith 2003).

Still, there is some evidence that even if the CRP payments were not continued, the return to cropping would be limited. Data presented in chapter 4.3.4 revealed that roughly 40 percent of the CRP lands are owned by retired or residential farmers. These are less likely to return to cropping, because they do not depend on farming incomes (Smith 2003, p. 11). Moreover, limited-resource and low-sales farms account for a further 24 percent share of CRP lands. The average age of limited-resource and low-sales farmers is 60 and 59 years respectively. Therefore, these might be interested in phasing down their business through land retirement (Hoppe and Wiebe 2003).

Designing the CRP, the USDA included some incentives to ensure long-term benefits. The planting of trees is supposed to produce particularly enduring benefits as it takes more efforts to return woodland to cropland than to plough land with grass covers. Until 1990, the USDA especially encouraged tree establishment by offering special incentives under its tree planting initiative. This policy was continued with the introduction of the enduring benefits factor into the EBI, which rewards land planted with trees with higher scores. Still, the success of these measures has been limited, as only 7 percent of the total CRP acreage was planted with trees by 2003 (see chapter 4.3.3). Another step towards ensuring enduring benefits from CRP practices was taken by the 2002 Farm Bill, which stipulated that land on which CRP contracts had expired should be automatically eligible for re-enrollment, thereby, easing the continuation of CRP practices. However, the contribution of the CRP to ensuring long-term benefits remains questionable, especially with respect to benefits that relate to the idling of open space rather than afforestation.

The arguably most important contribution to the achievement of enduring benefits does not stem from the CRP itself, but from the conservation compliance regulation implemented in 1985. It requires farmers, who return their CRP acres to crop production and request USDA payments, to apply an approved conservation system on this land. According to this regulation, farmers have to adopt measures to reduce erosion by at least 75 percent of the potential erodibility (Claassen et al. 2001, p. 22). Thus, the USDA fulfilled Whitby's (2000b, p. 329) demand that policies must implement some longer term control to deal with the end-of-contract problem. However, conservation compliance mainly addresses erosion and related problems. Wildlife benefits, for example, are neglected. Moreover, Wu (2000, p. 980) criticizes that definitional, implementation, and enforcement problems have hampered the effectiveness of these provisions. Consequently, it is questionable whether the CRP can provide enduring benefits beyond the contract period.

5.1.3.2 Information and Education

Information is of importance in the context of agri-environmental policies for at least two reasons. On the one hand, to be willing to participate, farmers have to be informed of the opportunity to receive compensation payments and of the requirements and implications related to these payments, e.g. the required management changes and resulting costs. On the other hand, education of farmers and the amount of information available to them will have large impacts on the quality of implementation of the practices they undertake, and thus directly affect the ecological effectiveness of a program.

With respect to participation issues, a study by Frederiksen and Johannessen (2001) suggests that providing only general information on a program is inappropriate to attract farmers. Moreover, farmers tend to request individualized information about whether their land qualified as well as background data indicating what fundamental environmental effects were envisaged. In addition, farmers are more likely to participate, if they receive information, education, and training on how to adopt the required practices (Penker 2003, p. 15). Several studies provide evidence that information activities in the context of the CRP have been insufficient. Esseks and Kraft (1989) acknowledge that USDA information about the CRP to farmers improved during the initial years of the program. For example, the share of eligible non-participants claiming not to be eligible declined from 50 percent in 1986 to 18 percent in 1988. However, information about the CRP was not sufficient. Up to 58 percent and up to 80 percent, respectively, of the farmers interviewed, were not aware of the tree planting initiative and the filter strip option offered since 1988. Still other studies state that many farmers did not know that their land was currently suffering from erosion (see Dunn et al. 1993, p. 136). The importance of informing farmers about their eligibility was emphasized once again by Loftus and Kraft (2003) who found that participation in buffer strips increases if land operators were informed that their streamside lands qualified for this practice. The non-achievement of the program's enrollment goals by 1990 (see chapter 5.1.1) may have resulted from these information deficits. In addition, studies document that many farmers underestimated the economic benefits and overestimated the costs of the CRP (see Dunn et al. 1993, p. 136). In this context, to correct the farmers' perception of personal costs incurred appears especially important (Loftus and Kraft 2003, p. 81). Esseks and Kraft (1989) as well as Loftus and Kraft (2003) found that the number of visits to local FSA offices was the most important influence on the farmers' knowledge of program features and participation. Thus, they advised that the USDA should induce more visits by farmers to local offices and increase the range of information material offered there. Moreover, the local agencies should proactively contact farmers with eligible land, although this might be a problem, as many offices are understaffed. Hardly any information on how farmers were informed during recent signups is available. However, due to the 1995 modification of the CRP mandating that farmers should be informed of the maximum annual per-acre rental rates, farmers' knowledge, particularly of the program's benefits, has probably improved. Still, there is a demand for further research in this field.

Penker (2003, p. 15) recognized that the quality of human intervention has a decisive impact on the ecological effectiveness of compensation payment instruments. To guarantee the quality of adopted practices, information, education and training are necessary. The results of a study by Miller and Bromley (1989) indicate that information and education concerning wildlife management on CRP lands appeared to have a low priority. Their survey revealed that 62 percent of the respondents had not been informed about improving wildlife habitat on their CRP fields. They concluded that the lack of information and education contributed strongly to the fact that wildlife habitat on CRP lands had remained underdeveloped during the first years. Chapter 5.1.2.5 has shown that wildlife benefits are now among the most important contributions of the CRP, however this is attributable to changed eligibility criteria and a revised EBI. How much information and education has been provided recently remains unclear.

5.1.3.3 Incentives

Generally, farmers enroll voluntarily in the CRP. Therefore, their decisions whether to participate in the program basically depend on the financial incentives offered. First of all, farmers need to receive compensation for foregone benefits and the additional costs incurred through participation in the CRP. These aspects are considered when the FSA determines the individual bid cap for rental payments for an offer and the cost-share payments (see chapters 4.2.5.1 and 4.2.7). It is unclear, though, whether these CRP payments reflect the potential technical expenses necessary to meet the requirements of the CRP, as demanded, by Penker, for example (2003, p. 16).

However, granting these payments may not be sufficient to induce farmers' participation. Chapter 3.2.2 indicated that, in addition to the above costs, land operators incur significant private transaction costs. Falconer (2000) found that private transaction costs have the potential to adversely impact the participation rates and thus the achievement of a program's objectives. Based on the data cited in chapters 4.2.5.1 and 4.2.7, it may be concluded that the CRP payments do not include a private transaction cost component, and may therefore neglect important costs. However, research in this field, especially on the level of private transaction costs, is needed before a final conclusion may be reached.

Ahrens et al. (2000) also found that compensation payments should consider private transaction costs. Furthermore, they identified additional psychological factors that should be included in the payments. According to them, incentives are also necessary to overcome the negative attitudes of farmers towards conservation practices. Closely related to this issue is that of a lack of information. The previous chapter has shown that uninformed farmers tend to overestimate program-induced costs and consequently are likely to require higher compensation payments than would actually be necessary. Ahrens et al. (2000) estimate that such effects (including transaction costs) may inflate the necessary incentives by up to 50 percent. However, they remark that the government's attempt to change attitudes through payments is open to question. Moreover, as the case of information shows, alternative tools may improve acceptance among farmers as well (see chapter 5.1.3.2), and probably at lower cost.

Chapter 4.2.7 shows that the USDA has implemented several additional incentives policies throughout the existence of the CRP. Both the corn bonus and the tree initiative represented clear examples of such policies, as they were designed to supplement existing rental payments, which should actually have been sufficient to compensate farmers. A similar tool was introduced for environmentally important practices under the continuous signup. Although rental payments for continuous signup acres are assessed with respect to the bid cap, which already takes individual conditions and costs into account, further payments of up to 20 percent are offered for some practices. This reveals that the USDA uses payments to overcome other obstacles rather than costs. Apart from these payments, continuous signup farmers receive another supplement, because they are excluded from competitive bidding. As USDA officials are subject to information asymmetries (see chapter 3.2.2), farmers may request the maximum acceptable rental rate without facing probable rejection. Thus, even farmers whose abatement costs are low will request the maximum rate and receive additional gains at the amount of the difference between the bid cap and their actual costs.

5.2 Cost-Effectiveness I: Production Costs

Chapter 3.2.1 mentioned that costs and benefits of conservation practices adopted may differ between farms. Kolstad (1987) found that such heterogeneity calls for treating each firm differently, according to its marginal contribution to conservation benefits and its marginal abatement costs, if production costs are to be minimized. This chapter presents approaches to differentiating compensation payment instruments in order to allocate resources cost-effectively, and demonstrates how they are implemented for the CRP.

5.2.1 Benefit-Cost Targeting

When selecting land for conservation purposes, decision makers have three options. They may target low-cost land, high-benefit land, or land that guarantees the highest ratio of benefits to cost. For cost targeting, Babcock et al. (1996, 1997) demonstrated that the cost-effectiveness crucially depends on the variability of costs and benefits and the correlation between costs and benefits. If the variability of costs is high, that is costs are strongly spatially concentrated, and the variability of benefits is low, cost targeting is likely to allocate resources cost-effectively.

On the other hand, if the variability of benefits is high and costs are distributed equally spatially, cost targeting will deliver inefficient solutions. Consequently, increases in cost variability will increase the benefits from cost targeting, and rising benefit variability will diminish cost-targeting success. Moreover, the correlation between costs and benefits determines the outcome of cost targeting. If both are negatively correlated, that is low cost land provides higher benefits than high-cost land, cost targeting maximizes benefits. However, cost targeting will not allocate resources cost-effectively in the reverse case of positive correlation.

Babcock et al. (1996, 1997) provide some evidence on variability and correlation for the United States. Since wind erosion benefits were negatively correlated with abatement costs, cost minimization performed well with respect to this factor, although wind erosion benefits were highly concentrated. In contrast, water quality benefits were positively correlated with costs, and highly concentrated and thus required careful targeting. Although higher wildlife benefits were provided on high cost lands, disadvantages from cost targeting were smaller than for water quality, because benefits were distributed equally. Thus, cost targeting is not able to provide the full range of benefits cost-effectively. Similarly, the success of benefit targeting depends on assumptions about variability and correlation. Therefore, Babcock et al. (1996, 1997) identify benefit-cost targeting as the first-best solution to guarantee the cost-effective allocation of conservation resources.

Benefit-cost targeting under the CRP is mainly influenced by the payment mechanism applied and the determined county acreage restrictions. Regarding the payment mechanism, the CRP has introduced posted prices as well as auction procedures. Both mechanisms differ with respect to the capability to allocate resources on the basis of benefit-to-cost ratios. As stated in chapter 2.2.2.1, posted prices are often set with respect to average abatement costs. Any farmer whose abatement costs are below the posted price will enroll under the management scheme and adopt a conservation practice. Farmers with lowest abatement costs are offered the highest incentives to enroll, irrespective of the benefits they produce. Thus, posted prices result in cost targeting. According to Latacz-Lohmann (1998) this can be seen as the most important drawback of fixed-rate payment systems.

Posted prices are paid for CRP lands enrolled during continuous signups (see chapter 4.2.5.1). However, negative impacts on cost-effectiveness are limited, since only land and practices that involve little costs and contribute substantially to environmental improvements are mandated to be eligible for continuous signups. Thus, these land and practices meet the condition of negative correlation between costs and benefits, under which cost targeting delivers cost-effective outcomes.

In contrast to posted prices, differences in costs and benefits may be considered when auctions are applied (Latacz-Lohmann 1998). A study by Latacz-Lohmann (1993) demonstrates that farmers with lower abatement costs will request lower compensation payments. This is related to the fact that farmers have to compete for conservation contracts and are more likely to be rejected if they request higher payments. Thus, farmers will avoid overstating their bids and reveal some information about their true abatement costs. This information about costs may be combined with the expected benefits on a plot of land offered in order to identify and select the bids that provide the highest benefit-cost ratios.

For most CRP acreages, the USDA has implemented an auction system (see chapter 4.2.5.1). However, the USDA did not use the potental advantages of such a bidding procedure during the first years. CRP acreages were mainly enrolled on the basis of cost. Selecting low-cost land maximized the amount of acres that could be enrolled for a given budget and thus helped to achieve the minimum enrollment rates, which were prescribed at least until 1990. Nevertheless, cost targeting under auctions had the same disadvantages as under posted prices.

Since 1990, CRP enrollment has been targeted with respect to benefit-to-cost ratios. Until 1995, offers were ranked by the ratio of EBI to government costs, which were likely to reflect the actual economic costs due the bidding procedure. Since 1995, the cost factor has been included in the EBI resulting in the highest scores for offers with the highest benefits per dollar expended. Osborn (1993) found that these changes in the enrollment procedure did indeed improve the environmental benefit-to-cost ratio of land enrolled after 1990 across the range of program goals compared to those acres enrolled during the first signups. His results indicated that such redirection had dramatic impacts on the spatial distribution of CRP acres and thus explained the characteristic features of figure 6 (chapter 4.3.2). Allocating resources on the basis of benefit-to-cost ratios rather than costs alone led to decreased CRP enrollment in the Northern and Southern Plains and in the Mountain region and in increased amounts of CRP land in the Lake States and the Corn Belt. These results were confirmed by a more recent study by Feather et al. (1999), who found that monetary CRP benefits after the introduction of the EBI were higher, with program acreage and costs virtually unchanged. These studies show that targeting the CRP on the basis of benefit-cost-ratios has been a success.

Two more critical aspects of the CRP auction design have to be mentioned that may prevent an appropriate identification of the cost component of the EBI. The CRP applies a static pay-as-bid auction (see chapters 2.2.2.2 and 4.2.5.1). First of all, static bidding processes perform poorly compared to dynamic auctions. Static auctions require bidders to make more complex decisions, as they have to get their bids right the first time. However, bidders do not only consider their abatement costs but also expectations about the clearing price. But since their estimation could be wrong, there is a risk that farmers that should adopt conservation practices from a cost-effectiveness point of view are rejected, because they have bid to high (DEFRA 2003). With respect to such effects, Hamsvoort and Latacz-Lohmann (1996) mentioned that not providing any information on bid caps would lead to inefficient solutions, as farmers may lack information on how to bid. Since 1995, CRP regulation has taken this advice into account, informing farmers about maximum acceptable rental rates and the composition of the EBI. However, the results could have been even better if a dynamic auction had been implemented. Under dynamic auctions, farmers, whose requests for compensation payments are too high and who consequently receive EBI scores that are too low, are allowed to revise their offers in subsequent rounds. Thus, price and allocation are determined through a process of open competition. Therefore, bidders are more likely to adjust their bid to their true abatement costs under dynamic auctions than under static auctions (Cramton and Kerr 1998).[31]

Secondly, uniform pricing appears to provide more cost-effective solutions than pay-as-bid pricing. Pay-as-bid approaches award the highest compensation payments to those bidders who are best able to guess the clearing price. Thus, bidders will always request more for the adoption of conservation practices than their actual abatement costs, depending on their assessment of how likely they think it will be accepted. Consequently, pay-as-bid auctions as well as static auctions result in distortions that may exclude the wrong bidders from participation. Unfortunately, from a cost-effectiveness point of view, the USDA has combined the two auction features that make allocation less efficient.

Apart from the payment mechanisms applied, a specific feature of the CRP that prevents appropriate benefit-cost targeting are the county acreage restrictions. A USGAO report (1989) identified that the CRP regulation limiting the amount of land enrolled to 25 percent of the cropland in any county countered cost-effective allocation. This restriction prevented the enrollment of counties with high benefit-cost ratios in their entirety. Due to this county limit, almost one third of the total amount of eligible acres was not available for enrollment in 1989.

Still, this critical issue was not addressed in the 1990 revisions. The 25 percent county restriction was not explicitly adjusted. The FSA may exceed this limit if impacts on local economies are not expected to be severe. However, information on how the local FSA offices weigh out economic impacts and the achievement of conservation goals is not available. Thus, there is no way of judging the extent to which this regulation may negatively affect the program's cost-effectiveness.

[31] Cost-effective dynamic auctions have to comply with some activity rules for revising bids. All bids must be entered in the initial round, any losing bid that is not improved in the next round must be permanently rejected, and the improvement must exceed the clearing price (that is, the clearing EBI) by at least the minimum bid increment (Cramton and Kerr 1998).

5.2.2 Multiple Benefits

When the CRP was implemented in 1985, it was mainly targeted at erosion control (see chapters 4.2.1 and 4.2.3). A USGAO report (1989) found that until 1990, the USDA had particularly focused CRP enrollment on land that was subject to wind erosion. This focus was apparent from the higher MARRs granted for acreages in the Mountain and the Plains regions, which accounted for a large amount of highly erodible land and where wind was the primary cause of erosion. However, the reduction of wind erosion essentially provided onsite benefits, such as increased soil productivity. On the other hand, water erosion reductions, which were less targeted, caused a variety of offsite benefits, e.g. improved water quality, better wildlife habitat, enhanced recreation resources, which were recognized to exceed onsite effects. Ribaudo (1986) found that the distribution of regions with significant offsite benefits in the United States did not coincide geographically with that of regions with large onsite benefits. Thus, considering onsite impacts only would result in an inefficient allocation of recourses, if social benefits are to be maximized. Similarly, Connor et al. (1995, in Babcock et al. 2001) observed that co-ordinating erosion reduction and nitrate leaching policies increased cost-effectiveness. When only erosion control was targeted, an expenditure of $10 per acre reduced erosion by 49 percent but increased nitrate leaching by 27 percent. The same expenditure, and probably a similar amount of conservation resources, diminished erosion by 42 percent and nitrate leaching by 12 percent when a mixed targeting strategy was used. Wu and Boggess (1999) found that ignoring interrelationships among environmental benefits, especially interactions and correlations, leads to cost-effective allocations in a few cases only. Therefore, a whole variety of benefits has to be considered when allocating conservation resources.

CRP officials responded to such criticism by widening the program's perspective in 1990 to broader environmental goals. Chapters 4.2.3 and 4.2.5 have outlined in detail how eligibility and enrollment procedures have changed through the years. Barbarika and Smith (2000, in Smith 2003) applied a standardized EBI scoring procedure to illustrate how the above changes affected expected benefits. Their results indicate that on the one hand, land enrolled during recent signups provided more water quality benefits, air quality benefits and benefits related to conservation priority areas compared with early signups. On the other hand, acreages enrolled during the 15th signup reduced erosion by 20 percent less than those of the first signup. However, these results rely on the validity of the EBI and do not reflect whether actual benefits have changed as well. Feather et al. (1999) use non-market economic benefit models to determine the impacts of the introduction of the EBI. According to their estimates, benefits from freshwater-based recreation, wildlife viewing, and pheasant hunting doubled due to the introduction of the EBI. Still, Ribaudo et al. (2001) have criticized the reliance of these estimates on improvements that were assumed rather than measured. Nevertheless, there is some evidence that enhancing the goals of the CRP has increased overall economic benefits.

5.2.3 Cumulative Effects

Basically, the CRP targets enrollment using physical criteria, e.g. soil erosion rates which are relatively easy to measure. Such targeting approaches assume that marginal values of environmental benefits are constant.[32] That is, for example, an additional unit of water erosion reduction results in a constant additional unit of benefit (e.g. better aquatic wildlife habitat due to improved water quality), irrespectively of how many units of water erosion reduction have already been achieved previously. However, Wu and Boggess (1999) demonstrated for watersheds that such approaches ignore the presence of cumulative effects. Cumulative effects occur when significant environmental improvements can be achieved only after conservation

[32] In this respect, Wu et al. (2000) criticize several studies examining approaches to improving cost-effectiveness of the CRP for assuming constant marginal benefits, e.g. that of Ribaudo (1986) (see chapter 5.2.2).

efforts exceed a certain threshold. If these pooling effects are neglected, the funds allocated to an area may be inadequate to reach the threshold levels.[33]

Their results suggest three strategies for more cost-effective allocation. First, given identical levels of environmental quality, equal allocation of funds between two watersheds only maximizes environmental benefits if the funds are sufficient to reach the threshold in both watersheds. Otherwise, the fund should be concentrated in one watershed. Second, if one watershed is cleaner due to previous conservation efforts and the budget is small, funds should be allocated to the cleaner watershed first. And third, if one watershed has a lower level of environmental quality because a production practice causes more damage in this watershed than in another, and adoption costs of conservation practices are identical in both watersheds, the former watershed should be funded first.

Wu and Boggess (1999) acknowledge that information on cumulative effects is difficult to obtain and to include in conservation programs. Nevertheless, some features of the CRP work in favour of a better consideration of cumulative effects, although these are not addressed directly. Since the 1990 revision changed CRP's bidding procedure from cost targeting to benefit-cost targeting, land subject to the most severe environmental damage, i.e. where land retirement produces the largest benefits, is enrolled prior to land with less severe problems if a conservation practice adopted on the former land causes the same costs as on the latter plot. Thereby, the CRP meets the third requirement of Wu and Boggess (1999). Several CRP features that have been discussed already in chapter 5.1.3.1 help to implement their second strategy. In particular, the EBI enduring benefits factor and the automatic eligibility of previously enrolled acres for re-enrollment direct conservation efforts towards land, where some environmental improvements have already been gained already. The EBI wildlife enhancement factor (see chapter 4.2.5.2) rewards farmers who undertake additional efforts to enhance wildlife habitat and thus contributes to a higher concentration of funds in certain areas (see Wu and Boggess' (1999) first proposition). Similarly, the promotion of enrollment in high priority wildlife areas by the USDA (see wildlife priority factor in chapter 4.2.5.2) also means that funds are concentrated on certain areas. However, these are only few attempts to take threshold effects into account, and many EBI factors still rely on physical criteria mainly (e.g. the erosion and the water quality factor), so that the CRP's general capability to address cumulative effects may be doubted.

5.2.4 Slippage Effects

Slippage effects are unintended impacts of the CRP that compromise the program's goals and may significantly affect cost-effectiveness. The most important slippage effect in the context of the CRP is that its implementation may cause non-cropland to be converted into cropland (Wu 2000).

The conversion of non-cropland to cropland may have several reasons. Babcock et al. (2001, p. 11) emphasize that programs which only grant payments for new or improved conservation activities may induce farmers who have already adopted such measures in the past to end these practices temporarily in order to become new adopters and to qualify for compensation payments. This problem relates to the baseline discussion of chapter 2.1. The baseline defines the degree to which property rights remain with the famers, and consequently, which practices will be compensated and which not. To avoid slippage effects, the baseline has to be set in such a way that the program rewards good practices, irrespectively of whether or not these have been adopted previously, instead of improved practices (see Claassen et al. 2001 for a detailed distinction). However, the CRP enrolls cropland only. Thus, it discriminates against operators who have already retired land in the past and consequently gives rise to such slippage effects.

[33] Case studies on steelhead trout and salmon habitat are provided by Wu et al. (2000) and Wu and Skelton-Groth (2002), respectively.

Wu (2000) researched two more important examples of slippage effects. First, output prices for agricultural goods may increase, as retiring land will reduce total agricultural production.[34] Consequently, cultivating land produces higher profits, and some non-cropland will be converted to cropland. Secondly, substitution effects may be another reason for slippage. When some cropland is retired under the CRP, scale economies and fixed input effects may lead farmers to substitute other idled land (e.g. idled land not eligible for the CRP) for crop production. Considering the Corn Belt, the Lake States, and the Northern Plains, Wu (2000) found that for every 100 acres of cropland retired, 15 (Lake States and Northern Plains) to 30 (Corn Belt) acres of non-cropland were converted to cropland. This conversion resulted in slippage effects that offset 9 percent of water erosion benefits and 14 percent of wind erosion benefits that could have been achieved by the CRP. Thus the environmental benefit estimates of chapter 5.1.2 were over-stated as they did not include slippage effects.

Moreover, Wu et al. (2001) found that in the presence of slippage effects benefit-cost targeting will no longer maximize environmental benefits, as stated in chapter 5.2.1. Thus, the benefit-cost-targeting approach of the CRP will only allocate resources cost-effectively if slippage effects are prevented. Therefore, Wu et al. (2001) proposes that non-cropland which offers high environmental benefits but might be converted into cropland should be made eligible for the CRP. Negative effects due to the conversion of non-cropland might also be restricted by the conservation compliance requirements mentioned in chapter 5.1.3.1. However, Wu (2000, p. 980) criticizes that definitional, implementation, and enforcement problems have hampered the effectiveness of these provisions.

5.2.5 Monetary Benefits

As mentioned already, CRP enrollment has been targeted mostly on the basis of physical measures (e.g. Erodibility Index or distance to watersheds). Ribaudo (1989a) emphasizes that, from an economic point of view, not only physical improvements have to be considered when targeting CRP land but the demand for these improvements as well. For example, water quality improvements could occur in areas where there was little demand for such improvements due to a lack of instream and offstream water users and result in small economic benefits only. Ribaudo (1989a) found that the distribution of acres under physical targeting differed significantly from that under targeting with respect to economic benefits. Consequently, physical targeting was not appropriate to maximize total economic benefits. Therefore, he advised that any targeting procedure should take into account the potential economic benefits. Ribaudo et al. (1989) concluded that CRP enrollment should be targeted to regions which have large populations and large concentrations of industry demanding water and recreation resources and where economic benefits were expected to be highest. In the context of the CRP, these suggestions imply that enrollment should shift from the sparsely populated Mountain and Plains regions to the more densely populated and heavily industrialized Lake States and the Northeast region. Similarly, Feather at al. (1999) demonstrated that improving the environment near heavily populated areas resulted in more recreational benefits than the same change in less populous regions. However, the above reallocation processes will be less dramatic if land is selected on the basis of benefit-to-cost ratios. Studies by Parks and Schorr (1997) and Plantinga et al. (2001) found that opportunity costs are higher in densely populated regions, e.g. due to foregone benefits from developing land for uses other than agriculture. Thus, the higher economic benefits in these regions are qualified by higher costs. Nevertheless, there is evidence that targeting on the basis of monetary benefit-to-cost ratios allows a more exact allocation. Feather et al. (1999) found that monetary benefit targeting would increase economic benefits in some areas, despite a reduction in the total amount of CRP land.

[34] Wu (2000) supports his assumption by citing the example of the Redwood National Park whose establishment in 1978 raised redwood lumber prices by 26 percent. This price increase led to increased profits and harvesting of old-growth redwood on other lands.

For the 26th signup, the EBI included population as part of the surface-water, ground-water, and air-quality factors (see chapter 4.2.5.2). Claassen et al. (2001, p. 25) criticize the fact that these population considerations only refer to county populations. However, even when impacts on environmental resources were local, populations in neighbouring counties may also be relevant. Moreover, populations in more distant areas should be considered since impacts might occur downstream, downwind, or along a migratory route.

In addition, Feather et al. (1999) suggest that benefit valuations could be used to improve the current EBI design. EBI factor points should be made proportional to factor benefit estimates in order to increase environmental benefits from the CRP. For example, their results indicated that wildlife-viewing and pheasant-hunting benefits were much higher than freshwater-recreation benefits (see chapter 5.1.2). This implies that weighing wildlife and water benefits equally at 100 points does not maximize economic benefits.

However, Feather et al. (1999) emphasize that benefit estimates are not yet comprehensive. Existing evaluation approaches concentrate on certain aspects only (e.g. pheasant hunting or freshwater-based recreation). Furthermore, estimates of non-use values are lacking completely. Consequently, additional research is necessary before economic benefit valuations may be used to redirect the CRP.

5.2.6 Temporal Differentiation

In chapter 3.2.1, it was emphasized that apart from issues of spatial allocation, which have been discussed in the previous chapters, cost-effective temporal allocation has to be addressed as well. Referring to the example of the cost-efficient conservation of stork species, Johst et al. (2002) find that compensation payments for haying should be concentrated on one week or a few particular weeks only rather than allocating them evenly though the year.

Temporal differentiation mainly refers to active management during the contract period. Therefore, it is of less importance for land retirement programs, such as the CRP, which only require one action at the beginning of the contract (establishing the cover). However, the CRP allows haying and grazing under certain conditions (see chapter 4.2.6). Little information is available on how these practices are to be adopted and whether they meet temporal differentiation requirements. Cost-effectiveness depends on the construction of the conservation plan which has to be set up by farmers in co-operation with FSA and NRCS officials to make actions correspond to the conservation goals of the CRP.

5.3 Cost-Effectiveness II: Transaction Costs

To date, little is known about transaction costs in the context of the CRP. Some studies provide estimates on such costs. Young and Osborn (1990a, p. 370) calculate that administrative costs amounted to $100 million for a 45-million-acre CRP for the period from 1986 to 1999. According to data provided by Heimlich (2003), actual CRP administrative costs for this period were almost three times as high, amounting to $283 million, although fewer acres were enrolled. A USGAO report (1999) stated that the technical support by the NRCS (see chapter 4.2.2) alone burdened the budget of the USDA with $46.9 million in the fiscal year of 1999. However, comprehensive data on CRP transaction costs are not available, because data on private transactions especially is lacking. Moreover, no research has been done on whether the CRP could have been designed to be less costly with respect to transaction costs. Still, discussion in this direction is possible when more general literature on transaction costs, particularly regarding the payment mechanism implemented for the CRP, is consulted. The remainder of this section is divided into two sections considering decision-making costs and implementation costs, respectively.

5.3.1 Decision-Making Costs

Several authors emphasize that schemes which allow for the differentiation of payments, such as auctions, perform worse than those that rely on uniform payments, e.g. posted prices, with respect to information costs incurred by the regulator (see, for example, Hanley et al. 1998, p. 108, Moxey et al. 1999, p. 188). The assessment and allocation of uniform payments is usually based on average data, such as average costs within a certain region or average benefits from the adoption of a certain practice. In contrast, instruments that differentiate payments require specific knowledge of individual abatement costs, benefits from individual plots of land, and so on, which is more difficult to acquire. This is an important drawback of auctions, the instrument used to implement differentiated compensation payments for the CRP (Hamsvoort and Latacz-Lohmann 1996, p. 9, Holm-Müller et al. 2002, p. 115). However, auctions are superior to other differentiation methods, in that the bidding process reveals information about bidders' costs and thus allows information-cost savings. Chapters 5.2.1 and 5.4.1 show that the capacity of auctions to provide information on costs depends on the auction type and its implementation. If these are inappropriate to cope with information asymmetries, the outcome of the auction may need further investigation resulting in additional costs. In the case of the CRP, however, the USDA neglects such problems and uses farmers' bids to determine the individual amount of compensation payments. Consequently, costs of acquiring data on farmers' abatement costs are eliminated. Still, information is needed to assess individual bid caps and EBI scores. However, these information costs are limited in practice as the USDA has a long tradition in collecting farming data, e.g. on erosion, soil productivity, and prevailing local rental rates (Mello et al. 2002, p. 91).

The above considerations only shed light on public information costs. However, farmers also incur information costs. Basically, these private costs do not differ between flat rate payments and differentiated payments if farmers make rational decisions. Under both schemes, farmers have to estimate the costs incurred from conservation practices and decide on this basis whether or not to participate, or which compensation to request in a bid. However, Holm-Müller et al. (2002) stated that farmers often use rough estimates only, such as rules of thumb, to determine their costs. Auctions may induce farmers to make more reliable estimates of their true abatement costs. Thus, private information costs might increase. Some features of the CRP auction particularly encourage accurate estimates (DEFRA 2003). Auctioning farmers not only consider their costs but the behaviour of other bidders as well to gain information rents (see chapter 3.2.2). Under static auctions, bidders have only one attempt to assess their offer. Since little information may result in too high offers and rejection, bidders have to make a lot of effort to find an appropriate bidding strategy. In contrast, under dynamic auctions, the strategies of other bidders are revealed. Farmers may use this information to adjust their offers and will make less effort in guessing others' bids. Bidders face similar problems under pay-as-bid auctions. As they will receive the compensation requested in their bids, bidders have to determine their offers in such a way that the information rent is maximized and the risk of rejection is minimized. A uniform bid process would allow rougher estimates, since every accepted bidder will be paid the clearing price and receive the maximum of information rent. Thus, CRP's static sealed-bid auctioning process increases private information costs. Moreover, CRP bids are not only ranked with respect to costs but to ecological benefits as well. Thus, farmers have to gather information on the ecological effectiveness of different conservation practices and on how these will be weighted in the EBI (Holm-Müller et al. 2002).

Falconer (2000) found that agri-environmental schemes need to provide some information to reduce private transaction costs. Particularly since 1995, the USDA has done so by informing farmers about bid caps and the composition of the EBI. This has helped to diminish private transaction costs in two ways. Firstly, strategic behaviour is limited to the bid cap since bids that exceed this amount will be rejected. Thus, farmers need to gain less information on how other farmers bid. Secondly, using the details of the construction of the EBI provided in chapter 4.2.5.2 and appendix III, which are available to farmers as well, implications and EBI scores can be easily determined when they depend explicitly on certain practices (e.g. wildlife benefit factor or enduring benefits factor) or on one measure only (erosion factor). However, the air quality factor and the water quality factor are less standardized and result in higher information costs for farmers due to their complexity.

Similar to information costs, differentiated payments also increase coordination costs. Particularly, auctions may involve a remarkable amount of public coordination costs since a specific platform has to be created where the auctioneer and bidders meet and the auction is held. A DEFRA (2003) report indicates that static auctions are less costly in this context than dynamic auctions, since the former entail only one round of bidding. Among dynamic auctions, ascending-clock approaches are the simplest because the auctioneer does not have to deal with entire supply schedules. Consequently, the USDA has chosen a least cost bidding procedure. One drawback of the CRP may be seen in its administration (see chapter 4.2.2). Falconer (2000) suggests that a single agency should be created to rationalize the administration of agri-environmental programs. The CRP is basically administered under the authority of the FSA. However, a lot of work is done by other agencies as well, particularly by the NRCS. The latter is responsible for the assessment of the ecological EBI factors, whilst the FSA determines the individual cost factor. Since the results of the FSA and the NRCS have to be aggregated to determine the EBI, public coordination costs are higher than if only one agency was responsible for the CRP. The splitting of authority between two agencies may also affect private coordination costs. When applying for enrollment and payments, and for signing the CRP contract, farmers have to consult the FSA (see chapters 4.2.5 and 4.2.6). However, when setting up the conservation plan, farmers are assisted by the NRCS (see chapter 4.2.4). Thus, the administration of the CRP is far from being the “one-stop-shop” for management advise and problem-solving demanded by Falconer (2000, p. 389). Coordinating the requirements and suggestions of both agencies may increase farmers’ decision-making costs.

5.3.2 Implementation Costs

Chapter 3.2.2 shows that implementation costs include costs of monitoring and costs of enforcing regulations. Two basic mechanisms can be employed to reduce costs of both categories. Becker’s (1968) study indicated that implementation costs could be reduced if expensive monitoring activities are substituted by more severe punishments, e.g. higher fines. Choe and Fraser (1998) found that imperfect monitoring could be compensated to some degree by paying higher incentives. However, both studies cannot be applied to the CRP in the context of this work due to lacking information about the sanctioning mechanisms of the program.

Nevertheless, the ease of monitoring may also be affected by the degree of payment differentiation. Although no research was available in this regard, it may be assumed that monitoring costs increase if differentiated payment schemes are accompanied by more individualized management prescriptions. For example, it may be useful from an ecological point of view to define specific conservation practices for every type of land. However, the greater the number of management practices, the greater the complexity of monitoring processes and the higher the implementation costs. The CRP is not subject to such problems, though, since it has combined differentiated payments with standardized practices and contracts.

5.4 Cost-Effectiveness III: Deadweight Losses

Chapter 3.2.3 has required budgetary costs to be minimized in order to reduce deadweight losses. As mentioned, the amount of budgetary costs depends on production costs, public and private transaction costs and an overcompensation component. Chapters 5.2 and 5.3 discussed how the CRP copes with production and transaction costs. Thus, this chapter focuses on overcompensation. The first section discusses information rents. The second section is devoted to further components that may increase the level of overcompensation.

5.4.1 Overcompensation due to Information Rents

5.4.1.1 Posted Prices vs. Auctions

Ahrens et al. (2000) demonstrate that compensation payments need to be differentiated to reduce information rents. In this respect, posted prices perform clearly inferior to auctions, since they determine fixed rates for certain areas or practices, irrespective of individual costs. As mentioned before, CRP pays posted prices to farmers who enroll under the contiuous signup. However, the CRP differentiates payments for continuous signup by assessing individual bid caps, that is, maximum compensation payments, for on the basis of local data. However, true abatement costs may be lower, and caps may still include information rents, since these calculations rely on general scientific models, which are usually subject to uncertainty.

Auctions are a much better approach to reduce information rents. Latacz-Lohmann (1993) demonstrated that low-cost bidders will hand in lower bids than high-cost bidders. Therefore, auctions may be used to determine the adequate amount of payments. In this context, different auction designs differently deliver cost-effective outcomes. Similarly to the discussion in chapter 5.2.1, dynamic auctions will reveal farmers' true costs better than static auctions. Among dynamic auctions, supply schedule bidding seems to be superior to ascending-clock auctions in the context of the CRP. Ascending-clock auctions determine a certain EBI and farmers may adjust the amount of land offered according to this index. However, to make such bidding procedure work, farmers need to be able to relate the levels of the determined EBI to the corresponding compensation payments. Thus, they would need information on the construction of the EBI's cost factor, which is not provided up to now. However, chapter 5.4.1.3 demonstrates that informing farmers about the exact composition of the EBI decreases the success of an auction. In contrast to the discussion of chapter 5.2.1, pay-as-bid approaches have to be preferred to uniform pricing in order to reduce overcompensations. Thus, the USDA should continue to pay farmers according to their bids, but switch from uniform to a dynamic auction in order to reduce information rents.

Apart from the basic design issues discussed above, the two subsequent chapters discuss further aspects that have appeared to be crucial when auctions are implemented: budget and enrollment limitations, and learning-the-bid processes.

5.4.1.2 Budget and Enrollment Limitations

Competitive auctions must provide for the rejection of a certain amount of bidders (Holm-Müller et al. 2002). Latacz-Lohmann (1993) emphasize that auctions require budget limitations, if they are to be competitive and cost-effective. Otherwise, all farmers that apply will be accepted, and thus, have no incentive to reveal information about their real costs. However, the USGAO report found that the USDA did not restrict the CRP budget and was more interested in meeting the enrollment goals set for the initial years. Consequently, it accepted all offers that did not exceed the maximum acceptable rental rate (MARR) without conducting any auctions. This problem was exacerbated even when USDA program managers set MARRs that were up to 300 percent higher than prevailing local rental rates. In addition, the low signup rate for the enrollments of 1989 and 1990 (see chapter 5.1.1) indicate that the CRP bidding process did not take into account the fact that the quality of the auction also depends on participation. If only a few farmers bid for a limited amount of conservation contracts, the probability of rejection decreases and farmers are encouraged to submit higher bids (Latacz-Lohmann 1993). Although the MARRs were designed to accept many farmers, enrollment goals were not achieved during these years. This implies that only few farmers were competing for CRP contracts in 1989 and 1990.

The USGAO advised the USDA to adopt certain program changes. First, it required flexible annual enrollment goals to be set for the CRP to shift the program's focus from enrolling acreage to meeting program goals. This would allow the implementation of a more competitive bidding system and lower MARRs. Moreover, the USDA should limit the total acres it was prepared to accept or the total funds it would obligate in each signup.

The 1990 revision of the CRP implemented some of the suggestions made by the USGAO. The 1990 Farm Bill mandated changes that made the CRP bidding process more competitive. After comparison with prevailing local rental rates, CRP offers were ranked with respect to costs and benefits. However, another USGAO report (1993) found that acreage targeting remained important to the program. At least for 1991, the USDA aimed for a minimum enrollment of 1.1 million acres. As the USDA only received few bids, it did not restrict enrollment and accepted all bids that did not exceed the bid cap. It is not known exactly until when this minimum enrollment limit was maintained. However, such a regulation became unnecessary when contracts started to expire in 1997. Since enough land was available for enrollment, the CRP bidding process should have worked more cost-effectively since then. Nevertheless, competitiveness problems due to insufficient enrollment rates may reoccur once the boom of CRP re-enrollment will have ended. For this case, Holm-Müller et al. (2002) suggest that intervals between signups should be prolonged. This is more or less what the USDA has done for recent signups. During the 1980s, signups were conducted every year, sometimes even two or three times a year. In contrast, the intervals between recent signup periods were between two and three years.

5.4.1.3 Learning the Caps

As mentioned before, during the initial years of the CRP, the USDA accepted those bids that did not exceed the MARRs. The USDA did not inform farmers about the exact amount of their individual MARR. Thereby, farmers should be encouraged to reveal information about their true abatement costs. However, a USGAO report (1989) found that the USDA's decision not to change the maximum acceptable rental rates negatively affected the amount of overcompensation granted by the CRP. Observing the bids made over several signup periods, farmers learned the level of the bid cap and adjusted their bids accordingly, a process that is called Bayesian learning (Hamsvoort and Latacz-Lohmann 1996). Shoemaker (1989) found that after only four signup periods, average contract rental rates approached or even equalled the maximum rental rate in all farm production regions. By the 9th signup, roughly 80 percent of all bids were almost exactly equal to the bid cap (Hamsvoort and Latacz-Lohmann 1996, p. 33). This development impeded competition among farmers and turned the CRP bid system into an offer system, under which farmers were paid the maximum acceptable rental rate and could enroll as many of their eligible acres as they wanted (USGAO 1989). The USGAO report (1989) stated that a combination of flexible budget or acreage limitations, and a working auction mechanism, as was already mentioned in the previous chapter, would result in differing bid caps and prevent Bayesian learning.

The 1990 revision of the CRP established such mechanisms to impede farmers learning the bid caps. Guessing the bid cap was made even more difficult, as farmers' rankings were not only based on costs but on a benefit indicator, the EBI, as well. Until 1995, farmers neither had been informed about the maximum annual per-acre rental payments the USDA would accept for their offered lands nor about how the EBI was calculated. Thus, estimating the bid cap appeared to be very difficult. In 1995, the USDA changed its information policy and decided to provide the above information. However, some degree of uncertainty for farmers has remained, because farmers do not know the score for the cost factor until each signup is complete. Set at a maximum of 200 points for the 15th signup (the first signup after the 1995 EBI revision), it was decreased to 150 points for the 16th signup, for example (Ribaudo et al. 2001). In addition, farmers could hardly estimate bid caps because the exact composition of the EBI factors has been adjusted several times since 1995 (see chapter 4.2.5.2). The recent policy of granting some information and withholding other appears particularly useful when Hamsvoort and Latacz-Lohmann's (1996) statement from chapter 5.2.1 is considered which indicated that providing no information at all may also result in inefficient allocations. Consequently, they found that an optimal range of information exists which allows for cost-effectiveness.

5.4.2 Further Components of Overcompensation

Ahrens et al. (2000) identify at least three more reasons why agencies may deliberately overcompensate. First of all, governments may have an interest in paying more than necessary in order to provide income support to farmers. This was constituted as an explicit goal of the CRP until 1990 and may be one reason why excessive MARRs were set (USGAO 1989). However, income transfer as a CRP objective was cut out during the 1990 revision. Thus, it may not be judged whether existing overcompensations have been created explicitly to provide income support.

Second, additional incentives are necessary to avoid slippage effects. Producers who have already retired land will not incur abatement costs when enrolling under a management scheme. To minimize overcompensations, these farmers should not receive any payments. The CRP does so by compensating only farmers who enroll cropland. However, chapter 5.2.4 has documented that funding of new adopters only may result in slippage effects counteracting cost-effectiveness requirements.

A third reason why overcompensation is necessary is that compensating abatement costs alone may not be sufficient to promote enrollment and to ensure ecological effectiveness. Chapter 5.1.3.3 has shown that additional incentives are necessary, which, of course, increase compensation costs. To limit deadweight losses, Ahrens et al. (2000) propose that agencies should differentiate between such incentives with respect to the expected environmental benefits of the practices adopted. The CRP meets this requirement since special incentives are only offered for acreages that enroll under continuous signups and are expected to produce significant environmental benefits (see chapter 4.2.5.1 and 4.2.7). Incentives not only include payments above the bid cap but information rents as well, since the USDA has refrained from applying a bidding process for these acreages. Typically, lands eligible for continuous enrollment contribute substantially to environmental improvements (see chapter 4.2.5.1).

In summary, it appears that USDA officials have found and implemented adequate means to cope with overcompensation in the context of the CRP.

6 Conclusion

The CRP is the largest conservation program in U.S. history. From 1986 to 2000, roughly $21 billion were spent to retire an average of 33 to 36 million acres of cropland annually. The 34.5 million acres enrolled by the end of 2003 accounted for 7.6 percent of the total U.S. cropland. However, such figures reveal little information about the quality of the CRP. Therefore, the objective of this work has been to evaluate the CRP economically. The evaluation has been based on two criteria: ecological effectiveness and cost-effectiveness.

Considering ecological effectiveness, this work has provided evidence that the CRP has contributed significantly to the achievement of a variety of environmental goals. Enrolled acres reduced erosion, improved soil productivity, contributed to cleaner air and water resources and enhanced wildlife habitat. However, it may be questioned whether these benefits are enduring.

Moreover, it has been demonstrated that the USDA has made efforts to meet the environmental goals of the CRP in a cost-effective manner. Particularly, the auction mechanism applied has helped to reduce production costs and deadweight losses. A drawback of bid selection processes is that they increase transaction costs. Nevertheless, literature is agreed that it is worth spending additional transaction costs for more efficient, differentiated conservation policies (see, for example, Hanley et al. 1998). Additionally, the cost-effectiveness of auctions depends on how an auction is implemented. In this respect, the CRP initially showed various problems, probably because it was the first program to implement a bidding procedure for conservation programs on a large scale. Since 1986, CRP authorities have been going through a learning process. Remarkably, most program changes the USDA has undertaken, e.g. making the bid system more competitive, introducing benefit-cost targeting, and considering multiple benefits, have actually contributed to the CRP being more cost-effective. However, the learning process has to continue. Further efficiency gains can be expected if the USDA changes from a static to a dynamic auction. Moreover, the bid acceptance process should better consider monetary benefits and cummulative effects when targeting CRP enrollment. With respect to the CRP's eligibility criteria, the USDA should make non-cropland available for enrollment to reduce slippage effects and relax the county limits on maximum enrollment.

This work has been subject to several limitations. Some aspects have not been considered due to a lack of information and research. For example, no study has been available which investigated transaction cost aspects of the CRP. The application of more general studies on transaction costs to the subject of the CRP has been particularly difficult for implementation costs, because little information was provided on how CRP prescriptions are monitored and enforced. In addition, statements for private transaction costs were only made on a general basis. Other aspects that still require further research are, for example, monetary benefits from the CRP, the capacity of the CRP bidding procedure to induce innovation, and the quality of the information provided by the USDA. Moreover, several criteria were excluded completely due to lacking information, e.g. effects on innovation, competition or political acceptance. Therefore, an all-embracing evaluation of the CRP will require more research in these fields, once the necessary data are available. In addition, it appears be useful to discuss in which way the implementation of performance-based instead of practice-based compensation approaches may help to meet the requirements of different evaluation criteria. Finally, this work has implicitly assumed that forcing conservation issues by granting compensation payments for land retirement will deliver optimal results. However, results presented for individual criteria in this work have to be compared to those of other conservation instruments, e.g. reserves. Moreover, some authors have doubted the suitability of land retirement to achieve conservation objectives cost-effectively. Babcock et al. (2001, p. 19) stated, for example, that land set asides are the most costly way of obtaining ecological benefits.

Nevertheless, if compensating farmers for idling cropland is considered a basic condition, the USDA has done well in optimizing the CRP. In this context, the application of an auction appears to be crucial. Criticisms mentioned refer to some aspects of implementation only but do not call the basic allocation mechnism into question. To date, changing from a practice-based to a performance-based approach is not practicable. Moreover, the CRP has always been a dynamic process. Therefore, one can assume that the CRP will be adapted continuously to cope with current and future problems, and is open to new options that allow an even better ecological and economical performance.

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Appendix I: Eligible Cover Practices

As of December 2003 (Source: USDA 2003g).

CP1 Newly introduced grasses and legumes	CP10 Existing grasses and legumes	CP22 Riparian buffers
CP2 New native grasses	CP11 Existing trees	CP23 Wetland restoration
CP3 New softwood trees	CP12 Wildlife food plots	CP24 Cross wind trap strips
CP3A New longleaf pines	CP13 Vegetative filter strips	CP25 Rare and declining habitat
CP3B New hardwood trees	CP15 Contour grass strips	CP26 Sediment retention
CP4 Permanent wildlife habitat	CP16 Shelterbelts	CP27 Farmable Wetland Program (wetland)
CP5 Field windbreaks	CP17 Living snow fences	CP 28 Farmable Wetland Program (upland)
CP6 Diversions	CP18 Salinity reducing vegetation	CP 29 Wildlife habitat buffer (marginal pasture)
CP7 Erosion control structures	CP19 Alley cropping	CP 30 Wetland buffer (marginal pasture)
CP8 Grass Waterway	CP20 Alternative perennials	CP 31 Bottomland hardwood
CP9 Shallow water areas for wildlife	CP21 Filter strips (grass)	

Appendix II: Erodibility Measures

Land Capability Classes (LCC) (Hamdar 1999)

The potential of land for growing crops may be divided into eight capability classes, class I being best suited for growing crops and class VIII being unsuitable for growing crops

Class I Soils have few limitations that restrict their use.

Class II Soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III Soils have severe limitations that reduce the choice of crops and require special conservation practices.

Class IV Soils have severe limitations that reduce the choice of plants, require very careful management, or both.

Class V Soils are not likely to erode but have other limitations that limit their use primarily to pasture, woodland, or wildlife.

Class VI Soils have severe limitations that make them generally unsuitable for cultivation and limit their use largely to pasture, woodland, or wildlife.

Class VII Soils have very severe limitations that make them unsuitable for cultivation and that restrict their use to pasture or range, woodland, or wildlife.

Class VIII Soils and land farms have limitations that preclude their use for commercial crop production and restrict their use to recreation, wildlife, or water supply, or esthetics purposes.

Soil Loss Tolerance Level (T) (Uri 2001)

The soil tolerance level is the maximum rate of annual soil erosion that may occur and still permit a high level of crop productivity to be obtained economically and indefinitely. Most values for cropland in the United States are between 1.4 and 2.3 kg per metric ton per year.

Erodibility Index (EI) (Uri 2001)

The Erodibility Index reflects how many times greater than the soil loss tolerance level (T) the inherent erosion potential is. For water (sheet and rill) erosion, its value is calculated as

$$EI = R*K*L*S/T$$

where

R = the rainfall and runoff factor, is the number of the rainfall erodibility index units plus a factor from runoff from snow melt or applied water where such runoff is significant;

K = the soil erodibility factor, is the soil loss rate per erodibility index unit for a specified soil as measured on a unit plot, which is defined as a 22 m length of uniform 9% slope continuously in clean tilled fallow;

L = the slope length factor, is the ratio of soil loss from the field slope to that from a 22 m length of uniform 9% slope continuously in clean tilled fallow; and

S = the slope steepness factor, is the ratio of soil loss from the field slope gradient to that from a 22 m lengthof uniform 9% slope continuously in clean tilled fallow.

Appendix III: Environmental Benefits Index

(Source: USDA 2003e)

N1 – Wildlife factor (0 to 100 points)

N1a – Wildlife habitat cover benefits (0 to 50 points)

Cover Practices (CP) for the N1a Criteria		
Practice*		Point Score
CP1 - Permanently introduced grasses and legumes.		
	Planting of 2 to 3 species of an introduced grass species.	10
	Mixture (minimum of 4 species) of at least 3 introduced grasses and at least 1 forb or legume species best suited for wildlife in the area.	40
CP2 - Establishment of permanent native grasses.		
	Mixed stand (minimum of 3 species) of at least 2 native grass species and at least 1 forb or legume species beneficial to wildlife.	20
	Mixed stand (minimum of 5 species) of at least 3 native grasses and at least 1 shrub, forb, or legume species best suited for wildlife in the area.	50
CP3 - Tree planting (general).**		
	Southern pines (softwoods) - Solid stand of pines/softwoods (planted at more than 550 trees per acre).	10
	Northern conifers (softwoods) - Solid stand of conifers/softwoods (planted at more than 850 trees per acre).	10
	Western pines (softwoods) - Solid stand of pines/softwoods (planted at more than 650 trees per acre).	10
	Southern pines (softwoods) - Pines/softwoods planted at a rate of 500 to 550 per acre depending upon the site index (state-developed standards) with 10 to 20 percent openings managed to a CP4D wildlife cover.	50
	Northern conifers (softwoods) - Conifers/softwoods planted at a rate of 750 to 850 trees per acre depending upon the site index (state-developed standards) with 10 to 20 percent openings managed to a CP4D wildlife cover.	50
	Western pines (softwoods) - Western pines (softwoods) - Pines/softwoods planted at a rate of 550 to 650 per acre depending upon the site index (state-developed standards) with 10 to 20 percent openings managed to a CP4D wildlife cover.	50
CP3A - Hardwood tree planting.		
	Solid stand of nonmast producing hardwood species.	10
	Solid stand of a single hard mast producing species.	20
	Mixed stand of hardwood species best suited for wildlife in the area.	30
	Mixed stand (3 or more species) of hardwood species best suited for wildlife in the area.	50
	Longleaf pine or Atlantic white cedar - Planted at rates appropriate for the site index.	50
CP4B - Permanent wildlife habitat (corridors), noneasement.		
	Mixed stand (minimum of 4 species) of either grasses, trees, shrubs, forbs, or legumes planted in mixes, blocks, or strips best suited for various wildlife species in the area. A wildlife conservation plan must be developed with the participant.	40
	Mixed stand (minimum of 5 species) of either predominately native species including grasses, forbs, legumes, shrubs, or trees planted in mixes, blocks, or strips best suited to providing wildlife habitat. Only native grasses are authorized. Introduced grasses are not authorized and cannot be included in cover mixes for 50-point N1a scores for CP4B. A wildlife conservation plan must be developed with the participant.	50
CP4D - Permanent wildlife habitat, noneasement.		
	Mixed stand (minimum of 4 species) of either grasses, trees, shrubs, forbs, or legumes planted in mixes, blocks, or strips best suited for various wildlife species in the area. A wildlife conservation plan must be developed with the participant.	40
	Mixed stand (minimum of 5 species) of either of predominately native species including grasses, forbs, legumes, shrubs, or trees planted in mixes, blocks, or strips best suited to providing wildlife habitat. Only native grasses are authorized. Introduced grasses are not authorized and cannot be included in cover mixes for 50-point N1a scores for CP4B. A wildlife conservation plan must be developed with the participant.	50
CP10 - Vegetative cover - grass - already established.		

	Solid stand of 1 to 3 species of introduced grasses.	30
	Solid stand of 1 to 3 species of native grasses.	40
	Mixed stand (minimum of 5 species) of at least 3 native grasses and at least 1 shrub, forb, or legume species best suited to wildlife in the area.	50
CP11 - Vegetative cover - trees - already established.		
	Solid stand of pine/softwood or solid stand of nonmast producing hardwood species.	10
	Solid stand of a single hard mast producing species.	20
	Mixed stand (2 species) of hardwoods best suited for wildlife in the area.	30
	Mixed stand (3 or more species) of hardwoods best suited for wildlife in the area.	50
	Established longleaf pine or Atlantic white cedar best suited for wildlife in the area.	50
	Pine/softwood established at, or thinned as needed, to provide 15 to 20 percent openings of native herbaceous and/or shrub planting or natural regeneration best suited for wildlife in the area. Tree thinning, if required or recommended by the state forester, must be completed within 3 years of the CRP-1 effective date. Trees must be removed from the site.	50
CP12 - Wildlife food plot.		
	Wildlife food plots are small non-cost-shared plantings in a larger area. Wildlife food plots will never be the predominant cover.	NA
CP25 - Rare and declining habitat restoration.***		
	Seeding or planting will be best suited for wildlife in the area. Plant species selections will be based upon Ecological Site Description data.	50

* Cover established must accomplish the purpose of the practice.

** State Conservationist may revise the Field Office Technical Guide (FOTG) on planting rate to be consistent with CRP.

The opening for southern and western pines must be a minimum of 2 acres up to a maximum of 5 acres in size for fields of 20 acres and larger. For smaller fields, the size is based on a percentage. Opening in northern conifers should be one-half to 2 acres in size. The opening may include buffers on the interior of the field. Field edges (borders) may be used if they are irregular in shape and average 30 feet in width.

Natural regeneration of native herbaceous or shrubby vegetation with required maintenance may be permitted within open areas if it is consistent with USDA Natural Resources Conservation Service (NRCS) technical standards and the Northern Bobwhite Conservation Initiative, and has concurrence from state fish and wildlife service (FWS) or U.S. FWS officials.

Open areas of native grasses and/or shrub planting best suited for wildlife in the area is considered CP3 for EBI scoring and contract purposes.

*** Technical practice standards for the selected habitat type must meet applicable standards and be approved by FSA at least 30 calendar days before the beginning of sign-up.

N1b – Wildlife enhancement (0, 5, or 20 points)

Practices for the N1b Criteria

Practice	Point Score
Wildlife water development. This is only permitted when it is consistent with the FOTG and where water may be a limiting factor.	20
Conversion of primarily a monoculture of relatively low wildlife habitat to native species that provide enhanced wildlife benefits.	20
Brood cover and rotated food plots - maximum of 5 acres.	5
Permanent food plot - 10 percent of field to a maximum of 5 acres.	5

N1c – Wildlife Priority Area (0 or 30 points)

N2a Water quality benefits from reduced erosion, runoff, and leaching (0 to 100 points)

N2a – Water quality area (0 or 30 points)

N2b – Groundwater quality (0 to 25 points)

N2c – Surface water quality (0 to 45 points)

N3 – Erosion factor (0 to 100 points)

Erodibility Index Points*					
EI	Points	EI	Points	EI	Points
4	5	10	35	16	65
5	10	11	40	17	70
6	15	12	45	18	75
7	20	13	50	19	80
8	25	14	55	20	90
9	30	15	60	21+	100
* EI of less than 4 = 0 points					

N4 – Enduring benefits factor (0 to 50 points)

Practices for the N4 Criteria	
Practice	Point Score
New hardwood tree, longleaf pine, and/or Atlantic white cedar plantings (CP3A).	50
Existing hardwood tree, longleaf pine, and/or Atlantic white cedar plantings (CP11).	40
New pine/softwood tree (CP3).	30
Rare and declining habitat restoration (CP25).	25
Existing pine/softwood tree -original contract signed as CP3 (CP11).	20
All other conservation practices not listed.	0

N5 – Air quality benefits from reduced wind erosion (0 to 45 points)

N5a – Wind erosion impacts (0 to 25 points)

N5b – Wind erosion soils list (0 or 5 points)

N5c – Air quality zones (0 or 5 points)

N5d – Carbon sequestration (3 to 10 points)

Practices for the N5d Criteria	
Practice	Point Score
CP3 (Tree planting - general), CP3A (Hardwood tree planting), CP11 (Vegetative cover - trees -already established).	10
CP25 (Rare and declining habitat restoration).	5
CP4b (Permanent wildlife habitat (corridors), noneasement), CP4d (Permanent wildlife habitat, noneasement).	4
CP1 (Permanent introduced grasses and legumes), CP2 (Establishment of permanent native grasses), CP10 (Vegetative grass - cover - already established).	3

N6 – Cost

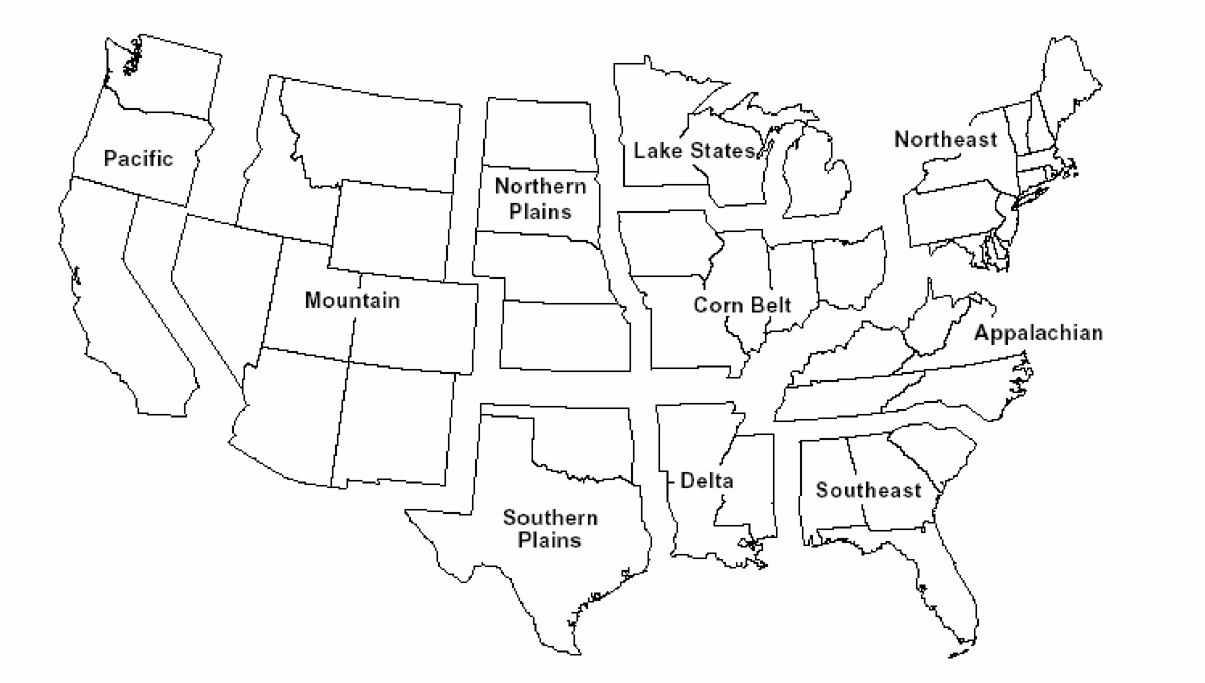
N6a – Bid factor (points determined after end of signup based on actual offer data)

N6b – Cost-share (0 or 10 points)

N6c – Offer less than maximum payment rate (0 or 15 points)

Appendix IV: U.S. Farm Production Regions

(Source: Osborn et al. 1995, p. 7)



Appendix V: Farm Typology Groups

Small Family Farms. Sales less than $250,000

> **Limited-resource.** Any small farm with gross sales less than $100,000, total farm assets less $150,000, and total operator household income less than $20,000.
>
> **Retirement.** Small farms whose operators report they are retired (excludes limited-resource farms operated by retired farmers). Retired operators continue to farm on small scale and sell enough farm products (at least $1,000 worth) to qualify as farms.
>
> **Residential.** Small farms whose operators report they had a major occupation other than farming (excludes limited-resource farms with operators reporting a nonfarm major occupation).
>
> **Farming-occupation farms.** Small farms whose operators report farming as their major occupation.
>
> > **Low-sales.** Farming-occupation farms with less than $100,000 (excludes limited resource farms whose operators report farming as their major occupation)
> >
> > **High-sales.** Farming-occupation farms with sales between $100,000 and $249,999.

Other family farms.

> **Large family farms.** Farms with sales between $250,000 and $499,999.
>
> **Very large family farms.** Farms with sales of $500,000 and more.

Nonfamily farms. Farms organized as nonfamily corporations or cooperatives, as well as farms operated by hired manager