

► Economics Of Zero-Grade Rice Systems In Arkansas

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Zero-grade management is a water saving option available to rice producers with limited water resources. The zero-slope allows water to travel faster and the flood to be more uniform across the field. Water savings for zero-graded rice fields can be as high as 60 percent compared to contour levee rice fields (Epting). Zero-grade rice production also eliminates the need to build levees, and tillage is almost entirely eliminated with the exception of occasional tillage over time to repair rutted fields. Zero-grade is a land improvement and requires a capital cost to be paid "upfront." The land owner must determine whether the work will be performed on a custom basis or using on-farm labor and owned dirt-moving equipment. The objectives of this study are as follows:

1. Compare the costs of precision leveling with on-farm labor and owned equipment to the cost of hiring the work done on a custom basis at varying levels of soil moved,
2. Compare the returns and costs of zero-grade to contour levee management for rice and soybeans.

Costs of Precision Leveling

Charges for custom work were obtained by contacting Arkansas land leveling businesses by phone during the summer 2006. The unit of payment for custom work can vary by hour or by cubic yard depending on the amount of soil moved per acre. If the per acre amount of soil moved is small (100 cubic yards or less), the custom work is usually charged on an hourly basis and ranges from \$125 to \$150 per hour. If large amounts of soil are moved per acre (greater than 100 cubic yards), the custom work is usually charged by cubic yard and ranges from \$1.15 - \$1.25 per cubic yard.

Table 1 presents a description of the equipment needed for on-farm precision leveling and the cost per hour and per cubic yard associated with each piece of equipment assuming 300 cubic yards of soil per acre are moved on 200 acres of land per year. Purchase price data are based on phone conversations with Arkansas farmers, land leveling professionals, and equipment dealers in Arkansas during the summer 2006. Cost figures include fuel, labor, repair and maintenance, depreciation, and interest. Fuel costs were calculated using a farm diesel price of \$2.20 per gallon, and labor costs were calculated assuming a labor wage of \$10 per hour. For this particular example, the total cost per unit of soil moved using owned equipment and on-farm labor ranges from \$0.83 per cubic yard if two dirt pans are used to \$0.90 per cubic yard if one dirt pan is used. Both cost estimates are lower than the custom charges of \$1.15 to \$1.25 per cubic yard reported above.

Table 2 presents the estimated per acre costs of precision leveling for selected volumes of soil moved using either owned equipment or custom hire. The per acre cost of precision leveling increases as the number of cubic yards of soil moved per acre increases. Custom hire is less costly than owned equipment at volumes less than or equal to 100 cubic yards per acre. Beyond 100 cubic yards, land leveling costs are lower when the work is performed using owned equipment. Greater efficiencies may also be achieved for large volumes of soil moved per acre using two dirt pans opposed to one as exhibited by lower per acre costs for dual pan compared with single pan equipment when 300 or more cubic yards of soil are moved per acre (Table 2).

Comparison of the Returns and Costs of Zero-Grade to Contour Levee Management

Gross returns and production costs for rice and soybeans with contour levee and zero-grade management are presented in Table 3. Rice and soybean yields on zero-grade fields are adjusted upward to reflect increased production due to the absence of levees. Rice yields tend to be lower on levees than in bays. Levees make no contribution to soybean yields since levees impede soybean headers and must be removed before combining. It is assumed that levees account for 10 % of the area in contour rice fields and 5 % of the area in contour soybean fields. Rice yields are assumed to be 35 % lower on levees, while soybean yields are assumed zero on levees.

Some cost items are higher for zero-grade management such as planting, weed control, fertilization, and water weevil control. Land preparation is also different for the two management systems. Contour levee systems depend heavily on tillage to manage weeds. In contrast, near

Table 1. Description of On-Farm Precision Leveling Setup

| Item | Purchase Price | Useful Life | Annual Use (Hours) | Cost per Hour | Cost per Cubic Yard ^a |
|------------------------------|----------------|-------------|--------------------|---------------|----------------------------------|
| <i>SinglePan</i> | | | | | |
| 4wd 400 Hp Tractor | 183,000 | 10 | 1,000 | 97.25 | 0.68 |
| Scraper – 18yd | 60,000 | 15 | 417 ^b | 22.36 | 0.16 |
| Laser Equipment | 25,600 | 10 | 417 | 9.85 | 0.07 |
| Total, Single Scraper | 268,600 | | | 129.47 | 0.90 |
| <i>DualPans</i> | | | | | |
| 4wd 400 Hp Tractor | 183,000 | 10 | 1,000 | 97.25 | 0.45 |
| Scraper – 18yd | 60,000 | 15 | 278 ^b | 33.54 | 0.16 |
| Scraper – 18yd | 60,000 | 15 | 278 | 33.54 | 0.16 |
| Laser Equipment | 27,600 | 10 | 278 | 15.93 | 0.07 |
| Total, Dual Scrapers | 330,600 | | | 180.28 | 0.83 |

^a Estimated volume of soil moved per hour for single pan setup is based on 8 cycles per hour with an 18-yard pan (144 cubic-yards per hour with 1 pan). Estimated volume of soil moved per hour for dual pan setup is based on 6 cycles per hour with two 18-yard pans (216 cubic-yards per hour with 2 pans).

^b Number of annual hours required to move 300 cubic yards of soil per acre on 200 acres using either single pan equipment or dual pan equipment.

Table 2. Estimated Costs of Precision Leveling Per Acre at Selected Volumes of Soil Moved with On-Farm Equipment and Custom Hiring.

| Volume of Soil Moved (cubic yards per acre) | Leveling Options ^a | | |
|---|-------------------------------|------------------|--------------|
| | Single Pan, Owned | Dual Pans, Owned | Custom Hired |
| 75 | 174 | 206 | 143 |
| 100 | 191 | 217 | 171 |
| 200 | 259 | 262 | 286 |
| 300 | 326 | 307 | 401 |
| 400 | 394 | 352 | 516 |
| 500 | 461 | 397 | 631 |
| 600 | 529 | 442 | 746 |
| 700 | 596 | 487 | 861 |
| 800 | 664 | 532 | 976 |
| 900 | 731 | 577 | 1,091 |
| 1000 | 799 | 622 | 1,206 |

^a Custom hired precision leveling charge = \$1.15 per cubic yard. Additional charges of \$10 per acre for obtaining a cut sheet of the field and \$46.45 per acre for applying one ton of loose raw broiler litter as a soil amendment are included in the total costs. Excluded from total costs are charges for ripping (subsoiling) prior to land leveling, which may be necessary if soil compaction or hardness prevents efficient scraper operation. Ripping would increase cost figures by an additional \$12 per acre.

ly all tillage is excluded on zero-grade fields to maintain the structure of the field over time. Thus, zero-grade management is in essence no-till management, and tillage costs are negligible. No costs are incurred for levee construction under zero-grade management, since the field has been land formed to a zero slope. Total irrigation costs are also lower for zero-grade management due to less water applied and greater irrigation efficiency. The absence of levees also increases rice harvest efficiency and reduces rice harvest costs. Combines are able to travel at faster speeds and harvest operations are completed earlier on rice acres.

Net returns for each crop under contour levee and zero-grade management are also presented in Table 3. Net returns above production costs for both crops are greater for zero-grade management. Based on data from Table 3, the estimated monetary benefit of zero-grade management on a crop enterprise basis is \$124 per acre for rice and \$49 per acre for soybeans assuming no yield loss on cut areas of the field.

References Cited

Epting, J. 2004. Water use in the Mississippi Delta – 2004 report. In: YMD Joint Water Management District Annual Report 2004, pp. 2-20. <http://www.ymd.org/annualreports.htm>
 Laughlin, D.H. and Spurlock, S.R. 2006. User's guide for the Mississippi State Budget Generator, Version 6.0 for Windows. Department of Agricultural Economics, Mississippi State University. <http://www.agecon.msstate.edu/laughlin/msbg.php>

Table 3. Gross Returns, Production Costs, and Net Returns Above Production Costs for Rice and Soybeans, Contour Levee and Zero-Grade Management

| <i>Economic Item</i> | <i>Contour Levee Rice</i> | <i>Zero-Grade Rice</i> | <i>Contour Levee Soybeans</i> | <i>Zero-Grade Soybeans</i> |
|---|---------------------------|------------------------|-------------------------------|----------------------------|
| <i>Crop Yields, Irrigation, and Gross Returns</i> | | | | |
| <i>Yield (bu/acre)</i> | 148 ^a | 154 | 40 | 42 |
| <i>Irrigation (acre-inches)</i> | 39 ^b | 15 | 12 | 8 |
| <i>Gross Returns (\$/acre)</i> | 500.70 ^c | 523.35 | 236.67 | 249.14 |
| <i>Production Costs and Net Returns (\$/acre)</i> | | | | |
| <i>Tillage</i> | 38.73 | 0.51 | 33.15 | 1.02 |
| <i>Planting</i> | 23.27 | 30.59 | 47.45 | 54.75 |
| <i>Levee Build & Seed</i> | 17.72 | 0.00 | 14.55 | 0.00 |
| <i>Weed Control</i> | 49.89 | 59.50 | 17.35 | 26.89 |
| <i>Fertilizer</i> | 123.96 | 123.74 | 33.03 | 38.55 |
| <i>Water Weevil Spray</i> | 0.00 | 12.64 | 0.00 | 0.00 |
| <i>Irrigation</i> | 144.63 | 64.51 | 55.46 | 43.39 |
| <i>Harvest</i> | 53.29 | 43.91 | 16.98 | 16.98 |
| <i>Rotary Cutter</i> | 0.00 | 5.18 | 0.00 | 0.00 |
| <i>Total Costs</i> | 441.49 | 340.58 | 217.97 | 181.58 |
| <i>Net Returns</i> | 59.21 | 182.77 | 18.70 | 67.55 |

^a Four-year average Arkansas rice and irrigated soybean crop yields for the period 2002-2005 are assumed for contour levee rice and soybeans. Rice and soybean yields are adjusted upward for zero-grade management (by a multiple of 1.04 for rice and 1.05 for soybeans) to reflect increased production from greater land area due to the absence of levees.

^b Rice irrigation quantities are based on irrigation levels reported for contour levee and zero-grade management in Epting.

^c Gross returns were calculated using market prices of \$3.39/bu rice and \$5.88/bu soybeans. Market prices are net of custom drying charges for rice (\$0.30/bu) and custom hauling charges for both rice and soybeans (0.15/bu).

^d Production costs are estimated using the Mississippi State Budget Generator (Laughlin and Spurlock).