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Economics of Furrow Irrigated Rice in Northeast Louisiana

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Furrow irrigated rice, or row rice, is a production practice that has been utilized in the Mid-South region since the late 1980's. Furrow irrigated rice has spread in popularity across the Mississippi River Delta Region in recent years. Much of this popularity is driven by the attractive yield potential, reduced input usage (e.g. labor), and efficient use of water. In the Delta Region, much attention for alternative rice irrigation practices rests on the potential for reduced groundwater withdrawal. Ongoing research is being conducted in areas of variety performance, nitrogen use efficiency, weed control, and irrigation efficiency by several land grant universities. Furrow irrigation and alternative wetting and drying (AWD) practices are at the forefront of water use research due to their potential to reduce water use without reducing yields. While both water management practices have the potential to reduce water use, quantity and timing of seasonal rainfall also plays a large role in the amount of water use of each water management practice.

Furrow irrigated rice is expected to increase significantly across the Mid-South this spring given the increased focus on farming sustainability and the announcement of furrow irrigated rice being covered by crop insurance. In Louisiana, furrow irrigated rice acres are expected to increase from just over 15,000 in 2019 to nearly 30,000 in the spring of 2020. However, it is important to note that weed control, fertility, and field cultivation activities can be difficult to quantify with this new practice as there are currently no university recommended best management practices that have been evaluated for economic efficiency. The use of chemicals and fertilizer may increase but potential cost savings may come in the way of reduced field passes (times over) and alterations in irrigation scheduling/timing. This report attempts to present a partial budget for the production of furrow irrigated rice in Louisiana. The production of furrow irrigated rice may vary from farm-to-farm based on the fact that this practice is relatively 'new.' Information from agricultural popular press, as well as, experimental data from both grower cooperators and LSU AgCenter experts are summarized in the following section. While research is ongoing, this economic report is intended to provide an estimated range of input costs per acre and sensitivity analysis of net returns above variable cost per acre.

The Federal Crop Insurance Corporation (FCIC) amended the Common Crop Insurance Regulations, Rice Crop Insurance Provisions to allow for new irrigation methods to align with changes contained within the 2018 Farm Bill effective for the 2020 and successive crop years. The 2018 Farm Bill required that the FCIC research and develop an insurance product that provides coverage for alternative irrigation practices for rice; specifically, alternate wetting and drying (intermittent flooding) and furrow irrigation practices. Prior to this rule, only continuously-flooded rice was covered under the Rice Crop Provisions. "*The intermittent flood irrigation and furrow irrigation methods are desirable alternatives to continuous flood* *irrigation because they produce a similar yield to continuously flooded fields while using less water and lowering greenhouse gas emissions*."

Intermittent flood irrigation is also known as alternative wetting and drying (AWD). AWD allows flood irrigation water within a field to subside naturally (dry down) during certain rice growth and development stages before the field is flooded again. Furrow irrigation is a method of crop irrigation where furrows are created to convey water down the field; capacity and equipment must be able to apply water uniformly across the crown of the field to assure water delivery to all rice plants in the field. These alternative production practices can offer existing rice growers flexibility to choose the most appropriate irrigation method for their farming operations while maintaining crop insurance eligibly.

General recommendations from LSU AgCenter Parish Agriculture and Natural Resource Agents, Specialists, and Louisiana rice growers with experience with FIR have highlighted the following recommendations at multiple meetings over the past year for the water management practice:

- Blast is one of the most destructive diseases in rice. Growing rice in upland conditions, like furrow irrigated rice, favors the development of the disease. Cultivar selection is critical and should include a cultivar resistant or moderately resistant to blast. Cultivars with less resistance to blast may require an additional fungicide application as compared flooded rice.
- FIR can change the insect spectrum as compared to flooded rice. Billbugs, which cannot survive in a flooded rice field, have thrived in furrow irrigated rice. The rice water weevil (RRW), which is the major pest in flooded rice, has shown to be less of a concern in the aerobic portion of FIR fields, however, in the bottom portions of FIR fields, where water is held, the weevil can still be problematic. Insecticide seed treatments that control the RRW should still be used in FIR.
- FIR can cause a shift in the weed spectrum as compared to flooded rice. Excellent weed control until the canopy closes in FIR is critical. Overlapping residual herbicides in FIR is often used to control troublesome weeds until canopy closure. FIR generally requires additional an herbicide application and increased production costs due to the expanded time to canopy closure and the absence of the flood as a weed control practice.
- Nitrogen (*N*) fertilizer and seed costs are the two largest expenses in row rice. Due to the alternating saturated and dry surface soil conditions in FIR, *N* fertilizer use is less efficient. Overcoming the reduced *N* use efficiency is generally accomplished by using approximately 100 pounds more urea during the growing season and implementing multiple *N* applications (spoon feeding). This practice also carries an aerial application fee per application. Most FIR growers are applying 3-split applications of 100 pounds of urea beginning at 4-leaf rice separated 7- to 10-days apart. Mid-season *N* applications are applied, if needed, according to visual evaluation, similar to mid-season applications in flooded rice.
- Harvest and post-harvest plans are critical. The need for and the ability to have on-farm storage for rice is important. An optimal window of harvest time conditions would equate to 100 acres per day. Growers should synchronize the logistics of row rice harvest along with corn and soybean harvest schedules. Growers must remember that the wait time at a rice mill is longer as compared to the wait at a grain elevator.

Economic information for this analysis was obtained through a demonstration field as published in the LSU Agricultural Center's Rice Research Verification Program, the 2019 LSU AgCenter's Row Rice Field Tour, and through conversations with grower cooperators, and rice consultants. Tables 1-4. Chemical costs are reflective of a Clearfield and non-Clearfield hybrid rice production system. *N* was applied via four applications. Irrigation costs are based on six applications of 3, 3, 5, 5, 5, and 5 acreinches. These direct cost estimates are projections and are not intended to be interpreted as a recommended average cost of production. It is, however, an attempt to estimate an initial per-acre cost for furrow irrigated rice in Northeast Louisiana.

Table 1. Estimated cost of producing furrow irrigated Clearfield hybrid rice production in Louisiana, 2020.

DIRECT EXPENSES	UNIT	PRICE	QTY	AMOUNT
CUSTOM SPRAY				
GPS Fee	acre	$0.25	7.00	$1.75
DRYING				
Drying Fee	cwt	$0.90	88.00	$79.20
FERTILIZERS				
N	lb	$0.41	200.00	$82.00
P	lb	$0.38	60.00	$22.80
K	lb	$0.27	40.00	$10.80
FUNGICIDES				
Stratego	pt	$60.00	0.70	$42.00
INSECTICIDES				
Karate Z	oz	$3.40	4.00	$13.60
SEED				
Clearfield Hybrid	acre	$170.00	1.00	$170.00
SERVICE FEE				
Digital Ag Fee	acre	$8.50	1.00	$8.50
CUSTOM FERT				
Aerial App. Fee	app	$7.00	4.00	$28.00
CUSTOM HAUL				
Haul	cwt	$0.30	80.00	$24.00
LABOR-HAND				
Implements	hour	$9.06	0.09	$0.82
LABOR-OPERATOR				
Self-Propelled	hour	$15.30	0.33	$5.05
LABOR-HIRED				
Tractors	hour	$11.33	0.49	$5.59
LABOR IRRIGATION				
Irrg. System	hour	$11.33	0.44	$4.94
DIESEL FUEL PRICE				
Tractors Self	gal	$2.44	6.76	$16.50
Self-Propelled	gal	$2.44	2.58	$6.30
Irrigation System	gal	$2.44	23.90	$58.32
REPAIR & MAINTENANCE	acre	$26.59	1.00	$26.59
INTEREST ON CAPITAL	acre	$9.01	1.00	$9.01
TOTAL DIRECT EXPENSES LESS HERB.	acre			$615.76

Table 2. Estimated herbicide prescription for Clearfield hybrid furrow irrigated rice in Louisiana.

HERBICIDES (Alternative A- CL Hybrid)				
DIRECT EXPENSES	UNIT	PRICE	QTY	AMOUNT
Sharpen	oz	$5.66	2.0	$11.32
Command	pt	$16.09	1.0	$16.09
Roundup	pt	$6.00	4.0	$24.00
Rice One	oz	$0.47	45.0	$21.15
Clearpath	lb	$57.57	0.6	$34.54
CUSTOM SPRAY				
Aerial App. Fee	app	$6.50	6.00	$39.00
TOTAL DIRECT EXPENSES	acre			$761.86

Information presented in Table 2 attempts to reflect the expected weed control measures that a producer in northeastern Louisiana would need to plan for in a FIR system. Based on conversations with agricultural professionals in the region, the use of Sharpen, Command, Roundup, Rice One, and Clearpath were recommended as representative herbicide control treatments for both pre and post emergence. The estimated total (to include application fees) is $107.10 per acre, a substantial outlay on a per-acre basis. These herbicide costs should be interpreted as a representative upper bound on what the realized weed control costs could be, their overall purpose is to serve as a conservative estimate for this particular expenditure in FIR. Individual producers' herbicide costs will vary given weed pressure, environmental conditions present for a producer's specific region/field(s), and cost structure/discounts available from their local chemical supplier. The chemical costs that are included in Table 2 were calculated from estimates obtained from local area cooperators, LSU Extension Agents, and the Mississippi State Extension Service.

Table 3. Estimated cost of producing furrow irrigated hybrid rice production in Louisiana, 2020.

DIRECT EXPENSES	UNIT	PRICE	QTY	AMOUNT
CUSTOM SPRAY				
GPS Fee	acre	$0.25	7.00	$1.75
DRYING				
Drying Fee	cwt	$0.90	88.00	$79.20
FERTILIZERS				
N	lb	$0.41	200.00	$82.00
P	lb	$0.38	60.00	$22.80
K	lb	$0.27	40.00	$10.80
FUNGICIDES				
Stratego	pt	$60.00	0.70	$42.00
INSECTICIDES				
Karate Z	oz	$3.40	4.00	$13.60
SEED				
Non-CL Hybrid	acre	$150.00	1.00	$150.00
SERVICE FEE				
Digital Ag Fee	acre	$8.50	1.00	$8.50
CUSTOM FERT				
Aerial App. Fee	app	$7.00	4.00	$28.00
CUSTOM HAUL				
Haul	cwt	$0.30	80.00	$24.00
LABOR-HAND				
Implements	hour	$9.06	0.09	$0.82
LABOR-OPERATOR				
Self-Propelled	hour	$15.30	0.33	$5.05
LABOR-HIRED				
Tractors	hour	$11.33	0.49	$5.59
LABOR IRRIGATION				
Irrg. System	hour	$11.33	0.44	$4.94
DIESEL FUEL PRICE				
Tractors Self	gal	$2.44	6.76	$16.50
Self-Propelled	gal	$2.44	2.58	$6.30
Irrigation System	gal	$2.44	23.90	$58.32
REPAIR & MAINTENANCE	acre	$26.59	1.00	$26.59
INTEREST ON CAPITAL	acre	$9.01	1.00	$9.01
TOTAL DIRECT EXPENSES LESS HERB.	acre			$595.76

Table 4. Estimated herbicide prescription for hybrid furrow irrigated rice in Louisiana.

HERBICIDES (Alternative B- non CL Hybrid)				
DIRECT EXPENSES	UNIT	PRICE	QTY	AMOUNT
Sharpen	oz	$5.66	2.0	$11.32
Command	pt	$16.09	1.0	$16.09
Roundup	pt	$6.00	4.0	$24.00
Rice One	oz	$0.47	45.0	$21.15
Stam	qt	$7.91	3.0	$23.73
Permit	oz	$21.22	0.75	$15.92
Facet	pt	$13.61	2.6	$35.39
CUSTOM SPRAY				
Aerial App. Fee	app	$6.50	6.00	$39.00
TOTAL DIRECT EXPENSES	acre			$782.35

Information presented in Table 4 attempts to reflect the expected weed control measures associated with FIR in northeastern Louisiana. Based on conversations with agricultural professionals in the region, the use of Sharpen, Command, Roundup, Rice One, Stam, Permit, and Facet could represent the pre and post emergence herbicide control measures necessary to in a FIR system. The estimated total (to include application fees) is $147.59 per acre, a substantial outlay on a per-acre basis.

The information in Tables 1 through 4 provides the cost structure of FIR which, in turn, incorporates additional aerial application fees for herbicides, additional *N*, as well as additional herbicide prescriptions employing Command, and Regiment specific to burndown and post-emergent weed control practices commonly encountered in FIR. Total direct costs per acre are estimated to be $712.95 but will most likely vary with weed pressure intensity.

The clearest benefit of furrow-irrigated rice is increased efficiency in planting, irrigation and harvest. Rice can often be no-tilled on beds from the previous year's crop. Fields left bedded will dry out quicker in the spring, allowing for more planting days between precipitation events. Less labor is required to irrigate furrow rice in a timely manner, allowing more land to be used for rice production. Another benefit of this production practice is harvest efficiency. Furrow-irrigated rice is harvested much like wheat, simultaneously as one field unit, as compared to having to harvest each paddy individually in a traditionally flooded rice production system. Also, fields in FIR can be re-bedded and left until spring with corn or soybeans no-tilled in. Through the use of no-till, a producer can save an estimated $7.82 per acre by omitting the activities of disking, hipping, and ditching fields typical to traditional flooded systems.

There are no appreciable water savings for FIR compared to permanent flood on every field in every year. Water savings, if observed, varies from year-to-year and field-to-field. Nitrogen deficiency and reduced yields on the top third of fields can be an issue due to lower fertilizer use efficiency where the soil is intermittently wet and dry but never completely flooded. Weed control can also be a challenge without the establishment of a permanent flood to aid in weed suppression.

Prior work done by the University of Missouri provides a perspective of both the advantages and disadvantages of FIR. The potential advantages for FIR include:

- Ability to rotate crops without tearing down levees, rebedding and annually reworking the ground.
- Have fields prepared in the fall for any crop next spring, allowing for crop mix flexibility.
- Eliminate levees to gain more planted land area.
- Grow rice on irregularly pitched fields.
- Grow rice on sandy soils.
- Establish permanent beds on heavy clay soils and on zero grade fields (for soybeans).

However, the disadvantages for FIR include:

- Comparisons for both yield and grain quality between traditionally flooded production rice systems and row rice are not easily made.
- Water management uniformity more difficult. (Upper 1/3, middle 1/3, lower 1/3)
- Fertilizer management uniformity more difficult. (Upper 1/3, middle 1/3, lower 1/3)
- Weed control more difficult. (Upper 1/3, middle 1/3, lower 1/3)
- Disease, particularly blast, potential is greater.
- Potential for more adjustments of pesticide applications.
- Row rice calls for the purchase and handling of collapsible poly tubing.
- Harvest window is the same as flooded rice but deep furrows can cause problems if the rice lodges.

Although all field conditions are not identical, this comparison of production costs is an initial attempt to evaluate system differences between FIR and traditional flooded rice. Through limited data observations, initial burndown herbicide applications appear to be similar for both Clearfield hybrid (furrow irrigated rice) and Clearfield (flood irrigated) systems. Field ditches, planting costs, and harvest costs (one combine with two grain carts) are also similar. Seed cost is the first major difference that appears in a comparison of the two systems as hybrid rice is preferred in FIR. Outside of seed cost, irrigation expenses are marginally higher in a continuous flood system as in FIR. For a row rice system, residual herbicides are required to keep the fields 'cleaner' for a longer period of time and may need to be overlapped until canopy closure. Differences in production cost categories were higher in the row rice system for seed, herbicide, and fertilizer. The flooded rice system had lower costs for herbicide, herbicide application, fungicide, fungicide application, fertilizer, fertilizer application, and irrigation. Nevertheless, lower chemical costs do not fully offset the increased costs associated with hybrid seed and greater fertilizer usage.

Prior to furrow irrigated rice adoption, growers need to consider their anticipated costs and returns. Likely, furrow irrigated rice will be produced in conjunction with corn, soybeans, and even cotton on northeastern Louisiana farms. Net returns above variable production cost is the appropriate metric one may use in making production decision comparisons among crops in the short run period of one crop year. Net returns above variable production costs (including land rent) are calculated and the differences between these values gives an estimate of the net return advantage of one crop over the other at assumed levels of cost, yield and price. Through funding provided by the Louisiana Rice Research Board, a farm management decision tool was developed to calculate net returns above variable costs and land rent for furrow irrigated rice, soybeans, and corn to show the differences between the net returns for two competing crops in tabular format. The values shown in the table can be interpreted as the advantage in net returns per acre for one crop (whose market prices are listed along the left side of the table) compared to the other crop (whose market prices are listed along the top of the table). For the range of market price combinations for which the crop on the left has a net return advantage over the other crop, those cell values with positive net return differences will be shaded yellow. As values for variable cost, yield, and rent are changed, the corresponding net return differences and highlighted cells with a net return advantage will change accordingly.

Figure 2 provides a net return comparison between row rice and soybeans. Production costs for rice that appear in the table represent the variable costs for a row rice system and are expressed in a single dollar amount per acre. The net return advantage (disadvantage) of rice is presented over a range of expected price and yield combinations. Farm program payments are not included in the table. Land rent is set at a 20% share, although, the option to enter a cash rent exists.

Figure 2. Net return comparison of rice to soybean production, under a range of rice prices and yields.

Rice Net Return Advantage Compared to Soybean Net Returns

			Soybean Price =	$9.00	per bushel
Rice Variable Costs =	$770	per acre	Soybean Variable Costs =	$415	per acre
			Soybean Expected Yield =	65	bushels per acre
Rice Share Rent =	20%	crop share	Soybean Share Rent =	20%	crop share
Rice Cash Rent =	$0	per acre	Soybean Cash Rent =	$0	per acre

Rice Yield (lbs/acre)

Rice Price ($/lb)	8,000	8,050	8,100	8,150	8,200	8,250	8,300	8,350	8,400
$0.1100	-119	-115	-110	-106	-101	-97	-93	-88	-84
$0.1125	-103	-99	-94	-90	-85	-81	-76	-72	-67
$0.1150	-87	-82	-78	-73	-69	-64	-59	-55	-50
$0.1175	-71	-66	-62	-57	-52	-47	-43	-38	-33
$0.1200	-55	-50	-45	-41	-36	-31	-26	-21	-17
$0.1225	-39	-34	-29	-24	-19	-14	-10	-5	$0
$0.1250	-23	-18	-13	-8	-3	$2	$7	$12	$17
$0.1275	-7	-2	$3	$8	$13	$19	$24	$29	$34
$0.1300	$9	$14	$19	$25	$30	$35	$40	$45	$51
$0.1325	$25	$30	$36	$41	$46	$52	$57	$62	$67
$0.1350	$41	$46	$52	$57	$63	$68	$73	$79	$84
$0.1375	$57	$63	$68	$74	$79	$85	$90	$96	$101
$0.1400	$73	$79	$84	$90	$95	$101	$107	$112	$118
$0.1425	$89	$95	$100	$106	$112	$118	$123	$129	$135
$0.1450	$105	$111	$117	$122	$128	$134	$140	$146	$151
$0.1475	$121	$127	$133	$139	$145	$151	$156	$162	$168

Values in table equal to rice net returns minus soybean net returns above variable costs

Figure 3 provides a net return comparison of row rice compared to a competing corn enterprise. The same methodology previously described is applied to this analysis. For each competing enterprise, production costs are entered as a fixed dollar amount so that system costs can be considered.

Figure 3. Net return comparison of rice to corn production under a range of rice prices and yields.

Rice Net Return Advantage Compared to Corn Net Returns

		Corn Price =	**$3.60** per bushel
Rice Variable Costs =	**$770** per acre	Corn Variable Costs =	**$520** per acre
		Corn Expected Yield =	**190** bushels per acre
Rice Share Rent =	**20%** crop share	Corn Share Rent =	**20%** crop share
Rice Cash Rent =	**$0** per acre	Corn Cash Rent =	**$0** per acre

Rice Yield (lbs/acre)

Rice Price ($/lb)	**8,000**	**8,050**	**8,100**	**8,150**	**8,200**	**8,250**	**8,300**	**8,350**	**8,400**
$0.1100	-93	-89	-84	-80	-76	-71	-67	-62	-58
$0.1125	-77	-73	-68	-64	-59	-55	-50	-46	-41
$0.1150	-61	-57	-52	-47	-43	-38	-34	-29	-24
$0.1175	-45	-40	-36	-31	-26	-22	-17	-12	-8
$0.1200	-29	-24	-20	-15	-10	-5	0	**$4**	**$9**
$0.1225	-13	-8	-3	**$2**	**$6**	**$11**	**$16**	**$21**	**$26**
$0.1250	**$3**	**$8**	**$13**	**$18**	**$23**	**$28**	**$33**	**$38**	**$43**
$0.1275	**$19**	**$24**	**$29**	**$34**	**$39**	**$44**	**$49**	**$55**	**$60**
$0.1300	**$35**	**$40**	**$45**	**$50**	**$56**	**$61**	**$66**	**$71**	**$76**
$0.1325	**$51**	**$56**	**$61**	**$67**	**$72**	**$77**	**$83**	**$88**	**$93**
$0.1350	**$67**	**$72**	**$78**	**$83**	**$88**	**$94**	**$99**	**$105**	**$110**
$0.1375	**$83**	**$88**	**$94**	**$99**	**$105**	**$110**	**$116**	**$121**	**$127**
$0.1400	**$99**	**$104**	**$110**	**$116**	**$121**	**$127**	**$132**	**$138**	**$144**
$0.1425	**$115**	**$121**	**$126**	**$132**	**$138**	**$143**	**$149**	**$155**	**$160**
$0.1450	**$131**	**$137**	**$142**	**$148**	**$154**	**$160**	**$166**	**$171**	**$177**
$0.1475	**$147**	**$153**	**$159**	**$165**	**$170**	**$176**	**$182**	**$188**	**$194**

Values in table equal to rice net returns minus corn net returns above variable costs

This farm management decision tool is available via the LSU AgCenter website. Please visit www.lsuagcenter.com and selected crops-rice-budgets.

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