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# Economic Comparison of Commodity and Conservation Program Benefits: An Example from the Mississippi Delta

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Changes to commodity programs in the 2002 Farm Bill increased the value of crop base acreages on which decoupled payments are received. The bill also expanded the availability of key conservation programs. This paper compares the value of payments from commodity programs (along with continued crop production) to the easement payment (and recreational lease revenue) available under the Wetland Reserve Program. A net present value model using risk-adjusted returns is employed in the analysis for Mississippi delta cropland containing rice, cotton, and soybean base. Sensitivity analysis is conducted on some of the key variables affecting the decision.

*Key Words:* conservation, countercyclical payment, direct payment, net present value, WRP

**JEL Classifications:** Q12, Q15, Q18, C15

While natural resource conservation programs have long been a prominent feature of U.S. agricultural policy, the 2002 Farm Security and Rural Investment Act (FSRIA) included an unprecedented emphasis on such programs. In addition to establishing new conservation programs, FSRIA provided increased support for existing programs. The Wetlands Reserve Program (WRP) is one of the existing conservation programs to be expanded considerably by FSRIA.

The WRP was initially authorized through the Food Security Act of 1985. Subsequent farm bills have reauthorized the program. The WRP does not have a funding limit. Rather, the program has an acreage enrollment cap that is established by Congress (USDA-NRCS 2004a). Under the Federal Agricultural Improvement and Reform (FAIR) Act of 1996, this acreage cap was established at 1.075 million acres. Under FSRIA, the acreage cap was more than doubled to 2.275 million acres. This program has been very popular in the lower Mississippi River delta region. In fact, Louisiana, Arkansas, and Mississippi are the top three states in the nation, respectively, in terms of acres enrolled in WRP. A relatively large percentage of the land in the delta regions of these three states meets the eligibility requirements for WRP enrollment, which basically hold that the land be capable of being restored to wetland conditions and be "suitable for wildlife benefits" (USDA-NRCS 2004a).

FSRIA also increased the level of commodity program payments available to eligible landowners and producers. Direct payments (continued at an increased level from the 1996 FAIR Act) and countercyclical payments (a new type of payment established in FSRIA) are decoupled from current production. That

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is, landowners who have a crop base can receive these payments regardless of what is planted on the farm in a given year.

In the lower Mississippi River delta region, most of the land that is eligible for WRP enrollment is cropland that has value not only in crop production but also for the commodity base on which decoupled payments can be received. Landowners need to carefully consider which alternative program—WRP enrollment or continued commodity program participation—will provide them the greatest benefit. The objective of this paper is to provide landowners with guidelines that will help them make the decision of whether to enroll cropland under a WRP easement. Specifically, this research will develop a net present value model to compare WRP enrollment to continued participation in commodity programs. Using this model, a number of different scenarios related to crop bases, productivity of the land, and potential income from recreational uses can be evaluated. Given recent changes to commodity program payment levels and to WRP easement values, this analysis is particularly timely.

## Evaluation of Conservation/Environmental Programs

A wealth of literature examines the conservation and environmental programs established in agricultural legislation; however, these studies tend to focus on the value of the environmental benefits provided or on the cost-effectiveness of the provision of these benefits. Most studies measure benefits and costs at some aggregate level (national, regional, or county).

Ribaudo et al. estimate the present value of natural resource benefits attributable to the Conservation Reserve Program (CRP), finding an aggregate value for such benefits of about $10 billion. Khanna et al. are concerned with the cost-effectiveness of land retirement programs. Using data from a single county covered by the Conservation Reserve Enhancement Program in Illinois, they find that the program is successful in meeting sediment abatement goals but that alternative land retirement scenarios could be more cost-effective.

Lichtenberg and Smith-Ramirez are also concerned with how effectively conservation programs meet conservation and environmental quality objectives. Using Maryland CRP data, they argue that the effectiveness of such programs may be compromised by adverse selection arising from the voluntary nature of such programs, by substantial costs associated with participation, and by the impact of political influence on the funding process. Feather, Hellerstein, and Hansen investigate how alternative approaches to targeting CRP funding would be likely to affect benefits from freshwater-based recreation, wildlife viewing, and pheasant hunting. They report that CRP targeting based on nonmarket valuation of benefits is feasible; however, they acknowledge that more research would be required to make such a system practical.

Many other studies on the CRP are available in the literature. As with those cited previously, the focus has been on costs, benefits, or implementation issues at the national or regional level (see, e.g., Babcock et al.; Ribaudo et al.; Young and Osborn).

Other conservation and environmental programs have also been explored in the literature. For example, Atwood et al. recently reported a cost-benefit analysis of the Environmental Quality Incentives Program in light of recent changes to that program in the 2002 Farm Bill. Nickerson and Lynch examine the impact on farmland values of state and county farmland preservation programs in Maryland.

A good deal of research has also been conducted on the WRP. In a study that actually predates the WRP, Heimlich, Carey, and Brazee use a net present value approach to estimate the least cost of creating a national wetlands reserve by purchasing permanent easements on existing cropland. A later study by Heimlich, conducted after the passage of WRP legislation, again estimates the cost of obtaining easements on various-size wetland reserves using the capitalized value of returns from agricultural production to estimate the cost of easements.

Ribaudo, Osborn, and Konyar investigate the effectiveness of land retirement programs at addressing the problem of non–point source pollution. Their analysis is not specific to the WRP but looks at land retirement programs generally and includes both WRP and CRP. They conclude that such programs can hypothetically generate benefits in excess of program costs but that to do so the land retirement programs must be carefully focused.

As with the other studies on conservation and environmental programs, previous research on the WRP program has focused on costs and benefits at the aggregate level. Little work has been done to evaluate the decision of whether to participate in such programs from the perspective of the individual decision maker. Poe explores the issue of how differences in property taxes between land enrolled in WRP and land remaining in agricultural production might affect the enrollment decision. He develops a conceptual model of the enrollment decision from the individual property owner's perspective; however, the focus of the empirical work is on aggregate enrollment patterns.

## Overview of the Wetlands Reserve Program

The WRP is essentially a land retirement program that is administered by the U.S. Department of Agriculture Natural Resource Conservation Service (NRCS) and funded by the Commodity Credit Corporation. The goal of the program is to protect wetlands that provide the greatest level of environmental value to society. To this end, the WRP provides landowners with financial and technological assistance to induce voluntary participation in wetland restoration on private lands (USDA-NRCS 2004c). Landowners have three choices of agreements to enroll land in the WRP: 1) perpetual easements, 2) 30-year easements, and 3) 10-year restoration cost share agreements (USDA-NRCS 2004b).

To obtain the acceptable ceiling for easement values, land is appraised for its value in agricultural uses. The easement value cannot exceed this appraised value. Also, the value of easement payments may have a payment cap that is region specific. For example, the 2003 payment cap for Mississippi is $900 per acre. The NRCS cannot exceed a payment of $900 per acre for proposed projects in Mississippi (Ray). Landowners enrolling projects into a perpetual WRP easement are paid the lowest of the agricultural value of the land, the payment cap, or the asking price of the landowner. Further, all costs of wetland restoration are paid by the U.S. Department of Agriculture.

## A Conceptual Model of WRP Enrollment Decisions

In one sense, the landowner's decision regarding whether to enroll land under a WRP easement is straightforward. Enrollment in WRP is desirable if the expected benefits outweigh the expected costs. Benefits of WRP enrollment would include the value of the up-front easement payment as well as the discounted value of future income from the property. Although WRP easements are quite restrictive, they do allow undeveloped recreational uses of the property. Thus, landowners are allowed to lease hunting and/or fishing rights on the property. Nonpecuniary benefits from WRP enrollment (e.g., personal satisfaction derived from environmental stewardship) may also be a consideration for some landowners, though these are obviously difficult to quantify.

Costs of WRP enrollment would include the direct costs of preparing and submitting a program application as well as the opportunity cost of forgone income from cropland. This opportunity cost would include not only the discounted value of future net returns from crop production but also the discounted value of future decoupled farm program payments since landowners are not eligible to receive such payments on land enrolled in the WRP program.[1] There may also be nonpecuniary costs associated with enrollment, such as a loss of satisfaction associated with surrender-

[1] The countercyclical payment is decoupled in that it is not linked to current production; however, the level of the countercyclical payment is affected by current market prices.

ing a certain amount of autonomy as a landowner.

Conceptually, an owner of land eligible for the WRP program would enroll that land under a WRP easement if the following condition holds:

$$(1)\quad AC + \sum_{i=1}^{T}\left(\frac{1}{1+r}\right)^{T}[(R_i - C_i) + PP_i] + EC \le EP + \sum_{i=1}^{T}\left(\frac{1}{1+r}\right)^{T}(RL_i - CL_i) + EB.$$

In this equation, $AC$ represents application costs; $T$ indicates the time period over which the decision is to be evaluated, $r$ represents a discount rate, $R_i$ represents returns from crop production in year $i$, $C_i$ represents costs associated with crop production in year $i$, $PP_i$ represents decoupled farm program payments on the land in question in year $i$ and includes both direct and countercyclical payments, $EC$ represents nonmonetary enrollment costs, $EP$ represents the value of the easement payment received on enrollment, $RL_i$ represents the value of recreational leases sold on the enrolled parcel for year $i$, $CL_i$ represents the annual cost associated with the recreational leases in year $i$, and $EB$ represents any nonmonetary benefits derived from enrollment.[2]

Some of the items in this model of the WRP enrollment decision are certain. Application costs and easement payment values are known with certainty. The direct payment portion of $PP_i$ is likewise certain. Future returns from crop production and from the countercyclical payment portion of $PP_i$ are stochastic—influenced by crop yields and prices. Income from recreational leases is not likely to vary once a lease is established; however, there clearly is some probability that the landowner will be unable to sell a lease on the property or that a lease will, at some point, be altered or terminated.

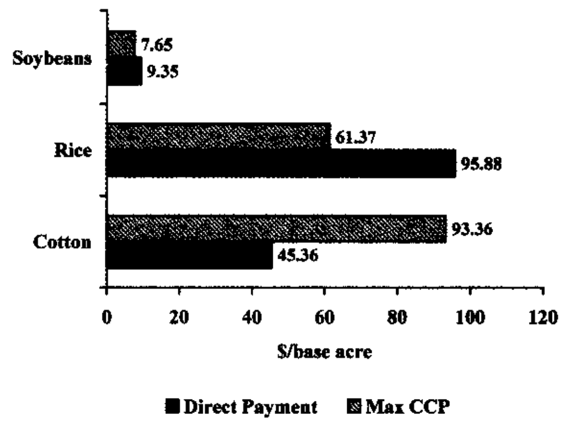


**Figure 1.** Direct and Maximum Countercyclical Payments per Base Acre (Notes: Direct and countercyclical payments are paid on only 85% of a farm's base. Cotton base yield = 800 lbs/ac; rice base yield = 48 cwt/ac; soybean base yield = 25 bu/ac.)

## Data and Methods

The enrollment decision condition in Equation (1) was programmed as a net present value model using Excel. This model was used to evaluate the trade-off between commodity program and WRP participation. In this model, three different possible crop bases were evaluated: cotton, rice, and soybeans. Base yields for the calculation of direct and countercyclical payments were 800 pounds per acre, 4,800 pounds per acre, and 25 bushels per acre for cotton, rice, and soybeans, respectively. These base yield values are consistent with average base yields in the delta region of Mississippi. Figure 1 shows the direct payment and the maximum possible countercyclical payment per acre associated with these base yield values.[3]

In order to incorporate returns from crop production into the model, USDA data on

[2] Costs associated with recreational leases would include not only the costs of establishing and enforcing such agreements (e.g., legal fees) but also costs for any activities required of the landowner by the terms of the lease (e.g., the planting of food plots for wildlife or the maintenance of hunting blinds).

[3] The countercyclical payment rate is determined by subtracting the direct payment rate and the higher of the loan rate or market price from the target price. Thus, the maximum countercyclical payment occurs when market price is equal to or less than the loan rate. As market prices increase above the loan rate, the countercyclical payment declines. If market price is equal to or greater than the target price minus the direct payment rate, the countercyclical payment is zero.

**Table 1.** Comparison of Net Present Value (NPV) of Returns from Commodity Program and Wetland Reserve Program Participation

| | Commodity Program NPV | | Wetland Reserve Program | |
|---|---|---|---|---|
| Base/Planted Crop | Average | Standard Deviation | Hunting Lease | NPV |
| Cotton/Cotton | $1,777 | $118.89 | $15/ac | $1,438 |
| Cotton/Soybeans | $1,489 | $78.11 | $25/ac | $1,576 |
| Rice/Rice | $1,850 | $156.42 | $35/ac | $1,654 |
| Rice/Soybeans | $1,753 | $47.56 | $45/ac | $1,732 |
| Soybeans/Soybeans | $867 | $59.94 | $55/ac | $1,810 |

costs and returns for the delta region from 1975 to 1996 were obtained. A series on returns to land, labor, and management was constructed by adding unpaid labor and land costs back to the value for economic returns to management. Market prices for the calculation of the countercyclical payment were taken from this same data series. A value of $900 per acre was used for the WRP easement value. This is the maximum easement value allowable in the state of Mississippi, and nearly all parcels in the delta enrolled under a permanent easement receive this maximum rate (Garner).

To estimate net present value of returns from commodity and conservation programs, a stochastic simulation model was developed. In this model, 10 annual values for cotton, rice, and soybean returns and for cotton, rice, and soybean countercyclical payments were simulated by randomly drawing from the empirical distribution of USDA-ERS cost and return data.[4] Note that in these random draws, crop returns and crop price (for the purpose of calculating the countercyclical payment) were drawn as a pair, not independently. For each of the 10 years, a series of 500 draws was conducted. The value of the direct payment was also calculated for each crop for each year. For land enrolled in WRP, a hunting lease value per acre was assumed for each year. This value was treated as a constant, and a number of alternative values were evaluated with the model. Annual returns are discounted assuming a discount rate of 6%. The value of land at the end of 10 years was also discounted and added to the value of the discounted stream of returns. Assumed land values were $1,250 per acre for land with cotton or rice base, $850 per acre for land with soybean base, and $813 per acre for land enrolled in WRP (i.e., 65% of the value of unencumbered land with a cotton or rice base).

## Results and Discussion

Net present value of returns from land enrolled in WRP under a permanent easement is compared to the net present value of returns from land with cotton, rice, or soybean base remaining in production. In this analysis, it is assumed that cotton base is planted to either cotton or soybeans, rice base is planted to either rice or soybeans, and soybean base is planted to soybeans only. Results of the net present value (NPV) model are presented in Table 1.

The NPV of returns on land placed in WRP is quite competitive with the NPV of commodity program and crop receipts from land remaining in production. The NPV of returns on land with soybean base is considerably lower than the NPV of returns on land enrolled in WRP, even at a low hunting lease rate. This reflects both the lower level of commodity program payments on soybeans (particularly in the delta, where soybean base yields tend to be relatively low) and the lower

[4] Note that this approach does not fully account for differences in land productivity. For example, in the delta of Mississippi, land with cotton base is likely to be more productive than land with soybean base; however, in this simulation, returns on soybeans grown on cotton base are the same as returns on soybeans grown on soybean base.

**Table 2.** Effect of Base Yields on Present Value of Returns from Commodity Program and Wetland Reserve Program Participation

| | Commodity Program Base Yields[a] | | | Wetland Reserve Program | |
|---|---|---|---|---|---|
| Base/Planted Crop | 85% of Average | Average | 115% of Average | Hunting Lease | NPV |
| Cotton/Cotton | $1,681 | $1,777 | $1,880 | $15/ac | $1,438 |
| Cotton/Soybeans | $1,387 | $1,489 | $1,598 | $25/ac | $1,576 |
| Rice/Rice | $1,713 | $1,850 | $1,987 | $35/ac | $1,654 |
| Rice/Soybeans | $1,608 | $1,753 | $1,899 | $45/ac | $1,732 |
| Soybeans/Soybeans | $859 | $867 | $877 | $55/ac | $1,810 |

[a] Average base yields are as follows: cotton = 800 lbs/ac, rice = 4,800 lbs/ac, soybeans = 25 bu/ac.

average returns from soybean production in the delta in comparison to returns from rice or cotton production. This indicates that on more marginal land in the delta, enrollment in WRP may very well be the highest and best use.

On land with cotton or rice base, continued commodity program participation and crop production yields a higher NPV than WRP enrollment except on WRP land receiving a very high hunting lease rate. Of course, this result is influenced by the levels of base yields. As noted, base yields that are consistent with base yields in the delta region of Mississippi have been used here. Sensitivity analysis was performed to determine how NPV results are affected by the level of base yield. In this analysis, NPV was calculated assuming base yields for all crops of 15% above and below the average. These results are shown in Table 2.

One serious problem with the foregoing comparisons, though, is that returns on land remaining in production are much more variable than the returns on WRP land (see standard deviations in Table 1). The bulk of the return from WRP participation—represented by the up-front easement payment—is known with certainty when the enrollment decision is made. In order to make a fair comparison, the present value of returns from the commodity program options being considered must be adjusted for the level of risk involved. This can be accomplished either by adding a risk premium to the discount rate or by adjusting the series of future returns to represent a certainty equivalent (Robison and Barry). The latter method is employed here.

Using the 500 possible values for crop returns and commodity program payments for each of the 10 years under consideration, certainty equivalents were calculated for each year using a constant absolute risk aversion (CARA) utility function. The mathematical form of the CARA function is as follows:

$$(2) \quad E(U)_c = \sum_{i=1}^{n} \omega_i(1 - e^{-cR_i}), \qquad c > 0,$$

where $R_i$ represents a series of risky returns, $c$ is a risk aversion coefficient, and $\omega_i$ is the weight associated with each observation $i$.[5] Equation (2) is used to convert the 500 return values for each year of the simulation into a utility value for a number of different levels of risk aversion.[6] Given this utility value for each year, Equation (2) can be solved for $R$, yielding the certainty equivalent, as indicated here:

$$(3) \quad CE_c = \frac{\ln(1 - \bar{U})}{-c},$$

[5] In this model, all observations are weighted equally so that the weight of each observation is 1/500.

[6] Following Babcock, Choi, and Feinerman, risk aversion coefficients are set so that the associated risk premium corresponds to a given percentage of the gamble size, where gamble size is approximated by the standard deviation of returns. In this model, risk aversion coefficients corresponding to risk premiums of 10%, 20%, 30%, 40%, and 50% of the gamble size are used.

**Table 3.** Comparison of Present Value of Certainty Equivalents of Returns from Commodity Program and Wetland Reserve Program Participation

| | Risk Aversion Coefficient[a] | | | | |
|---|---|---|---|---|---|
| Base Crop/Planted Crop | 0.004 | 0.008 | 0.013 | 0.018 | 0.024 |
| Cotton/Cotton | $1,737 | $1,694 | $1,646 | $1,591 | $1,527 |
| Cotton/Soybeans | $1,473 | $1,457 | $1,438 | $1,416 | $1,389 |
| Rice/Rice | $1,782 | $1,711 | $1,636 | $1,557 | $1,473 |
| Rice/Soybeans | $1,747 | $1,741 | $1,734 | $1,726 | $1,717 |
| Soybeans/Soybeans | $857 | $848 | $838 | $827 | $815 |

[a] Reading from left to right, risk aversion coefficients correspond to a risk premium that is 10%, 20%, 30%, 40%, and 50% of the gamble size, respectively.

where $CE_c$ represents the certainty equivalent for a decision maker whose risk aversion is characterized by the risk aversion coefficient $c$ and $\bar{U}$ represents a given level of utility. Certainty equivalents for each year are then discounted to obtain a present value. Table 3 reports the present value of certainty equivalents for each of the commodity program/crop production options considered.

The relatively variable level of returns from cotton and rice production causes the certainty equivalents for returns from these options to decline fairly rapidly as risk aversion level increases. When certainty equivalents are considered, at moderate levels of risk aversion, WRP participation begins to look considerably more attractive than either of these options, even at relatively low hunting lease rates (see Table 1 for NPV of WRP returns). For land with a rice base, soybean production looks like a fairly attractive option compared to WRP enrollment. A large percentage of the rice base payment is represented by the direct payment, which is not variable, and soybean production returns are considerably less variable (and considerably lower on average) than rice production returns.

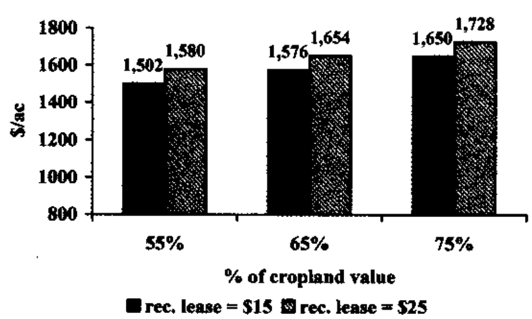


**Figure 2.** Effect of Market Value of WRP-Enrolled Land on Present Value of Returns to WRP Participation (Notes: Percentages denote market value of land enrolled in WRP as a percentage of cropland value. Cropland value is assumed to be $1,250/ac.)

One additional factor that will have an important impact on a comparison of WRP and commodity program participation is the value of land encumbered with a WRP lease. The greater the potential for recreational use of a given property, the less its value will decline as a result of the WRP easement. Results in Tables 1 through 3 assume that the value of the encumbered land is 65% of the value of unencumbered cropland. Figure 2 reports the results of different assumptions regarding this land value. Two recreational lease rates are represented in this figure.

Results presented here indicate that, not surprisingly, there may be circumstances under which continued commodity program participation and crop production will yield a greater return (or higher utility to the decision maker) than enrollment in WRP. A fairly large number of factors will influence the outcome of any comparison of WRP and commodity program benefits. While some sensitivity analysis of key factors affecting the WRP enrollment decision has been presented here, a more complete evaluation of all such factors is not possible given the space limitations of the current format. The results presented here are intended to illustrate the commodity program and WRP comparison under a limited set of reasonable assumptions and also to provide a basis for discussion of the issues that are critical for the decision maker to consider.

### Key Factors Influencing WRP Enrollment Decision

As the results in Table 1 clearly indicate, the type of crop base on a given parcel has a tremendous influence on the value of future commodity program returns. Cotton and rice bases tend to be considerably more valuable than soybean base by virtue of the higher direct and potentially higher countercyclical payments on these crops. In the delta region of Mississippi, much of the land that qualifies for WRP enrollment is also very well suited to rice production (Ray). It is therefore likely that rice base exists on a significant portion of WRP-eligible land.[7]

In a similar vein, the level of base yields also clearly will influence the value of commodity program participation relative to WRP enrollment. The higher the base yield, the larger the total direct and countercyclical payments that will be received and the greater the opportunity cost of forfeiting that base through WRP enrollment.

Another perhaps less obvious factor influencing the outcome of this comparison of WRP and commodity program participation is the value of land encumbered with a WRP easement. To what extent is the value of the land reduced by the permanent and quite restrictive WRP easement? This is a difficult question to answer given the lack of objective data on the issue. In the examples presented here, it was assumed that the encumbered land's value was 65% of the value of unencumbered cropland. This value was based on anecdotal reports from the delta region. In all likelihood, there is considerable variability in the value of land enrolled under a WRP easement. Enrolled land that is close to a major population center and that is relatively accessible likely has a high market value based solely on its potential for recreational use. On such land, a WRP easement may have a minimal effect on value. By contrast, land that is further removed from a population center or that is not easily accessible likely would have a lower value strictly for recreational use. The value of such land should be expected to be considerably lower than that of unencumbered farmland.

Even on land with rice or cotton base and good base yields, WRP enrollment may be a very attractive option. In many instances, only a portion of the acreage covered by an FSA farm serial number may be eligible for enrollment in WRP. If there are sufficient "free acres" on the farm (i.e., acreage on the farm that is excess of the total crop base on the farm), land can be enrolled in WRP without affecting the total commodity program payment received by the farm.

### Summary and Conclusions

This study examines the decision of whether to enroll existing cropland in the WRP program under a permanent easement or to remain in the commodity program and continue crop production. A net present value model is used to value future revenue streams. Also, to evaluate the impact of the risk associated with a particular land use, prior to discounting, future revenue streams are converted to certainty equivalents using a constant absolute risk aversion utility function. Results shed light on the key factors that should influence a decision maker's WRP enrollment decision.

The outcome of a comparison between commodity program/crop production and WRP enrollment will be greatly influenced by the type of crop base on a parcel of land as well as by the level of base yields on that parcel. Cotton and rice bases are particularly valuable because of the relatively high value of the direct payments and the potential for relatively high countercyclical payments from these crops.

Another important factor for decision mak-

[7] Relatively little land that is qualified for WRP is also suitable for cotton production; however, some land of that type may be eligible to enter the WRP as an inclusion with a larger adjacent parcel that does qualify.

ers to consider is the value of land encumbered with a WRP easement. Location and other external amenities related to recreation potential of the land will have an import impact on this variable. The greater the value of a parcel of land solely for recreational use, the more attractive WRP enrollment will look from an economic perspective.

This research also raises some interesting questions for further study. First, the effect of the productivity of the land needs further examination. Second, research is needed into the issue of recreational leases. What are certain amenities worth? Would it be possible for a landowner to estimate the recreational lease potential of a piece of land based on various characteristics of that land? This would be useful information for landowners considering WRP enrollment or any other type of conservation easement. Finally, conservation easement decisions would seem to have all the essential characteristics of a real options problem. An investigation of the issue employing the real options framework could perhaps provide additional useful insights.

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