Estimating financial costs and benefits of supplemental irrigation

JULIE SHORTRIDGE AND MITCHELL PAOLETTI

DEPARTMENT OF BIOLOGICAL SYSTEMS ENGINEERING







VIRGINIA TECH.





United States Department of Agriculture

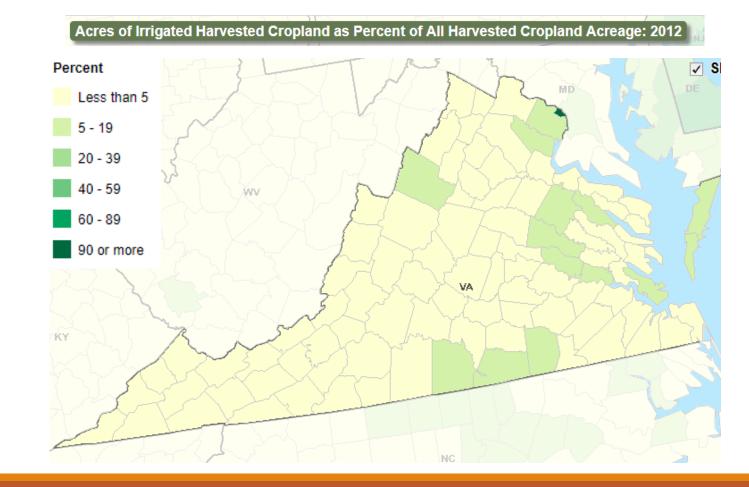
National Institute of Food and Agriculture

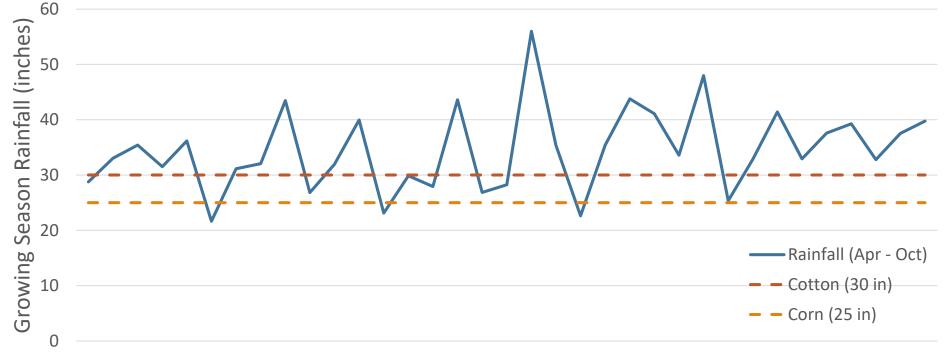
ALL ABOUT IRRIGATION WORKSHOP | MARCH 6, 2018

Talk Overview

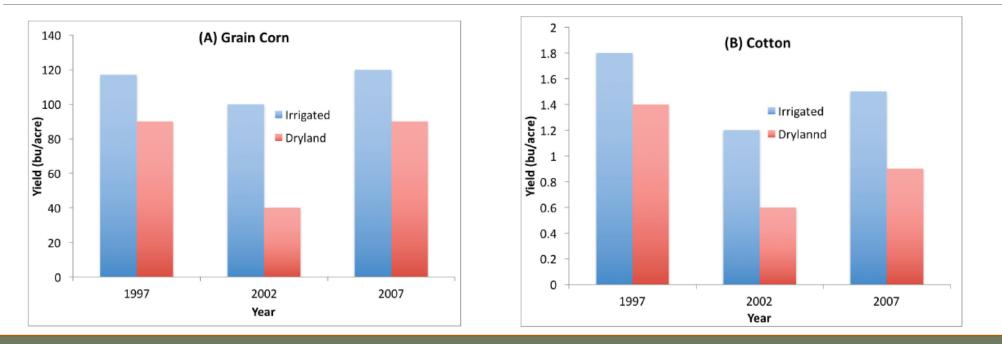
- Irrigation in Humid Climates
- The Irrigation Financial Estimator Tool (IFET)
- How IFET works
- Example scenarios and results
- Plans for future development

- Irrigated cropland:
 < 5% to 20% of total, depending on county
- Supplemental irrigation: operated during dry periods and droughts, rather than all season
- Almost every Eastern state has seen an increase in irrigation in past decade





1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005 2007 2009 2011 2013 2015



"Crop farms with access to sufficient irrigation water were able to take advantage of excellent prices along with excellent yields... leading to record breaking net income... However, dryland farms didn't fare as well." (Nebraska IANR News, 2012)

Figures from Clemson Cooperative Extension bulletin: "Comparison of Irrigated and Dryland Crop Production in SC "

"The cost of power is usually the biggest shock to a new irrigator. The grower will get his first electric/fuel bill once he has started irrigating and will probably have sticker shock." (2) "Irrigation costs you if you have it or if you don't. If you don't have it during a drought, you can incur significant loss. And in other years, farmers use their irrigation less often than normal because of above-average rainfall." (3)

"Investment decisions should in many cases account for total costs and the returns the investments generate not just in terms of years, but decades." (3)

2. Irrigator.education.com; 3. Capital Farm Credit

What factors influence financial costs and returns from irrigation?

<u>Capital Costs</u> System type Acreage Water source Power/fuel source

Financing options

Operating Costs

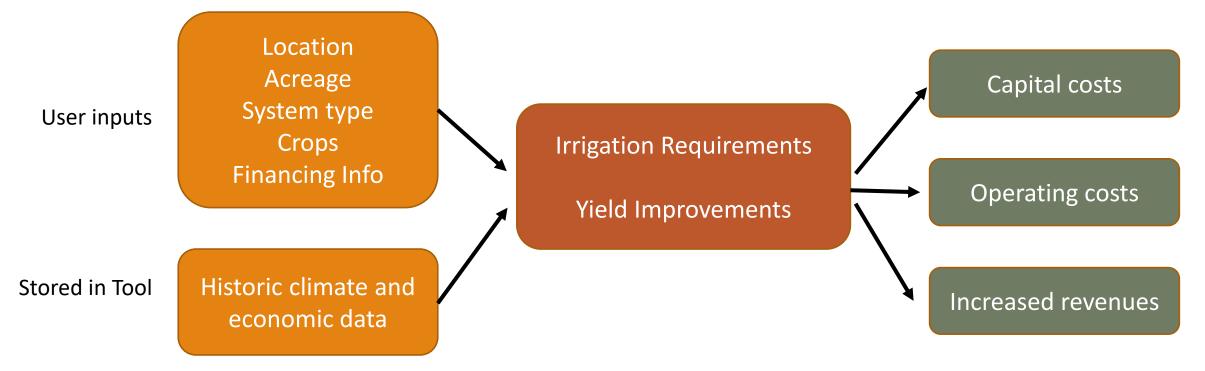
Water needs Fuel source and prices Labor requirements and costs Maintenance requirements

Returns

Rainfall Yield improvements Crops prices

Irrigation Financial Estimator Tool (IFET)

Goal: Create a user-friendly, customizable tool to estimate financial costs and benefits of irrigation for row crop production in Virginia



How IFET works – user inputs

ਜ਼ 5 ੇ ਜ		Tool	Locked - Exce	l.		·	<u> </u>		3 – 6 /×
File Home Insert Page Layout	Formulas Data Review View								ge, Julie 🛛 🗛 Share
$\begin{array}{c c} & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & & \\ & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ &$	A - E = G Merge		• % 9 Number	• 00. 0.⇒ 0.♦ 00.	Conditional Formatting	Format as Cell Table * Styles * Styles	Insert Delete Form		Sort & Find & Find & Filter * Select *
A Investment Information	B(D		E	F	G	Н	1
Agricultural and Finance Information County Crop1 Crop2 Arres of Crop 1 Arres of Crop 2 Soil System Power Irrigation Scheduling Method Amount per Week (in) Labor Cost (5/hr) Repayment Period (years) Useful Ufe of System Interest (%) Calculate	User inputs Suffolk city Corp Grown Please setect the first corp grown from the drop-down list. This enty must be filled Uteser Rainfall Deficit \$10.00 10 20 4								
Suggested Useful Lives: Center Pivo: 20-25 years Drip: 10-15 years Linear Move: 15-20 years Linear Move: 15-20 years Instructions Tool Results Sum dy	nmary Detailed Cost Results Detailed Bo	enefit Results	(+)	1				: •	F 1000

	A			B	3	
1	Investment Information	า				
2	Agricultural and Finance Information	on			User Inp	uts
3						
4	County				Suffolk o	ity
5	Crop1				Co	orn 🔻
6	Crop2	Cor				
7	Acres of Crop 1	Cot	ton beans			
8	Acres of Crop 2	Whe				
9	Soil	Nor	ne			
10	System				out before "Cr	op 2"
11	Power				Die	sel
12	Irrigation Scheduling Method				Rainfall Def	icit
13	Amount per Week (in)					
14	Labor Cost (\$/hr)				\$10.	.00
15	Repayment Period (years)					10
16	Useful Life of System					20
17	Interest (%)					4
18	Calculate					
19	Calculate					

20

How IFET works - results

	А	В	С	D	E	F	G	H
2	Results - System Costs					Expected	d Annua	l Costs
3	Investment Costs							
4	Total Investment Cost	\$157,100						
5	Annual Loan Repayment	\$19,400						
6								¢C 800
7	Operating Costs							\$6,800
8	Average Annual Fuel Cost	\$6,800						
9	Average Annual Labor Cost	\$1,000						
10	Average Annual Maintenance Cost	\$1,600						\$1,60
11	Total Annual Operating Costs	\$9,400				\$19,400		\$1,00
12	Total Annual Costs	\$28,800						
13								
14	Results - Increased Revenues							
15	Average Additional Income with Irrigation	\$28,800						
16	Average Net Revenue (including loan repayment)	\$0			Fuel	Labor Mai	ntenance	Annual L
17	Average Net Revenue(not including loan repayment)	\$19,400			- 1 001			



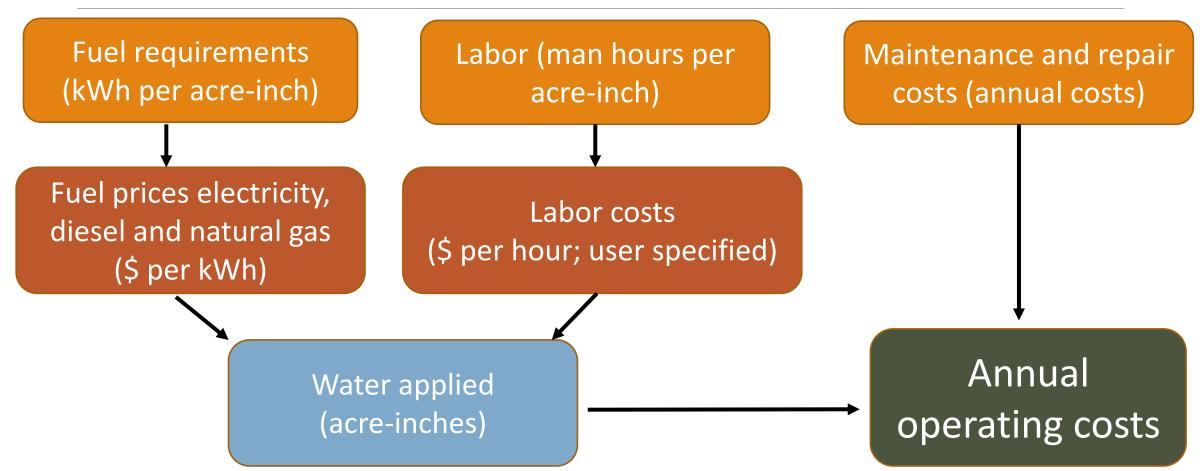
18

How IFET works – capital costs

Reviewed extension, research and industry literature for capital costs

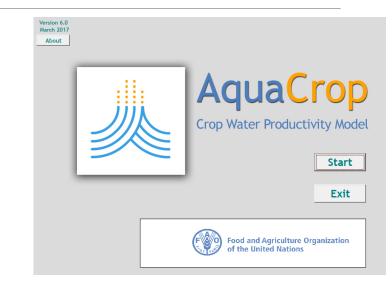
System Type	Minimum capital cost per acre	Maximum capital cost per acre
Center Pivot	\$900	\$1300
Lateral	\$1000	\$1600
Big Gun	\$500	\$900
Drip	\$900	\$1600

How IFET works – operating costs

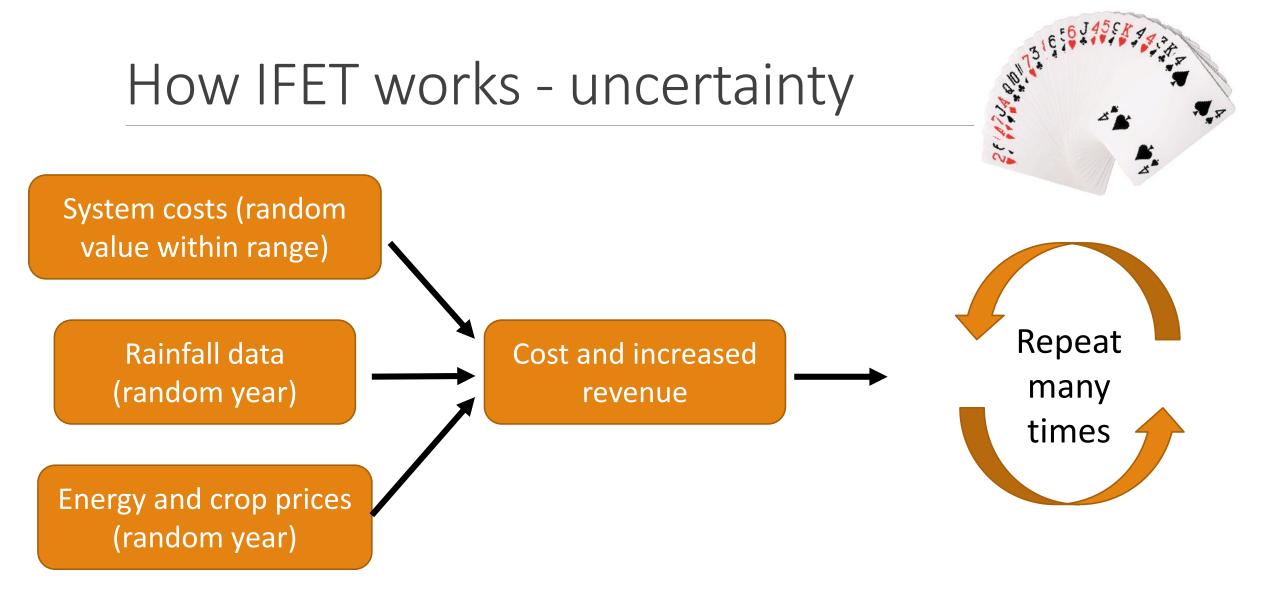


How IFET works – increased revenues

- Used AquaCrop model to estimate rainfall/yield relationships
- Compare to NASS yields to validate
- Developed governing equations that predict yield based on:
 - Crop and soil type
 - Growing season rainfall
 - Occurrence of dry periods (e.g., 10 days with no rainfall)
- Estimate yields three ways:
 - Rainfall only
 - Scheduled irrigation (user specified)
 - Rainfall deficit (optimized)



Increased revenue = (Irrigated Yield – Rainfed Yield) x price



IFET – Example Calculations

Agricultural and Finance Information	User Inputs
County	Suffolk city
Crop	Cotton
Acres	100
Soil	Loamy Sand
System	Center Pivot
Power	Diesel
Irrigation Style	Rainfall Deficit
Labor Cost (\$/hr)	\$12.00
Repayment Period	6
(years)	D
Useful Life of System	20
Interest (%)	4

Example Calculations – Results summary

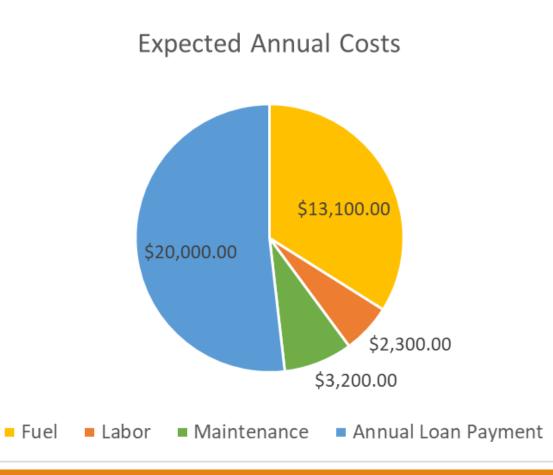
Results - System Costs

Investment Costs	
Total Investment Cost	\$104,700
Annual Loan Repayment	\$20,000

Operating Costs	
Average Annual Fuel Cost	\$13,100
Average Annual Labor Cost	\$2,300
Average Annual Maintenance Cost	\$3,200
Total Annual Operating Costs	\$18,600
Total Annual Costs	\$38,600

Results - Increased Revenues

Average Additional Income with Irrigation	\$26,600
Average Net Revenue (including loan repayment)	-\$12,000
Average Net Revenue(not including loan repayment)	\$8,000



Example Calculations – Detailed Costs

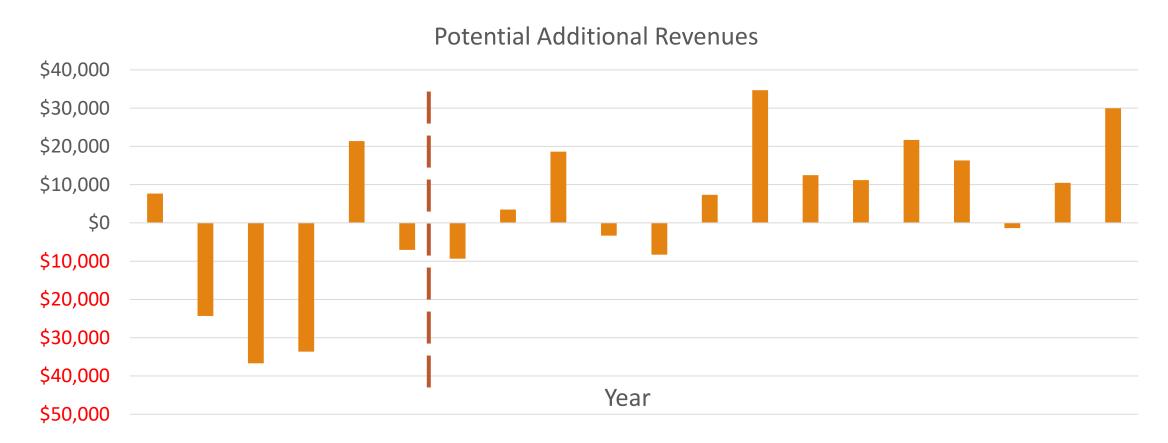
Operating Costs	Low Estimate	Average Estimate	High Estimate
Fuel	\$9,900	\$13,100	\$16,300
Labor	\$1,900	\$2,300	\$2,700
Maintenance	\$2,600	\$3,200	\$3,600
Total	\$14,400	\$18,600	\$22,600

System Cost	Low Estimate	Average Estimate	High Estimate
Total Investment	\$89,200	\$107,900	\$120,600
Annual Loan Payment	\$17,000	\$20,000	\$23,000

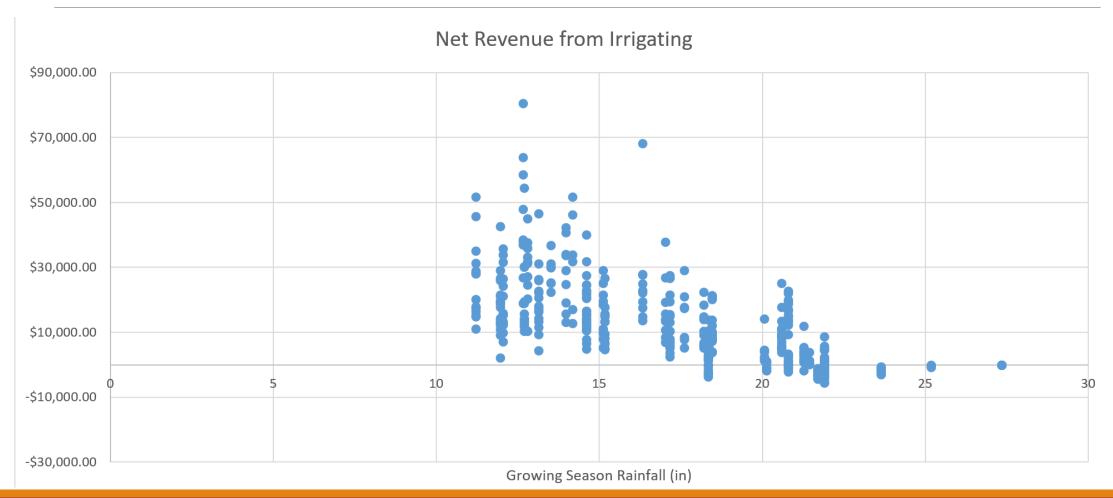
Example calculations – detailed revenues

	Low	Average	High
Value of Investment	Estimate	Estimate	Estimate
Average Additional			
Income with Irrigation	\$18,900	\$26,300	\$34,600
Average Net Revenue			
(not including loan			
repayment)	\$1,300	\$8,100	\$15,600
Average Net Revenue			
(including loan			
repayment)	-\$18,900	-\$11,900	\$1,300

Example calculations – detailed revenues

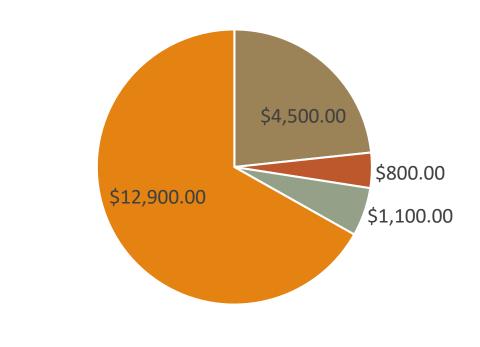


Example Calculations – detailed revenues

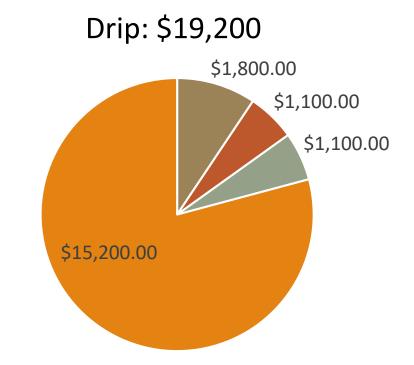


Example calculations – comparing systems

100 acres, Suffolk, corn, sandy loam

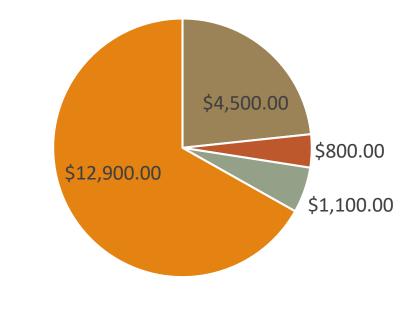


Pivot: \$19,400



Example calculations – comparing scheduling

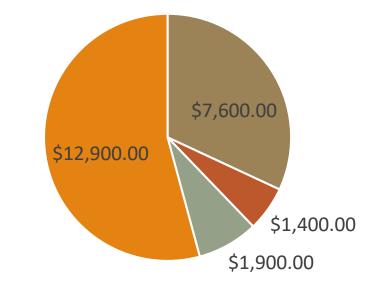
100 acres, Suffolk, corn, sandy loam, center pivot



Fuel

Rainfall Deficit

Scheduled: 0.5" per week



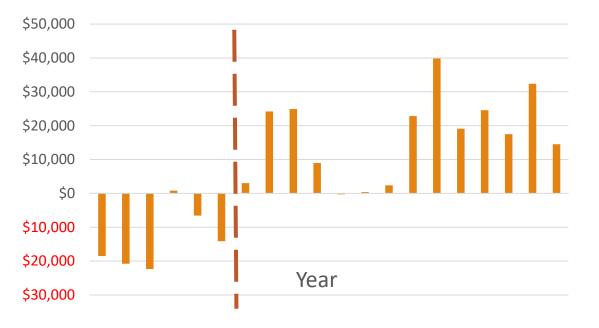
Labor Maintenance Annual Loan Payment
Fuel Labor Maintenance Annual Loan Payment

Example calculations – comparing scheduling

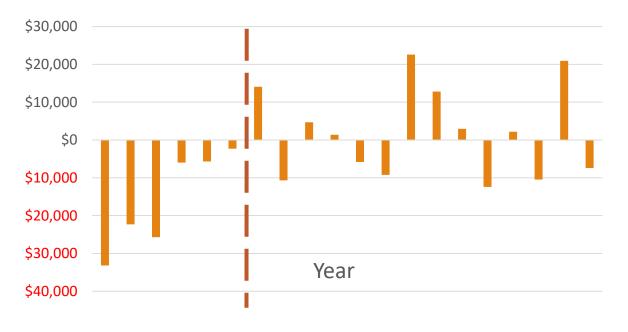
Rainfall Deficit

Scheduled: 0.5" per week

Potential Additional Revenue







Conclusions and Plans for Future Development

- Conclusions
 - Preliminary/ballpark information
 - Profitability varies with rainfall, prices

•Future Development

- Additional crops
- Groundwater/surface water
- More refined finance information
- Web-based version
- Documentation (extension bulletin): will be completed this summer



Thank you!

Download tool at: <u>https://sites.google.com/vt.edu/jshortridge/irrigation-workshop</u>

Julie Shortridge

Assistant Professor and Extension Specialist Biological Systems Engineering Virginia Tech

<u>jshortridge@vt.edu</u> 540-231-2797

