A Farm-level Economic Analysis of Tile Terraces and Contour Grass Strips in Missouri

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Farm-level Economic Analysis of Tile Terraces and Grass Buffer Strips in Missouri

The landscape of Missouri is as varied as its agriculture. The Missouri River runs from Northwest Missouri, south to Kansas City and across the central portion of the state, to St. Louis where it meets up with the Mississippi River. The topography of much of the state includes flat land along rivers and streams as well as hill ground. While the flat bottomland includes much of the row cropping land, the hill ground in much of the state is cropped as well.

Throughout the years, this hill ground has been prone to erosion. How Missouri farmers have combated this erosion is at the heart of this analysis. Much of the states hill crop ground has been put into tile terrace systems. However, another option is to use contour grass strips to control the erosion. The objective of this study is to compare the economic benefits of tile terraces and contour grass strips.

Background Information

Tile Terraces

Tile terrace systems are a combination of earth embankments and tile drain pipe laid out based on the contours of a field.

A terrace is an earth embankment, channel, or a combination ridge and channel, constructed across a slope. Terraces are designed to conserve rainfall and help with erosion control on sloping cropland. Terraces can be designed and constructed in many different types and configurations such as broad based, steep-back, grass-back, ridge, gradient, level, tile outlet and others. The type of terrace chosen should fit the type of management and machinery used on the farm. Typically, terraces are placed 90 to 120 feet apart in the field to match common equipment widths.

The tile part of this system consists of tile drains on the uphill side of the terraces. These drains feed into a system of underground pipe that discharges excess water from the field to a grass waterway at the bottom of the field. Typical tile sizes used are four, six and eight inches in diameter. The tile drain pipe

grows larger as you move down the slope of the field to accommodate the increase in water flow in the pipe. The tile usually runs 30 to 36 inches deep.

The Missouri Department of Natural Resources (DNR), with money from the State Parks and Soils Tax, administer cost-share money for the establishment of tile terrace systems. This program will cover 75 percent of the cost to build tile terraces. Since each soil and water conservation district is allocated a fixed amount of money for this program, local boards may set limits on the cost-share amounts a farm can receive in a single year.

Contour Grass Strips

Contour grass strips are alternate strips of grass down the slope with wider cultivated strips that are farmed on the contour. The grass strips are more narrow (15-30 feet wide) than the cultivated strips (90–120 feet wide). The grass strips are designed to reduce sheet and rill erosion, and trap sediment. Sediment, nutrients, pesticides and other contaminants are removed from the runoff as they pass through the grass strips. The grass strips can also provide food and nesting cover for wildlife. Contour grass strips are best on uniform slopes ranging from four to eight percent.

Land placed into grass strips are part of the federally administered conservation reserve program (CRP) Grass Contour Strips (CP15A) conservation practice. CP15A is part of the Continuous CRP program. This is a non-competitive program where participants can sign up at any time and know their payment rate in advance. The land enrolled in the program becomes unavailable for agricultural production for the ten year length of the contract.

In return for establishing the grass strips, two forms of payments are available to CP15A participants. First, cost-share assistance totaling 90 percent of the establishment of the grass strips is available. This 90 percent consists of the normal 50 percent cost-share and an additional practice incentive payment (PIP) of 40 percent. The second payment, received each year for the life of the contract, consists of two parts:

- an annual rental payment based on the relative productivity of the soil and the average dryland cash rental rate, and
- a maintenance incentive payment (MIP) of $4.00 per acre to cover maintenance obligations.

Certain restrictions apply to this program and other continuous sign-up enrollments. Among them are the requirements that: (1) a producer must have owned or operated the land for at least 12 months prior to submitting the offer to enroll, and (2) the cropland must have been planted to an agricultural commodity at least four of the years from 1996 to 2001.

The program is administered by the United States Department of Agriculture (USDA) Farm Service Agency (FSA). The program has had relatively limited participation in Missouri. As of May 2007, there were 2,258 acres enrolled in CP15 in Missouri and a total of 84,647 acres enrolled in all states combined. Two states, Washington and Iowa, have 82 percent of the enrolled acres with Missouri ranking fourth.

Methods and Procedures

To analyze the farm-level decision, we turned to the Food and Agricultural Policy Research Institute (FAPRI) system of representative farms to estimate the expected stream of revenues for a farm enrolled in CP-33. This approach is well established and offers the advantage of using "real-world" parameters in a stochastic simulation model that incorporates projections of future product prices and input costs. This is particularly important in view of recent and expected developments in agricultural commodity markets. In this report, the farm-level results of enrolling in CP-33 are compared to a baseline projection without a CP-33 practice. We assume that current government policy is extended indefinitely. For more information on the representative farm baseline modeling process and the most recent baseline projections, visit the FAPRI-MU website. The report is *FAPRI-UMC Report #04-07, Baseline Outlook for the Missouri Representative Farms.*

Tile terraces and contour grass strips were imposed separately on three representative farms. The baseline farm used was built specifically to look at the farm level impacts of participation in the continuous CRP CP33 program, *FAPRI-MU Report #23-07, A Farm-level Economic Analysis of Wildlife Habitat Buffers in Missouri*. This panel and facilitator were instrumental in gathering the information needed for this report as well. The three resulting variations of the farm are detailed below. We then broadened the analysis by applying the same procedures to two existing representative farms.

In this study, we did not look at the effectiveness of tile terraces and grass contour strips in controlling erosion. In some fields, due to soil type, slope, etc., tile terraces may be more effective then grass contour strips in controlling soil erosion. Also, we looked at the establishment of warm season grasses in the grass contour strips. While this is not an absolute requirement of the practice, it is recommended by the field staff so the grass strips have the added benefit of enhancing wildlife habitat.

Another consideration when making the decision between tile terraces and grass contour strips is the time/hassle consideration. Is it more time consuming to farm a field that has grass contour strips versus tile terraces? Is it more of a hassle in working the ground when you have grass contour strips versus tile terraces? While those issues were not addressed, during the research there is an understanding that those are some of the issues individual producers must address when making these decisions.

One additional point to consider when implementing contour grass strips is the possibility of damage when spraying herbicide on the remaining crop acres. Herbicide drift and the potential damage to the grass strips adds another level of complexity to the management decisions facing today's producers.

Benchmark Farm

To develop data for the farm, we set up a structured discussion with a group of producers. With the valuable assistance of Missouri Department of Conservation (MDC) staff, five cooperative farmers in Carroll County were identified to serve on a discussion panel. At the first session, held in late March 2007, producers had an orderly discussion of their current farming operations that, by consensus, resulted in a baseline representative farm which included the major elements of the individual farms. The data for this representative farm was entered into the simulation model and preliminary results were presented to the panel at this session.

In brief, the baseline representative farm can be described as 700 arable acres—440 acres owned and 260 leased on 50-50 share with landlords. The majority of the land is above the flood plain on rolling fields. Over time, 200 acres have been enrolled in various CRP's with a weighted average annual rental payment of $70 per acre. Corn and soybeans are raised on 220 acres each year and 60 acres are planted to wheat double-crop soybeans.

Whole farm, average yields for the baseline farm are: 145 bushels for corn, 43 bushels for full season soybeans, 58 bushels for wheat and 20 bushels for double-cropped soybeans. These average yields are based on the most recent five years. A ten year history of yields was obtained from crop insurance records of the panel members. These localized yields are the basis of the distribution to estimate variability.

The baseline farm described above was modified to include tile terraces on one 40 acre field. In Carroll County, the maximum amount of cost-share dollars on which a producer can receive payment for terrace systems is approximately $10,000 per year. With the cost of tile terrace systems at $500/acre, we installed the tile terrace system on 20 acres per year in the first two years (2006 & 2007) of the ten year simulation. The farm incurred a cost of $10,000 in each of those two years and received cost share payments of $7,500 per year.

The baseline farm described above was also modified to include contour grass strips on one 40 acre field. With input from NRCS staff in the Carroll County office, the 40 acre field was laid out with grass contour strips as follows:

- 60 foot grass strip at the bottom of the field
- 30 foot grass strips every 90 feet

This resulting field now has 11 acres planted to grass contour strips and 29 acres of tillable crop ground. This land is enrolled in the CP15A program for 10 years.

The cost to establish the grass contour strips with a four-way mix of warm season grass (big bluestem, little bluestem, switchgrass and side-oats grama) is summarized in Table 1. The cost per acre for establishment was $130.75 resulting in a total cost of $1,438.25. A total of 90 percent cost share resulted in a payment of $1,294.43.

Table 1. Establishment costs per acre.

Seed	
4-way mix	$65.00
Fertilizer	
N, P, K & Lime	$41.25
Equipment Rental	
Culti-packer	$5.00
Air Seeder	$6.50
Fertilizer Buggy	$4.00
Fuel	$9.00
Total	$130.75

The annual payment including soil rental rate and MIP totals $90.07 per acre. This results in a payment of $990.77 annually.

Other Farms

Tile terrace and grass contour strip acreage were imposed on the additional representative farms in the same ratio as the benchmark farm. Establishment costs and cost-share assistance per acre were assumed to be identical to the baseline farm. Soil rental rates were estimated based on county average information and farm crop yields. Descriptions of the additional representative farms follow.

The Ralls County panel farm in northeast Missouri was first established in 1997. The farm consists of 1460 acres planted to row crops and a cow-calf operation of 80 cows running on 400 acres. Unlike the Carroll County farm, this one does not have any "risk-free" income from acres enrolled in the general CRP sign-up. Land tenure is partitioned with 49 percent of the acres owned, 36 percent cash leased and 15 percent share leased on 50-50 basis. A total of 80 acres are established with tile terrace and grass contour strips.

The Bates County farm in west-central Missouri has some similarity to the Ralls County farm in that it farms 1400 acres of row crops. The beef cattle enterprise plays a larger role in future income and soybeans are a more prominent enterprise. Calves are raised from 150 cows on 440 forage acres. Soybeans are double-cropped on 340 acres. Average crop yields and the soil rental rate is less than the Ralls County farm. Yield risk is also greater for the Bates farm. In terms of land tenure, 43 percent of the acres are owned, 34 percent are cash leased, and 23 percent are share leased, 40-60 for corn and 33-67 for other crops. The scenarios examine an establishment of 80 acres in tile terrace and grass contour strips.

We looked at multiple farms to add robustness to the analysis. However, it is important to note that although we use the county designation to identify the uniqueness of a representative farm this does not infer any general conclusions about profitability.

Simulation Methods

The three farms are simulated for three scenarios: Baseline, Tile Terrace and Contour Grass Strip with the Farm Level Income and Policy Simulation Model (FLIPSIM) for a total of ten years. The first year, 2006, is historical and, thus, no risk is applied to yields and prices. In the projected years, 2007 through 2015, yields and prices are allowed to vary, as they have historically, due to

weather conditions. For the one field in the Tile Terrace and Grass Contour Strip scenarios, we simulated a crop rotation plan identical to the average for the whole-farm, i.e. soybeans in 2006 followed by corn, corn followed by wheat double-cropped soybeans, and then back to soybeans. This rotation may not be what is actually practiced by the panel, but the approach minimizes the effects of confounding the financial results simply due to a particular crop selection preference.

Simulation Results

The core of this analysis is presented in tables for selected output variables comparing the baseline to the two scenarios for each of the three farms. Tables 2, 3 and 4 compare the baseline to the tile terrace. Tables 5, 6 and 7 compare the baseline to the contour buffer strips. Tables 8, 9 and 10 compare the tile terraces to the contour buffer strips. The baseline and scenario absolute numbers are the means of 500 iterations. These numbers are largely self-explanatory, but the following discussion pertaining to the Carroll County farm is provided to aid interpretation.

Baseline vs. Tile Terraces

Over the next ten years, government payments from all direct sources such as general CRP, direct payments, countercyclical payments (CCP) and marketing loan benefits, average $8570 for the baseline farm (Table 2). With the installation of tile terraces, government payments increase in the first two years (2006 & 2007). These additional government payments, $7,500 per year for the first two years, are the cost share money received for installing the tile terraces. Since no acres are taken out of production, market receipts are identical under baseline and the tile terrace scenario.

Annual cash operating expenses increase by an average of $2,280 per year. This is primarily front loaded when the farm pays for the instillation of the tile terraces in the first two years. The net effect of the installation of the tile terraces is lower net cash farm income in each year of the simulation.

From the farmer's perspective, the felt change appears in returns to family living. This is a residual value that quantifies the cash available for operator withdrawal after paying all cash expenses, including taxes, debt service and cash outlay, for capital replacement. This single variable is perhaps the best indicator of the economic incentive for the farmer. By this metric, the farm family has less

cash in each year of the scenario, resulting in $8,420 less over ten years. On an annual per acre basis, the farm family has less cash by an average -$1.68 per acre.

The risk of a cash flow deficit is moderately high to severe for the baseline farm. Under the scenario, the probability of generating insufficient cash to meet all farm business and family living obligations declines, but only slightly.

One issue we did not address is how much gully repair is required in the baseline farm. Assuming no tile terraces or grass contour strips on the baseline farm means some repair work will be needed to repair gully's created by runoff. The cash cost of field repair may exceed the $1.68 per acre impact of installing terraces.

The Ralls County farm return to family living declines by $3,590 over the ten year simulation (Table 3). The Bates County farm has a slight increase in returns to family living of $1,110 over the ten year period (Table 4). This farm has lower taxable income that results in lower taxes resulting in higher returns to the family.

Baseline vs. Contour Grass Strips

Table 5 compares the same output variables from the baseline and contour grass strips scenario. Government payments are higher in each year of the scenario and average $1,110 higher per year under the contour grass strips scenario. However, the higher government payments are not enough to offset the decrease in market receipts (-$3,480 per year) due to the loss of 11 acres of tillable crop ground. Thus, total receipts decline by an average of -$2,370 over the ten year period.

Under the scenario, cash operating cost average -$790 a year less than the baseline due to fewer acres of farm ground that is now in grass contour strips. However, the loss in income is greater than the decrease in costs and thus net cash farm income is lower in each year under the scenario.

Returns to family living, the amount left over for the operator's management and labor, averages -$2.78 per acre under the scenario.

For the other two farms (Tables 6 & 7), returns to family living per care follow the same trend as the Carroll County farm, lower then under the baseline.

The Ralls County farm's return to family living per acre is -$1.07 when compared to the baseline and the Bates County farm's is $-0.91/acre less then the baseline.

Tile Terraces vs. Contour Grass Strips

Table 8 summarizes the economic costs and returns when comparing the two scenarios of tile terraces and contour grass strips. By taking 11 acres out of crop production, the contour grass strip scenario has lower total receipts (-$3,870 per year on average) and lower cash operating costs (-$3,070 per year on average). While the two numbers are almost a wash, the lost income is slightly higher than the decrease in cost and thus results in lower net cash farm income (-$810 per year on average) under the grass contour strip scenario.

The resulting effect on returns to family living is also negative when comparing the grass contour strip scenario to the tile terrace scenario by -$1.09 per acre on average.

Once again, the other two farms follow a similar pattern (Tables 9 & 10). The Ralls County farm's return to family living is -$0.88 per acre under the grass contour strip scenario when compared to the tile terrace scenario. The Bates County farm's return to family living is -$0.97 per acre.

Table 2. Financial implications of installing tile terraces on 40 acres of the Carroll County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Baseline	11.9	7.8	7.9	7.9	8.1	8.1	8.2	8.4	8.6	8.7	8.57	85.74
Tile Terraces	19.4	15.3	7.9	7.9	8.1	8.1	8.2	8.4	8.6	8.7	10.07	100.74
Absolute change	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.50	15.00
Percentage change, %	63.0	95.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	17.5	
Market receipts, ($1,000)												
Baseline	163.6	171.6	176.8	178.4	179.2	180.1	180.2	181.5	182.3	180.8	177.45	1,774.48
Tile Terraces	163.6	171.6	176.8	178.4	179.2	180.1	180.2	181.5	182.3	180.8	177.45	1,774.48
Absolute change	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Percentage change, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total receipts, ($1,000)												
Baseline	175.5	179.4	184.7	186.4	187.3	188.3	188.4	189.9	190.9	189.5	186.02	1,860.22
Tile Terraces	183.0	186.9	184.7	186.4	187.3	188.3	188.4	189.9	190.9	189.5	187.52	1,875.22
Absolute change	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.50	15.00
Percentage change, %	4.3	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	
Cash operating costs ($1,000)												
Baseline	96.7	98.4	98.7	96.6	96.8	97.2	96.8	105.7	105.9	106.3	99.92	999.18
Tile Terraces	107.3	109.1	98.9	96.8	97.0	97.4	97.0	105.9	106.1	106.6	102.19	1,021.94
Absolute change	10.6	10.7	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.28	22.76
Percentage change, %	10.9	10.9	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.3	
Net cash farm income ($1,000)												
Baseline	78.8	81.0	86.0	89.8	90.5	91.0	91.6	84.2	85.1	83.1	86.11	861.05
Tile Terraces	75.7	77.8	85.8	89.6	90.3	90.9	91.4	84.1	84.9	82.9	85.33	853.30
Absolute change	-3.1	-3.2	-0.2	-0.2	-0.2	-0.1	-0.2	-0.2	-0.2	-0.2	-0.78	-7.75
Percentage change, %	-3.9	-3.9	-0.3	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.3	-0.9	
Returns to family living ($1,000)												
Baseline	54.7	47.4	45.3	52.6	47.6	38.6	39.3	21.6	15.4	5.5	36.78	367.83
Tile Terraces	52.7	46.0	45.2	52.1	47.1	38.2	38.8	21.0	14.3	4.1	35.94	359.41
Absolute change	-2.0	-1.4	0.0	-0.5	-0.4	-0.5	-0.5	-0.6	-1.0	-1.5	-0.84	-8.42
Percentage change, %	-3.6	-3.0	0.0	-1.0	-0.9	-1.2	-1.3	-2.7	-6.7	-26.5	-2.3	
Ending cash reserves ($1,000)												
Baseline	18.5	29.1	37.9	55.2	66.4	68.4	71.4	57.4	42.2	24.6	47.11	
Tile Terraces	16.5	25.7	35.0	52.6	63.8	65.6	68.5	54.3	39.0	21.2	44.22	
Absolute change	-2.0	-3.4	-2.9	-2.6	-2.6	-2.8	-2.9	-3.1	-3.2	-3.5	-2.90	
Percentage change, %	-10.7	-11.8	-7.6	-4.7	-4.0	-4.0	-4.1	-5.3	-7.7	-14.0	-6.2	
Probability of a cash deficit (%)												
Baseline	na	34.2	36.6	26.6	38.4	54.8	51.6	75.6	81.2	80.4	53.27	
Tile Terraces	na	37.4	36.8	27.2	38.8	54.8	52.8	75.6	81.6	81.2	54.02	
Absolute change	na	3.2	0.2	0.6	0.4	0.0	1.2	0.0	0.4	0.8	0.76	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Baseline	109.38	94.72	90.50	105.20	95.10	77.22	78.64	43.18	30.70	11.02	73.57	
Tile Terraces	105.42	91.90	90.46	104.12	94.26	76.32	77.60	42.00	28.64	8.10	71.88	
Absolute change	-3.96	-2.8	0.0	-1.1	-0.8	-0.9	-1.0	-1.2	-2.1	-2.9	-1.68	

Table 3. Financial implications of installing tile terraces on 80 acres of the Ralls County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Baseline	34.5	23.3	23.7	23.6	24.1	24.3	24.7	25.4	25.9	26.3	25.59	255.90
Tile Terraces	42.0	30.8	31.2	31.1	24.1	24.3	24.7	25.4	25.9	26.3	28.59	285.90
Absolute change	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	3.00	30.00
Percentage change, %	21.7	32.2	31.6	31.8	0.0	0.0	0.0	0.0	0.0	0.0	11.7	
Market receipts, ($1,000)												
Baseline	479.3	505.0	521.8	521.7	520.5	525.0	525.6	526.4	531.6	529.0	518.58	5,185.75
Tile Terraces	479.3	505.0	521.8	521.7	520.5	525.0	525.6	526.4	531.6	529.0	518.58	5,185.75
Absolute change	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Percentage change, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total receipts, ($1,000)												
Baseline	513.8	528.3	545.5	545.4	544.6	549.3	550.3	551.8	557.5	555.3	544.17	5,441.65
Tile Terraces	521.3	535.8	553.0	552.9	544.6	549.3	550.3	551.8	557.5	555.3	547.17	5,471.65
Absolute change	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	3.00	30.00
Percentage change, %	1.5	1.4	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.6	
Cash operating costs ($1,000)												
Baseline	364.8	374.9	379.9	380.4	385.5	379.6	383.3	381.1	376.9	376.1	378.26	3,782.55
Tile Terraces	375.4	385.5	390.5	391.0	385.6	379.6	383.3	381.1	376.9	376.1	382.50	3,825.00
Absolute change	10.6	10.5	10.6	10.7	0.1	0.0	0.0	0.0	0.0	0.0	4.25	42.45
Percentage change, %	2.9	2.8	2.8	2.8	0.0	0.0	0.0	0.0	0.0	0.0	1.1	
Net cash farm income ($1,000)												
Baseline	149.0	153.4	165.6	165.0	159.1	169.7	167.0	170.6	180.6	179.2	165.91	1,659.10
Tile Terraces	145.9	150.4	162.5	161.8	159.0	169.6	167.0	170.6	180.6	179.2	164.66	1,646.62
Absolute change	-3.1	-3.0	-3.1	-3.2	-0.1	0.0	0.0	0.0	0.0	0.0	-1.25	-12.48
Percentage change, %	-2.1	-2.0	-1.9	-1.9	-0.1	0.0	0.0	0.0	0.0	0.0	-0.8	
Returns to family living ($1,000)												
Baseline	95.3	74.9	69.2	64.3	35.7	32.6	15.4	25.6	27.0	36.1	47.59	475.91
Tile Terraces	95.7	74.2	68.5	63.5	35.5	32.3	15.0	25.2	26.6	35.8	47.23	472.32
Absolute change	0.5	-0.7	-0.7	-0.8	-0.1	-0.4	-0.4	-0.3	-0.4	-0.3	-0.36	-3.59
Percentage change, %	0.5	-0.9	-1.1	-1.2	-0.4	-1.2	-2.5	-1.3	-1.4	-0.8	-0.8	
Ending cash reserves ($1,000)												
Baseline	62.2	104.0	144.1	183.1	195.2	208.8	207.4	221.6	245.7	286.4	185.85	
Tile Terraces	62.7	103.8	143.6	182.4	195.4	209.5	208.4	222.7	246.9	287.7	186.31	
Absolute change	0.5	-0.2	-0.6	-0.6	0.2	0.7	1.0	1.1	1.2	1.3	0.46	
Percentage change, %	0.7	-0.2	-0.4	-0.3	0.1	0.4	0.5	0.5	0.5	0.4	0.2	
Probability of a cash deficit (%)												
Baseline	na	28.8	32.8	34.6	45.6	49.6	54.4	48.8	45.2	40.4	42.24	
Tile Terraces	na	29.8	33.6	35.2	44.8	49.4	54.4	48.8	44.8	40.6	42.38	
Absolute change	na	1.0	0.8	0.6	-0.8	-0.2	0.0	0.0	-0.4	0.2	0.13	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Baseline	51.21	40.24	37.19	34.56	19.18	17.55	8.26	13.74	14.51	19.41	25.59	
Tile Terraces	51.45	39.88	36.80	34.16	19.10	17.34	8.06	13.56	14.31	19.26	25.39	
Absolute change	0.24	-0.4	-0.4	-0.4	-0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.19	

Table 4. Financial implications of installing tile terraces on 80 acres of the Bates County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Baseline	33.8	24.4	24.8	24.7	25.2	25.5	25.7	26.3	26.8	26.9	26.40	263.97
Tile Terraces	41.3	31.9	32.3	32.2	25.2	25.5	25.7	26.3	26.8	26.9	29.40	293.97
Absolute change	7.5	7.5	7.5	7.5	0.0	0.0	0.0	0.0	0.0	0.0	3.00	30.00
Percentage change, %	22.2	30.7	30.3	30.4	0.0	0.0	0.0	0.0	0.0	0.0	11.4	
Market receipts, ($1,000)												
Baseline	525.6	524.6	534.5	534.6	534.3	536.7	541.7	547.0	549.7	553.0	538.17	5,381.74
Tile Terraces	517.6	510.6	519.8	523.4	527.4	529.3	537.9	540.0	542.1	549.3	529.76	5,297.57
Absolute change	-8.0	-14.0	-14.6	-11.3	-6.9	-7.3	-3.8	-7.0	-7.6	-3.7	-8.42	-84.17
Percentage change, %	-1.5	-2.7	-2.7	-2.1	-1.3	-1.4	-0.7	-1.3	-1.4	-0.7	-1.6	
Total receipts, ($1,000)												
Baseline	559.4	549.1	559.2	559.3	559.5	562.1	567.4	573.3	576.5	580.0	564.57	5,645.71
Tile Terraces	558.9	542.6	552.1	555.5	552.6	554.8	563.6	566.3	568.9	576.2	559.15	5,591.54
Absolute change	-0.5	-6.5	-7.1	-3.8	-6.9	-7.3	-3.8	-7.0	-7.6	-3.7	-5.42	-54.17
Percentage change, %	-0.1	-1.2	-1.3	-0.7	-1.2	-1.3	-0.7	-1.2	-1.3	-0.6	-1.0	
Cash operating costs ($1,000)												
Baseline	366.1	374.4	376.3	375.5	375.2	374.7	384.6	390.3	394.6	397.8	380.95	3,809.45
Tile Terraces	376.5	384.7	386.7	385.9	375.2	374.7	384.6	390.3	394.6	397.8	385.10	3,850.95
Absolute change	10.4	10.4	10.4	10.4	0.0	0.0	0.0	0.0	0.0	0.0	4.15	41.50
Percentage change, %	2.8	2.8	2.8	2.8	0.0	0.0	0.0	0.0	0.0	0.0	1.1	
Net cash farm income ($1,000)												
Baseline	193.3	174.7	183.0	183.8	184.3	187.4	182.8	183.0	181.9	182.2	183.63	1,836.26
Tile Terraces	190.4	171.8	180.1	180.9	184.3	187.4	182.8	183.0	181.9	182.2	182.47	1,824.73
Absolute change	-2.9	-2.9	-2.9	-2.9	0.0	0.0	0.0	0.0	0.0	0.0	-1.15	-11.53
Percentage change, %	-1.5	-1.6	-1.6	-1.6	0.0	0.0	0.0	0.0	0.0	0.0	-0.6	
Returns to family living ($1,000)												
Baseline	124.6	92.9	88.6	113.4	104.0	88.9	29.5	51.5	22.0	44.0	75.94	759.43
Tile Terraces	124.9	92.7	88.7	113.7	104.5	89.1	29.6	51.5	21.9	43.9	76.05	760.54
Absolute change	0.3	-0.2	0.1	0.3	0.5	0.1	0.1	0.0	0.0	0.0	0.11	1.11
Percentage change, %	0.3	-0.2	0.2	0.2	0.5	0.1	0.3	-0.1	-0.2	0.0	0.1	
Ending cash reserves ($1,000)												
Baseline	91.6	151.7	207.5	288.4	360.4	417.9	416.5	436.5	426.8	439.0	323.64	
Tile Terraces	91.9	151.9	207.8	289.0	361.4	419.1	417.9	437.9	428.3	440.5	324.56	
Absolute change	0.3	0.1	0.3	0.5	1.1	1.2	1.4	1.4	1.4	1.5	0.92	
Percentage change, %	0.3	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Probability of a cash deficit (%)												
Baseline	na	14.4	14.8	9.6	13.4	19.0	58.0	41.6	63.4	45.6	31.09	
Tile Terraces	na	15.2	15.4	11.0	13.4	19.0	57.8	41.8	63.2	45.6	31.38	
Absolute change	na	0.8	0.6	1.4	0.0	0.0	-0.2	0.2	-0.2	0.0	0.29	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Baseline	67.72	50.51	48.14	61.64	56.53	48.34	16.04	28.00	11.93	23.89	41.27	
Tile Terraces	67.89	50.39	48.22	61.78	56.80	48.40	16.08	27.98	11.91	23.88	41.33	
Absolute change	0.17	-0.1	0.1	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.06	

Table 5. Financial implications of installing contour grass strips on 40 acres of the Carroll County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Baseline	11.9	7.8	7.9	7.9	8.1	8.1	8.2	8.4	8.6	8.7	8.57	85.74
Contour grass strips	14.2	8.8	8.9	8.9	9.0	9.1	9.2	9.4	9.6	9.7	9.68	96.76
Absolute change	2.3	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.10	11.02
Percentage change, %	19.0	12.5	12.2	12.4	12.2	12.0	11.7	11.6	11.3	11.0	12.9	
Market receipts, ($1,000)												
Baseline	163.6	171.6	176.8	178.4	179.2	180.1	180.2	181.5	182.3	180.8	177.45	1,774.48
Contour grass strips	161.3	167.5	173.2	175.6	174.9	176.4	177.4	177.2	178.5	178.0	173.97	1,739.73
Absolute change	-2.3	-4.1	-3.6	-2.8	-4.3	-3.8	-2.8	-4.3	-3.8	-2.8	-3.48	-34.75
Percentage change, %	-1.4	-2.4	-2.0	-1.6	-2.4	-2.1	-1.6	-2.4	-2.1	-1.6	-2.0	
Total receipts, ($1,000)												
Baseline	175.5	179.4	184.7	186.4	187.3	188.3	188.4	189.9	190.9	189.5	186.02	1,860.22
Contour grass strips	175.4	176.3	182.1	184.5	184.0	185.5	186.6	186.6	188.1	187.6	183.65	1,836.49
Absolute change	-0.1	-3.1	-2.7	-1.9	-3.3	-2.8	-1.9	-3.4	-2.9	-1.8	-2.37	-23.73
Percentage change, %	0.0	-1.7	-1.4	-1.0	-1.8	-1.5	-1.0	-1.8	-1.5	-1.0	-1.3	
Cash operating costs ($1,000)												
Baseline	96.7	98.4	98.7	96.6	96.8	97.2	96.8	105.7	105.9	106.3	99.92	999.18
Contour grass strips	97.6	97.0	97.5	96.0	95.5	96.1	96.3	104.5	104.9	106.0	99.13	991.26
Absolute change	0.8	-1.4	-1.2	-0.6	-1.3	-1.1	-0.5	-1.3	-1.0	-0.3	-0.79	-7.92
Percentage change, %	0.8	-1.4	-1.2	-0.6	-1.4	-1.1	-0.5	-1.2	-0.9	-0.3	-0.8	
Net cash farm income ($1,000)												
Baseline	78.8	81.0	86.0	89.8	90.5	91.0	91.6	84.2	85.1	83.1	86.11	861.05
Contour grass strips	77.9	79.3	84.6	88.5	88.5	89.4	90.3	82.1	83.2	81.6	84.52	845.21
Absolute change	-0.9	-1.7	-1.5	-1.3	-2.0	-1.7	-1.3	-2.1	-1.9	-1.5	-1.58	-15.84
Percentage change, %	-1.1	-2.1	-1.7	-1.4	-2.2	-1.8	-1.5	-2.5	-2.2	-1.8	-1.8	
Returns to family living ($1,000)												
Baseline	54.7	47.4	45.3	52.6	47.6	38.6	39.3	21.6	15.4	5.5	36.78	367.83
Contour grass strips	54.3	46.2	44.3	51.8	46.3	37.5	38.4	19.9	13.0	2.3	35.39	353.94
Absolute change	-0.4	-1.2	-0.9	-0.8	-1.3	-1.1	-1.0	-1.7	-2.3	-3.2	-1.39	-13.89
Percentage change, %	-0.8	-2.6	-2.1	-1.6	-2.6	-2.8	-2.5	-7.6	-15.2	-58.4	-3.8	
Ending cash reserves ($1,000)												
Baseline	18.5	29.1	37.9	55.2	66.4	68.4	71.4	57.4	42.2	24.6	47.11	
Contour grass strips	18.1	27.5	35.4	52.2	62.3	63.4	65.8	50.6	34.3	15.7	42.52	
Absolute change	-0.4	-1.6	-2.5	-3.0	-4.1	-5.0	-5.6	-6.8	-7.9	-9.0	-4.60	
Percentage change, %	-2.3	-5.6	-6.6	-5.5	-6.2	-7.3	-7.8	-11.9	-18.8	-36.3	-9.8	
Probability of a cash deficit (%)												
Baseline	na	34.2	36.6	26.6	38.4	54.8	51.6	75.6	81.2	80.4	53.27	
Contour grass strips	na	35.6	37.4	27.8	39.4	55.8	53.2	77.4	82.0	82.6	54.58	
Absolute change	na	1.4	0.8	1.2	1.0	1.0	1.6	1.8	0.8	2.2	1.31	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Baseline	109.38	94.72	90.50	105.20	95.10	77.22	78.64	43.18	30.70	11.02	73.57	
Contour grass strips	108.54	92.30	88.64	103.54	92.60	75.06	76.70	39.88	26.04	4.58	70.79	
Absolute change	-0.84	-2.4	-1.9	-1.7	-2.5	-2.2	-1.9	-3.3	-4.7	-6.4	-2.78	

Table 6. Financial implications of installing contour grass strips on 80 acres of the Ralls County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Baseline	34.5	23.3	23.7	23.6	24.1	24.3	24.7	25.4	25.9	26.3	25.59	255.90
Contour grass strips	38.7	25.0	25.4	25.3	25.8	26.0	26.4	27.1	27.6	28.0	27.51	275.11
Absolute change	4.2	1.7	1.7	1.7	1.7	1.7	1.6	1.7	1.7	1.6	1.92	19.21
Percentage change, %	12.3	7.2	7.1	7.0	7.0	6.9	6.6	6.6	6.4	6.2	7.5	
Market receipts, ($1,000)												
Baseline	479.3	505.0	521.8	521.7	520.5	525.0	525.6	526.4	531.6	529.0	518.58	5,185.75
Contour grass strips	473.7	496.7	515.3	515.5	511.8	518.2	519.4	517.7	524.6	522.9	511.58	5,115.82
Absolute change	-5.6	-8.3	-6.5	-6.2	-8.6	-6.8	-6.1	-8.7	-7.0	-6.0	-6.99	-69.93
Percentage change, %	-1.2	-1.6	-1.2	-1.2	-1.7	-1.3	-1.2	-1.7	-1.3	-1.1	-1.3	
Total receipts, ($1,000)												
Baseline	513.8	528.3	545.5	545.4	544.6	549.3	550.3	551.8	557.5	555.3	544.17	5,441.65
Contour grass strips	512.4	521.7	540.7	540.8	537.6	544.2	545.8	544.8	552.2	550.9	539.09	5,390.93
Absolute change	-1.4	-6.6	-4.8	-4.5	-7.0	-5.1	-4.5	-7.0	-5.3	-4.4	-5.07	-50.72
Percentage change, %	-0.3	-1.3	-0.9	-0.8	-1.3	-0.9	-0.8	-1.3	-1.0	-0.8	-0.9	
Cash operating costs ($1,000)												
Baseline	364.8	374.9	379.9	380.4	385.5	379.6	383.3	381.1	376.9	376.1	378.26	3,782.55
Contour grass strips	366.2	370.9	377.7	378.9	381.5	377.6	381.9	377.3	375.0	374.9	376.19	3,761.86
Absolute change	1.4	-4.1	-2.2	-1.5	-4.0	-2.0	-1.4	-3.9	-1.9	-1.2	-2.07	-20.69
Percentage change, %	0.4	-1.1	-0.6	-0.4	-1.0	-0.5	-0.4	-1.0	-0.5	-0.3	-0.5	
Net cash farm income ($1,000)												
Baseline	149.0	153.4	165.6	165.0	159.1	169.7	167.0	170.6	180.6	179.2	165.91	1,659.10
Contour grass strips	146.2	150.8	163.0	162.0	156.1	166.5	163.9	167.5	177.1	176.0	162.91	1,629.05
Absolute change	-2.8	-2.6	-2.6	-3.0	-3.0	-3.1	-3.1	-3.1	-3.5	-3.2	-3.01	-30.05
Percentage change, %	-1.9	-1.7	-1.6	-1.8	-1.9	-1.9	-1.9	-1.8	-1.9	-1.8	-1.8	
Returns to family living ($1,000)												
Baseline	95.3	74.9	69.2	64.3	35.7	32.6	15.4	25.6	27.0	36.1	47.59	475.91
Contour grass strips	94.8	73.5	67.8	62.6	33.9	30.8	13.2	23.1	23.7	32.6	45.60	455.96
Absolute change	-0.5	-1.3	-1.4	-1.7	-1.8	-1.9	-2.2	-2.5	-3.3	-3.5	-2.00	-19.95
Percentage change, %	-0.5	-1.8	-2.0	-2.7	-5.0	-5.7	-14.2	-9.6	-12.0	-9.7	-4.2	
Ending cash reserves ($1,000)												
Baseline	62.2	104.0	144.1	183.1	195.2	208.8	207.4	221.6	245.7	286.4	185.85	
Contour grass strips	61.8	102.2	141.0	178.4	189.1	201.3	198.6	211.4	233.8	273.0	179.06	
Absolute change	-0.4	-1.8	-3.1	-4.7	-6.1	-7.4	-8.8	-10.2	-11.9	-13.4	-6.79	
Percentage change, %	-0.7	-1.7	-2.2	-2.6	-3.1	-3.6	-4.3	-4.6	-4.8	-4.7	-3.7	
Probability of a cash deficit (%)												
Baseline	na	28.8	32.8	34.6	45.6	49.6	54.4	48.8	45.2	40.4	42.24	
Contour grass strips	na	29.6	33.2	34.8	46.8	50.0	54.4	49.2	45.6	41.2	42.76	
Absolute change	na	0.8	0.4	0.2	1.2	0.4	0.0	0.4	0.4	0.8	0.51	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Baseline	51.21	40.24	37.19	34.56	19.18	17.55	8.26	13.74	14.51	19.41	25.59	
Contour grass strips	50.97	39.52	36.44	33.64	18.22	16.55	7.09	12.42	12.76	17.54	24.51	
Absolute change	-0.24	-0.7	-0.8	-0.9	-1.0	-1.0	-1.2	-1.3	-1.7	-1.9	-1.07	

Table 7. Financial implications of installing contour grass strips on 80 acres of the Bates County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Baseline	33.8	24.4	24.8	24.7	25.2	25.5	25.7	26.3	26.8	26.9	26.40	263.97
Contour grass strips	37.8	25.9	26.3	26.2	26.7	26.9	27.2	27.8	28.3	28.4	28.14	281.39
Absolute change	4.1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.74	17.42
Percentage change, %	12.0	6.1	6.0	6.0	6.0	5.8	5.7	5.7	5.4	5.4	6.6	
Market receipts, ($1,000)												
Baseline	525.6	524.6	534.5	534.6	534.3	536.7	541.7	547.0	549.7	553.0	538.17	5,381.74
Contour grass strips	521.0	516.6	525.8	529.4	525.9	527.8	536.5	538.5	540.7	547.8	531.02	5,310.15
Absolute change	-4.6	-8.0	-8.6	-5.3	-8.4	-8.8	-5.2	-8.5	-9.0	-5.2	-7.16	-71.59
Percentage change, %	-0.9	-1.5	-1.6	-1.0	-1.6	-1.6	-1.0	-1.5	-1.6	-0.9	-1.3	
Total receipts, ($1,000)												
Baseline	559.4	549.1	559.2	559.3	559.5	562.1	567.4	573.3	576.5	580.0	564.57	5,645.71
Contour grass strips	558.9	542.6	552.1	555.5	552.6	554.8	563.6	566.3	568.9	576.2	559.15	5,591.54
Absolute change	-0.5	-6.5	-7.1	-3.8	-6.9	-7.3	-3.8	-7.0	-7.6	-3.7	-5.42	-54.17
Percentage change, %	-0.1	-1.2	-1.3	-0.7	-1.2	-1.3	-0.7	-1.2	-1.3	-0.6	-1.0	
Cash operating costs ($1,000)												
Baseline	366.1	374.4	376.3	375.5	375.2	374.7	384.6	390.3	394.6	397.8	380.95	3,809.45
Contour grass strips	367.7	371.1	373.3	374.2	372.1	371.9	383.3	387.1	391.7	396.6	378.91	3,789.08
Absolute change	1.6	-3.2	-2.9	-1.3	-3.2	-2.9	-1.3	-3.2	-2.9	-1.2	-2.04	-20.37
Percentage change, %	0.4	-0.9	-0.8	-0.3	-0.8	-0.8	-0.3	-0.8	-0.7	-0.3	-0.5	
Net cash farm income ($1,000)												
Baseline	193.3	174.7	183.0	183.8	184.3	187.4	182.8	183.0	181.9	182.2	183.63	1,836.26
Contour grass strips	191.1	171.4	178.8	181.3	180.6	182.9	180.3	179.2	177.2	179.7	180.25	1,802.46
Absolute change	-2.2	-3.3	-4.2	-2.5	-3.7	-4.5	-2.5	-3.8	-4.7	-2.5	-3.38	-33.80
Percentage change, %	-1.1	-1.9	-2.3	-1.4	-2.0	-2.4	-1.3	-2.1	-2.6	-1.4	-1.8	
Returns to family living ($1,000)												
Baseline	124.6	92.9	88.6	113.4	104.0	88.9	29.5	51.5	22.0	44.0	75.94	759.43
Contour grass strips	124.4	91.1	86.1	112.3	102.1	86.9	28.7	49.7	19.3	42.3	74.27	742.71
Absolute change	-0.2	-1.9	-2.5	-1.2	-1.9	-2.1	-0.8	-1.9	-2.6	-1.7	-1.67	-16.72
Percentage change, %	-0.2	-2.0	-2.8	-1.0	-1.8	-2.3	-2.8	-3.6	-11.9	-3.9	-2.2	
Ending cash reserves ($1,000)												
Baseline	91.6	151.7	207.5	288.4	360.4	417.9	416.5	436.5	426.8	439.0	323.64	
Contour grass strips	91.4	149.6	202.9	282.6	352.6	407.9	405.6	423.5	411.1	421.5	314.88	
Absolute change	-0.2	-2.1	-4.6	-5.8	-7.8	-9.9	-10.9	-12.9	-15.7	-17.5	-8.76	
Percentage change, %	-0.3	-1.4	-2.2	-2.0	-2.2	-2.4	-2.6	-3.0	-3.7	-4.0	-2.7	
Probability of a cash deficit (%)												
Baseline	na	14.4	14.8	9.6	13.4	19.0	58.0	41.6	63.4	45.6	31.09	
Contour grass strips	na	15.0	15.8	10.0	14.8	19.6	58.0	42.6	65.4	46.8	32.00	
Absolute change	na	0.6	1.0	0.4	1.4	0.6	0.0	1.0	2.0	1.2	0.91	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Baseline	67.72	50.51	48.14	61.64	56.53	48.34	16.04	28.00	11.93	23.89	41.27	
Contour grass strips	67.59	49.50	46.79	61.01	55.50	47.21	15.59	26.99	10.51	22.96	40.36	
Absolute change	-0.13	-1.0	-1.4	-0.6	-1.0	-1.1	-0.5	-1.0	-1.4	-0.9	-0.91	

Table 8. Financial implications of installing tile terraces versus contour grass strips on 40 acres of the Carroll County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Tile Terraces	19.4	15.3	7.9	7.9	8.1	8.1	8.2	8.4	8.6	8.7	10.07	100.74
Contour grass strips	14.2	8.8	8.9	8.9	9.0	9.1	9.2	9.4	9.6	9.7	9.68	96.76
Absolute change	-5.2	-6.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	-0.40	-3.98
Percentage change, %	-27.0	-42.6	12.2	12.4	12.2	12.0	11.7	11.6	11.3	11.0	-4.0	
Market receipts, ($1,000)												
Tile Terraces	163.6	171.6	176.8	178.4	179.2	180.1	180.2	181.5	182.3	180.8	177.45	1,774.48
Contour grass strips	161.3	167.5	173.2	175.6	174.9	176.4	177.4	177.2	178.5	178.0	173.97	1,739.73
Absolute change	-2.3	-4.1	-3.6	-2.8	-4.3	-3.8	-2.8	-4.3	-3.8	-2.8	-3.48	-34.75
Percentage change, %	-1.4	-2.4	-2.0	-1.6	-2.4	-2.1	-1.6	-2.4	-2.1	-1.6	-2.0	
Total receipts, ($1,000)												
Tile Terraces	183.0	186.9	184.7	186.4	187.3	188.3	188.4	189.9	190.9	189.5	187.52	1,875.22
Contour grass strips	175.4	176.3	182.1	184.5	184.0	185.5	186.6	186.6	188.1	187.6	183.65	1,836.49
Absolute change	-7.6	-10.6	-2.7	-1.9	-3.3	-2.8	-1.9	-3.4	-2.9	-1.8	-3.87	-38.73
Percentage change, %	-4.1	-5.7	-1.4	-1.0	-1.8	-1.5	-1.0	-1.8	-1.5	-1.0	-2.1	
Cash operating costs ($1,000)												
Tile Terraces	107.3	109.1	98.9	96.8	97.0	97.4	97.0	105.9	106.1	106.6	102.19	1,021.94
Contour grass strips	97.6	97.0	97.5	96.0	95.5	96.1	96.3	104.5	104.9	106.0	99.13	991.26
Absolute change	-9.8	-12.1	-1.4	-0.8	-1.5	-1.3	-0.7	-1.4	-1.2	-0.6	-3.07	-30.68
Percentage change, %	-9.1	-11.1	-1.4	-0.8	-1.5	-1.3	-0.7	-1.3	-1.1	-0.5	-3.0	
Net cash farm income ($1,000)												
Tile Terraces	75.7	77.8	85.8	89.6	90.3	90.9	91.4	84.1	84.9	82.9	85.33	853.30
Contour grass strips	77.9	79.3	84.6	88.5	88.5	89.4	90.3	82.1	83.2	81.6	84.52	845.21
Absolute change	2.2	1.5	-1.2	-1.1	-1.8	-1.5	-1.2	-2.0	-1.7	-1.3	-0.81	-8.09
Percentage change, %	2.9	1.9	-1.4	-1.2	-2.0	-1.7	-1.3	-2.3	-2.0	-1.5	-0.9	
Returns to family living ($1,000)												
Tile Terraces	52.7	46.0	45.2	52.1	47.1	38.2	38.8	21.0	14.3	4.1	35.94	359.41
Contour grass strips	54.3	46.2	44.3	51.8	46.3	37.5	38.4	19.9	13.0	2.3	35.39	353.94
Absolute change	1.6	0.2	-0.9	-0.3	-0.8	-0.6	-0.4	-1.1	-1.3	-1.8	-0.55	-5.47
Percentage change, %	3.0	0.4	-2.0	-0.6	-1.8	-1.7	-1.2	-5.0	-9.1	-43.5	-1.5	
Ending cash reserves ($1,000)												
Tile Terraces	16.5	25.7	35.0	52.6	63.8	65.6	68.5	54.3	39.0	21.2	44.22	
Contour grass strips	18.1	27.5	35.4	52.2	62.3	63.4	65.8	50.6	34.3	15.7	42.52	
Absolute change	1.6	1.8	0.4	-0.4	-1.5	-2.2	-2.7	-3.8	-4.7	-5.5	-1.70	
Percentage change, %	9.4	7.0	1.1	-0.8	-2.3	-3.3	-3.9	-6.9	-12.1	-25.9	-3.8	
Probability of a cash deficit (%)												
Tile Terraces	na	37.4	36.8	27.2	38.8	54.8	52.8	75.6	81.6	81.2	54.02	
Contour grass strips	na	35.6	37.4	27.8	39.4	55.8	53.2	77.4	82.0	82.6	54.58	
Absolute change	na	-1.8	0.6	0.6	0.6	1.0	0.4	1.8	0.4	1.4	0.56	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Tile Terraces	105.42	91.90	90.46	104.12	94.26	76.32	77.60	42.00	28.64	8.10	71.88	
Contour grass strips	108.54	92.30	88.64	103.54	92.60	75.06	76.70	39.88	26.04	4.58	70.79	
Absolute change	3.12	0.4	-1.8	-0.6	-1.7	-1.3	-0.9	-2.1	-2.6	-3.5	-1.09	

Table 9. Financial implications of installing tile terraces versus contour grass strips on 80 acres of the Ralls County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Tile Terraces	42.0	30.8	31.2	31.1	24.1	24.3	24.7	25.4	25.9	26.3	28.59	285.90
Contour grass strips	38.7	25.0	25.4	25.3	25.8	26.0	26.4	27.1	27.6	28.0	27.51	275.11
Absolute change	-3.3	-5.8	-5.8	-5.8	1.7	1.7	1.6	1.7	1.7	1.6	-1.08	-10.79
Percentage change, %	-7.8	-18.9	-18.6	-18.8	7.0	6.9	6.6	6.6	6.4	6.2	-3.8	
Market receipts, ($1,000)												
Tile Terraces	479.3	505.0	521.8	521.7	520.5	525.0	525.6	526.4	531.6	529.0	518.58	5,185.75
Contour grass strips	473.7	496.7	515.3	515.5	511.8	518.2	519.4	517.7	524.6	522.9	511.58	5,115.82
Absolute change	-5.6	-8.3	-6.5	-6.2	-8.6	-6.8	-6.1	-8.7	-7.0	-6.0	-6.99	-69.93
Percentage change, %	-1.2	-1.6	-1.2	-1.2	-1.7	-1.3	-1.2	-1.7	-1.3	-1.1	-1.3	
Total receipts, ($1,000)												
Tile Terraces	521.3	535.8	553.0	552.9	544.6	549.3	550.3	551.8	557.5	555.3	547.17	5,471.65
Contour grass strips	512.4	521.7	540.7	540.8	537.6	544.2	545.8	544.8	552.2	550.9	539.09	5,390.93
Absolute change	-8.9	-14.1	-12.3	-12.0	-7.0	-5.1	-4.5	-7.0	-5.3	-4.4	-8.07	-80.72
Percentage change, %	-1.7	-2.6	-2.2	-2.2	-1.3	-0.9	-0.8	-1.3	-1.0	-0.8	-1.5	
Cash operating costs ($1,000)												
Tile Terraces	375.4	385.5	390.5	391.0	385.6	379.6	383.3	381.1	376.9	376.1	382.50	3,825.00
Contour grass strips	366.2	370.9	377.7	378.9	381.5	377.6	381.9	377.3	375.0	374.9	376.19	3,761.86
Absolute change	-9.2	-14.6	-12.8	-12.2	-4.1	-2.0	-1.4	-3.9	-1.9	-1.2	-6.31	-63.14
Percentage change, %	-2.4	-3.8	-3.3	-3.1	-1.1	-0.5	-0.4	-1.0	-0.5	-0.3	-1.7	
Net cash farm income ($1,000)												
Tile Terraces	145.9	150.4	162.5	161.8	159.0	169.6	167.0	170.6	180.6	179.2	164.66	1,646.62
Contour grass strips	146.2	150.8	163.0	162.0	156.1	166.5	163.9	167.5	177.1	176.0	162.91	1,629.05
Absolute change	0.3	0.5	0.5	0.1	-2.9	-3.1	-3.1	-3.1	-3.5	-3.2	-1.76	-17.57
Percentage change, %	0.2	0.3	0.3	0.1	-1.8	-1.8	-1.9	-1.8	-1.9	-1.8	-1.1	
Returns to family living ($1,000)												
Tile Terraces	95.7	74.2	68.5	63.5	35.5	32.3	15.0	25.2	26.6	35.8	47.23	472.32
Contour grass strips	94.8	73.5	67.8	62.6	33.9	30.8	13.2	23.1	23.7	32.6	45.60	455.96
Absolute change	-0.9	-0.7	-0.7	-1.0	-1.6	-1.5	-1.8	-2.1	-2.9	-3.2	-1.64	-16.36
Percentage change, %	-0.9	-0.9	-1.0	-1.5	-4.6	-4.6	-12.1	-8.4	-10.8	-9.0	-3.5	
Ending cash reserves ($1,000)												
Tile Terraces	62.7	103.8	143.6	182.4	195.4	209.5	208.4	222.7	246.9	287.7	186.31	
Contour grass strips	61.8	102.2	141.0	178.4	189.1	201.3	198.6	211.4	233.8	273.0	179.06	
Absolute change	-0.9	-1.6	-2.6	-4.1	-6.3	-8.2	-9.8	-11.3	-13.1	-14.7	-7.25	
Percentage change, %	-1.4	-1.5	-1.8	-2.2	-3.2	-3.9	-4.7	-5.1	-5.3	-5.1	-3.9	
Probability of a cash deficit (%)												
Tile Terraces	na	29.8	33.6	35.2	44.8	49.4	54.4	48.8	44.8	40.6	42.38	
Contour grass strips	na	29.6	33.2	34.8	46.8	50.0	54.4	49.2	45.6	41.2	42.76	
Absolute change	na	-0.2	-0.4	-0.4	2.0	0.6	0.0	0.4	0.8	0.6	0.38	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Tile Terraces	51.45	39.88	36.80	34.16	19.10	17.34	8.06	13.56	14.31	19.26	25.39	
Contour grass strips	50.97	39.52	36.44	33.64	18.22	16.55	7.09	12.42	12.76	17.54	24.51	
Absolute change	-0.48	-0.4	-0.4	-0.5	-0.9	-0.8	-1.0	-1.1	-1.5	-1.7	-0.88	

Table 10. Financial implications of installing tile terraces versus contour grass strips on 80 acres of the Bates County representative farm

Calendar year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average	Cumul.
						Whole-farm						
Government payments, ($1,000)												
Tile Terraces	41.3	31.9	32.3	32.2	25.2	25.5	25.7	26.3	26.8	26.9	29.40	293.97
Contour grass strips	37.8	25.9	26.3	26.2	26.7	26.9	27.2	27.8	28.3	28.4	28.14	281.39
Absolute change	-3.4	-6.0	-6.0	-6.0	1.5	1.5	1.5	1.5	1.5	1.5	-1.26	-12.58
Percentage change, %	-8.3	-18.8	-18.6	-18.7	6.0	5.8	5.7	5.7	5.4	5.4	-4.3	
Market receipts, ($1,000)												
Tile Terraces	525.6	524.6	534.5	534.6	534.3	536.7	541.7	547.0	549.7	553.0	538.17	5,381.74
Contour grass strips	521.0	516.6	525.8	529.4	525.9	527.8	536.5	538.5	540.7	547.8	531.02	5,310.15
Absolute change	-4.6	-8.0	-8.6	-5.3	-8.4	-8.8	-5.2	-8.5	-9.0	-5.2	-7.16	-71.59
Percentage change, %	-0.9	-1.5	-1.6	-1.0	-1.6	-1.6	-1.0	-1.5	-1.6	-0.9	-1.3	
Total receipts, ($1,000)												
Tile Terraces	566.9	556.6	566.7	566.8	559.5	562.1	567.4	573.3	576.5	580.0	567.57	5,675.71
Contour grass strips	558.9	542.6	552.1	555.5	552.6	554.8	563.6	566.3	568.9	576.2	559.15	5,591.54
Absolute change	-8.0	-14.0	-14.6	-11.3	-6.9	-7.3	-3.8	-7.0	-7.6	-3.7	-8.42	-84.17
Percentage change, %	-1.4	-2.5	-2.6	-2.0	-1.2	-1.3	-0.7	-1.2	-1.3	-0.6	-1.5	
Cash operating costs ($1,000)												
Tile Terraces	376.5	384.7	386.7	385.9	375.2	374.7	384.6	390.3	394.6	397.8	385.10	3,850.95
Contour grass strips	367.7	371.1	373.3	374.2	372.1	371.9	383.3	387.1	391.7	396.6	378.91	3,789.08
Absolute change	-8.8	-13.6	-13.3	-11.7	-3.2	-2.9	-1.3	-3.2	-2.9	-1.2	-6.19	-61.87
Percentage change, %	-2.3	-3.5	-3.4	-3.0	-0.8	-0.8	-0.3	-0.8	-0.7	-0.3	-1.6	
Net cash farm income ($1,000)												
Tile Terraces	190.4	171.8	180.1	180.9	184.3	187.4	182.8	183.0	181.9	182.2	182.47	1,824.73
Contour grass strips	191.1	171.4	178.8	181.3	180.6	182.9	180.3	179.2	177.2	179.7	180.25	1,802.46
Absolute change	0.7	-0.4	-1.3	0.4	-3.7	-4.5	-2.5	-3.8	-4.7	-2.5	-2.23	-22.27
Percentage change, %	0.4	-0.2	-0.7	0.2	-2.0	-2.4	-1.3	-2.1	-2.6	-1.4	-1.2	
Returns to family living ($1,000)												
Tile Terraces	124.9	92.7	88.7	113.7	104.5	89.1	29.6	51.5	21.9	43.9	76.05	760.54
Contour grass strips	124.4	91.1	86.1	112.3	102.1	86.9	28.7	49.7	19.3	42.3	74.27	742.71
Absolute change	-0.6	-1.6	-2.6	-1.4	-2.4	-2.2	-0.9	-1.8	-2.6	-1.7	-1.78	-17.83
Percentage change, %	-0.4	-1.8	-3.0	-1.2	-2.3	-2.5	-3.1	-3.5	-11.8	-3.8	-2.3	
Ending cash reserves ($1,000)												
Tile Terraces	91.9	151.9	207.8	289.0	361.4	419.1	417.9	437.9	428.3	440.5	324.56	
Contour grass strips	91.4	149.6	202.9	282.6	352.6	407.9	405.6	423.5	411.1	421.5	314.88	
Absolute change	-0.6	-2.2	-4.9	-6.3	-8.8	-11.2	-12.3	-14.4	-17.1	-19.0	-9.68	
Percentage change, %	-0.6	-1.5	-2.3	-2.2	-2.4	-2.7	-2.9	-3.3	-4.0	-4.3	-3.0	
Probability of a cash deficit (%)												
Tile Terraces	na	15.2	15.4	11.0	13.4	19.0	57.8	41.8	63.2	45.6	31.38	
Contour grass strips	na	15.0	15.8	10.0	14.8	19.6	58.0	42.6	65.4	46.8	32.00	
Absolute change	na	-0.2	0.4	-1.0	1.4	0.6	0.2	0.8	2.2	1.2	0.62	
						Per cropped acre (pre-enrollment crop + forage acres)						
Returns to family living, $ per acre												
Tile Terraces	67.89	50.39	48.22	61.78	56.80	48.40	16.08	27.98	11.91	23.88	41.33	
Contour grass strips	67.59	49.50	46.79	61.01	55.50	47.21	15.59	26.99	10.51	22.96	40.36	
Absolute change	-0.30	-0.9	-1.4	-0.8	-1.3	-1.2	-0.5	-1.0	-1.4	-0.9	-0.97	

Alternative Acres

The previous scenarios assumed the maximum acres established in the contour buffer strips on each of the three farms. This assumes grass strips of 30' and crop strips of 90'. Under that scenario, the farms placed 10.9 acres in grass for the Carroll County farm and 21.8 acres in grass for the Ralls and Bates County farms. Another alternative would be to use the minimum grass strip width (15') and the maximum crop strip width (120'). Under this scenario, the Carroll County farm places 5.9 acres in grass and the Ralls and Bates County farms place 11.8 acres in grass.

Table 11 looks at the impact on returns to family living per acre under the Maximum and the Minimum scenarios described above. The Carroll county farm's return to family living would be $0.66 higher under the Minimum scenario then the Maximum scenario. This would result in average returns to family living of $330 per year.

The two additional farms, the Ralls and Bates County farms, see similar results.

Table 11. Comparison of return to family living under minumum and mximum acres established in contour buffer strips.

		Absolute change from		
Returns to family living, $ per acre	Average	Baseline	Tile Terrace	Max Acres
Carroll County Farm				
Baseline	73.57			
Tile Terraces	71.88			
Contour grass strips				
Minimum (5.9 acres)	71.45	-2.12	-0.43	0.66
Maximum (10.9 acres)	70.79	-2.78	-1.09	0.00
Ralls County Farm				
Baseline	25.59			
Tile Terraces	25.39			
Contour grass strips				
Minimum (11.8 acres)	24.73	-0.86	-0.67	0.21
Maximum (21.8 acres)	24.51	-1.07	-0.88	0.00
Bates County Farm				
Baseline	41.27			
Tile Terraces	41.33			
Contour grass strips				
Minimum (11.8 acres)	40.63	-0.64	-0.70	0.27
Maximum (21.8 acres)	40.36	-0.91	-0.97	0.00

Conclusions

As a purely economic decision, there is little difference in the ten year return to family living when comparing tile terraces and contour grass strips. Again, this report does not look at the effectiveness of tile terraces or grass contour strips in controlling erosion.

For landowners who wish to implement practices that benefit wildlife, in addition to control erosion, there is little financial reason to prefer the terrace system.

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Notes

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