

Evaluating Conservation Practices: Buffer Strips vs. Improved Pasture

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Concern about the environment has greatly increased in recent years. It makes sense that anyone associated with agriculture should attempt to be aware of the environmental implications of various agricultural practices. Though much research needs to be done to answer specific questions relating to certain environmental concerns, we already are aware of many important benefits associated with grassland agriculture. Furthermore, we know that certain special management practices and techniques can greatly increase such benefits.

This research will provide an economic analysis of buffer strip versus improved pasture as a means for reducing soil erosion and nutrient runoff. Improvements to water quality can be achieved through increased knowledge and understanding of the challenges faced by the farm community and the level of pollution reduction needed to meet quality standards.

Introduction

The impact of agricultural practices on water quality continues to be a major public concern. Sediments, nutrients, and pesticides can run off farm fields to rivers, streams, and public water supplies. Good manure management practices are needed more than ever before. Livestock practices which can cause impacts to water quality include both intensive and non-intensive operations. These operations can be successful environmentally when managed correctly, but animal waste can cause degradation of water resources if it is not properly managed. Quality water is essential to maintaining not only a healthy environment, but also a healthy economy. Typically, major contaminants arise from residential, industrial, or agricultural sources. To maintain high quality fresh water it is necessary to minimize contamination of surface and ground water sources.

Nutrients entering the water supply come from existing sources (native or non-improved pastures) or from imported nutrients (feed, minerals, chemicals, fertilizer). Existing nutrients come and go as organic material that is recycled through the environment. Imported nutrients include fertilizers, livestock feeds and supplements, and chemicals used by humans or in agricultural practices. Nutrient mismanagement can have devastating impacts on stream ecosystems. Ackerman and Taylor (1995) identified intensive livestock operations as point sources of pollution to streams. For example, a swine operation in Illinois was linked to ongoing fish kills in an adjacent stream. The open-front facility lacked any waste collection structure to collect nutrient-rich runoff. Manure drained directly from the feedlot into the adjacent stream. Dissolved oxygen,

phosphorus and ammonia concentrations exceeded Illinois water quality standards.

Applied research is required to identify technologies that will enable Tennessee producers (especially livestock producers) to remain competitive while complying with current and emerging federal and state water and environmental regulations.

The application of plant nutrients (nitrogen and phosphorus) in excess of pasture or crop demand can result in the contamination of surface and ground water. For example, Andres (1995) found nitrate contamination in ground water under cropland that received excessive applications of manure. Factors contributing to the nitrate contamination include: agricultural land use; flat topography; well drained, highly permeable soils and aquifer characteristics. However, Andres (1995) found that nitrate contamination was more severe in areas with intensive animal production than elsewhere. Approximately one-third of the wells had nitrate concentrations in excess of the drinking water standards. Although cow-calf operations have lower livestock densities than feedlots, grazing and cow-calf operations can potentially contaminate surface water. Robbins (1979) found that runoff is proportionately higher from a heavily grazed watershed than moderately or lightly grazed watersheds. High runoff is due to the compaction of the soil from cattle's hooves and grazing practices. Water contamination from grazing operations includes increased sediment and bacterial counts in runoff (Walker, 2003).

Grazing land managers can minimize water quality problems by practicing good grazing management. The key is having a good understanding of livestock behavior. Careful application of common grazing management principles to manipulate behavior can help managers remain profitable while minimizing adverse impacts on water quality.

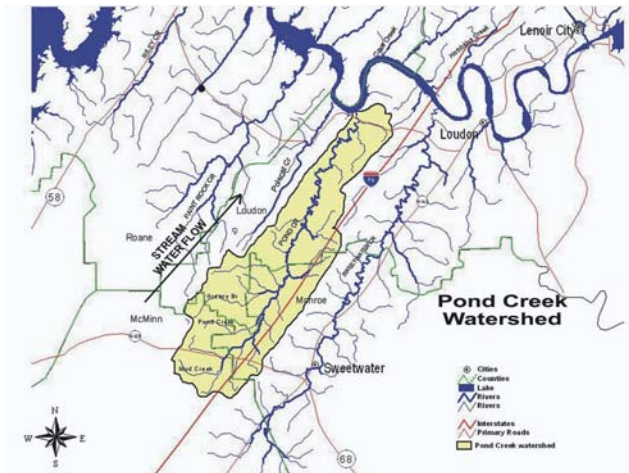
How grazing management strategies are applied will depend on the topography, productivity, and vegetative type of the grazing resources; and management resources such as livestock, fences, water, time, and management ability.

Best management practices (BMPs) are designed for the specific purpose of controlling non-point source pollution. BMPs must be effective and practical. With the exception of very large feedlots, animal waste disposal is largely a non-point source problem. No one system is “best.” Every scenario has advantages and disadvantages. It is up to the land user to determine which compromises will be most effective. These trade-offs will include labor needs, cost of setup and maintenance, regulations, convenience, and technical competency of the individual available to oversee operations. While these BMPs appear costly to install, in some circumstances they may provide economic benefits to offset the lost profits from alternative uses. Before beginning construction, however, landowners and users should understand the economic tradeoffs. Benefits of vegetative buffer strips and improved pasture need to be compared with installation and maintenance costs. This paper provides results on a survey that was conducted in the Pond Creek watershed and an overview of several studies that have conducted economic analysis of buffer strip and improved pasture establishment.

Method:

A survey was conducted in the Pond Creek Watershed during January and early February of 2004. The main agricultural producers are beef cow-calf operations and dairy farms that are similar to those in the rest of the Southeastern United States. I, along with Lena Beth Carmichael of the UT Agricultural Extension Service, drove the Pond Creek Watershed and administered the surveys face-to-face with the producers. This gave producers the opportunity to express their personal insight and concerns about the watershed. We started out trying to survey the largest producers and worked our way down to the smaller producers. We conducted surveys in each of the 3 counties (McMinn, Monroe and Loudon) and set an initial goal of covering 50% of the 23,000+ acreage in the watershed. This watershed was chosen due to its ideal conditions and similarity to the rest of the region.

Producer Demographics:



This survey was conducted on 28 producers in the Pond Creek Watershed. This watershed is located in Monroe, McMinn and Loudon County, Tennessee. The average age of the 28 producers surveyed was 51 years old with a range of 80 years old

being the maximum and 20 years old being the minimum. The percentage of young farmers surveyed was 11%. This slightly skewed the demographic downward in relation

to the state average of 55 years of age. The greatest percentage of respondents (28.6%) was between the ages of 50 – 60. Over 55% of the producers surveyed had been farming for life. The next largest percentage of respondents (18%) said they had been farming between 40 – 60 years.

When compared to the average Tennessee farm demographics, producer surveyed in the Pond Creek Watershed were very similar to those. State census data from 2002 showed the average Tennessee farm size at 130 acres with the greatest concentration (50.0%) of respondents falling in the 100 – 299 acres category. However, the second largest percentage of producers surveyed (39.28%) owned farms over 300 acres, with 7.12% falling into the 300 – 499 acres category. Eleven percent of the producers surveyed had farms of less than 100 acres in size. Thirty-two percent of the producers responded that they rented no land. The largest percentage (39.29%) of those who did rent land, rented between 100 – 299 acres.

A wide variety of crops were grown by these producers. Some of these crops included corn, soybeans, wheat and tobacco. The average acreage of corn planted per producer was 60 acres with 300 acres being the maximum grown by any producer. The average acreage of soybeans planted per producer was 59 acres with 600 acres being the maximum grown by any producer. The average acreage of wheat planted per producer was 64 acres with 200 acres being the maximum grown by any producer. The average acreage for tobacco was much smaller at less than 1 acre planted per producer. The most any producer planted of cotton was 2 acres. The average acreage for Hay/Pasture grown was 125 acres per producer with 300 acres being the maximum.

A large variety of animals were also raised by these 28 producers. Some types of these animals are beef cattle, dairy cattle, goats, swine, poultry, sheep, horses and Holstein steers. The largest number of animals came from dairy cattle operations totaling 2,800. This came to an average of 100 head of dairy cattle per farm with the maximum number of head on a farm being at 350. Along with those 2,800 head of dairy cattle, 460 heads were sold previously that year from the 28 producers. The next largest group of animals was beef cattle totaling 1,465 head. This came to an average of 52 head of beef cattle per farm with the maximum number of head on a farm being 200 head. Along with those 1,465 head of beef cattle, 692 head were sold previously that year. The third largest group of animals was Holstein steers totaling 350 head.

When asked whether or not in the last 5 years if their farm net income has increased, decreased or stayed the same, 38% of the producers responded that their net income had decreased. Thirty-seven percent reported that their net income had increased while 25% reported no change. When asked about how much off-farm income makes up their total family income, nearly 58% responded that no off-farm income was received. However, 15% received over 70% of their income from off-farm sources.

Producer Survey Results:

1. What was your most recent farm improvement?

Table 1: Most recent Farm Improvement

Farm Equipment/Upgrade Repair	29%	Built New Barn	7%	Improve Pasture	0%
Install/Upgrade Manure System	10.5%	Repair Barn	18%	Built New Pond	0%
Install Alternative Water Source	10.5%	Fencing	18%	Improved Pond	0%
Cattle Crossing	0%	Buffer Strips	0%	Renovate Farm	7%

The most recent farm improvement chosen by the Pond Creek producers was Farm Equipment Upgrade/Repair at 29%. This was not surprising seeing as how something always is in need of repair on a working farm. The next highest response was

a tie with Built New Barn and Fencing at 18%. Buffer Strips, Improve Pasture, Built New Pond and Improve Pond received no responses.

2. How much did you spend on this investment?

Table 2: Investment Spent (All surveys)

Maximum	Minimum	Average
\$200,000	\$150	\$25,916

Table 3: Investment Spent (All surveys except for outliers)

Maximum	Minimum	Average
\$100,000	\$500	\$19,984

The maximum investment of \$200,000 was a new barn. Actually the producer was unable to build the entire barn due to budget constraints and so only built half a barn. The minimum investment of \$150 was spent on fencing. The average dollar amount spent on these investments was \$25,916 (Table 2).

After taking out the original maximum and minimum, the new results were found (Table 3). The new maximum was at \$100,000 and the new minimum was at \$500. The average amount spent is now \$19,984. Both these averages are very high and were not expected. These results show us that the average producer in Pond Creek heavy overhead costs.

3. If you could make a list of farm improvements that currently need to be made, what would they be and how much would they cost (estimate)?

There was a wide variety of improvements that producers listed as projects that currently need to be made. Some of these improvements were cattle crossing, barn repair, fencing, manure storage, build new pond and buffer strips. The highest listed improvement that needed to be made was barn repair with an average cost estimate of

\$8,000. Prices for all these improvements ranged from \$200,000 for manure storage to \$700 for fencing.

4. When do you plan on making these improvements?

Table 4: Plans for improvements

Less than 1 year	21%
1 – 2 years	25%
3 – 5 years	18%
More than 5 years	18%
No Response	18%

Twenty-five percent of the respondents answered that they were going to make these improvements in 1 – 2 years. Twenty-one percent planned on making these improvements within a year. Eighteen percent of the producers did not respond to this question. These results tell us that the majority of the producers have other farm obligations that are in need of being completed in order to continue on with their current farm operation.

5. How do these improvements rank with adding best management practices for water quality?

Table 5: Farm improvements vs. Water quality

Farm improvements are more important than water quality	29%
Farm improvements are equally important than water quality	64%
Farm improvements are less important than water quality	7%

The largest response (64%) from the producers indicated that they felt as though farm improvements were equally important to water quality. Only 7% felt as though farm improvements were less important than water quality. These results on the producer’s feelings were very surprising and could have been brought on by a misunderstanding of the question and the thought of choosing a “right” answer rather than how they actually feel and think.

6. How much knowledge do you have of the following conservation programs?
 Level of Knowledge = High, Moderate, Low and None

Table 6: Conservation Programs

Stewardship Incentive Program (SIP)
Environmental Quality Incentive Program (EQIP)
National Conservation Buffer Initiative (NCBI)
Grassland Reserve Program (GRP)
Conservation Reserve Program (CRP)
Conservation Reserve Enhancement Program (CREP)
Wetland Reserve Program (WRP)

The responses to this question were very alarming and call for a change in how producers receive information about different conservation programs. Sixty-eight percent knew nothing about the Stewardship Incentive Program (SIP), while only 25% had a moderate amount of knowledge about it. Thirty-two percent knew nothing about the Environmental Quality Incentive Program (EQIP) with 43% knowing a moderate amount and only 4% (1 response) having a high knowledge about it. Sixty-four percent knew nothing about the National Conservation Buffer Initiative (NCBI) with another 14% knowing very little about the program. Knowledge about the Grassland Reserve Program (GRP) was at 39% for both moderate knowledge and no knowledge. The Conservation Reserve Program (CRP) had the highest level of knowledge with 11% having a “high” knowledge of the program and 18% having a “moderate” amount of knowledge about CRP. The Conservation Reserve Enhancement Program (CREP) was the least known about. Seventy-five percent responded that they knew nothing about the program. Fourteen percent responded with a “low” knowledge of the program. The Wetland Reserve Program (WRP) was the final program asked about. Forty-three percent of the respondents said they had no knowledge of the program while 40% said they had a “moderate” amount of knowledge about the program. Only 2 out of 7 programs had a

response of a “high” knowledge, these two programs being EQIP and CRP. Both CRP and EQIP are 2 major conservation programs and these results show a major problem that is occurring in the Pond Creek Watershed.

7. What source do you use to learn about conservation programs? Select all that apply.

Table 7: Sources of knowledge

Extension Agent	86%
Neighbor	36%
Family	36%
Newspaper/Magazine	61%
Farm Bureau Agent	7%
NRCS Staff	43%
Not Interested in Conservation Programs	0%
Other	18%

The largest source that Pond Creek producers use to learn about conservation programs is their Extension Agent (86%). This is followed by 61% using Newspaper/Magazine, 43% using NRCS Staff, and 36% using both neighbor and family. Only 7% used a Farm Bureau Agent to learn about programs. No producer responded that they were not interested in conservation programs. The use of the Extension Agent is a large number and compliments the Extension Service greatly. However this could be why we saw what we saw in Question 6. The Extension Agent doesn’t cover all these programs and so the farmer is getting a limited view of programs. More needs to be done on behalf of NRCS and Farm Bureau.

8. How would you classify the condition of your pasture?

Table 8: Pasture Condition

Excellent	4%
Good	50%
Fair	21%
Poor	25%

Fifty percent of the respondents reported that their pasture was in “good” condition while only 4% reported that their pasture was in “excellent” condition. The next two most frequent responses were “poor” and “fair” with 25% and 21% respectively. These results from this tell us that the majority of the pasture land in the watershed is not in the best of condition and that Improved Pasture would be a big benefit for the entire watershed.

9. How often do you take soil samples? Which soil lab do you use? Why?

Table 9: Frequency soil sampling

Twice a year
Once a year
Once every 2 years
Once every 3 years
Never
No Response

The respondents answer was broken into two categories: Pasture land and Crop land. Thirty percent responded that they take soil samples every year on their pasture land and 21% take soil samples both every 2 years and every 3 years. Fifty-three percent reported taking soil samples every year on their crop land followed by 32% taking samples every 2 years. These results were expected seeing as how it is more important to have your cropland properly adjusted compared to your pasture land.

10. How does soil testing impact your farm operation? Select all that apply.

Table 10: Impacts of soil testing

Improves Decision Making	82%
Improves Profitability	64%
Takes up too much time	7%
No Benefit	0%

Eighty-two percent reported that soil testing “improves decision making” followed by 64% saying it “improves profitability.” Only 7% of the respondents said that it “takes up too much time” while no one reported that it gives them no benefit.

Questions 11, 12, 13 and 14 were used in this survey to review the different practices that each farmer has in improving their pasture and crop land. Knowing what and how much the farmer is putting out on the ground is vital to making an educated decision on what to do about water quality concerns.

11. When was the last time you planted new seed to improve your pasture land?

Table 11: New seed planted

1 year ago	57%
2 years ago	25%
3 years ago	7%
4 years ago	0%
5+ years ago	11%

This question follows along with Question 8. Fifty-seven percent said that they had planted new seed 1 year ago followed by 25% planting new seed 2 years ago. Further questioning about what type of seed used would be beneficial to understanding why not more of the pasture land is ranked at a higher condition.

12. When was the last time you fertilized and/or limed your pasture land and crop land?

Table 12: Frequency of fertilizer and Lime

1 year ago
2 years ago
3 years ago
4 years ago
5+ years ago

All responses for fertilizing pasture and crop land reported doing so 1 year ago. However, not the same was for lime. Sixty-eight percent reported liming their pasture land 1 year ago while 75% reported liming their crop land 1 year ago.

13. What type of fertilizer/lime do you use on your Pasture and Crop land?

Table 13: Type of fertilizer/lime used

Commercial
Livestock Manure
Lime
Synagro

Responses for Pasture land were: 96% used commercial fertilizer, 68% used livestock manure, 61% used lime and 25% used Synagro. Responses for Crop land were: 100% used commercial fertilizer, 68% used livestock manure, 57% used lime and 18% used Synagro. Responses were very similar for each of the two categories.

14. What was the nitrogen, phosphorous and potassium content used (lbs/acre)?

Fifty percent reported that they did not know the content that they had used in their fields along with 21% not responding to the question. Of the responses that were obtained, an average of 36 lbs/acre of nitrogen was used, 23 lbs/acre of phosphorous was used and 20 lbs/acre of potassium was used. All three nutrients that were applied were on average applied in very small amounts.

15. In the past 5 years, would you say that your farm net income has increased, decreased or stayed the same?

The largest response (54%) said that their farm net income had decreased in the last five years. The next highest number (25%) reported that there had been no change in farm net income. Only 21% of the respondents had seen an increase in income. The majority of the respondents that had seen a decrease in net income were dairy cattle operators along with a horse farm while the majority that saw an increase in income were beef cattle operators.

16. Rank the following concerns most often related with your farm operation.
 1 = Most Concerned 8 = Least Concerned

Table 14: Ranking of farm concerns

Financial Solvency
Environmental Regulations
Zoning/Planning
Labor
Odor Nuisance Complaints
Liability
Estate/Trusts/Wills
Health/Age/Physical Abilities

The following concerns are ranked in order from most concerned (1) to least concerned (8): 1) Financial Solvency 2) Environmental Regulations 3)

Questions 17, 18 and 19 were used in this survey to study producer’s feelings towards adopting different best management practices and to find out at what price the average farmer is willing to adopt these practices.

17. Rank the following best management practices according to your willingness to adopt these practices to improve water quality.

1 = Most Willing 5 = Least Willing

Table 15: Rankings of BMP adoption

Alternative Water Source
Buffer Strips
Improved Pasture
Cattle Crossing
Fencing
Manure Testing
Nutrient Management Plan
Manure Composting
Protected Heavy-Use Area(s)
Integrated Pest Management
Soil Testing Program

The BMP that was most willing to be adopted was Improved Pasture with a 92% ranking of 1 for most willing. The next BMP that was most willing to be adopted was a

Soil Testing Program at 79% ranking it as a 1 for most willing. Fencing was the BMP that producers were least willing to adopt with 57% responding with a 5. Alternative Water Sources, Cattle Crossings, Manure Testing, Nutrient Management Plan, and Integrated Pest Management were all BMPs that the producers ranked as fairly willing to adopt. Producers felt fairly neutral towards Manure Testing.

18. Have you ever signed up for a conservation program with USDA, EPA, NRCS, etc. that uses cost share as an incentive to participate?

As anticipated, a large percentage (68%) of the respondents chose “yes” in that they had participated in such programs involving cost share. However, the remaining 32% that answered “no” is a rather alarming discovery and goes along with the findings from questions 6 and 7.

19. What level of cost share would it take for you to participate in the following best management practices?

Table 16: Cost share required to participate

Alternative Water Source
Buffer Strips
Improved Pasture
Cattle Crossing
Fencing
Manure Testing
Nutrient Management Plan
Manure Composting
Protected Heavy-Use Area(s)
Integrated Pest Management
Soil Testing Program

Fencing and Manure Composting were the two BMPs that had the highest average cost-share, being at nearly 90%. Buffer Strips, Cattle Crossings, Protected Heavy-Use Area(s) and Integrated Pest Management were the next highest with cost-share averaging 80%. Slightly below these four were Alternative Water Source, Manure Testing and

Nutrient Management Plan at 70% cost-share. Improved Pasture and Soil Testing Programs required the lowest cost share at 50% and 40% respectively.

Questions 20 and 21 were used in this survey to learn of the different concerns and fondness of the producers in the watershed about improved pasture practices. By finding out what they like and don't like about using improved pasture practices we can better suit our recommendations in a way that is considerate towards their feelings and will not automatically be shot down by the farmer.

20. How would you rank the following benefits of using improved pasture practices?

1 = Most Beneficial 5 = Least Beneficial

Table 17: Ranking of improved pasture benefits

Increased Carrying Capacity
Lower Death Rate
Greater Value of Cull Stock
Increase in Property Value
Higher Weaning Weights

The benefits listed above from using improved pasture practices are ranked as the following in order from most beneficial to least beneficial: 1) Increased Carrying Capacity 2) Increase in Property Value 3) Higher Weaning Weights 4) Greater Value of Cull Stock 5) Lower Death Rate. Rankings 2 and 3, Increase in Property Value and Higher Weaning Weights had very similar results with Increase in Property Value just slightly ranking greater than Higher Weaning Weights. The benefit of a Lower Death Rate ranked substantially lower than the other four benefits.

21. How would you rank the following disadvantages of using Improved Pasture practices?

Table 19: Rankings of improved pasture disadvantages

1 = Most Harmful 5 = Least Harmful

Initial Costs
Regular Maintenance Costs
Ecological Disruption
Selective grazing by Stock
Increased Maintenance Planning

The disadvantages listed above from using improved pasture practices are ranked as the following in order from most harmful to least harmful: 1) Initial Costs 2) Regular Maintenance Costs 3) Increased Maintenance Planning 4) Selective Grazing by Stock 5) Ecological Disruption. Initial costs far outweighed the other disadvantages with 76% choosing it as the most harmful disadvantage of using improved pasture practices. On the other spectrum, Ecological Disruption was chosen as the least harmful disadvantage by 71% of the respondents.

Survey Conclusion

This survey was taken to better understand the needs and wants of the producers in the Pond Creek Watershed. Mixed results were found that both surprised and reassured our attitude on how these producers felt.

Financial Solvency, the biggest concern of the producers in the watershed, was not surprising at all. This tells us that they are busy just trying to stay in business and can't worry about water quality concerns. What we were not expecting was such a large dollar amount spent on their recent farm improvement. At \$25,917, this can place a huge burden on any size operation. The lack of knowledge of conservation programs was also unexpected. This could be due to the lack of assistance that they are getting from different government agencies. With the majority getting their information from Extension Agents, this can create a limited view for the producer due to the fact that the

Extension Agent does not cover all the conservation programs. High cost share was anticipated for the adoption of the different best management practices.

When looking at these results, we come to the conclusion that because of such high maintenance costs and the fear of going out of business, producers are not willing to adopt many of these new practices that cost them money to start. Therefore, it is going to take high cost share on the governments' behalf to get these practices into utilization.

Economics

Previous research by Waikato Regional Council (2004), Ohio State University (Nakao, et al., 1999), Campbell and Vere (1983) and Greg Cuomo (2001) have started the difficult task of evaluating the benefits (measurable and non-measurable) and costs of BMPs such as buffer (filter) strips and improved pasture. Table 1 presents the results of a four study by the Waikato Regional Council that measured both on-site and off-site benefits to the region and assessed both the measurable (in environmental outcomes or dollar terms) and non-measurable benefits. In this study measurable benefits of soil conservation were mostly on-site, such as: (1) reducing property damage; (2) reducing agricultural production loss by stabilizing land mass movement and surface erosion; and (3) reducing farm infrastructure damage to farm roads, fences, water supplies and buildings. Non-measurable benefits of soil conservation were mostly off-site benefits, such as: (1) aesthetics; (2) improved water quality for swimming and boating; (3) improved water quality for stock and humans; (4) improved habitat for aquatic animals and plants; (5) increased biodiversity from land returned to native vegetation; and (6) market access – probable market pressure to demonstrate sustainable farming.

Likewise, the study conducted by Ohio State University (1999) estimated the

social and private benefits of filter strips. The social benefits under this study were environmental, where the public downstream obtains benefits through reduced sediment flows, improved stream water quality, additional fish and wildlife habitat, and better scenery along streams. Using estimates from Forster, Bardos, and Southgate (1987) of \$0.32 per ton for treatment of sediment in water supplies (a 10% reduction in annual gross soil erosion could lower annual water treatment costs by 4%), this study estimated that a 25% reduction in the amount of sediment entering surface water supplies could save \$3.2 million per year in water treatment costs. In addition, there are potential economic benefits due to reduction in ditch maintenance and cleaning costs. The estimated cost of ditch maintenance in western Ohio counties averages \$450 per mile per year. Based on an estimate by Forster and Abraham (1985), each 10% reduction in soil erosion could reduce these costs by 11%.

The private benefits calculated under this study dealt with harvesting and marketing the vegetation grown on buffer (filter) strips. Two examples of revenue producing filter strips estimated were hay and timber. For hay, the average price for alfalfa in Ohio in 1996 was \$134.58 per ton, and for other hay it was \$75.42 per ton (Ohio Department of Agriculture Annual Report 1996). Using a conservative price of \$75 per ton, annual returns were calculated at \$225 for years 1 and 2, \$375 in years 3 and 4, and \$338 in year 5. Harvesting costs of \$35 per ton must also be taken into account. Note, however, that some logistical problems caused by baling small areas, or safety problems associate with baling a long, narrow filter strip along a stream or ditch bank, may cause relatively high costs for baling.

Although timber production brings revenue, tree planting requires the landowner

to have a longer time horizon than the other options because the benefits occur 60 to 80 years in the future. Further, total revenue will vary depending on site quality, and on the effort placed on timber management. Under a low managed timber option planted with oaks, the stands estimated worth is approximately \$6,080 after 80 years of growth. Under the high managed timber option planted in walnut, the stands estimated worth is approximately \$20,323 after 80 years of growth and management.

The costs of installing and maintaining filter strips on pasture and cropland include: (1) land rental costs, (2) seed and fertilizer costs, and (3) equipment and labor costs. Some costs, such as seed and fertilizer, will occur only when the filter strip is installed, while others, such as land rental, equipment, and labor, may occur throughout the life of the filter strip to maintain it. These costs will vary from place to place, depending on soil fertility, planting and management systems, and the intended use of the vegetative material in the filter strip.

The previous studies have looked solely at the economic benefits related to buffer strip establishment while Campbell and Vere (1983) investigated the economics of improved pasture establishment. Improved pasture establishment has long been recognized as being the most economic means of permanently improving livestock production and farm incomes. Over 40 years ago, Gruen (1959) concluded that the long run return to on farm investment in pasture improvement was considerably greater than that of any method of raising farm income – including the purchase of additional land. Because these conclusions remain valid, it is worth restating the two components of Gruen's underlying economic question: (i) how profitable is such investment likely to be?; and (ii) what is the best pasture establishment program that can be adapted to the

producer's own resources and circumstances?

The profitability of pasture improvement is the difference between the long run costs and returns from the investment. The costs are those of establishment and maintenance (including seed, fertilizer, herbicide, fuels, machinery, and extra stock), capital costs (including fences, water and buildings) and interest on borrowed funds. The returns are the increased value of livestock production and the capitalized value of the land and improvements. Although it usually takes several years before new pastures mature to full stocking potential, existing pastures will reap benefits much sooner to the producer and public alike. A study many years ago rings all too true today, Pearse (1963) noted that producers requiring a quick return to alleviate cost-price pressures find no comfort the fact that pasture establishment could take three to eight years before returns from pasture establishment exceed the costs. Thus the decision to invest in pasture improvement/establishment must give due consideration to the associated risks and the producer's attitudes towards them.

Campbell and Vere (1983) demonstrated that pasture improvement/establishment programs are costly but become self-financing in relatively short periods. Their study showed that the program pays for itself in five years with the present day value of the projected net returns (discounted at 18%) estimated to be \$25,116 or approximately \$25 per hectare. A study by Cuomo (2001) estimated that a modest increase of \$50 per acre in net returns from currently under-managed pastureland could be attainable. This project focused on extending current 150-day grazing season to 210 days, ensuring a season-long forage supply, and developing pasture and grazing management strategies that will maintain desirable forage species.

Conclusions

Water quality is a critical issue facing all livestock producers. When proposing best management practices, it is important to evaluate the entire operation. There is no one system that will be 'best' for all producers. Every situation is different and has its own circumstances. Regardless of the BMP(s) adopted, understanding of livestock behavior could help in developing a conservation program that reduces manure impacts on water quality while helping farm operations to remain profitable. Because technical and economic recommendations for buffer strips and improved pasture are based on a number of assumptions and qualifications, they may not be appropriate in each individual situation. Previous studies have shown that given careful planning and management on-farm investment in buffer strips and improved pasture to be most profitable.

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<u>Soil conservation work</u>	<u>Benefits</u>	<u>Measurement</u>
Fenced riparian strips (no planting)	Reduced faecal coliforms	By up to 50 percent
	Reduced sediment to waterways	More than 40 percent
	Reduced dissolved phosphorus	More than 25 percent
	Reduced particulate nitrogen	More than 30 percent
Riparian tree planting	Reduced bank erosion	From 24 - 39 percent to 5 - 8 percent in big storms
Pole planting on slopes	Reduced hill country type erosion	From 10 to 2 - 5 percent in big storms, from 1 to 0.2 - 0.5 percent in small storms
	Reduced farm infrastructure damage	\$7 - \$48/ha.
Block tree planting	Reduced hill country type erosion	From 1 percent to 0.1 percent in small storms and from 10 percent to 1-2 percent in big storms
	Reduced sediment to waterways	By 50 to 90 percent when the whole catchment is planted. Planting only the headwaters can reduce sediment by 30 to 50 percent
	Reduced production loss in big storms	2 percent loss in plantation forest compared with 10 percent for pasture in erosion prone headwaters
Land retirement on slopes	Reduced hill country type erosion	From 1 to 0.1 percent in small storms From 10 to 1-2 percent in big storms
	Reduced sediment in waterways	By more than 90 percent when the whole catchment is retired
Engineering measures	Land stabilised after 10 to 20 years	Pasture levels returned to 100 percent Stock carrying capacity increased from 1 - 2 to 5 - 7 stock units per hectare