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Financial and Economic Analysis of CRP, Row Crop, and White Pine Production on Erodible Lands of Southern Ohio

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Introduction

Soil erosion from farming has been a matter of great concern during the past several decades. Soil erosion is defined as the displacement of soil particles, plant nutrients and organic matter from land by agents like rain, running water, wind or storm. The sustainable soil erosion rate related to on-site productivity is expressed in terms of a T-level, which is up to 5 tons of soil loss per acre per year (SSSA, 1987). When the soil erosion rate is higher than the T-level, natural productivity is unsustainable and significant on-site as well as off-site damage may result.

In the past, reduced productivity and other on-site damage due to soil erosion were considered major issues for soil conservation policies and programs (Baum *et al.*, 1990; Hitzhusen, 1991; Ribaudo, 1986). However, recent studies have shown that the off-site damage of soil erosion such as sedimentation, water pollution, down-stream impacts, and harmful effects to aquatic and terrestrial wildlife, may be more serious and costly than on-site damage (Clark *et al.*, 1985; Colacicco *et al.*, 1989; Hitzhusen, 1991; Napier and Camboni, 1988; Ribaudo, 1986; Ribaudo *et al.*, 1989; Steiner, 1990). This paper draws from Shakya's M.S. thesis (1992) which focuses on both the on- and off-site impacts of soil erosion and hypothesizes that the erosive practices of row crop production on highly erodible (marginal) land may not only be non-sustainable but may also present costly consequences to society. The introduction of white pine plantations (WPP) on such lands is a proposed alternative which would be sustainable and would generate on-site and off-site benefits due to reduced soil erosion.

The WPP is compared with conventional row crop production and the on-going federal Conservation Reserve Program (CRP) in eight southern Ohio

counties within 60 miles of Mead Paper Corporation. The CRP provides an annual rental payment to farmers who retire their erodible lands from production. Both financial and economic analyses of row crop production (RC), CRP, and WPP are carried out to compare benefits and costs from farmers' as well as from a societal standpoint.

Methodology

Under a financial or private accounting stance, costs and returns are measured from the farmers' perspective, market or administered prices are used, externalities are not usually fully internalized, taxes are treated as a cost and subsidies are a benefit. Under a societal or economic accounting stance, taxes and subsidies are considered as transfer of payment from individuals to the public at large and vice versa (Gregory, 1987; Mishan, 1972). In this economic analysis subsidies are replaced by actual opportunity cost of the resources involved (eg. land). Consumer surplus losses (from analysis by Ribaudo *et al.*, 1989 and Young and Osborn, 1989) are included and a social time preference rather than private opportunity cost of capital is used. Finally, the downstream economic impacts of soil erosion are included.

Benefit-cost analysis (BCA) is widely applicable in estimating benefits and costs from a societal accounting stance in developmental, natural-resource and environmental programs (Dasgupta and Pearce, 1978; Hufschmidt *et al.*, 1988). The Net Present value (NPV) is selected as a benefit-cost criterion for evaluating various alternatives in this study. A NPV of a project is defined as:

$$NPV = \sum_{t=0}^{T} \frac{b_t - c_t}{(1+i)^t} \quad \ldots\ldots\ldots \quad [1]$$

Where,

b_t = benefits in year t

c_t = costs in year t

T = total project period in years

i = discount rate

If NPV > 0, the project is acceptable.

The NPV gives the present value of the income stream for the individual or private entrepreneur (farmers and/or land owners) in financial analysis. In economic analysis NPV provides the present value of all net benefits or gains to the whole society or nation. The following variables are considered as benefits (+) and costs (-) in RC, CRP, and WPP depending on whether one is doing economic or financial analysis:

Alternatives -

(a) RC :

Economic : $B_r - C_r - C_{op} - C_{on} - C_{of}$

Financial: $B_r - C_r + F_{sr} - C_{on}$

(b) CRP :

Economic : $B_{of} + B_{on} - C_{op} - C_{cc} - C_{ec} - C_{mc}$

Financial: $F_s + B_{on} - \frac{1}{2}C_{ec} - C_{mc}$

(c) WPP :

Economic : $B_{of} + B_{on} + B_w - C_{op} - C_{cc} - C_{ew} - C_{mw}$

Financial: $F_s + B_{on} + B_w - \frac{1}{2}C_{ew} - C_{mw}$

Where,

B_{of} = off-site benefits from reduced soil erosion, this is for CRP and WPP where erosion rate is reduced to below T-level.

B_{on} = on-site benefits from reduced soil erosion, this is for CRP and WPP where erosion rate is reduced to below T-level.

B_r = gross return from row crop (without federal payment).

B_w = return from the sale of white pine product.

C_{cc} = increase in consumers' cost due to the increase in market price of food commodities.

C_{ec} = establishment costs for CRP cover crops, including grasses, legumes, trees, windbreaks, filter-strips or wildlife covers.

C_{ew} = establishment costs for white pine, including cost for site preparation, tree saplings and planting.

C_{mc} = maintenance costs for CRP land to assure complete vegetative coverage and freedom from unwanted weeds.

C_{mw} = maintenance costs for WPP, to suppress weeds in first four year's of white pine growth.

C_{of} = off-site costs of soil erosion under RC.

C_{on} = on-site costs of soil erosion under RC.

C_{op} = social opportunity cost of land, includes rental value of land without considering federal subsidy.

C_r = costs for row crop, includes costs for various inputs such as seed, fertilizers, land taxes (does not include land rents).

F_s = annual federal subsidies (land rents) for CRP and WPP.

F_{sr} = federal subsidies to row crop (govt. payment)

The determination of a social discount rate for economic analysis is arguable and difficult. For financial analysis, the discount rate is usually assumed to be the marginal or opportunity cost of money to the farm or firm

for which analysis is being done (Gittinger, 1984). Hence, in this study, the market interest rate will be used for the discount rate in financial analysis. The study done by Irwin, Forster and Sherrick (1988) shows that the mean return to farm assets is 10.63 and Consumer price index is 4.58 (over a period of 1947 to 1984). From their study, the real interest rate is estimated to be 6 percent which is used for financial analysis in this study.

In economic analyses, it may be justifiable to use a social discount rate 'r' since WPP has (1) a relatively long project life (30 years) that may be extended to several future 30-year periods; (2) farsighted objectives of sustainability; and (3) an inter-generation involvement. The Forest Service recommends the use of a 4 percent discount rate for long-term land and resource planning (Gregory, 1987). The use of alternative discount rates (r) in sensitivity analyses in the M.S. thesis research by Shakya (1992) provided information regarding the influence of 'r' in the comparison of proposed projects.

The off- and on-site costs of soil erosion are important factors in this analysis. For the costs of soil erosion, the average value from Ribaudo's analysis of the Appalachian, Corn belt, and Northeast regions is used. Southern Ohio, while in the Corn-belt, lies adjacent to the other two regions and has characteristics of all three regions. On-site costs of soil erosion do not differ much among these regions due to similarities in soils and crops (land use) which, when averaged, do not differ much. Off-site costs, on the other hand, show greater variation with the Northeast region having the highest.

Many factors are responsible for higher off-site costs vs. on-site costs (Hitzhusen, 1992). One major factor is population density, which has a

positive relationship with off-site costs. A high population density, such as in the Northeast region, results in a high demand for water quality, recreational and aesthetic values of water bodies (lakes, rivers and reservoirs). Although the population density of the study-counties is in the low range, the density of state parks and lakes and the population within a 25- to 50-mile radius of state parks and lakes in these counties appears higher. Therefore, Shakya (1992) did a sensitivity analysis of on-site and off-site costs of soil erosion taking low and medium values. The low values are averages of the Appalachia and Corn-belt regions, while the medium values are averages of all three regions.

Various scenarios of CRP and WPP along with RC (the three main alternatives of the study) were developed considering possible trends in farmers' choices for future use of land. For example, a farmer may wish to revert back to row-crop production after 10 years of CRP or 30 years of WPP. Such scenarios enable one to make contingencies for the uncertainty of land-use programs. The CRP may not, in fact, continue for a 30-year period. Modifications, such as the recent CRP easement program, are also likely to change the focus of the program, depending upon the impact of current progress and response. Similarly, the land-leasing program of Mead Paper Corporation in Ohio in which Mead bears all plantation and maintenance costs for white pine, also may not continue beyond the initial proposed period of 30 years. Therefore, the proposed alternative WPP is compared with several most likely combinations of RC, CRP and some options of WPP itself.

Analysis and Results

The results of the financial and economic analyses for each of the alternatives utilizing medium values of soil erosion costs are presented in

Table 1. The alternatives are compared on the basis of NPV. The discussion of results has been subdivided into two main sections, i.e., economic and financial analyses.

Economic Analysis

The economic analysis (data in Table 1) for all alternatives shows RC as having a negative NPV, which implies that it generates more aggregate costs than benefits from the societal standpoint. This outcome of RC results mainly because the off-site costs of soil erosion are internalized in the analysis, i.e., higher soil erosion costs increases social costs of RC. In the analysis, the CRP is assumed to extend into the future for three 10-year cycles. The CRP alternative, on the other hand, appears to be more beneficial than RC from the viewpoint of society since it generates net economic gain.

From a societal standpoint, the CRP and the CRP easement program are almost the same. In fact, the major difference between the two is that the latter provides a federal subsidy on reserve land for only half (15 years) of the 30-year project period. This difference, however, will have impact on the financial analyses and naturally, the alternative providing subsidies throughout the project period (30 years) is more attractive to farmers. The higher NPV of the CRP as compared to the CRP easement program is presented in Table 1 under the financial analysis.

The fourth scenario, where one 10-year contract period of CRP is followed by farmers reverting land to RC, also did not appear economically feasible even though it was better than RC alone. This was shown by the less negative value of NPV for CRP/RC as compared to RC. Since the NPV is negative in both cases, society will incur net costs.

reason for this is the cost of land clearing involved with converting the established forest into farmland once again at the end of the project period. It can be noted, however, that based upon the economic analysis, the WPP/RC alternative is still better than the CRP, the CRP/RC, and/or the RC.

Financial Analysis

The financial analysis provides costs and revenues of the land use alternatives from the farmer's accounting stance. Based on the reasoning of direct returns/gains, a farmer would rank the CRP easement program as the least attractive. The RC option has a higher NPV than the CRP, which raises the question of why farmers would enroll in CRP? Although there is some possibility of over- or under-estimation of NPVs, two lines of reasoning may be used to explain the seeming contradiction. The first involves risk averse behavior of the farmer, that is, a farmer would prefer to enroll in CRP because of guaranteed, although somewhat lower, income. In the case of RC, the return in not guaranteed (eg., due to the possibility of crop failure or lower market price). The second line of reasoning considers farmers' awareness towards problems of soil erosion and environmental quality. Along with the realization of long-term environmental costs which will ultimately effect everyone, they may also be aware that returns from RC on highly erodible lands are not sustainable.

Contrary to the economic analysis, in the financial analysis the CRP/RC scenario was more attractive to farmers than CRP alone. However, the WPP was the most attractive alternative since it not only achieved the objectives of soil erosion (hence environmental pollution) control, but also offered a means of productively using lands of high erosion hazard (i.e. return from pine product at the end of project period). The WPP/MEAD scenario had a higher NPV

than WPP. In this case MEAD bears all costs of establishment and maintenance of white pine plantation. Although WPP has proved to be more appealing to farmers than other alternatives analyzed in this study, farmers could be hesitant to plant a white pine plantation because it requires a longer term commitment.

The WPP/RC option had a lower NPV than RC alone, implying that it is not profitable for farmers to grow white pine if they intend to revert the land to RC after 30 years. This is because of the high cost associated with land clearing at the end of the project period. From a financial perspective, the farmer would be better off by simply maintaining RC instead of choosing WPP/RC.

Conclusions and Implications

Based upon the analyses and interpretation of results obtained from this study the conclusions drawn are as follows:

(a) Despite a high ranking in the financial analysis, RC, from a societal accounting stance was the least desirable alternative.

(b) RC implemented on land after 10 years of CRP enrollment remained unfavorable from the viewpoint of society.

(c) The CRP generates positive NPV in the case of medium soil erosion values, but the NPV became negative in Shakya's thesis research (1992) as the discount rate increased to 8 percent in the case of low soil erosion values. Therefore, the CRP is more sensitive to the discount rate when the values of soil erosion cost are low. Although, the CRP-easement program generates positive NPV under both low and medium erosion values, it is the least desirable option from the farmers accounting stance.

(d) The WPP/RC ranked reasonably high in both analyses, but it is less

attractive than RC from the farmer's perspective because of high land clearing costs.

(e) The WPP and WPP/MEAD ranked highest in both the economic and financial analyses and hence were the best options taking both the perspective of farmers and society as a whole.

The WPP holds promise for future implementation to benefit society and the agricultural community. Since WPP generates more NPV than CRP, federal expenditure could be saved by reducing subsidies to a level where WPP would maintain its attractiveness when compared to CRP and RC. Besides meeting all the objectives of CRP, WPP has added gains of insuring longer term environmental protection and providing a marketable product at the end of project period. Although a conservative assumption of soil erosion under WPP was used by equating it to that under CRP, there is some evidence to suggest that erosion may be less under WPP. However, there may be some reluctance on the part of the farmer to adopt WPP because of the long-term commitment required. This aspect of WPP concerning farmers' willingness to undertake long term commitment needs more extensive field survey and research for validation. The social costs incurred from transportation of WPP (trucking) and more site specific estimates of soil erosion costs are two other issues requiring more detailed investigation.

This study assumed that the current property rights or entitlement will not change. However, any changes in property rights over time related to penalizing farmers instead of subsidizing them for soil erosion control, could produce different results, particularly for the farmers. This issue needs additional study because property rights related to land use are constantly changing and appear to be moving in favor of downstream users.

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