

## **Economic Feasibility Analysis of Tail-water Recovery Systems in the Mississippi Delta**

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# **Economic Feasibility Analysis of Tail-water Recovery Systems in the Mississippi Delta**

## **Objective**

The objective of this paper is to evaluate the economic feasibility of constructing tail-water recovery systems as a source for supplemental irrigation water in the Mississippi Delta.

## **Background**

Land area in the Mississippi Delta experiencing effects of dewatering increased from 1.2 million acres (27%) in 1993 to 1.8 million acres (40%) in 2013. In response to the drawdown in the aquifer various water conservation practices are currently being proposed and/or implemented. These include practices that improve furrow irrigation efficiency such as varying the size of punched holes in irrigation pipe for varying row lengths, use of surge valves and/or using soil moisture sensor technology for irrigation timing. These practices require a small initial investment to adopt. Tail-water recovery systems have been proposed to conserve the aquifer by providing supplemental surface water for irrigation purposes. Tail-water recovery systems require large initial investments to install.

## **Data and Methods**

This study compares the expected net present value of estimated returns to land, unpaid management and profit generated by corn and soybean production projected over the 2014-2023 time period for non-irrigated production, furrow irrigation with and without a tail-water recovery system, and center pivot irrigation with and without a tail-water recovery system. The net present value (NPV) method uses the discounting formula the non-uniform series of projected returns for

the production systems to value the respective net returns at one point in time (Barry, Hopkin and Baker).

$$NPV = -INV + \sum_{n=1}^{10} \frac{P_n}{(1+i)^n}$$

where:

$INV$  = tail water recovery system cost per acre,  
 $P_n$  = net returns per acre to land, unpaid management and profit in  
year  $n$ ,  
 $i$  = discount rate.

The net present value criterion directly accounts for the timing and magnitude of the investment in tail water recovery and projected returns. The sign and size of each alternative's net present value determines its ranking and acceptability. For this study, all alternatives are income generating so the investment with the largest net present value is the most favored. The discount rate for a particular investment is the rate that the equity capital employed in each enterprise could return in its most favorable alternative use. Since this value would vary from producer to producer, the discount rates used in this study are parameterized over a range of 5% to 10%.

The decision support aid developed for this study is based on enterprise budgets developed by Mississippi State University Extension personnel. These include budgets for non-irrigated soybeans, non-irrigated corn, furrow irrigated soybeans, furrow irrigated corn, center-pivot irrigated soybeans and center-pivot irrigated corn (MSU) and are shown in Appendix I.

Investment costs for center-pivot and tail-water recover system are based on local cost estimates

and are adjusted for cost assistance payments available from the Natural Resource Conservation Service (NRCS) Environmental Quality Enhancement Program (Appendix II).

The output prices and yields for soybeans and corn along with input prices for soybean and corn production are adjusted on an annual basis over the planning horizon. These adjustments are the calculated percentage changes in indices of prices paid by farmers for each item forecast in the Food and Agricultural Policy Research Institute (FAPRI) U.S. Baseline Briefing Book (Appendix III).

An important component in calculating the expected net present value of estimated returns to land, unpaid management and profit for each one of these systems is the amount of acreage that is available to farm in each system. The baseline analysis in this study is for a 160 acre square tract. Each production system's productive acreage is adjusted for turn rows, ditches and tail-water recovery reservoir if applicable. The acreage available to farm for each system is shown below in Table 1 with drawings for each system shown in Appendix IV.

Table 1. Acres Available to Farm for Each System.

System	Irrigated Acres	Dryland Acres
Dryland	0	151.86
Furrow Irrigated	147.88	0
Furrow Irrigated - TWR	132.9	0
CP Irrigated	133.66	17.2
CP Irrigated - TWR	122.27	11.9

## Results and Discussion

Initial tail-water recovery system investment costs of \$801.61 per acre are estimated after NRCS assistance (Appendix II). Calculated NPV results for each system are shown below in Table 2.

Table 2. Net Present Value Analysis Results for Alternative Irrigation Systems.

System	NPV @ 5%	NPV @ 6%	NPV @ 7%	NPV @ 8%	NPV @ 9%	NPV @ 10%
Dryland	\$ 343,668	\$ 327,193	\$ 311,869	\$ 297,600	\$ 284,296	\$ 271,878
Furrow Irrigated	\$ 507,321	\$ 482,611	\$ 459,643	\$ 438,268	\$ 418,351	\$ 399,771
Furrow Irrigated - TWR	\$ 345,302	\$ 323,286	\$ 302,823	\$ 283,780	\$ 266,036	\$ 249,483
CP Irrigated	\$ 479,972	\$ 456,585	\$ 434,846	\$ 414,615	\$ 395,764	\$ 378,179
CP Irrigated - TWR	\$ 337,210	\$ 316,465	\$ 297,184	\$ 279,241	\$ 262,522	\$ 246,926
CP Investment- No TWR - From Dryland	\$ 462,878	\$ 436,740	\$ 412,442	\$ 389,827	\$ 368,752	\$ 349,090

Depending on the discount rate selected, conversion of a furrow irrigated 160 acre tract to a tailwater recovery system would result in a reduction in net present value ranging from \$149,928 at a 10% discount rate to a reduction of \$162,019 at a 5% discount rate over the ten-year planning horizon. In addition, the furrow irrigated tailwater recovery system's estimated net present value only exceeds the estimated net present value for dryland production at the 5% discount rate. This comparison would need to be made in light of the fact that USDA cost assistance is only available for land currently under irrigation.

### **Conclusions and Need for Further Research**

These results indicate that the amount of land needed to be set aside to implement a tailwater recovery system as outlined may not be an economically viable investment. However, as with many investments the specific case is very important and needs to be analyzed on its own merits. In the case where current structures are available to store water, for example been used catfish production ponds these results may be changed. Also, if restrictions on water use are imposed these results could change. However it should be noted that each of the production systems budgeted are currently below permit values for the Mississippi Delta.

## References

Barry, P.J., J.A. Hopkin, and C.B. Baker. "Financial Management in Agriculture." 4th Edition, Danville, IL: The Interstate Printers and Publishers, Inc., 1983.

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Mississippi State University (MSU). "Delta 2013 Planning Budgets", Department of Agricultural Economics Budget Report 2012-07, December 2012.  
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## **Appendix I**

Soybeans, early-planted, RR, stale seedbed, 12R 30"				
Delta Area, Mississippi, 2013				
				2013
Soybean Yield	bu			42
Soybean Price	Dollars			\$ 13.05
				548.1
CUSTOM SPRAY	acre	\$ 21.00	1	\$ 21.00
HARVEST AIDS	acre	\$ 3.73	1	\$ 3.73
FERTILIZERS	acre	\$ 20.12	1	\$ 20.12
FUNGICIDES	acre	\$ 14.94	1	\$ 14.94
HERBICIDES	acre	\$ 40.60	1	\$ 40.60
INSECTICIDES	acre	\$ 7.94	1	\$ 7.94
SEED/PLANTS	acre	\$ 52.00	1	\$ 52.00
ADJUVANTS	acre	\$ 0.35	1	\$ 0.35
HAULING	acre	\$ 11.76	1	\$ 11.76
CUSTOM LIME	acre	\$ 9.00	1	\$ 9.00
INOCULANT	acre	\$ 1.25	1	\$ 1.25
HAND LABOR	hour	\$ 9.06	0.1127	\$ 1.02
OPERATOR LABOR	hour	\$ 11.71	0.428	\$ 5.01
UNALLOCATED LABOR	hour	\$ 11.73	0.3852	\$ 4.52
DIESEL FUEL	gal	\$ 3.50	4.5806	\$ 16.03
REPAIR & MAINTENANCE	acre	\$ 8.44	1	\$ 8.44
INTEREST ON OP. CAP.	acre	\$ 4.71	1	\$ 4.71
TOTAL DIRECT EXPENSES				\$ 222.42
RETURNS ABOVE TOTAL DIRECT EXPENSES				\$ 325.68
CAPITAL RECOVERY				
Implements	acre	\$ 8.57	1	\$ 8.57
Tractors	acre	\$ 10.04	1	\$ 10.04
Harvesters	acre	\$ 11.04	1	\$ 11.04
TOTAL CAPITAL RECOVERY				\$ 29.65
TOTAL SPECIFIED COSTS				\$ 252.07
RETURNS ABOVE TOTAL SPECIFIED EXPENSES				\$ 296.03



Soybeans, early-planted, RR, stale seedbed, 12R 30"				
Furrow irrigated, 9 ac-in., Delta Area, Mississippi, 2013				
				2013
Soybean Yield	bu			65
Soybean Price	Dollars			\$ 13.05
				\$ 848.25
CUSTOM SPRAY	acre	\$ 21.00	1	\$ 21.00
HARVEST AIDS	acre	\$ 1.86	1	\$ 1.86
FERTILIZERS	acre	\$ 29.60	1	\$ 29.60
FUNGICIDES	acre	\$ 13.92	1	\$ 13.92
HERBICIDES	acre	\$ 40.60	1	\$ 40.60
INSECTICIDES	acre	\$ 9.75	1	\$ 9.75
IRRIGATION SUPPLIES	acre	\$ 7.92	1	\$ 7.92
SEED/PLANTS	acre	\$ 52.00	1	\$ 52.00
ADJUVANTS	acre	\$ 0.27	1	\$ 0.27
HAULING	acre	\$ 18.20	1	\$ 18.20
CUSTOM LIME	acre	\$ 9.00	1	\$ 9.00
INOCULANT	acre	\$ 1.25	1	\$ 1.25
HAND LABOR	hour	\$ 9.06	0.1127	\$ 1.02
IRRIGATE LABOR	hour	\$ 9.06	0.3625	\$ 3.28
OPERATOR LABOR	hour	\$ 11.71	0.5806	\$ 6.80
UNALLOCATED LABOR	hour	\$ 11.72	0.4519	\$ 5.30
DIESEL FUEL	gal	\$ 3.50	5.948	\$ 20.82
ELECTRICITY	kWh	\$ 0.14	91.1385	\$ 12.76
REPAIR & MAINTENANCE	acre	\$ 12.72	1	\$ 12.72
INTEREST ON OP. CAP.	acre	\$ 5.79	1	\$ 5.79
TOTAL DIRECT EXPENSES				\$ 273.86
RETURNS ABOVE TOTAL DIRECT EXPENSES				\$ 574.39
CAPITAL RECOVERY				
Implements	acre	\$ 10.72	1	\$ 10.72
Tractors	acre	\$ 14.14	1	\$ 14.14
Irrigation Equipment	acre	\$ 35.44	1	\$ 35.44
Harvesters	acre	\$ 11.04	1	\$ 11.04
TOTAL CAPITAL RECOVERY				\$ 71.34
TOTAL SPECIFIED COSTS				\$ 345.20
RETURNS ABOVE TOTAL SPECIFIED EXPENSES				\$ 503.05

Soybeans, early-planted, RR, stale seedbed, 12R 30"				
CP Irrigated, 9 ac-in., Delta Area, Mississippi, 2013				
				2013
Soybean Yield	bu			65
Soybean Price	Dollars			\$ 13.05
				\$ 848.25
CUSTOM SPRAY	acre	\$ 21.00	1	\$ 21.00
HARVEST AIDS	acre	\$ 1.86	1	\$ 1.86
FERTILIZERS	acre	\$ 29.60	1	\$ 29.60
FUNGICIDES	acre	\$ 13.92	1	\$ 13.92
HERBICIDES	acre	\$ 40.60	1	\$ 40.60
INSECTICIDES	acre	\$ 9.75	1	\$ 9.75
SEED/PLANTS	acre	\$ 52.00	1	\$ 52.00
ADJUVANTS	acre	\$ 0.27	1	\$ 0.27
HAULING	acre	\$ 18.20	1	\$ 18.20
CUSTOM LIME	acre	\$ 9.00	1	\$ 9.00
INOCULANT	acre	\$ 1.25	1	\$ 1.25
HAND LABOR	hour	\$ 9.06	0.1127	\$ 1.02
IRRIGATE LABOR	hour	\$ 9.06	0.2036	\$ 1.84
OPERATOR LABOR	hour	\$ 11.71	0.5021	\$ 5.88
UNALLOCATED LABOR	hour	\$ 11.72	0.4519	\$ 5.30
DIESEL FUEL	gal	\$ 3.50	5.3054	\$ 18.57
ELECTRICITY	kWh	\$ 0.1435	64.292	\$ 9.23
REPAIR & MAINTENANCE	acre	\$ 25.31	1	\$ 25.31
INTEREST ON OP. CAP.	acre	\$ 5.79	1	\$ 5.79
TOTAL DIRECT EXPENSES				\$ 270.39
RETURNS ABOVE TOTAL DIRECT EXPENSES				\$ 577.86
CAPITAL RECOVERY				
Implements	acre	\$ 10.72	1	\$ 10.72
Tractors	acre	\$ 14.14	1	\$ 14.14
Irrigation Equipment	acre	\$ 56.90	1	\$ 56.90
Harvesters	acre	\$ 11.04	1	\$ 11.04
TOTAL CAPITAL RECOVERY				\$ 92.80
TOTAL SPECIFIED COSTS				\$ 363.19
RETURNS ABOVE TOTAL SPECIFIED EXPENSES				\$ 485.06

Corn, stale seedbed, BtRR, non-irrigated, 8-row 38"				
135 bu yield goal, Delta Area, Mississippi, 2013				
				2013
Corn Yield	bu			135
Corn Price	dollars			\$ 6.02
				\$ 812.70
CUSTOM SPRAY	acre	\$ 10.75	1	\$ 10.75
FERTILIZERS	acre	\$ 191.04	1	\$ 191.04
HERBICIDES	acre	\$ 38.06	1	\$ 38.06
INSECTICIDES	acre	\$ 7.24	1	\$ 7.24
SEED/PLANTS	acre	\$ 86.84	1	\$ 86.84
CUSTOM FERTILIZE	acre	\$ 7.00	1	\$ 7.00
HAULING	acre	\$ 37.80	1	\$ 37.80
CUSTOM LIME	acre	\$ 22.50	1	\$ 22.50
HAND LABOR	hour	\$ 9.06	0.1752	\$ 1.59
OPERATOR LABOR	hour	\$ 11.71	0.5107	\$ 5.98
UNALLOCATED LABOR	hour	\$ 11.70	0.4597	\$ 5.38
DIESEL FUEL	gal	\$ 3.50	5.385	\$ 18.85
REPAIR & MAINTENANCE	acre	\$ 11.24	1	\$ 11.24
INTEREST ON OP. CAP.	acre	\$ 10.49	1	\$ 10.49
TOTAL DIRECT EXPENSES				\$ 454.76
RETURNS ABOVE TOTAL DIRECT EXPENSES				\$ 357.94
CAPITAL RECOVERY				
Implements	acre	\$ 10.48	1	\$ 10.48
Tractors	acre	\$ 19.08	1	\$ 19.08
Harvesters	acre	\$ 10.91	1	\$ 10.91
Self-Propelled	acre	\$ 1.01	1	\$ 1.01
TOTAL CAPITAL RECOVERY				\$ 41.48
TOTAL SPECIFIED COSTS				\$ 496.24
RETURNS ABOVE TOTAL SPECIFIED EXPENSES				\$ 316.46

Corn, stale seedbed, BtRR, 8-row 38", 185 bu yield goal				
Furrow Irrigated, 13 ac-in., Delta Area, Mississippi, 2013				
	Unit	Price	Quantity	2013
Corn Yield	bu			185
Corn Price	dollars			\$ 6.02
				\$1,113.70
CUSTOM SPRAY	acre	\$ 10.75	1	\$ 10.75
FERTILIZERS	acre	\$ 283.02	1	\$ 283.02
HERBICIDES	acre	\$ 38.06	1	\$ 38.06
INSECTICIDES	acre	\$ 7.24	1	\$ 7.24
IRRIGATION SUPPLIES	acre	\$ 7.92	1	\$ 7.92
SEED/PLANTS	acre	\$ 100.20	1	\$ 100.20
CUSTOM FERTILIZE	acre	\$ 7.00	1	\$ 7.00
HAULING	acre	\$ 51.80	1	\$ 51.80
CUSTOM LIME	acre	\$ 22.50	1	\$ 22.50
HAND LABOR	hour	\$ 9.06	0.1752	\$ 1.59
IRRIGATE LABOR	hour	\$ 9.06	0.3875	\$ 3.51
OPERATOR LABOR	hour	\$ 11.71	0.5893	\$ 6.90
UNALLOCATED LABOR	hour	\$ 11.70	0.4597	\$ 5.38
DIESEL FUEL	gal	\$ 3.50	6.3396	\$ 22.19
ELECTRICITY	kWh	\$ 0.14	131.6445	\$ 18.89
REPAIR & MAINTENANCE	acre	\$ 15.10	1	\$ 15.10
INTEREST ON OP. CAP.	acre	\$ 14.16	1	\$ 14.16
TOTAL DIRECT EXPENSES				\$ 616.21
RETURNS ABOVE TOTAL DIRECT EXPENSES				\$ 497.49
CAPITAL RECOVERY				
Implements	acre	\$ 12.52	1	\$ 12.52
Tractors	acre	\$ 23.17	1	\$ 23.17
Irrigation Equipment	acre	\$ 35.44	1	\$ 35.44
Harvesters	acre	\$ 10.91	1	\$ 10.91
Self-Propelled	acre	\$ 1.01	1	\$ 1.01
TOTAL CAPITAL RECOVERY				\$ 83.05
TOTAL SPECIFIED COSTS				\$ 699.26
RETURNS ABOVE TOTAL SPECIFIED EXPENSES				\$ 414.44

Corn, stale seedbed, BtRR, 8-row 38", 185 bu yield goal				
CP Irrigated, 13 ac-in., Delta Area, Mississippi, 2013				
	Unit	Price	Quantity	2013
Corn Yield	bu			185
Corn Price	dollars			\$ 6.02
				\$ 1,113.70
CUSTOM SPRAY	acre	\$ 10.75	1	\$ 10.75
FERTILIZERS	acre	\$ 283.02	1	\$ 283.02
HERBICIDES	acre	\$ 38.06	1	\$ 38.06
INSECTICIDES	acre	\$ 7.24	1	\$ 7.24
SEED/PLANTS	acre	\$ 100.20	1	\$ 100.20
CUSTOM FERTILIZE	acre	\$ 7.00	1	\$ 7.00
HAULING	acre	\$ 51.80	1	\$ 51.80
CUSTOM LIME	acre	\$ 22.50	1	\$ 22.50
HAND LABOR	hour	\$ 9.06	0.1752	\$ 1.59
IRRIGATE LABOR	hour	\$ 9.06	0.2036	\$ 1.84
OPERATOR LABOR	hour	\$ 11.71	0.5107	\$ 5.98
UNALLOCATED LABOR	hour	\$ 11.70	0.4597	\$ 5.38
DIESEL FUEL	gal	\$ 3.50	5.697	\$ 19.94
ELECTRICITY	kWh	\$ 0.14	92.6587	\$ 13.30
REPAIR & MAINTENANCE	acre	\$ 27.71	1	\$ 27.71
INTEREST ON OP. CAP.	acre	\$ 14.52	1	\$ 14.52
TOTAL DIRECT EXPENSES				\$ 610.83
RETURNS ABOVE TOTAL DIRECT EXPENSES				\$ 502.87
CAPITAL RECOVERY				
Implements	acre	\$ 12.52	1	\$ 12.52
Tractors	acre	\$ 23.17	1	\$ 23.17
Irrigation Equipment	acre	\$ 56.90	1	\$ 56.90
Harvesters	acre	\$ 10.91	1	\$ 10.91
Self-Propelled	acre	\$ 1.01	1	\$ 1.01
TOTAL CAPITAL RECOVERY				\$ 104.51
TOTAL SPECIFIED COSTS				\$ 715.34
RETURNS ABOVE TOTAL SPECIFIED EXPENSES				\$ 398.36

## **Appendix II**

### Estimated Cost for Tail Water Recovery Systems

	Quantity	Price/Unit	Cost
On-Farm Storage Reservoir	28,000	\$ 1.35	\$ 37,800.00
Tailwater Recovery Ditch	35,700	\$ 1.35	\$ 48,195.00
Drain Pipe	4	\$ 2,550.00	\$ 10,200.00
Pumping Plant	2	\$ 24,500.00	\$ 49,000.00
Flow Meters	1	\$ 2,000.00	\$ 2,000.00
Dog Leg (Z Drop)	2	\$ 2,500.00	\$ 5,000.00
Seed Levee	1	\$ 4,500.00	\$ 4,500.00
Water Control Structure	1	\$ 4,000.00	\$ 4,000.00
Sub-total			\$ 160,695.00
Underground Pipe - 12" - Furrow System	3,584	\$ 8.75	\$ 31,360.00
Underground Pipe - 12" - CP System	1,677	\$ 8.75	\$ 14,673.75
Bridges for Center Pivot	12	\$ -	\$ -
Tailwater Recovery - Furrow Subtotal			\$ 192,055.00
Tailwater Recovery - CP Subtotal			\$ 175,368.75
Acres Levelled	135		
Land Leveling (yards moved per acre)	300	\$ 1.35	\$ 54,675.00
Tailwater Recovery - Furrow Subtotal per Irrigated Acre			\$ 1,856.51
Tailwater Recovery - CP Subtotal per Acre			\$ 1,881.44
Contingency (%)		10%	
Tailwater Recovery - Furrow Subtotal per Irrigated Acre w/contingency			\$ 2,042.16
Tailwater Recovery - CP Subtotal per Irrigated Acre w/ contingency			\$ 2,069.58
NRCS Financial Assistance			\$ 164,868.80
Tailwater Recovery - Furrow Subtotal per Acre/contingency			\$ 801.61
Tailwater Recovery - CP Subtotal per Acre / contingency			\$ 721.19

## **Appendix III**

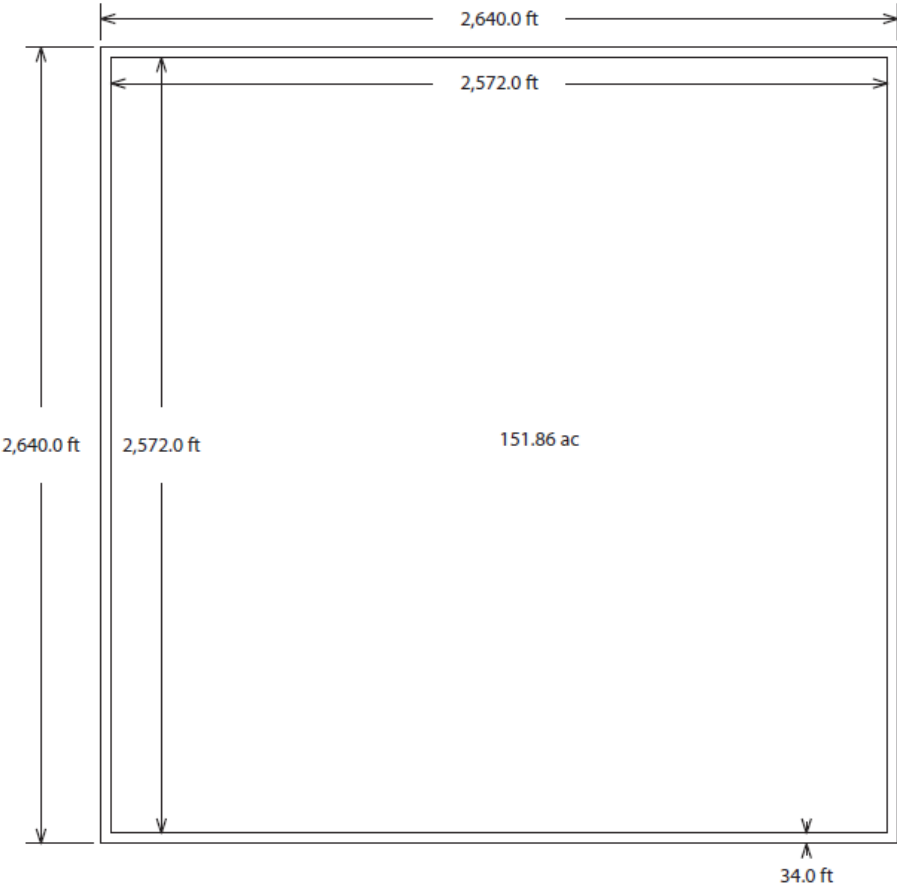


FAPRI Projections of Indices of Prices Paid by Farmers and Select Feed Grain and Oilseed Yields and Prices.

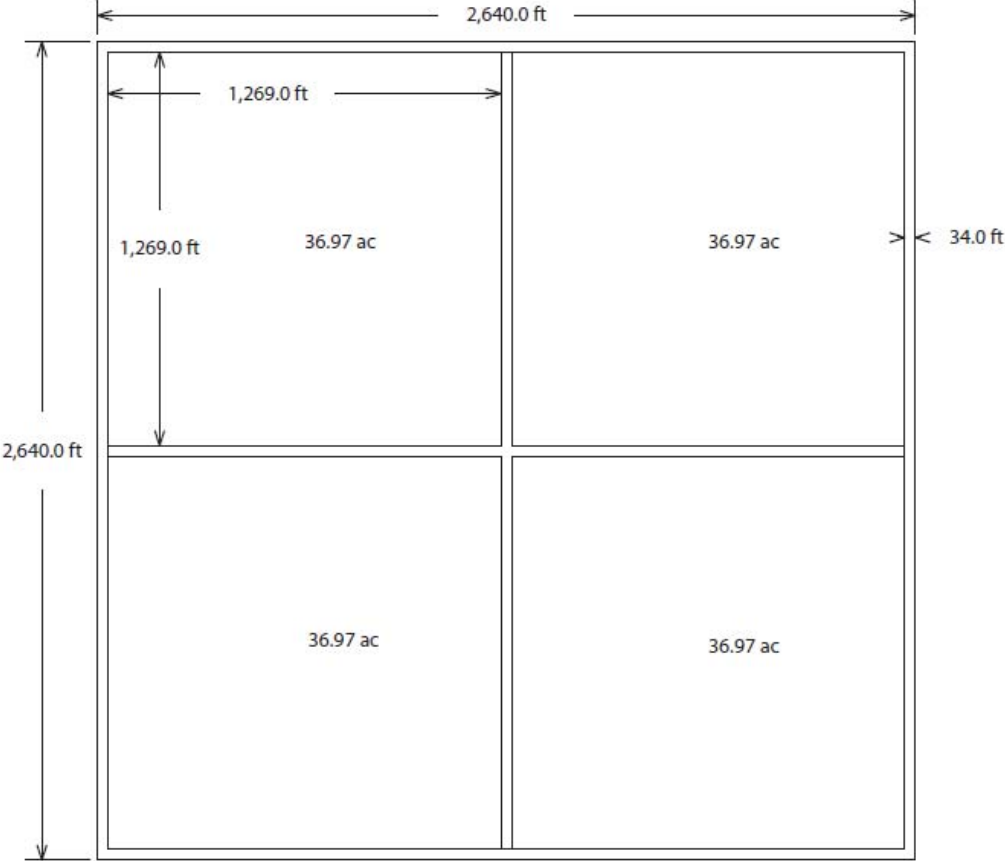
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
<b>Production items</b>	229	234	226	224	226	229	234	240	245	249	254
Feed	261	271	217	208	209	212	215	218	218	218	217
Livestock & poultry	168	174	178	176	169	163	161	164	168	171	175
Seeds	358	372	376	371	373	380	390	401	410	419	427
Fertilizer	336	346	348	342	338	339	346	354	362	369	378
Mixed fertilizer	307	313	316	310	306	306	311	318	326	331	339
Nitrogen fertilizer	351	363	362	358	355	359	368	378	388	395	405
Potash and phosph.	381	397	402	392	385	382	387	394	402	409	417
Agricultural chemicals	153	158	163	164	168	171	176	180	185	188	192
Fuels	358	335	322	311	322	332	344	356	365	374	384
Supplies & repairs	171	176	179	183	186	190	195	199	204	208	213
Autos & trucks	118	121	123	125	127	128	130	132	133	134	136
Farm machinery	256	262	267	273	280	287	295	303	310	318	327
Building material	176	180	184	187	190	194	197	200	203	206	209
Farm services	168	171	175	177	181	185	191	196	202	207	213
Interest*	145	149	156	161	176	192	199	204	208	211	216
Taxes**	232	242	249	256	263	269	276	283	290	297	306
Wage rates	199	204	209	215	221	227	234	241	248	255	263
<b>Corn - Farm Price</b>	7.08	5.18	4.69	4.73	4.79	4.83	4.88	4.88	4.87	4.84	4.82
<b>Soybeans - Farm Price</b>	14.2	11.49	11.25	10.98	11.22	11.47	11.67	11.65	11.69	11.69	11.68
<b>Corn Yield</b>	123.4	161.8	164.3	166.3	168.6	170.8	172.6	174.8	176.9	178.7	180.7
<b>Soybean Yield</b>	39.6	43.5	44.1	44.6	45.1	45.6	46	46.5	47	47.5	47.9

## **Appendix IV**

Drawing 1. Acres available for the 160 acre dryland crop production system, with 8.14 acres in turn rows.



Drawing 2. Acres available for the 160 acre furrow irrigated crop production system, with 12.12 acres in turn rows.



Drawing 3. Acres available for the 160 acre furrow irrigated -tail water recovery crop production system, with 8.9 acres in turn rows, 10.3 acres of reservoir, 7.9 acres of tail water recovery ditches and 132.9 acres in production.

