Whole Farm Economic Evaluation of No-Till Rice Production in Arkansas

K. Bradley Watkins
kbwatki@uark.edu
University of Arkansas
Division of Agriculture
Rice Research and Extension Center
2900 Hwy. 130 E
Stuttgart, AR 72160
870-673-2661 ext 225

Jason L. Hill
Jlh04@uark.edu
University of Arkansas
Division of Agriculture
Rice Research and Extension Center
2900 Hwy. 130 E
Stuttgart, AR 72160
870-673-2661 ext 255

Merle M. Anders
rrec_manders@futura.net
University of Arkansas
Division of Agriculture
Rice Research and Extension Center
2900 Hwy. 130 E
Stuttgart, AR 72160
870-673-2661 ext 230

Tony E. Windham
twindham@uaex.edu
University of Arkansas
Division of Agriculture
Cooperative Extension Service
2301 South University Ave. Box 391
Room 110M
Little Rock, AR, 72203
501-671-2196

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meetings, Little Rock, Arkansas, February 5-9, 2005

Abstract

Rice in Arkansas is typically produced using intensive tillage. No-till rice has been studied, but the research focus has been limited to impacts on yields and per acre net returns. This analysis evaluates the profitability of no-till rice at the whole-farm level using both enterprise budget analysis and linear programming.

Keywords: conventional till, linear programming, no-till, operation size, rice, rotation, soybean, tenure, whole-farm profitability

Whole Farm Economic Evaluation of No-Till Rice Production in Arkansas

Introduction

Arkansas is the top rice producing state in the U.S. and accounts for nearly 46 percent of total U.S. rice production (U.S. Department of Agriculture, Economic Research Service). Most rice production in Arkansas involves intensive cultivation. Fields are “cut-to-grade” every few years and disked and “floated” (land planed) annually in early spring to ensure smooth water movement across the field. Conventional tillage accounts for nearly two-thirds of all planted rice acres, while stale seedbed (seedbed preparation in fall followed by burn-down herbicides prior to planting in the spring) accounts for over a quarter of all planted rice acres. True no-till (rice planted directly into the previous crop residue without tillage at any time) accounts for 10 percent of planted rice acres in Arkansas (Wilson and Branson).

Nearly all Arkansas rice production occurs in eastern Arkansas in the Mississippi Alluvial Valley. Surface water quality in this region is significantly influenced by geography, climate, and agriculture. The area has little topographic relief, and soils are predominantly composed of dense alluvial clay sub-soils that limit water infiltration (Kleiss et al.). Surface soils contain little organic matter and are comprised of silt and clay particles that are readily transported by runoff from tilled fields during heavy rainfall (Huitink et al.). Eastern Arkansas waterways are highly turbid in areas dominated by agriculture (Arkansas Department of Environmental Quality), and land activities that impact surface water in eastern Arkansas also impact the Mississippi River and Gulf of Mexico (Kleiss et al.).

In June 2003, the U.S. Environmental Protection Agency finalized approval of the list of Arkansas waterways impaired by pollution (U.S. Environmental Protection Agency). The next steps for Arkansas will be to calculate Total Maximum Daily Loads (TMDLs) for each impaired waterway and develop plans for achieving compliance with state water quality standards. Siltation is the primary pollutant identified for most eastern Arkansas waterways, and conservation practices like no-till will likely be recommended as remedial mechanisms. A TMDL for turbidity has already been calculated for the L'Anguille River located in northeastern Arkansas. Row crop agriculture is cited as a major contributor to turbidity in this river, and no-till is one of the measures recommended for reducing silt loads into this waterway (Arkansas Soil and Water Conservation Commission).

The economics of no-till management in rice have not been fully explored. Economic studies of the subject (Pearce et al., Smith and Baltazar, and Watkins, Anders, and Windham) have been limited to enterprise budget analyses based on experimental plots and have produced mixed findings. A major shortcoming of such studies is that production costs from plot research often poorly reflect the true machinery costs observed for a typical commercial farm operation. Also, operation size and tenure are ignored in these studies. Tenure is especially important for Arkansas rice production since the majority of cropland is rented using a 25 percent straight share arrangement where the landlord receives 25 percent of the crop as a land charge (Parsch and Danforth, 1994). The objectives of this study are to evaluate the profitability of no-till relative to conventional till rice management for typical Arkansas rice farms and determine the impacts of farm size and tenure on the profitability of no-till relative to conventional till rice management at the whole farm level.

Data and Methods

This study compares the profitability of no-till to conventional till rice management for a medium rice farm (1200 acres) and a large rice farm (2400 acres) growing both rice and soybeans in a two-year rotation. Machinery complements were developed for both operation sizes under conventional till (CT) and no-till management (NT). A third tillage option (NT75) was also evaluated in which the farm operator maintains machinery for both conventional till and no-till and uses no-till management 3 out of 4 years. This option assumes the farm operator uses conventional till once every four years to remove ruts that develop in the field over time due to harvest traffic (grain carts and combines) during potentially wet harvest periods.

The machinery complements were constructed based on actual equipment observed in Arkansas rice production and closely tied to timing for completion of land preparation, planting, and harvesting operations. Ownership costs (depreciation, interest, taxes, insurance, and housing) for machinery complement items were calculated based on ASAE Standards formulas (American Society of Agricultural Engineers). Depreciation in particular was estimated for each item based on current list prices and remaining value equations that account for both machinery age and annual usage. The remaining value equations published in the ASAE Standards are reduced forms of remaining value functions estimated by Cross and Perry (1995, 1996).

Operating expenses for each rice and soybean enterprise were calculated using the Mississippi State Budget Generator (MSBG). The machinery labor, fuel, and repairs and maintenance expenses used in the MSBG corresponded with the timing of operations, annual use hours, and performance rates (hours/acre) of items in each machinery complement. Other operating expenses (seeds, fertilizer, pesticide, custom application) were based on production inputs obtained from a long-term rice-based cropping systems study at Stuttgart, Arkansas.

Net returns were calculated as gross returns (price x yield) less operating and ownership expenses. Five-year season average market prices for rice ($2.37/bushel) and soybeans ($5.60/bushel) for the period 1999 - 2003 were used as expected prices in the study. A five-year average loan deficiency payment of $1.25/bu was added to the rice market price to obtain a total cash price of $3.62/bushel for rice. Hauling and drying expenses of $0.42/bushel rice and $0.15/bushel soybean were subtracted from expected prices to account for per unit custom charges. Average yields for the period 2000 - 2003 were obtained from the long-term cropping systems study to represent expected yields for rice and soybeans under conventional till and no-till management. Expected NT75 yields were calculated by taking a weighted average of no-till expected yields (75 percent) and conventional till expected yields (25 percent).

Per acre net returns were calculated for both owned and rented cropland under no-till and conventional till management. Net returns to rented cropland were calculated using the typical 25 percent straight share arrangement. In this arrangement, the landlord receives 25 percent of the crop, pays 25 percent of the custom hauling and drying charges associated with the crop, and pays 100 percent of all belowground irrigation expenses (well, pump, and gearhead). The farm operator receives 75 percent of the crop, pays 75 percent of the custom drying and hauling expenses related to the crop, pays 100 percent of all aboveground irrigation expenses (power unit, fuel), and pays 100 percent of all other production expenses.

Linear programming models were constructed for each farm size to evaluate the whole-farm profitability of no-till relative to conventional till management for typical Arkansas rice farms growing both rice and soybeans in a two-year rotation. The objective functions of each LP model maximized whole farm returns to CT, NT, and NT75 subject to constraints on total cropland available, owned cropland, and rented cropland. Buying activities for labor and diesel fuel were incorporated into each LP model to evaluate the impact of different wage rates and fuel costs on whole farm profitability. A general specification of the LP models used in the study is presented in Table 1.

Returns and Expenses by Operation Size and Tenure

Per acre returns and expenses by operation size and crop for owned and rented cropland are presented in Table 2. Gross returns are lower for NT and NT75 compared with CT due to lower expected rice and soybean yields for no-till relative to conventional till at Stuttgart, Arkansas over the 2000 - 2003 period (187 bushels/acre conventional till rice vs. 173 bushels/acre no-till rice; 46 bushels/acre conventional till soybeans vs. 42 bushels/acre soybeans). Operating (variable) expenses for rice and soybeans are slightly lower for NT and NT75 compared with CT due to lower diesel fuel costs, repairs and maintenance costs, and labor costs resulting from fewer machinery operations devoted to land preparation under no-till management. However, much of these cost savings are offset by higher herbicide application costs for no-till relative to conventional till management.

Operating expenses vary little across operation size and remain invariant for owned and rented cropland since the farm operator pays virtually all of the operating expenses in a typical straight share arrangement. However, ownership (fixed) expenses vary considerably by operation size, tillage, and tenure. Per acre ownership expenses decline in every case when going from 1200 acres to 2400 acres due to size economies resulting from spreading machinery inputs over more acres. Per acre ownership expenses also decline when going from CT to NT and to a lesser degree NT75 due to less land preparation equipment in the machinery complement for NT and less usage of land preparation equipment for NT75. Finally, ownership expenses decline when going from owned to rented land due to all belowground irrigation expenses being paid by the landlord rather than the farm operator in a straight share arrangement.

Net returns to the farm operator tend to vary most by operation size. Per acre net returns to rice, soybeans, and the farm increase when going from 1200 acres to 2400 acres due to size economies resulting from spreading machinery across more acres. Net returns to the farm operator are also impacted by tenure. Per acre net returns to the farm are nearly the same across tillage treatments on owned land. However, per acre net returns to NT are larger than those to CT on rented land. This is due in large part to a combination of lower ownership expenses for NT resulting from less land preparation equipment in the machinery complement and lower irrigation ownership expenses resulting from the farm operator's use of irrigation wells supplied and maintained by the landlord.

Per acre net returns to the landlord for a typical 25 percent straight share rental arrangement are reported for comparison purposes in the last column in Table 2. Net returns to the landlord are invariant by operation size since these returns are derived primarily from the share of the crop and therefore are driven primarily by crop yields. Since expected crop yields in this study are lower for no-till than for conventional till management, per acre net returns to the landlord for NT and NT75 are smaller than those for CT.

Linear Programming Results

Optimal LP net return solutions for a 1200-acre rice operation under CT, NT, and NT75 are presented in Table 3. Solutions are reported for four scenarios: 1) the "Base Solution," in which the price of diesel and the labor wage are held at levels reported in 2004 Arkansas crop budgets ($0.90/gallon diesel; $6.70/hour labor); 2) a "High Fuel Cost" scenario, in which the price of off road diesel is raised to levels observed in Arkansas during the latter part of 2004 ($1.63/gallon); a "High Labor Cost" scenario, in which the per hour labor wage rate is raised to the level reported by the Arkansas Agricultural Statistics Service for Arkansas field workers in 2004 ($8.12/hour); and 4) a "High Fuel and Labor Cost" scenario where the price of diesel and the wage rate are the same as those in scenarios 2 and 3 above. Optimal solutions for each scenario were generated assuming 32 percent of total cropland acres are owned and 68 percent rented. These percentages were calculated using tenure data from the 2002 Census of Agriculture for counties comprising the Arkansas Grand Prairie region (Arkansas, Lonoke, Monroe, and Prairie Counties).

The optimal solutions for the 1200-acre operation are similar across tillage practices under the Base scenario. The NT strategy is slightly more profitable than CT under the Base scenario (+$3,333). The larger return for NT is totally attributable to higher returns on rented cropland, where NT nets $4,127 more return than CT. NT earns $794 less return on owned acres relative to CT under the Base scenario. The NT75 strategy is slightly less profitable than the CT strategy under the Base Scenario. Returns to NT75 are lower than those to CT on both owned and rented acres.

An increase in wage rate from $6.70/hour to $8.12/hour produces similar results relative to the Base Scenario. Under the High Labor Cost scenario, the NT strategy earns slightly more return for the 1200-acre operation when compared to the CT strategy (+$5,165). Again, the larger return for NT is attributed exclusively to higher returns on rented cropland, where NT nets $5,372 more return than CT. NT earns $208 less return on owned acres relative to CT under the High Labor Cost scenario. The NT75 strategy is again less profitable than the CT strategy under the High Labor Cost Scenario. The lower return to the NT75 strategy occurs on owned acres, where NT75 earns $1,633 less return than CT.

Return differences between NT and CT are much larger for the 1200-acre operation under the High Fuel Cost scenario and the High Fuel and Labor Cost scenario. Under the former scenario NT earns $7,358 more return than CT, while under the latter scenario NT earns $9,190 more return than CT. In both cases, NT earns more return than CT on both owned and rented cropland, with the largest share of the return difference attributable to rented cropland.

Optimal LP net return solutions for a 2400-acre rice operation under CT, NT, and NT75 are presented in Table 4. The optimal solution for NT is larger than that for CT in all four scenarios, with return differences ranging from +$18,603 under the Base scenario to +$31,551 under the High Fuel and Labor Cost scenario. The optimal net return for NT75 is also larger than that for CT in all four scenarios, ranging from +$14,090 under the Base scenario to +$23,991 under the High Fuel and Labor Cost scenario. The greater profitability of no-till strategies for the 2400-acre operation relative to the 1200-acre operation is due primarily to greater size economies for the larger farm operation. In all instances, the no-till strategies earn more return than CT on both owned and rented cropland. However, as in the case of the 1200-acre operation, the largest share of the return difference is attributable to returns from rented cropland.

Conclusions

The results of this study indicate that no-till management can be profitable for Arkansas rice production because of cost savings. The primary cost savings of no-till relative to conventional till are attributable to reduced ownership costs resulting from less dependence on land preparation equipment. Operating cost savings are also evident for no-till management in the form of lower fuel, repairs and maintenance, and labor expenses resulting from fewer land preparation operations prior to planting. However, a large portion of these cost savings is offset by higher herbicide application costs for no-till compared with conventional till management.

Operation size has a large impact on the profitability of no-till rice management. Larger operations may benefit more from no-till management than smaller operations due to greater size economies resulting from more efficient use of machinery. No-till management may magnify size economics that are already present in large operations by further lowering per acre ownership costs. Tenure also has a major impact on the profitability of no-till management in Arkansas rice production. The economic benefits from no-till management may be greater on rented land than on owned land given the structure of rental arrangements used in Arkansas rice production. On rented land, the farm operator benefits from use of irrigation wells that are supplied and maintained by the landlord. The landlord pays these "belowground" expenses. Thus, the farm operator's ownership expenses are lower on rented acres than on owned acres. No-till further magnifies ownership cost savings on rented acres by further reducing ownership costs associated with land preparation.

The current structure of rental arrangements in Arkansas rice production may act as a deterrent to no-till adoption. Crop share arrangements are the primary rental strategies used in Arkansas rice production, and the landlord's return is driven primarily by crop yields. Since cost savings from no-till accrue exclusively to the farm operator in these arrangements, the landlord benefits only if crop yields increase. Ancillary evidence from agronomic studies suggests that no-till crop yields are generally lower or not significantly different from conventional till crop yields in rice production, at least in the short run (Bollich, Cartwright et al., Pearce et al., Smith and Baltazar). Crop yields in this study were slightly lower for no-till than for conventional till, and corresponding per acre net returns to the landlord were also slightly lower. Thus adjustment may be required in current rental arrangements to allow landlords to receive some of the economic benefits of no-till management.

References

American Society of Agricultural Engineers. "ASAE Standards, Agricultural Machinery Management." ASAE EP496.2, February 2003.

American Society of Agricultural Engineers. "ASAE Standards, Agricultural Machinery Management Data." ASAE D497.4, February 2003.

Arkansas Department of Environmental Quality. "2002 Integrated Water Quality Monitoring and Assessment Report." Arkansas Department of Environmental Quality, Water Division. WQ02-10-1, 2002.

Arkansas Soil and Water Conservation Commission. "Arkansas' Nonpoint Source Pollution Management Program Annual Report 2002." Arkansas Soil and Water Conservation Commission, January 2003.

Bollich, P.K. "Conservation Tillage Practices for Rice in Southwest Louisiana." In: T.C. Keisling (ed.) Proceedings of the 1991 Southern Conservation Tillage Conference. Arkansas Agricultural Experiment Station, Special Report 148, June 1991, pp. 11-12.

Cartwright, R.D., C.E. Parsons, W.J. Ross, R. Eason, F.N. Lee, and G.E. Templeton. "Effect of Tillage System on Sheath Blight of Rice." In: R.J. Norman and T. H. Johnston (eds.) B.R. Wells rice research studies 1997. Arkansas Agricultural Experiment Station, Research Series 460, October 1998, pp. 245-250.

Cross, T.L. and G.M. Perry. "Depreciation Patterns for Agricultural Machinery." American Journal of Agricultural Economics, 77 (1), February 1995, pp. 194-204.

Cross, T.L. and G.M. Perry. "Remaining Value Functions for Farm Equipment." Applied Engineering in Agriculture, 12 (5), 1996, pp. 547-553.

Huitink, G, P. Tacker, J. Sills, M. Daniels, and J.C. Boils, Jr. "Soil Erosion and Clear Water." University of Arkansas Cooperative Extension Service, FSA1028, 1998.

Kleiss, B.A., R.H. Coupe, G.J. Gonthier, and B.G. Justus. "Water Quality in the Mississippi Embayment, Mississippi, Louisiana, Arkansas, Missouri, Tennessee, and Kentucky, 1995-98." U.S. Department of the Interior, U.S. Geological Survey, Circular 1208, 2000.

Parsch, L.D. and D.M. Danforth. "Rice Rental Arrangements in Arkansas." Proceedings of the 25th Rice Technical Working Groups, New Orleans, LA, March 6-9, 1994, pp. 77-78.

Pearce, A.D., C.R. Dillon, T.C. Keisling, and C.E. Wilson, Jr. "Economic and Agronomic Effects of Four Tillage Practices on Rice Produced on Saline Soils." Journal of Production Agriculture, 12 (2), 1999, pp. 305-312.

Smith, R.J., Jr. and A.M. Baltazar. "Reduced- and No-Tillage Systems for Rice and Soybeans." In: B.R. Wells (ed.) Arkansas Rice Research Studies, 1991. Arkansas Agricultural Experiment Station, Research Series 422, June 1992, pp. 104-107.

United States Department of Agriculture, Economic Research Service. "Rice Situation and Outlook Yearbook." Market and Trade Economics Division, Economic Research Service, U.S. Department of Agriculture, RCS-2003, November 2003.

United States Environmental Protection Agency. "Final Arkansas 2002 303(d) List: Final EPA Action June 9, 2003." U.S. Environmental Protection Agency. http://www.epa.gov/earth1r6/6wq/ecopro/artmdl/final_ar_2002_303d_list.pdf

Watkins, K.B., M.M. Anders, and T.E. Windham. "An Economic Comparison of Alternative Rice Production Systems in Arkansas." Journal of Sustainable Agriculture, 24 (4), 2004, pp. 57-78.

Wilson, C.E. Jr., and J.W. Branson. "Trends in Arkansas Rice Production." In: R.J. Norman, J.-F. Meullenet, and K.A.K. Moldenhouer (eds.). B.R. Wells Rice Research Studies 2003. University of Arkansas Agricultural Experiment Station, Research Series 517, August 2004, pp.15-21.

Table 1. General Specification of Linear Programming Models for Arkansas Rice Farms Growing Rice and Soybeans in a Two-Year Rotation.

	Owned								Rented								
	Rice			Soybean					Rice			Soybean					
Constraint	CT[a]	NT	NT75	CT	NT	NT75	Fuel	Labor	CT	NT	NT75	CT	NT	NT75	Fuel	Labor	RHS
Objective	OR_{CT}	OR_{NT}	OR_{NT75}	OS_{CT}	OS_{NT}	OS_{NT75}	-F	-L	RR_{CT}	RR_{NT}	RR_{NT75}	RS_{CT}	RS_{NT}	RS_{NT75}	-F	-L	
Total Acres	1	1	1	1	1	1			1	1	1	1	1	1			≤ A
Owned Acres	1	1	1	1	1	1											≤ A_O
Rented Acres									1	1	1	1	1	1			≤ A_R
CT Acres	1			1					1			1					≤ A_{CT}
NT Acres		1			1					1			1				≤ A_{NT}
NT75 Acres			1			1					1			1			≤ A_{NT75}
Owned Fuel	FR_{CT}	FR_{NT}	FR_{NT75}	FS_{CT}	FS_{NT}	FS_{NT75}	-1										≤ 0
Owned Labor	LR_{CT}	LR_{NT}	LR_{NT75}	LS_{CT}	LS_{NT}	LS_{NT75}		-1									≤ 0
Rented Fuel									FR_{CT}	FR_{NT}	FR_{NT75}	FS_{CT}	FS_{NT}	FS_{NT75}	-1		≤ 0
Rented Labor									LR_{CT}	LR_{NT}	LR_{NT75}	LS_{CT}	LS_{NT}	LS_{NT75}		-1	≤ 0
Owned CT Rotation	-1			1													= 0
Owned NT Rotation		-1			1												= 0
Owned NT75 Rotation			-1			1											= 0
Rented CT Rotation									-1			1					= 0
Rented NT Rotation										-1			1				= 0
Rented NT75 Rotation											-1			1			= 0

[a] CT = Conventional Till; NT = No-Till; NT75 = No-Till 75 percent (3 out of 4 years); OR = return above operating and ownership expenses to owned rice acres ($/acre); OS = return above operating and ownership expenses to owned soybeans acres; RR = Return above operating and ownership expenses to rented rice acres; RS = return above operating and ownership expenses to rented soybeans acres; A = total cropland acres; A_O and A_R = owned and rented acres, respectively; A_{CT}, A_{NT}, and A_{NT75} = Conventional Till, No-Till, and No-Till 75 percent acres, respectively; F = diesel price ($/gallon); L = labor wage ($/hour); FR and FS = diesel requirement for rice and soybeans, respectively (gallons/acre); LR and LS = labor requirements for rice and soybeans, respectively (hours/acre).

Table 2. Per Acre Returns and Expenses for 1200 and 2400 Acre Arkansas Rice Farms Producing Rice and Soybeans in a Two-Year Rotation.

		Owned				Rented				
Enterprise	Tillage	Gross Return	Operating Expenses	Ownership Expenses	Net Return	Gross Return	Operating Expenses	Ownership Expenses	Net Return	Landlord's Net Return[c]
					1200 Acre Operation ($/acre)					
Rice	CT[a]	588.80	196.38[b]	83.17	309.25	441.60	193.26	73.88	174.46	134.79
	NT	553.60	192.49	62.47	298.64	415.20	189.37	53.18	172.65	125.99
	NT75	562.40	193.34	72.54	296.52	421.80	190.22	63.25	168.33	128.19
Soybean	CT	250.70	141.39	73.41	35.90	188.03	140.46	64.12	-16.55	52.45
	NT	228.90	133.41	53.12	42.37	171.68	132.47	43.83	-4.63	47.00
	NT75	234.35	135.30	62.98	36.07	175.76	134.37	53.69	-12.29	48.36
Farm[d]	CT	419.75	168.88	78.29	172.58	314.81	166.86	69.00	78.96	93.62
	NT	391.25	162.95	57.80	170.51	293.44	160.92	48.50	84.01	86.50
	NT75	398.38	164.32	67.76	166.30	298.78	162.29	58.47	78.02	88.28
					2400 Acre Operation ($/acre)					
Rice	CT	588.80	194.48	67.88	326.44	441.60	191.36	58.59	191.65	134.79
	NT	553.60	187.13	46.16	320.31	415.20	184.01	36.87	194.32	125.99
	NT75	562.40	188.93	51.53	321.94	421.80	185.81	42.24	193.75	128.19
Soybean	CT	250.70	140.92	64.00	45.78	188.03	139.98	54.71	-6.67	52.45
	NT	228.90	130.04	42.33	56.53	171.68	129.10	33.04	9.53	47.00
	NT75	234.35	132.82	47.36	54.17	175.76	131.89	38.07	5.81	48.36
Farm	CT	419.75	167.70	65.94	186.11	314.81	165.67	56.65	92.49	93.62
	NT	391.25	158.58	44.25	188.42	293.44	156.56	34.95	101.93	86.50
	NT75	398.38	160.88	49.45	188.05	298.78	158.85	40.15	99.78	88.28

[a] CT = Conventional Till; NT = No-Till; NT75 = No-Till 75 percent (3 out of 4 years).
[b] Owned and rented operating expenses calculated assuming a labor wage of $6.70/hour and a diesel price of $0.90/gallon.
[c] Landlord's net return is calculated as gross returns (25 percent of owned gross returns) less belowground irrigation expenses associated with well, pump, and gearhead ($12.41/acre rice; $10.22/acre soybean).
[d] Per acre farm returns and expenses are calculated as one-half acre rice plus one-half acre soybean assuming a two-year rice-soybean rotation for each farm operation.

Table 3. Linear Programming Net Return Optimal Solutions for 1200 Acre Arkansas Rice Farm Producing Rice and Soybeans in a Two-Year Rotation

Optimal Solution	CT [a]	NT	NT75	Difference NT-CT	Difference NT75-CT
Diesel Price = $0.90/gallon, Labor = $6.70/hour (Base Solution)					
Farm [b]	130,699	134,032	127,524	3,333	-3,175
Owned Return	66,270	65,476	63,858	-794	-2,412
Rented Return	64,429	68,556	63,666	4,127	-764
Diesel Price = $1.63/gallon, Labor = $6.70/hour (High Fuel Cost)					
Farm [b]	104,498	111,856	104,787	7,358	289
Owned Return	57,885	58,379	56,582	494	-1,303
Rented Return	46,613	53,476	48,205	6,864	1,592
Diesel Price = $0.90/gallon, Labor = $8.12/hour (High Labor Cost)					
Farm [b]	125,263	130,428	123,630	5,165	-1,633
Owned Return	64,530	64,322	62,612	-208	-1,918
Rented Return	60,733	66,105	61,018	5,372	285
Diesel Price = $1.63/gallon, Labor = $8.12/hour (High Fuel and Labor Costs)					
Farm [b]	99,062	108,252	100,893	9,190	1,831
Owned Return	56,146	57,226	55,336	1,080	-810
Rented Return	42,916	51,026	45,557	8,109	2,641

[a] CT = Conventional Till; NT = No-Till; NT75 = No-Till 75 percent (3 out of 4 years)

[b] Assumes 32 percent of total cropland acres are owned and 68 percent are rented.

Table 4. Linear Programming Net Return Optimal Solutions for 2400 Acre Arkansas Rice Farm Producing Rice and Soybeans in a Two-Year Rotation

Optimal Solution	CT [a]	NT	NT75	Difference NT-CT	Difference NT75-CT
Diesel Price = $0.90/gallon, Labor = $6.70/hour (Base Solution)					
Farm [b]	292,448	311,051	306,538	18,603	14,090
Owned Return	142,935	144,708	144,426	1,773	1,491
Rented Return	149,513	166,344	162,112	16,830	12,599
Diesel Price = $1.63/gallon, Labor = $6.70/hour (High Fuel Cost)					
Farm [b]	238,233	266,699	260,145	28,467	21,912
Owned Return	125,586	130,515	129,580	4,929	3,994
Rented Return	112,647	136,184	130,565	23,538	17,918
Diesel Price = $0.90/gallon, Labor = $8.12/hour (High Labor Cost)					
Farm [b]	282,173	303,860	298,341	21,687	16,168
Owned Return	139,647	142,406	141,803	2,760	2,156
Rented Return	142,526	161,454	156,538	18,928	14,012
Diesel Price = $1.63/gallon, Labor = $8.12/hour (High Fuel and Labor Costs)					
Farm [b]	227,957	259,508	251,949	31,551	23,991
Owned Return	122,298	128,214	126,957	5,916	4,659
Rented Return	105,660	131,295	124,991	25,635	19,332

[a] CT = Conventional Till; NT = No-Till; NT75 = No-Till 75 percent (3 out of 4 years)

[b] Assumes 32 percent of total cropland acres are owned and 68 percent are rented.