



# Economic Models for Dairy Management Evaluation

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# Outline

120 minutes

## **Reproductive benefits**

Gains from improved reproductive efficiency

## **Dairy reproductive economic analysis**

A reproductive performance analysis tool



## **UW-DairyRepro\$Plus**

A tool to analyze reproductive management programs

## **Dynamic dairy farm model**

Whole dairy farm simulation and optimization model



**Reproductive benefits**

# Gains from reproduction

Important economic factors

## **Milk**

More productivity

## **Calves**

More offspring

## **Culling**

Less losses

## **Selective culling**

Better capacity for selection

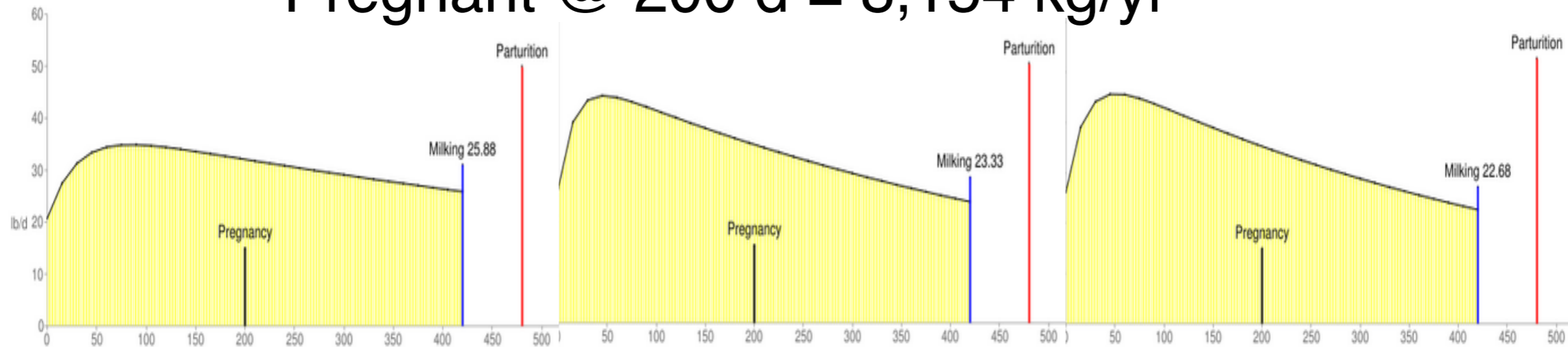
## **Reproductive costs**

Decreased

# Milk and reproduction

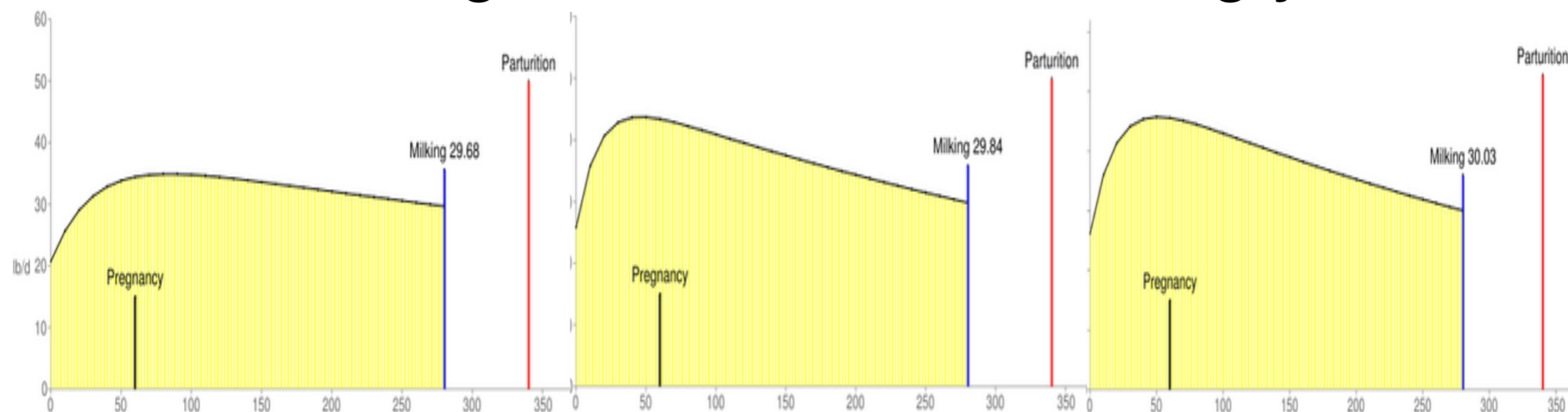
Follow the lactation curve

Pregnant @ 200 d = 8,154 kg/yr



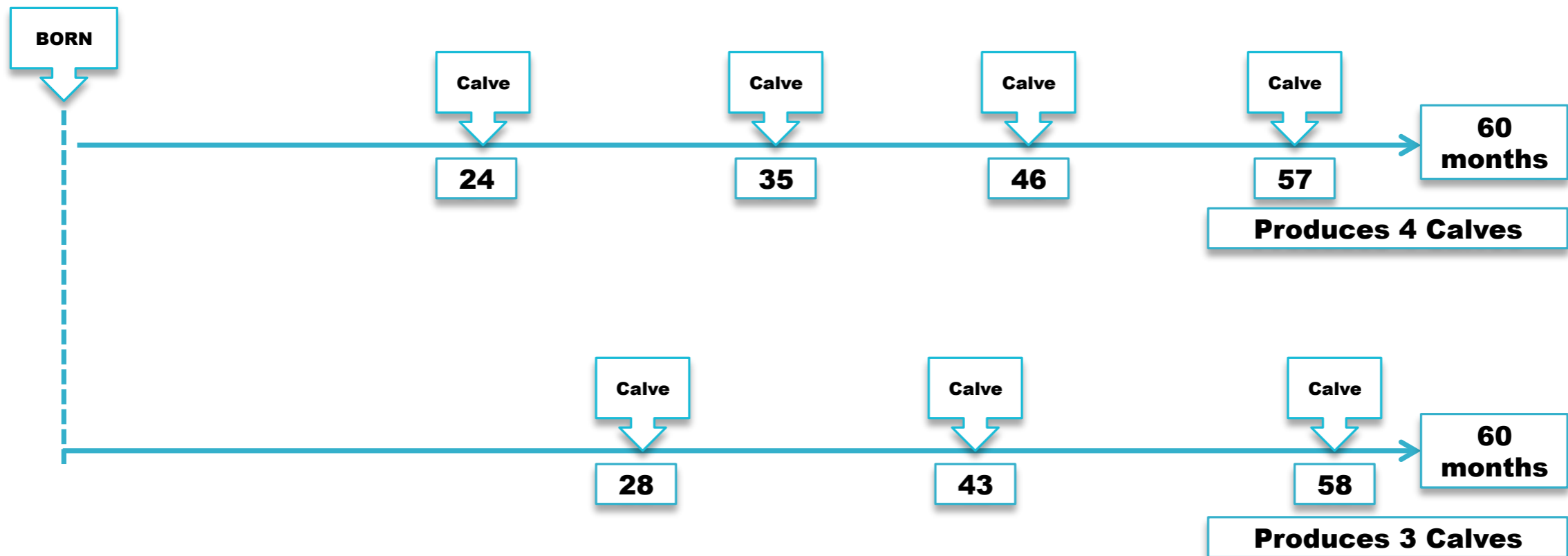
Pregnant @ 60 d = 8,370 kg/yr

+216 kg/yr



# Calves and reproduction

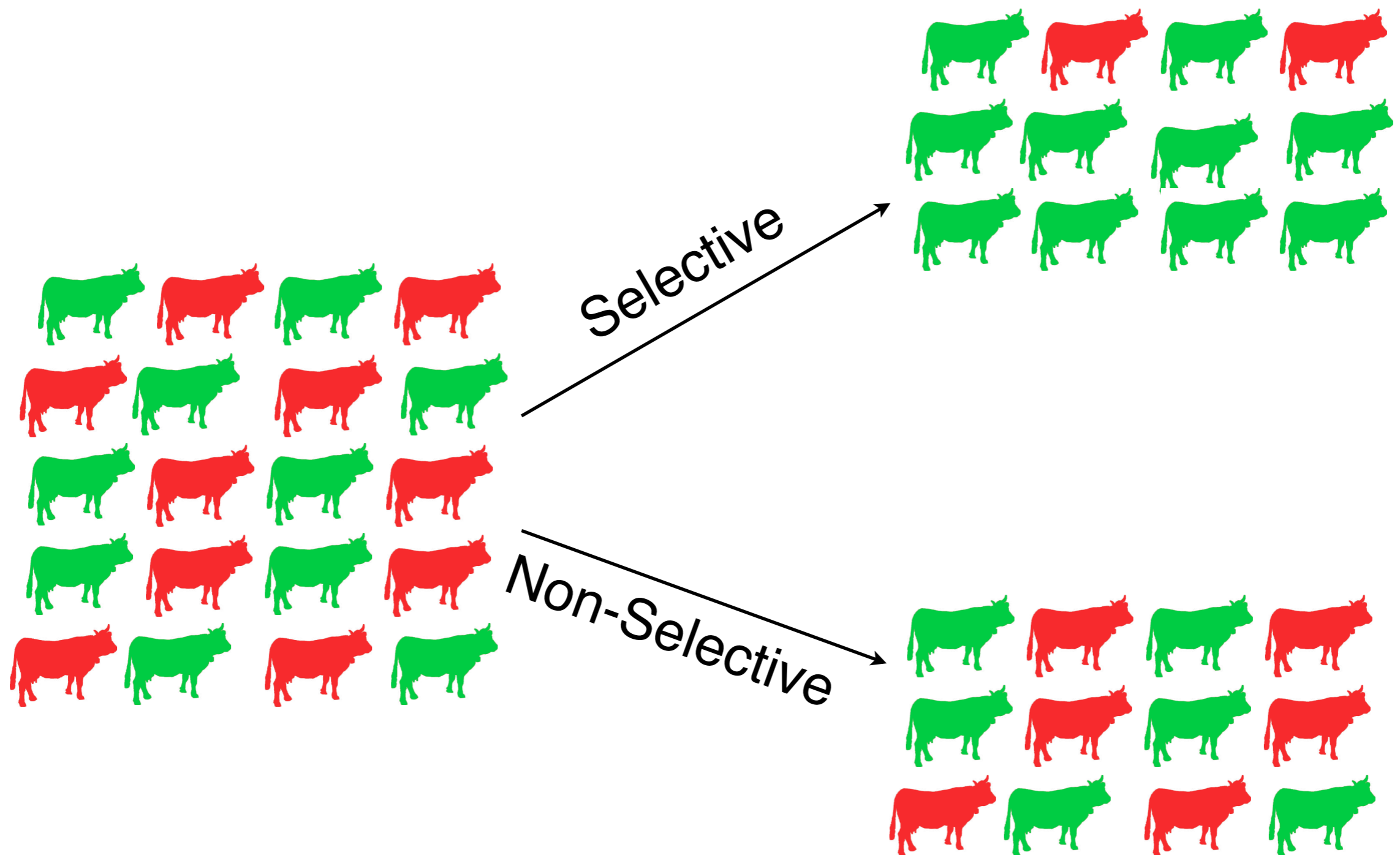
Improved offspring



One more calf in 60 months life expectancy

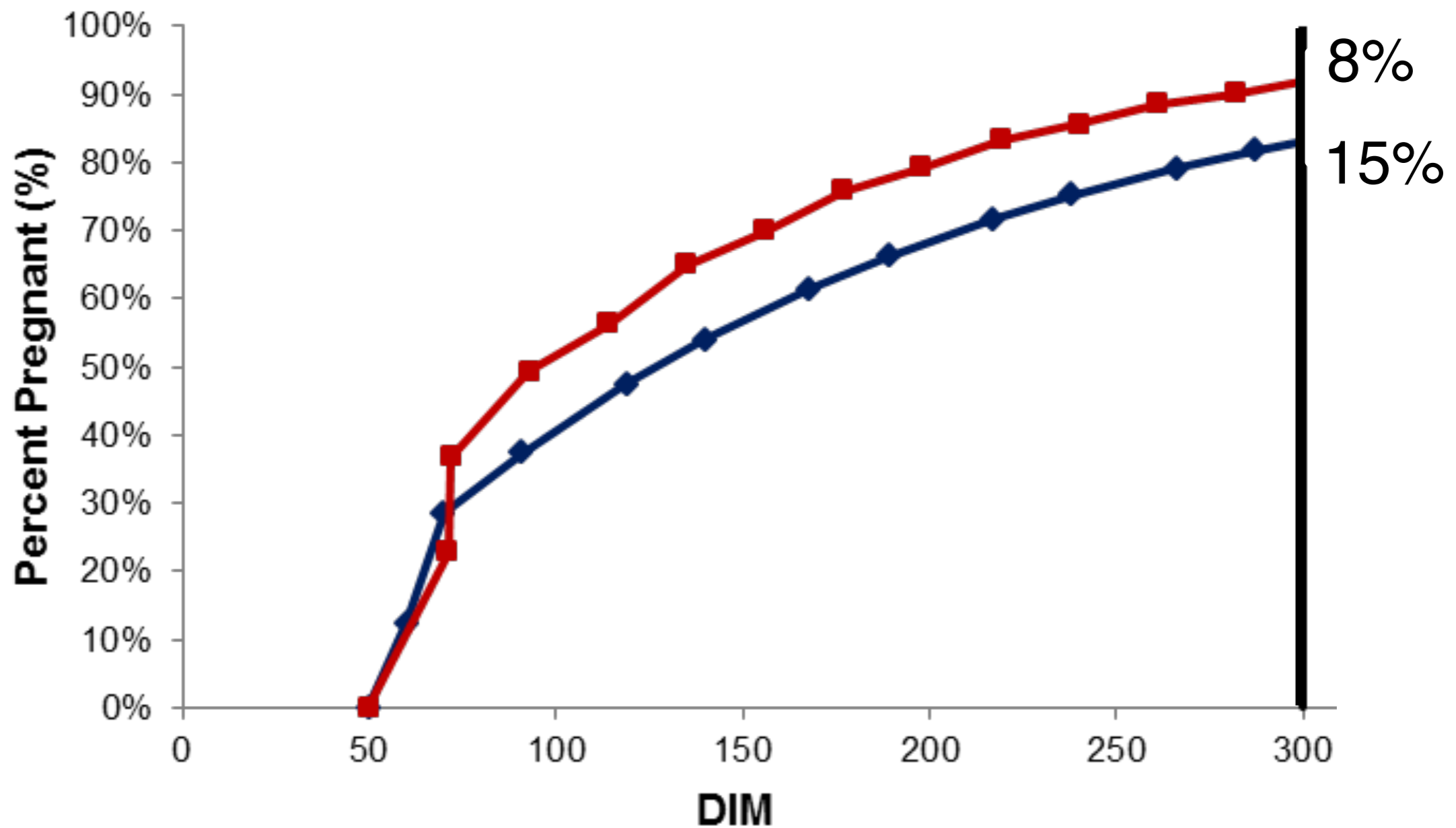
# Selective culling

Opportunity to retain best cows



# Reproductive culling

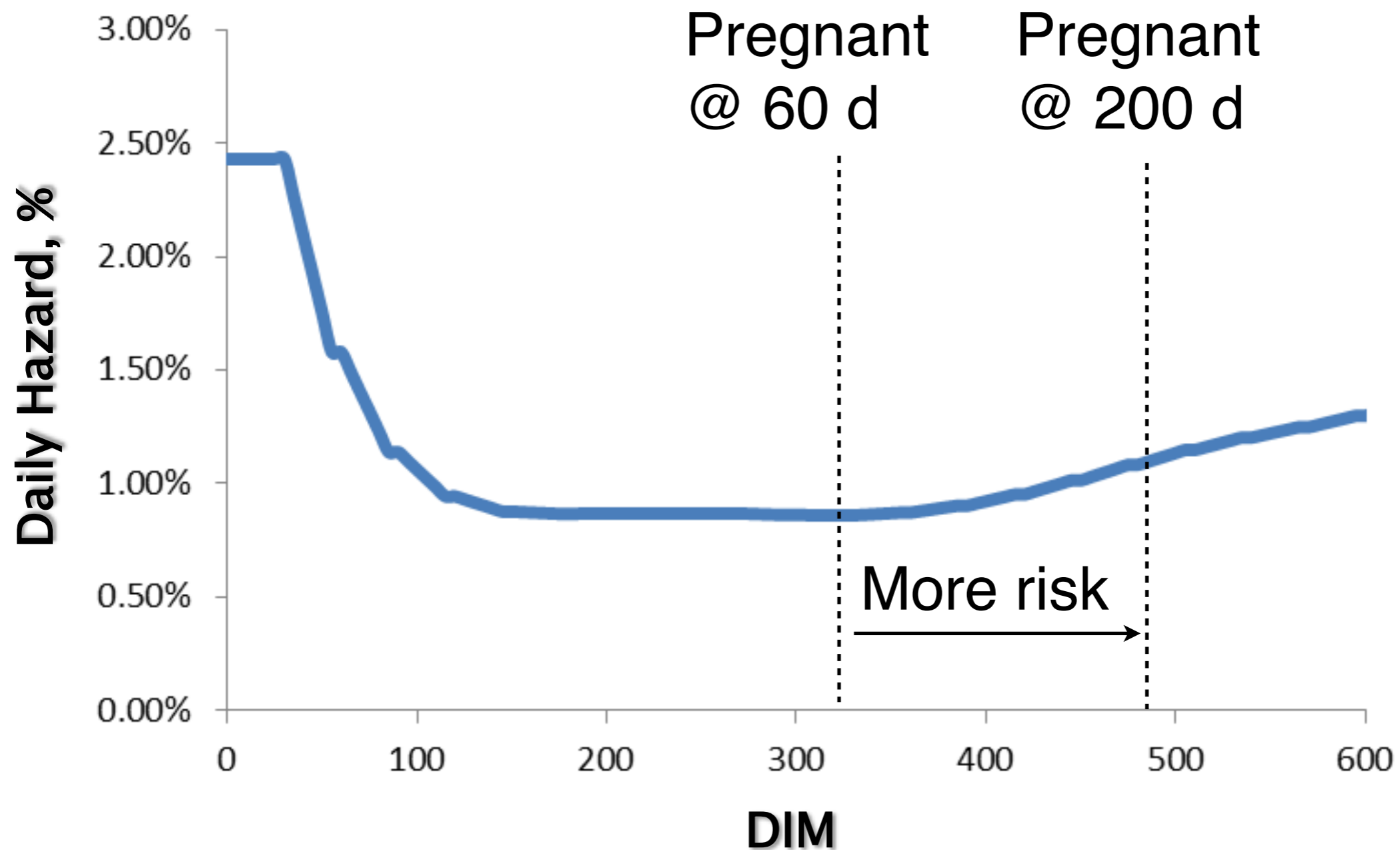
Higher survival if pregnant





# Involuntary culling

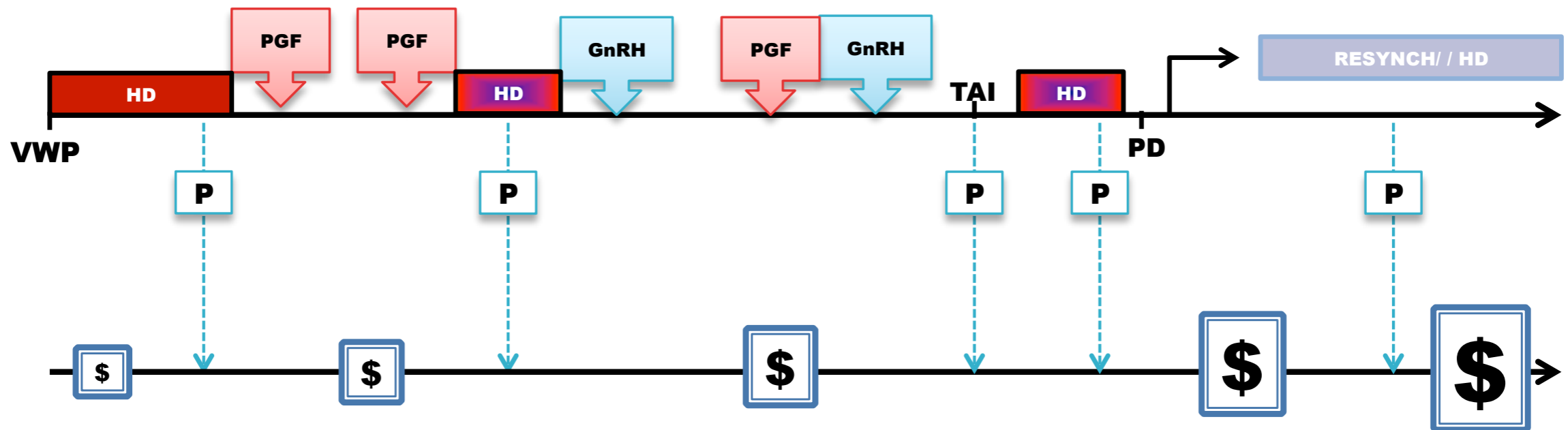
Higher risk late in lactation



# Reproduction costs

How long take a cow become pregnant

## Reproductive events



## Reproductive costs



# Dairy reproductive analysis

# Dairy reproductive analysis

Analyses of overall performance

## Markov-chain model

Simulates dairy herd and replacements for 9 lactations

## Transition probabilities

Drive model dynamics from one state to the next according to stages (time)

## Steady state

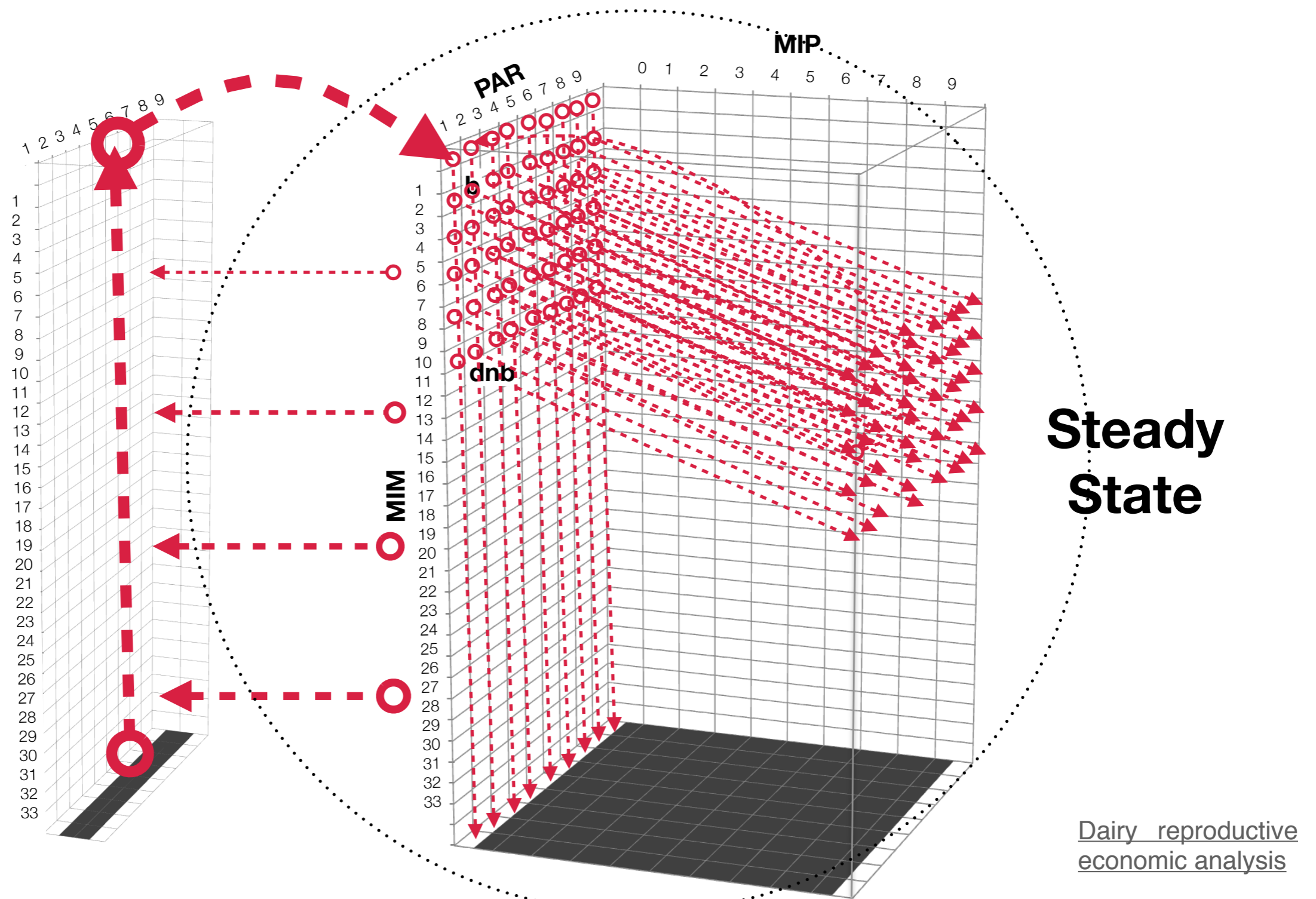
Equilibrium at which herd dynamics don't change more

## Measures net return

Response to reproductive performance

# The model

## Markov-chains to steady state



# Dairy reproductive analysis

Net return of reproductive performance

	Total Revenues & Costs				
	IOFC	Cull	Repro	Calves	Net Return
\$/herd/month	15681.47	-1282.69	-765.5	1190.15	14823.42
\$/herd/day	522.72	-42.76	-25.52	39.67	494.11
\$/cow/year	1907.91	-156.06	-93.14	144.8	1803.52

Milk income over  
feed cost

Cost of culling  
and replacing

Cost of  
reproduction

Income from  
newborn

Value of  
reproductive  
program

# Dairy reproductive analysis

## Net return of reproductive performance

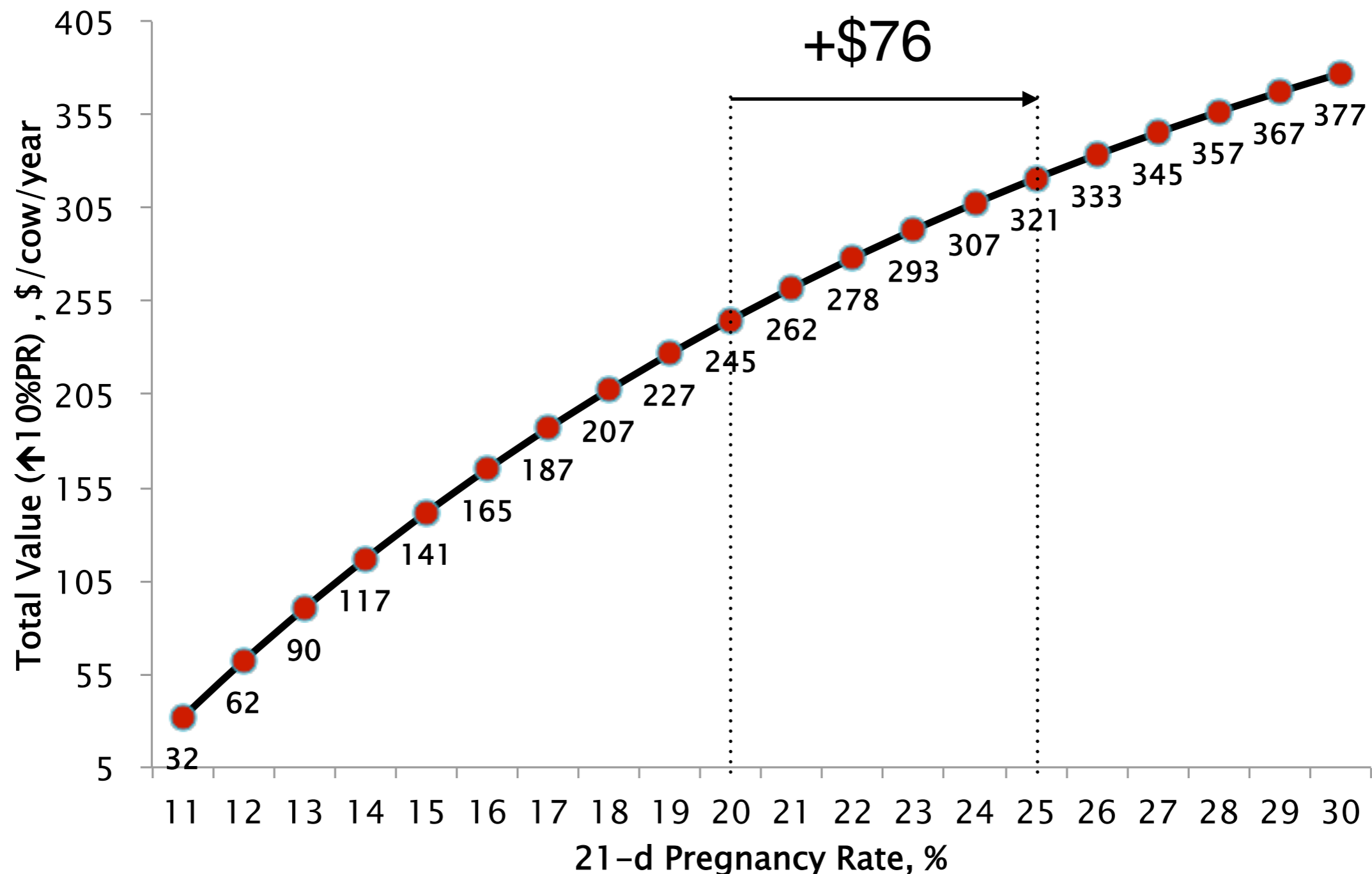
Program	21-d Pregnancy Rate	Reproductive cost \$/cow per mo	Net return \$/cow per yr
Current	20	20	1,749
Alternative	25	20	1,825

**\$76/cow per year**

Gain for improving 21-d Pregnancy rate from 20 to 25%

# Dairy reproductive analysis

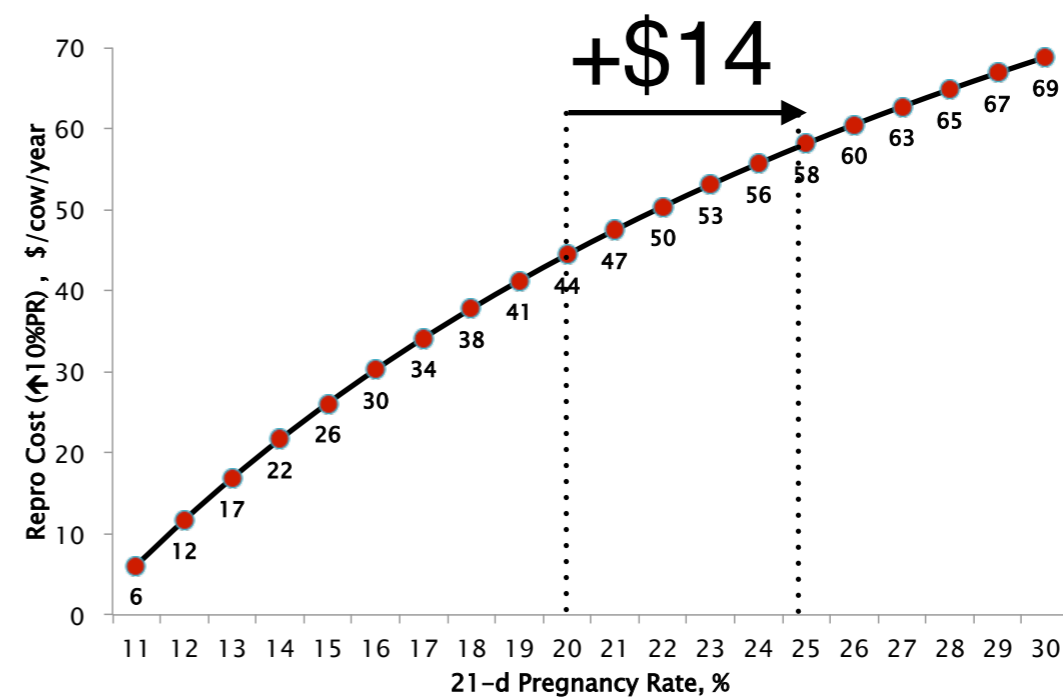
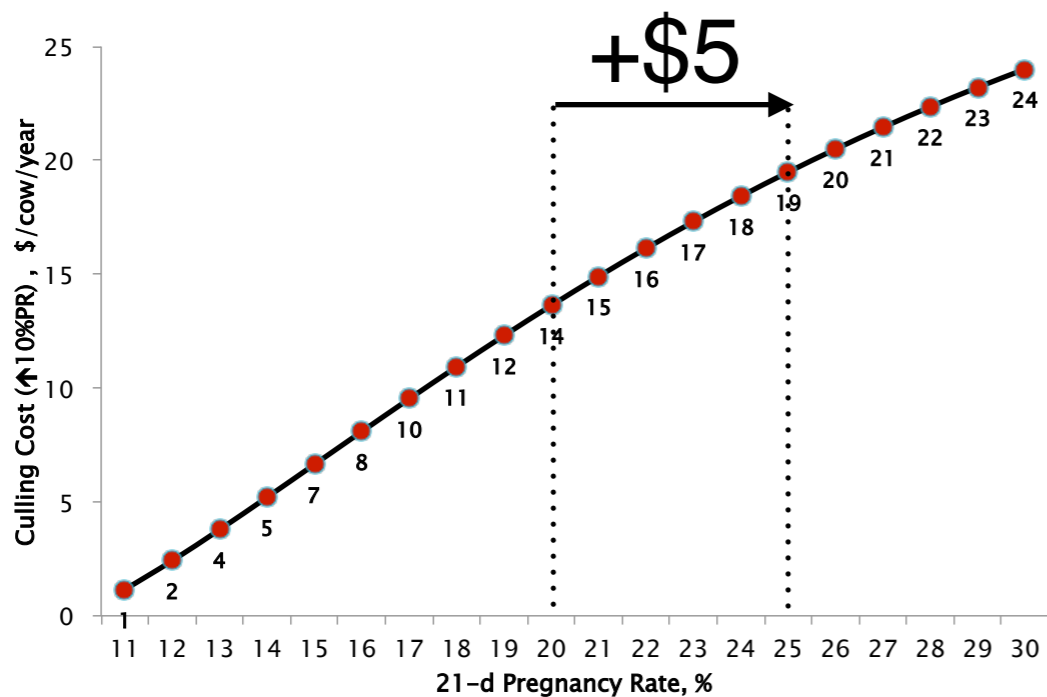
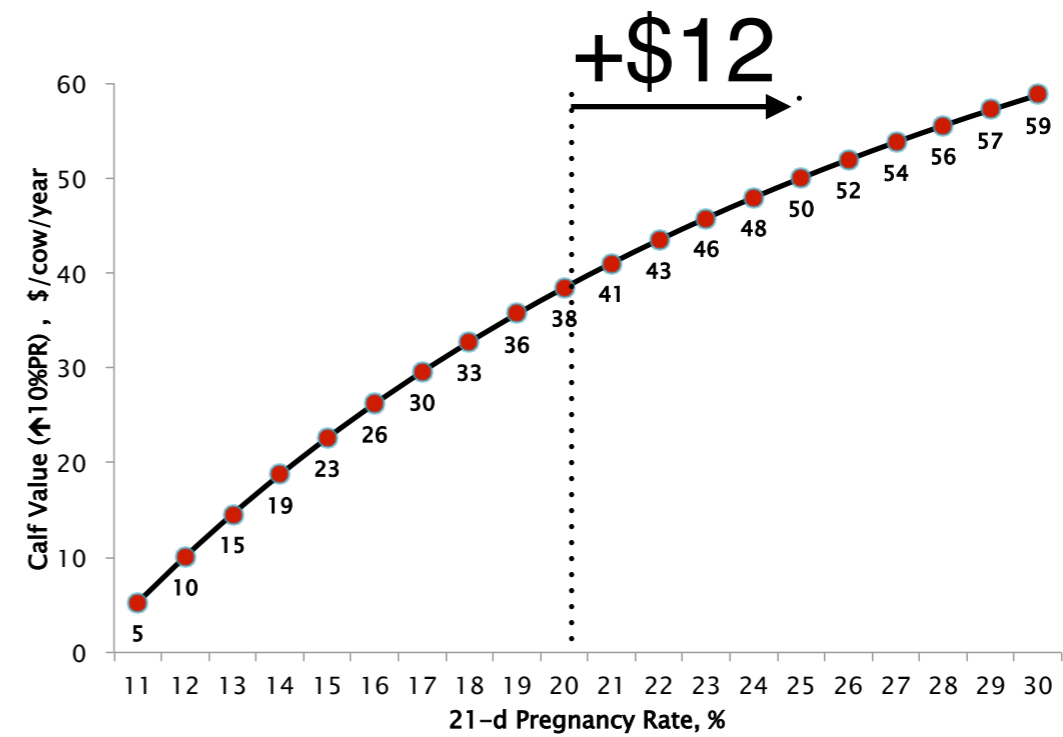
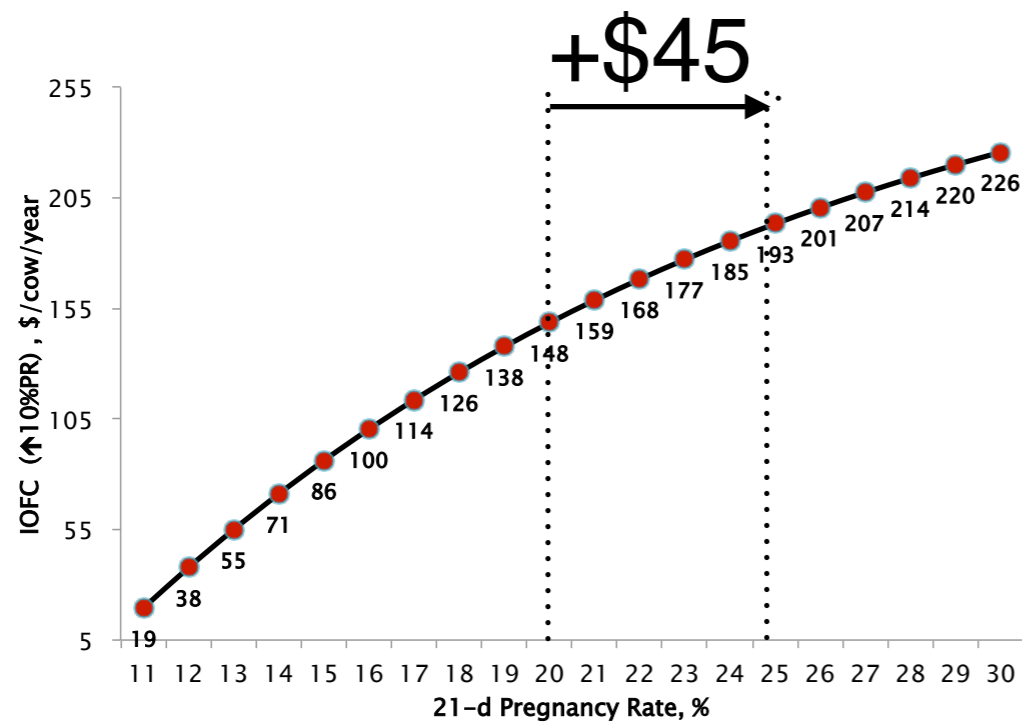
## Net return of reproductive performance





# Dairy reproductive analysis

## Important economic factors



# Dairy reproductive analysis

Net return according to herd structure

	Lactation 2										Cull Cows	IOFC	Cull	Repro	Calves
1	2.22										0.05	496.63	-24.76	0.00	0.00
2	2.17										0.04	583.36	-28.14	54.14	0.00
3	1.58	0.53									0.04	548.87	-20.23	39.52	0.00
4	1.16	0.39	0.52								0.04	504.36	-19.29	28.94	0.00
5	0.86	0.28	0.38	0.50							0.04	460.98	-18.34	21.56	0.00
6	0.65	0.21	0.28	0.37	0.48						0.04	420.67	-17.53	16.30	0.00
7	0.50	0.16	0.21	0.27	0.35	0.47					0.04	378.82	-17.42	12.44	0.00
8	0.38	0.12	0.16	0.20	0.26	0.34	0.46				0.04	337.30	-18.79	9.51	0.00
9	0.29	0.09	0.12	0.15	0.19	0.25	0.34	0.45			0.04	296.98	-17.06	7.23	0.00
10	0.22	0.07	0.09	0.11	0.14	0.19	0.25	0.33	0.44		0.05	166.87	-23.82	5.43	0.00
11	0.16	0.05	0.07	0.09	0.11	0.14	0.18	0.24	0.32	0.43	0.05	76.70	-25.51	4.01	85.40
12	0.12	0.04	0.05	0.06	0.08	0.11	0.14	0.18	0.23	0.31	0.04	49.60	-19.79	0.00	62.53
13	0.11		0.04	0.05	0.06	0.08	0.10	0.13	0.17	0.23	0.03	31.30	-16.82	0.00	45.61
14	0.10			0.03	0.05	0.06	0.08	0.10	0.13	0.17	0.03	18.26	-14.47	0.00	33.83
15	0.09				0.03	0.04	0.06	0.08	0.10	0.13	0.03	9.10	-12.24	0.00	25.49
16	0.07					0.03	0.04	0.06	0.08	0.10	0.08	3.00	-10.14	0.00	19.39
17	0.00						0.03	0.04	0.06	0.07	0.01	-5.62	-2.77	0.00	14.71
18	0.00							0.03	0.04	0.06	0.00	-6.20	-1.82	0.00	11.03
19	0.00								0.03	0.04	0.00	-5.95	-1.06	0.00	8.11
20	0.00									0.03	0.00	-2.47	-0.47	0.00	5.89

Cows leaving

Cow population

Economic Factors

# Dairy reproductive analysis

## Net return according to herd structure

### Dairy Reproductive Economic Analysis

V.E. Cabrera



United States  
Department of  
Agriculture

National Institute  
of Food and  
Agriculture



THE UNIVERSITY  
of  
**WISCONSIN**  
MADISON

Overview

Upload

Repro

Abort

Cull

Milk

Economics

Run Model

Results

Analyze

Information

This is a Markov-chain model that simulates a dairy herd and their replacements for nine lactations: from the moment of the first calving to the ninth parturition. The model follows monthly probabilistic events of aging, culling, mortality, becoming pregnant, having an abortion, calving, and starting a next lactation. A defined lactation curve determines the milk production depending on lactation number, month in milk, and reproductive status. Cows that are culled or die are replaced the next month, so the herd population remains constant. The model performs a number of iterations until the herd population reaches a "steady state." Steady state of the herd population occurs when the proportion of cows in each specific state (lactation, month in milk, reproductive status) do not change from one iteration (month) to the next.

Analysis

The model uses pre-defined or user-defined probabilities of reproduction, abortion, culling, and mortality to simulate a proportion of cows from one state to the next. For instance, a nonpregnant cow could become pregnant, be culled, or die and a pregnant cow could abort, be culled, die, or calve at the end of gestation. These events occur monthly for each cow in the herd. The value of a reproductive program is then calculated every month for each cow in the herd as the sum of five factors: milk income over feed cost (IOFC), culling cost, mortality cost, income from newborns (calves), and cost of the reproductive program:

Own farm data

Value of Reproductive Program = Income Over Feed Cost + Culling Cost + Mortality Cost + Income from Newborn + Reproductive Program Cost

Once the herd population reaches steady state, the value of the studied reproductive program is calculated as the sum product of the value of the reproductive program in each cow state times the proportion of cows in each state. Different reproductive programs yield different herd structures and consequently different economic values.

Following the tabs in this application you can define a reproductive program, edit the expected probabilities of abortion, culling, and mortality, and define other managerial and economic parameters. An option to download and manipulate these values in a spreadsheet format and then to upload it is also available.

Video

demonstration

Once you have defined the input parameters you could run the model. The results will be displayed as a snapshot of the expected herd at "steady state" and the monthly and total value of the reproductive program based on the five parameters defined above.

# Dairy reproductive analysis

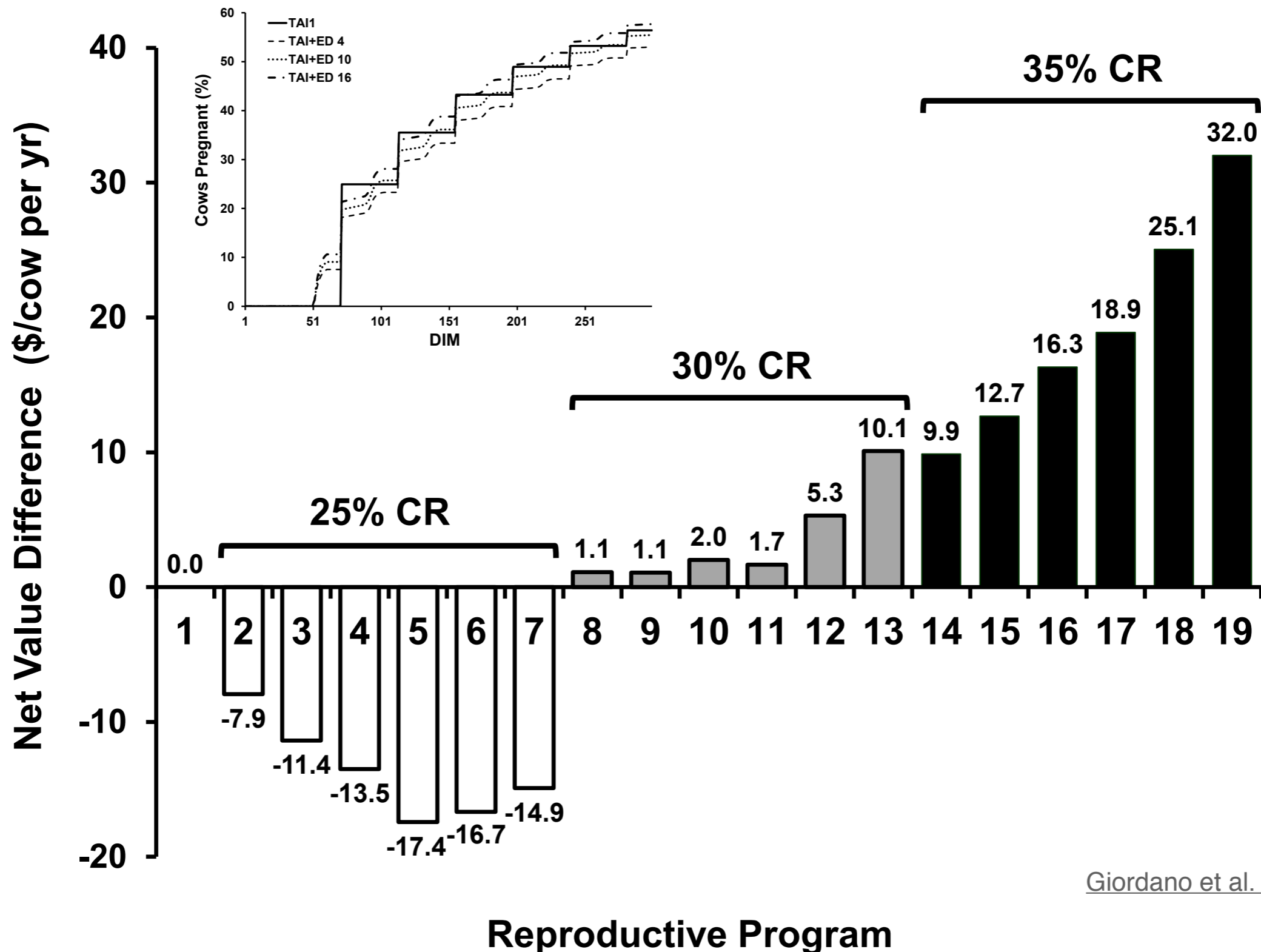
## An application

Program number	Program	First AI			Second and subsequent AI		
		ED before first TAI <sup>1</sup>	CR ED <sup>2</sup> before first TAI	CR TAI	ED before TAI	CR ED before TAI	CR TAI
1	TAI 1 <sup>3</sup>	—	—	42	—	—	30
2	TAI+ED 2 <sup>4</sup>	30	25	40	30	25	30
3	TAI+ED 3	40	25	38	40	25	30
4	TAI+ED 4	50	25	36	50	25	30
5	TAI+ED 5	60	25	34	60	25	28
6	TAI+ED 6	70	25	32	70	25	28
7	TAI+ED 7	80	25	30	80	25	28
8	TAI+ED 8	30	30	40	30	30	30
9	TAI+ED 9	40	30	38	40	30	30
10	TAI+ED 10	50	30	36	50	30	30
11	TAI+ED 11	60	30	34	60	30	28
12	TAI+ED 12	70	30	32	70	30	28
13	TAI+ED 13	80	30	30	80	30	28
14	TAI+ED 14	30	35	40	30	35	30
15	TAI+ED 15	40	35	38	40	35	30
16	TAI+ED 16	50	35	36	50	35	30
17	TAI+ED 17	60	35	34	60	35	28
18	TAI+ED 18	70	35	32	70	35	28
19	TAI+ED 19	80	35	30	80	35	28

TAI=Timed AI; ED=Estrus detection; CR= Conception rate

# Dairy reproductive analysis

## An application



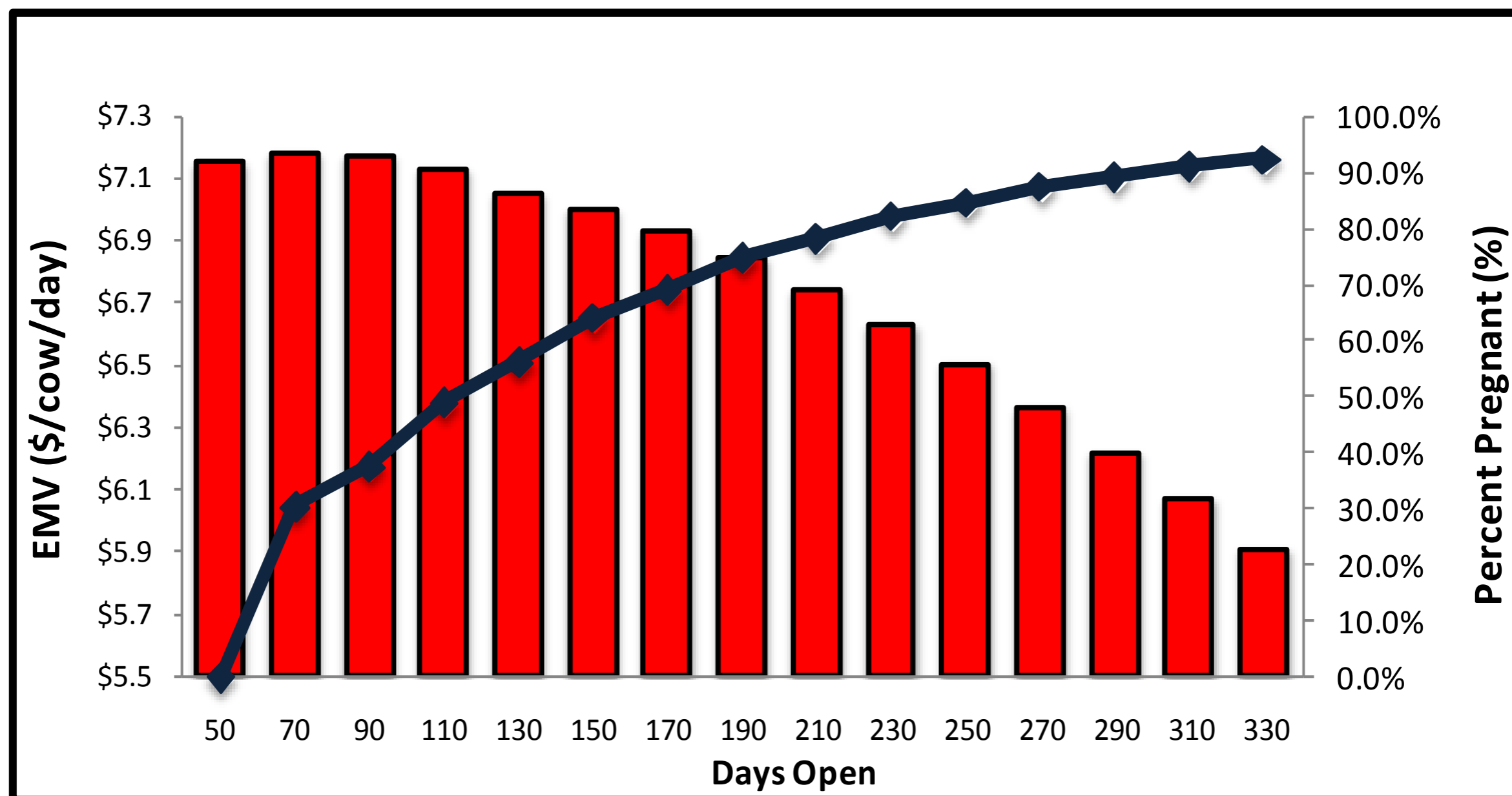


**UW-DairyRepro\$Plus**

# UW-DairyRepro\$Plus

Analyses of reproductive programs

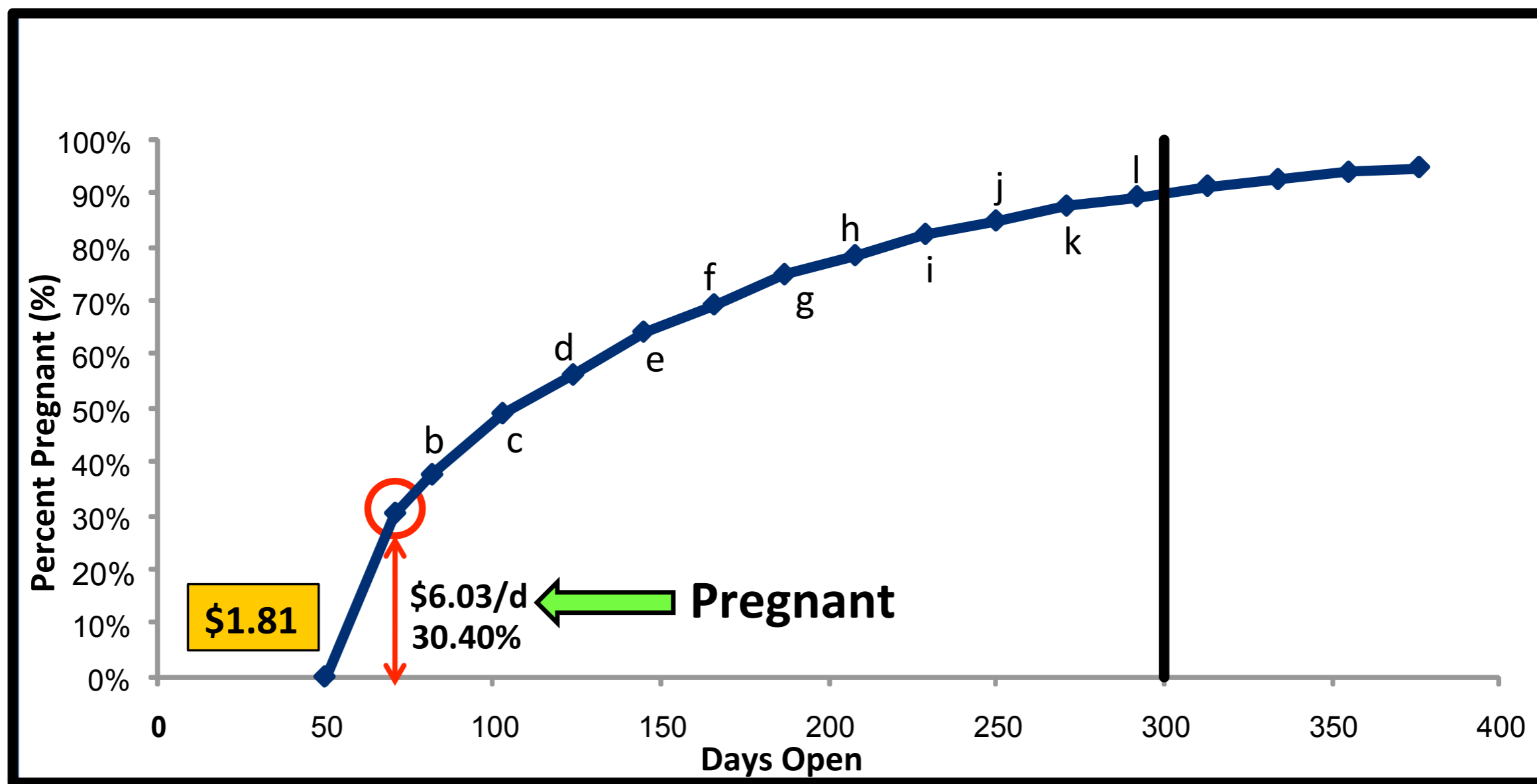
Expected monetary value vs. Reproductive program



# UW-DairyRepro\$Plus

Analyses of reproductive programs

The reproductive value

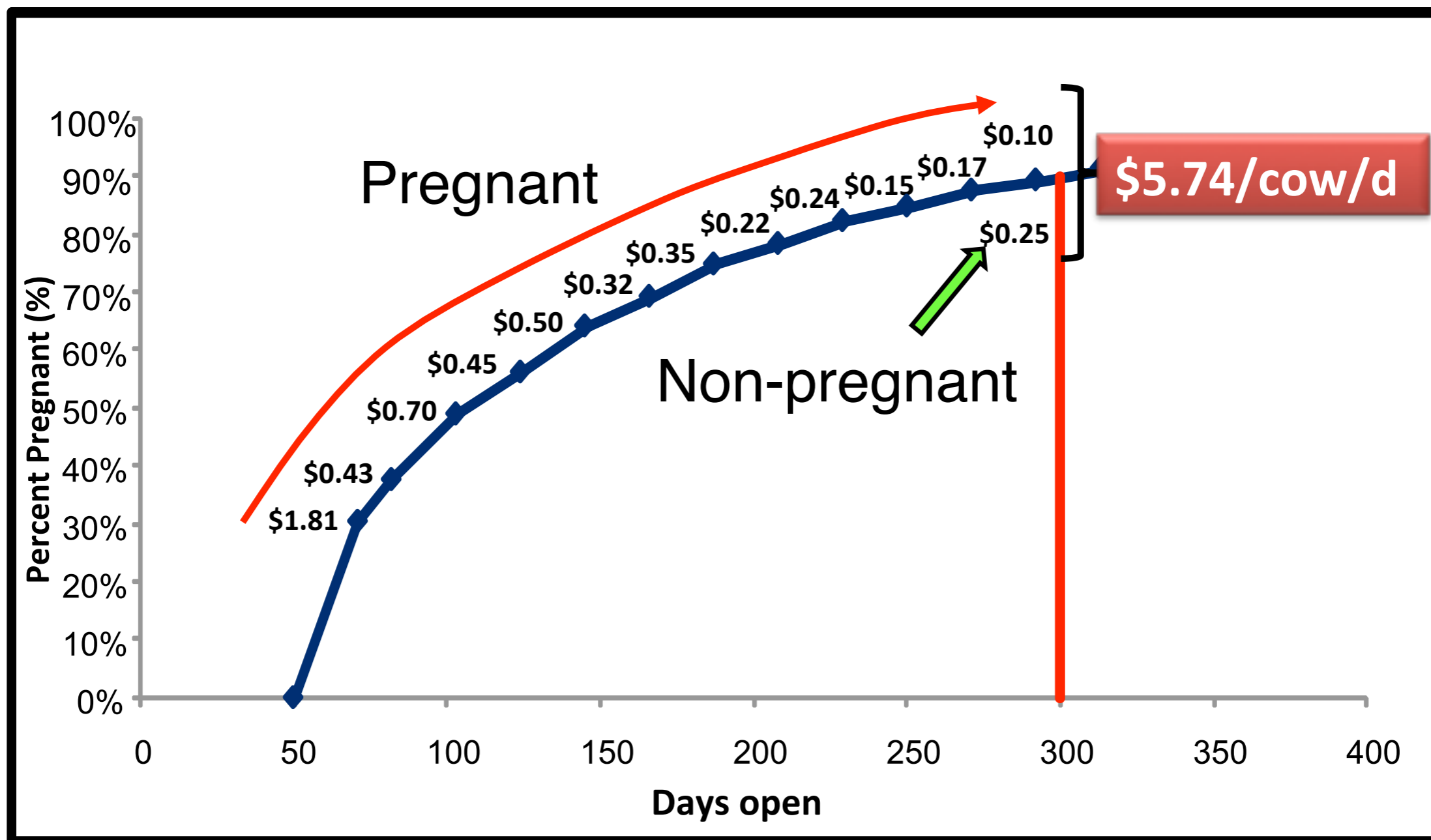




# UW-DairyRepro\$Plus


Analyses of reproductive programs

The reproductive value




# UW-DairyRepro\$Plus

## Decision support tool



**UW-Dairy Repro\$ Plus**  
Victor E. Cabrera & Julio O. Giordano  
Department of Dairy Science



Farm Name: \_\_\_\_\_ Location: \_\_\_\_\_

### 1. Herd Parameters

Lactating Cows, #	500
Parity 1	175
Parity 2	125
Parity ≥ 3	200
Body Weight, lb/cow	
Parity 1	1,350
Parity 2	1,400
Parity ≥ 3	1,450
Involuntary Culling, %/yr	20.0%
Mortality, %/yr	6.0%
Stillbirth, %/yr	6.0%

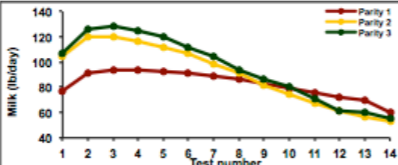
### 2. Economic Parameters

Milk Price, \$/cwt	15.00
Cost Feed Lactating, \$/lb DM	0.10
Dry Period Fixed Cost, \$/d	2.20
Female Calf Value, \$	125
Male Calf value, \$	50
Heifer Replacement Value, \$	1,250
Cow Salvage Value, \$	650
Labor Cost for Injection, \$/hr	15.00
Heat Detection Cost, \$/hr	15.00
AI Cost, \$/cow	15.00
Interest Rate, %/yr	5.0%

### 3. Lactation Curves (lb/cow/test)

Own Farm Lactations (Enter/Edit NUMBERS Below)

Test	Parity 1	Parity 2	Parity ≥ 3
1	77	105	107
2	91	120	126
3	94	120	128
4	94	116	125
5	93	112	120
6	91	107	112
7	89	98	104
8	87	91	94
9	83	82	86
10	79	75	81
11	76	68	71
12	72	61	61
13	70	57	60
14	60	53	55



### 4. Reproductive Program

	Current	Alternative
1 <sup>st</sup> Service postpartum	Ovsynch	Presynch-Ovsynch-12
2 <sup>nd</sup> and subsequent services	Ovsynch	Ovsynch
Resynch before preg check	NO	YES

5. Do you know total breeding costs (semen, hormones, and pregnancy diagnosis)?  
If "Yes" check box

### 6. Reproductive Program Parameters

	Current	Alternative
Voluntary Waiting Period, d	60	72
Estrus Cycle Duration, d		22
Maximum DIM for Breeding, d		330
DIM to 1 <sup>st</sup> TAI, d	60	72
Interbreeding Interval, d	49	35
Heat Bred Before 1 <sup>st</sup> TAI, %	0%	0%
CR Heat Bred Before 1 <sup>st</sup> TAI, %	0%	0%
Heat Bred After 1 <sup>st</sup> TAI, %	0%	0%
CR Heat Bred After 1 <sup>st</sup> TAI, %	0%	0%
CR 1 <sup>st</sup> Service TAI, %	33%	42%
CR 2 <sup>nd</sup> + Services TAI, %	30%	30%
Cost of 1 <sup>st</sup> Service TAI, \$		
Cost of 2 <sup>nd</sup> + Services TAI, \$		
Cost of Heat Breeding, \$		
Cost resynch before preg check, \$		13.7
Calving Interval, d		
Dry Period, d		60

### 7. Heat Detection Labor Cost

	Current	Alternative
Laborers hr/d	1	1
hr/d	2.5	2.5

### 8. Activity Monitors for Heat Detection

	Current	Alternative
System Cost, \$	7,000	0
Number of monitors	250	0
Cost per monitor, \$	100	0
Maintenance, \$/yr	250	0
Life expectancy, yr	10	0
Salvage value, %	25%	0%

### 9. Pregnancy Diagnosis Cost


	Current	Alternative
Palpation, \$/hr	105	
Ultrasound, \$/hr		135
Blood Test, \$/cow		

### 10. Labor Required for Injections and Labor Required for Pregnancy Diagnosis


		Mon	Tue	Wed	Thu	Fri	Sat	Sun
Current	Injections	Laborers hr/d	1		1			
		# Cows	50		30			
	Pregnancy Diagnosis	hr/d	1					
		# Cows	30					
Alternative	Injections	Laborers hr/d	2		1			
		# Cows	75		60			
	Pregnancy Diagnosis	hr/d	1					
		# Cows	30					

### 11. Hormones Cost

	Vial, \$	# Doses
GnRH	Factrel	20 10
PGF	Estrumate	25 10
P4 Insert	CIDR	
hCG	Chorulon	

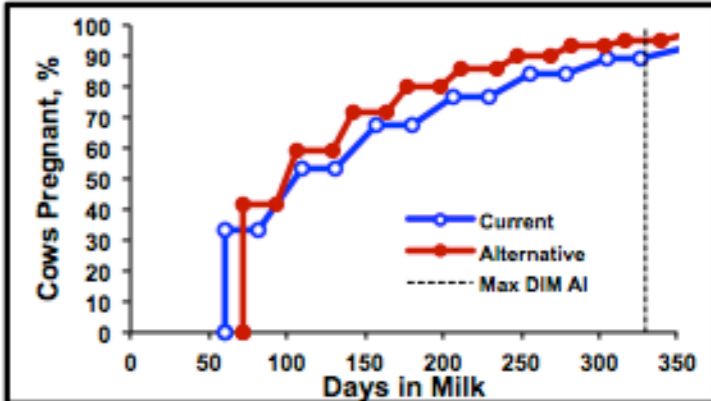


**UW-Dairy Repro\$ Plus**  
Victor E. Cabrera & Julio O. Giordano  
Department of Dairy Science



### Reproductive Programs Summary

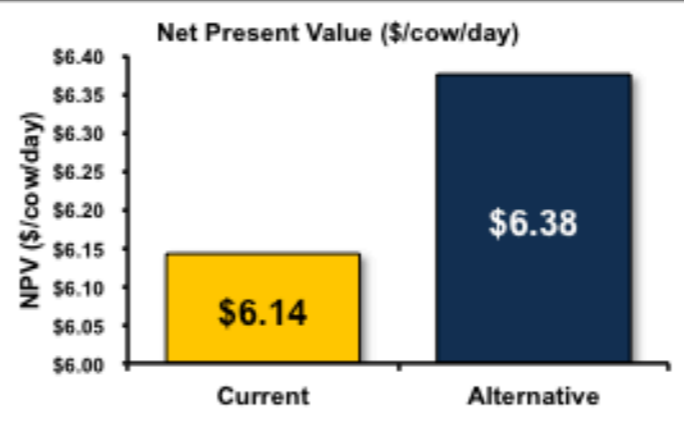
	Current	Alternative
1 <sup>st</sup> Service Postpartum	Ovsynch	Presynch-Ovsynch-12
2 <sup>nd</sup> and Following Services	Ovsynch	Ovsynch
Voluntary Waiting Period, d	60	72
Maximum DIM for Breeding, d	330	
DIM 1 <sup>st</sup> TAI, d	60	72
Interbreeding Interval, d	49	35
Heat Bred Before 1 <sup>st</sup> TAI, %	0%	0%
CR Heat Bred Before 1 <sup>st</sup> TAI, %	0%	0%
Heat Bred After 1 <sup>st</sup> TAI, %	0%	0%
CR Heat Bred After 1 <sup>st</sup> TAI, %	0%	0%
CR 1 <sup>st</sup> Service TAI, %	33%	42%
CR 2 <sup>nd</sup> + Services TAI, %	30%	30%
Cost 1 <sup>st</sup> Service Breeding, \$	26.7	34.5
Cost Resynch Breedings, \$	26.7	28.5
Cost Heat Breedings, \$	18.5	19.5
Pregnancy Diagnosis Method	Palpation	Ultrasound
Pregnancy Diagnosis Cost, \$	3.5	4.5
<b>Activity Monitors for Heat Detection</b>		
System + monitors cost, \$	32000	0
Salvage value, \$	8000	0
Value after depreciation, \$	24000	0
Total cost per d of period, \$/d	6.58	0.00
Maintenance, \$/d	0.68	0.00
Cost Per Cow/d, \$	0.017	0.000




### Expected change by switching to the ALTERNATIVE program

21d-PR, %	8
21d-SR, %	18
Avg. CR, %	5
DO, d	-7
PCI, mo	-0.7

### Net Present Value (\$/cow/day)



### Profit (\$/herd/year) made by switching to the ALTERNATIVE program



\$42,537

[Return to INPUT sheet](#)

# UW-DairyRepro\$Plus

## Input data

The screenshot shows the 'UW-DairyRepro\$Plus' software interface. It includes sections for:
 

- 1. Herd Parameters:** Lactating Cows (#) for Parity 1 (175), Parity 2 (125), and Parity ≥ 3 (200); Body Weight (lb/cow) for Parity 1 (1,350), Parity 2 (1,400), and Parity ≥ 3 (1,450); Involuntary Culling (%/yr) at 20.0%; Mortality (%/yr) at 6.0%; and Stillbirth (%/yr) at 6.0%.
- 2. Economic Parameters:** Milk Price (\$/cwt) at 15.00; Cost of Feed Lactating (\$/lb DM) at 0.10; Dry Period Fixed Cost (\$/cow) at 2.20; Female Calf Value (\$) at 125; Male Calf Value (\$) at 50; Heifer Replacement Value (\$) at 1,250; Cow Salvage Value (\$) at 850; Labor Cost for Injection (\$/hr) at 15.00; Heat Detection Cost (\$/hr) at 15.00; AI Cost (\$/cow) at 15.00; and Interest Rate (%/yr) at 5.0%.
- 3. Lactation Curves (lb/cow/week):** A line graph showing milk yield over 14 weeks for three parity groups.
- 4. Reproductive Program:** Options for service postpartum, estrus synchronization, and pregnancy diagnosis.
- 6. Reproductive Program Parameters:** Values for estrus cycle duration, DM for breeding, and various heat detection and pregnancy diagnosis costs.
- 10. Labor Required for Injections and Labor Required for Pregnancy Diagnosis:** A table showing labor requirements by day of the week for current and alternative programs.
- 11. Hormone Cost:** A table listing costs for Estrus Synchronizer, PGF, Estradiol, PA Invert, and CIDR.

## Herd

<b>Lactating Cows, #</b>	<b>500</b>
Parity 1	175
Parity 2	125
Parity ≥ 3	200
<b>Body Weight, lb/cow</b>	
Parity 1	1,350
Parity 2	1,400
Parity ≥ 3	1,450
<b>Involuntary Culling, %/yr</b>	<b>20.0%</b>
<b>Mortality, %/yr</b>	<b>6.0%</b>
<b>Stillbirth, %/yr</b>	<b>6.0%</b>

# UW-DairyRepro\$Plus

## Input data

The screenshot shows the 'UW-DairyRepro\$Plus' software interface. It includes sections for:
 

- 1. Herd Parameters:** Lactating Cows (#), Parity 1-3, Body Weight (lb/cow), Involuntary Culling (%/yr), Mortality (%/yr), Stillbirth (%/yr).
- 2. Economic Parameters:** Milk Price (\$/cwt), Cost Feed Lactating (\$/lb DM), Dry Period Fixed Cost (\$/d), Female Calf Value (\$), Male Calf Value (\$), Heifer Replacement Value (\$), Cow Salvage Value (\$), Labor Cost for Injection (\$/hr), Heat Detection Cost (\$/hr), AI Cost (\$/cow), Interest Rate (%/yr).
- 3. Lactation Curves (lb/cow/week):** A table with columns for Year, Parity 1, and Parity 2, and rows for weeks 1-14.
- 4. Reproductive Program:** Options for service postpartum, estrus, and pregnancy diagnosis.
- 5. Do you know total breeding costs (semen, hormones, and pregnancy diagnosis)?** A checkbox.
- 6. Reproductive Program Parameters:** Involuntary Waiting Period, Estrus Cycle Duration, Maximum DM for breeding, Interbreeding Interval, CR Heat Shed Before/After 1<sup>st</sup> TAI, CR 1<sup>st</sup> Service TAI, CR 2<sup>nd</sup> Service TAI, Cost of 1<sup>st</sup> Service TAI, Cost of 2<sup>nd</sup> Service TAI, Cost of Heat Breeding, Cost resynch before prog check, Calving Interval, Dry Period.
- 7. Heat Detection Labor Cost:** Laborers, \$/hr.
- 8. Activity Monitors for Heat Detection:** System Cost, Number of monitors, Cost per monitor, Maintenance, Life expectancy, Salvage value.
- 9. Pregnancy Diagnosis Cost:** Papalton, Ultrasound, Blood Test.
- 10. Labor Required for Injections and Labor Required for Pregnancy Diagnosis:** A weekly schedule for injections and labor.
- 11. Hormone Cost:** Val, \$, # Doses for Estrus, PGF, PA Invert, CIDR.

## Economics

Milk Price, \$/cwt	15.00
Cost Feed Lactating, \$/lb DM	0.10
Dry Period Fixed Cost, \$/d	2.20
Female Calf Value, \$	125
Male Calf value, \$	50
Heifer Replacement Value, \$	1,250
Cow Salvage Value, \$	650
Labor Cost for Injection, \$/hr	15.00
Heat Detection Cost, \$/hr	15.00
AI Cost, \$/cow	15.00
Interest Rate, %/yr	5.0%

# UW-DairyRepro\$Plus

## Input data

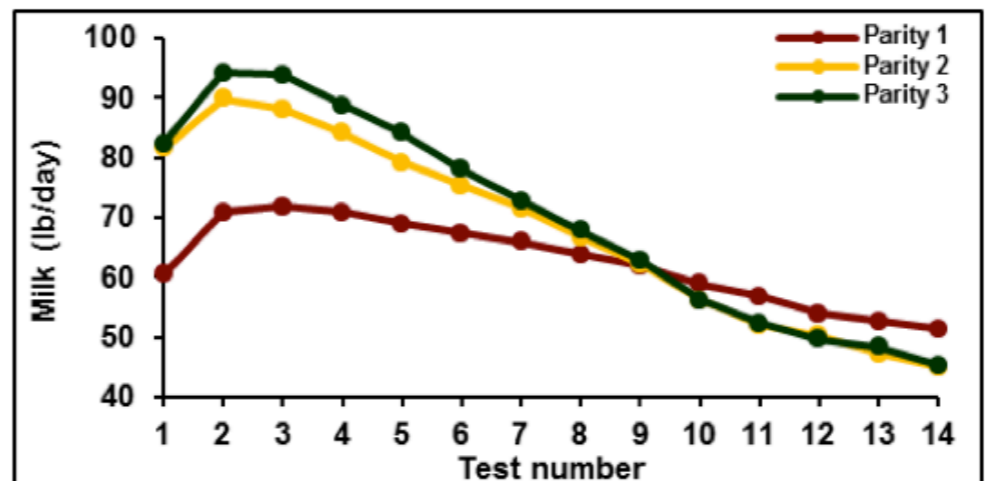
The screenshot displays the 'UW-DairyRepro\$Plus' software interface. It is divided into several sections for data entry:

- 1. Herd Parameters:** Includes fields for Lactating Cows (#), Parity 1-3, Body Weight (lb/cow), Parity 1-3, Involuntary Culling (%/yr), Mortality (%/yr), and Stillbirth (%/yr).
- 2. Economic Parameters:** Lists costs for Milk Price, Feed, Dry Period, Female Calf Value, Male Calf Value, Heifer Replacement Value, Cow Salvage Value, Labor for Injection, Heat Detection, AI Cost, and Interest Rate.
- 3. Lactation Curves (lb/cow/yr):** A table for entering milk yield data for Parity 1, 2, and ≥ 3 across 14 tests.
- 4. Reproductive Program:** Options for service postpartum, 2nd and subsequent services, and resynch before prog check.
- 5. Do you know total breeding costs (semen, hormones, and pregnancy diagnosis)?** A checkbox for 'Yes'.
- 6. Reproductive Program Parameters:** Fields for Mounting Waiting Period, Estrus Cycle Duration, Maximum DM for breeding, Interbreeding Interval, CR Heat Shed Before/After 1st TAL, CR Heat Shed After 1st TAL, CR 1st Service TAL, CR 2nd Service TAL, Cost of 1st Service TAL, Cost of 2nd Service TAL, Cost of Heat Breeding, and Calving Interval.
- 7. Heat Detection Labor Cost:** Fields for Laborers and Hourly Rate.
- 8. Activity Monitors for Heat Detection:** Fields for System Cost, Number of monitors, Cost per monitor, Maintenance, Life expectancy, and Salvage value.
- 9. Pregnancy Diagnosis Cost:** Fields for Papapain, Ultrasound, and Blood Test costs.
- 10. Labor Required for Injections and Labor Required for Pregnancy Diagnosis:** Grids for labor hours per day (Mon-Sun) for Injections and Pregnancy Diagnosis.
- 11. Hormones Cost:** Table for Val. \$ and # Doses for GnRH, PGF, PA insert, and CIDR.

## Lactation curves

Own Farm Lactations (Enter/Edit NUMBERS Below)

Test	Parity 1	Parity 2	Parity ≥ 3
1	77	105	107
2	91	120	126
3	94	120	128
4	94	116	125
5	93	112	120
6	91	107	112
7	89	98	104
8	87	91	94
9	83	82	86
10	79	75	81
11	76	68	71
12	72	61	61
13	70	57	60
14	60	53	55



# UW-DairyRepro\$Plus

## Detailed definition of reproduction

The screenshot shows the 'UW-DairyRepro\$Plus' software interface. It includes sections for:
 

- 1. Herd Parameters:** Lactating Cows (#), Body Weight (lb/cow), Involuntary Culling (%/yr), Mortality (%/yr), Stillbirth (%/yr).
- 2. Economic Parameters:** Milk Price (\$/cwt), Cost Feed Lactating, \$/lb DM, Dry Period Fixed Cost, \$/c, Female Calf Value, \$, Male Calf Value, \$, Heifer Replacement Value, \$, Cow Salvage Value, \$, Labor Cost for Injection, \$/hr, Heat Detection Cost, \$/hr, AI Cost, \$/cow, Interest Rate, %/yr.
- 3. Lactation Curves (lb/cow/week):** A table with columns for Parity (1, 2, 3) and weeks (1-14).
- 4. Reproductive Program:** A table with columns for Current and Alternative, and rows for 1st and 2nd service postpartum, and Resynch before preg check.
- 6. Reproductive Program Parameters:** A table with columns for Current and Alternative, and rows for various parameters like Voluntary Waiting Period, Estrus C, Maximum DM for Breed/Inf, etc.
- 7. Heat Detection Labor Cost:** A table with columns for Current and Alternative, and rows for Laborers and Hour.
- 8. Activity Monitors for Heat Detection:** A table with columns for Current and Alternative, and rows for System Cost, Number of monitors, etc.
- 9. Pregnancy Diagnosis Cost:** A table with columns for Current and Alternative, and rows for Pregnancy Diagnosis, Ultrasound, Blood Test, etc.
- 11. Hormones Cost:** A table with columns for Val, \$, and # Doses, and rows for Estrus, Estradiol, PG, Invert, and Cholesterol.

## Reproductive programs

	Current	Start day
1 <sup>st</sup> Service postpartum	Ovsynch	Tue
2 <sup>nd</sup> and subsequent services	Ovsynch	Tue
Resynch before preg check	YES	

	Alternative	Start day
1 <sup>st</sup> Service postpartum	Presynch-Ovsynch-12	Thu
2 <sup>nd</sup> and subsequent services	Ovsynch	Tue
Resynch before preg check	YES	

# UW-DairyRepro\$Plus

## Define reproduction performance

### Reproductive programs

The screenshot shows the 'UW-DairyRepro\$Plus' software interface. It includes sections for:
 

- 1. Herd Parameters:** Lactating Cows, Parity 1-3, Body Weight, Mortality, Stillbirths.
- 2. Economic Parameters:** Milk Price, Feed Costs, Dry Period Fixed Cost, Female Calf Value, Male Calf Value, Heifer Replacement Value, Cow Salvage Value, Labor Cost for Injection, Heat Detection Cost, AI Cost, Interest Rate.
- 3. Lactation Curves:** A table and graph showing milk yield over 14 days for Parity 1, 2, and 3.
- 4. Reproductive Program:** A table comparing 'Current' and 'Alternative' programs for services postpartum, estrus, and pregnancy diagnosis.
- 6. Reproductive Program Parameters:** Voluntary Waiting Period, Estrus Cycle Duration, Maximum DIM for Breeding, DIM to 1st TAI, Interbreeding Interval, Heat Bred Before 1st TAI, CR Heat Bred After 1st TAI, CR 1st Service TAI, CR 2nd+ Services TAI, Cost of 1st Service TAI, Cost of 2nd+ Services TAI, Cost of Heat Breeding, Cost resynch before preg check, Calving Interval, Dry Period.
- 7. Heat Detection Labor Cost:** Laborers, Hourly Rate.
- 8. Activity:** System, Number of monitors, Cost per monitor, Maintenance, Life expectancy, Salvage value.
- 9. Pregnancy Diagnosis Cost:** Papalton, Ultrasound, Blood Test.
- 10. Labor Required for Injections and Labor Required for Pregnancy Diagnosis:** A weekly schedule for injections and pregnancy diagnosis.
- 11. Hormone Cost:** Fertil, Estradiol, PGF, PA Invert, Chorion, Val, # Doses.

Voluntary Waiting Period, d  
 Estrus Cycle Duration, d  
 Maximum DIM for Breeding, d  
 DIM to 1<sup>st</sup> TAI, d  
 Interbreeding Interval, d  
 Heat Bred Before 1<sup>st</sup> TAI, %  
 CR Heat Bred Before 1<sup>st</sup> TAI, %  
 Heat Bred After 1<sup>st</sup> TAI, %  
 CR Heat Bred After 1<sup>st</sup> TAI, %  
 CR 1<sup>st</sup> Service TAI, %  
 CR 2<sup>nd</sup>+ Services TAI, %  
 Cost of 1<sup>st</sup> Service TAI, \$  
 Cost of 2<sup>nd</sup>+ Services TAI, \$  
 Cost of Heat Breeding, \$  
 Cost resynch before preg check, \$  
 Calving Interval, d  
 Dry Period, d

	Current	Alternative
Voluntary Waiting Period, d	60	72
Estrus Cycle Duration, d	22	
Maximum DIM for <u>Breeding</u> , d	330	
DIM to 1 <sup>st</sup> TAI, d	60	72
Interbreeding Interval, d	49	35
Heat Bred Before 1 <sup>st</sup> TAI, %	50%	50%
CR Heat Bred Before 1 <sup>st</sup> TAI, %	35%	35%
Heat Bred After 1 <sup>st</sup> TAI, %	40%	40%
CR Heat Bred After 1 <sup>st</sup> TAI, %	35%	35%
CR 1 <sup>st</sup> Service TAI, %	33%	42%
CR 2 <sup>nd</sup> + Services TAI, %	30%	30%
Cost of 1 <sup>st</sup> Service TAI, \$		
Cost of 2 <sup>nd</sup> + Services TAI, \$		
Cost of Heat Breeding, \$		
Cost resynch before <u>preg</u> check, \$		
Calving Interval, d	13.7	
Dry Period, d	60	

# UW-DairyRepro\$Plus

Expected performance 1<sup>st</sup> service

<b>Synchronization Program</b>	<b>VWP (d)</b>	<b>Conception Rate (%)</b>	
		<b>Mean</b>	<b>Range</b>
Presynch-Ovsynch-14	70-85	37	(32-42)
Presynch-Ovsynch-12	70-85	42	(37-47)
Presynch-Ovsynch-11	70-85	43	(37-47)
Presynch-Ovsynch-10	70-85	44	(37-47)
Double-Ovsynch	70-85	47	(40-50)
G-6-G	70-85	45	(37-47)
Ovsynch	60-75	33	(30-37)
Cosynch-72	60-75	26	(25-33)
Presynch-Ovsynch-12 w/CIDR	70-85	45	(40-50)
Double-Ovsynch w/ CIDR	70-85	50	(43-53)
Ovsynch w/ CIDR	60-75	36	(40-50)
Cosynch-72 w/ CIDR	60-75	32	(33-40)



# UW-DairyRepro\$Plus

Expected performance 2<sup>nd</sup>+ services

<b>Synchronization Program</b>	<b>Interbreeding Interval</b>	<b>Conception Rate (%)</b>	
	<b>(d)</b>	<b>Mean</b>	<b>Range</b>
Ovsynch-Day 25	35	27	(24-30)
Ovsynch-Day 32	42	30	(25-35)
Ovsynch-Day 39	49	28	(25-32)
Double-Ovsynch	49	38	(33-42)
Short-Double-Ovsynch	42	34	(30-38)
HGPG (hCG-7d-Ovsynch)	35	37	(33-41)
GGPG (GnRH-7d-Ovsynch)	35	34	(27-37)
G-6-G	49	35	(32-38)
Cosynch-72-Day 25	35	23	(20-25)
Cosynch-72-Day 32	42	28	(24-32)
Cosynch-72-Day 39	49	25	(23-28)
Ovsynch-Day 32 w/ CIDR	42	33	(28-38)
Double-Ovsynch w/ CIDR	49	41	(36-45)
Short-Double-Ovsynch w/CIDR	42	37	(33-41)
HGPG (hCG-7d-Ovsynch) w/CIDR	35	40	(36-41)
GGPG (GnRH-7d-Ovsynch) w/ CIDR	35	35	(30-40)
G-6-G w/CIDR	49	38	(33-41)
Cosynch-72-Day 32 w/CIDR	42	31	(27-35)

# UW-DairyRepro\$Plus

## Use of heat detection devices

The screenshot shows the 'UW-DairyRepro\$Plus' software interface. It includes sections for:
 

- 1. Herd Parameters:** Lactating Cows (Parity 1-3), Body Weight, Mortality, and Stillbirth rates.
- 2. Economic Parameters:** Milk Price, Feed Costs, and various replacement and salvage values.
- 3. Lactation Curves:** A table and graph showing milk yield over 14 days for different parities.
- 4. Reproductive Program:** Options for current and alternative breeding strategies.
- 6. Reproductive Program Parameters:** Detailed settings for estrus cycle, heat detection, and pregnancy diagnosis.
- 7. Heat Detection Labor Cost:** Labor requirements for heat detection.
- 8. Activity Monitors for Heat Detection:** System cost, number of monitors, and maintenance details.
- 9. Pregnancy Diagnosis Cost:** Costs for palpation, ultrasound, and blood tests.
- 10. Labor Required for Injections and Labor Required for Pregnancy Diagnosis:** Weekly labor schedules.
- 11. Hormones Cost:** Costs for various hormone treatments.

## Activity monitors for heat detection


**New!**

System Cost, \$  
 Number of monitors  
 Cost per monitor, \$  
 Maintenance, \$/yr  
 Life expectancy, yr  
 Salvage value, %

	Current	Alternative
System Cost, \$	0	7,000
Number of monitors	0	350
Cost per monitor, \$	0	110
Maintenance, \$/yr	0	350
Life expectancy, yr	0	10
Salvage value, %	0%	25%


# UW-DairyRepro\$Plus

## Examine results



THE UNIVERSITY  
**WISCONSIN**  
MADISON

**UW-Dairy Repro\$ Plus**  
Victor E. Cabrera & Julio O. Giordano  
Department of Dairy Science



UW  
**Extension**  
University of Wisconsin-Extension

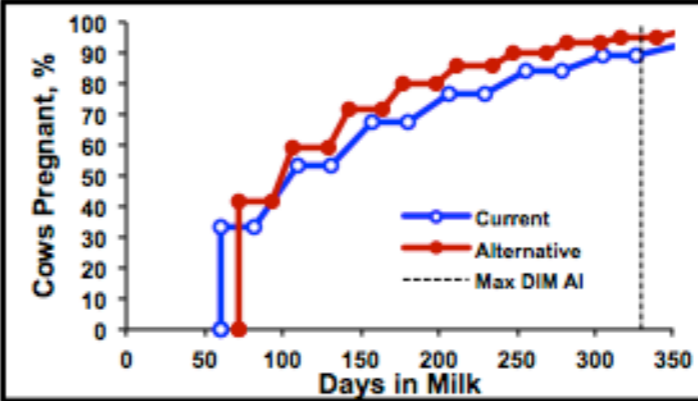
  

**Reproductive Programs Summary**

	Current	Alternative
1 <sup>st</sup> Service Postpartum	Ovsynch	Presynch-Ovsynch-12
2 <sup>nd</sup> and Following Services	Ovsynch	Ovsynch
Voluntary Waiting Period, d	60	72
Maximum DIM for Breeding, d	330	
DIM 1st TAI, d	60	72
Interbreeding Interval, d	49	35
Heat Bred Before 1 <sup>st</sup> TAI, %	0%	0%
CR Heat Bred Before 1 <sup>st</sup> TAI, %	0%	0%
Heat Bred After 1 <sup>st</sup> TAI, %	0%	0%
CR Heat Bred After 1 <sup>st</sup> TAI, %	0%	0%
CR 1 <sup>st</sup> Service TAI, %	33%	42%
CR 2 <sup>nd</sup> + Services TAI, %	30%	30%
Cost 1st Service Breeding, \$	26.7	34.5
Cost Resynch Breedings, \$	26.7	28.5
Cost Heat Breedings, \$	18.5	19.5
Pregnancy Diagnosis Method	Palpation	Ultrasound
Pregnancy Diagnosis Cost, \$	3.5	4.5

**Activity Monitors for Heat Detection**

	Current	Alternative
System + monitors cost, \$	32000	0
Salvage value, \$	8000	0
Value after depreciation, \$	24000	0
Total cost per d of period, \$/d	6.58	0.00
Maintenance, \$/d	0.68	0.00
Cost Per Cow/d, \$	0.017	0.000



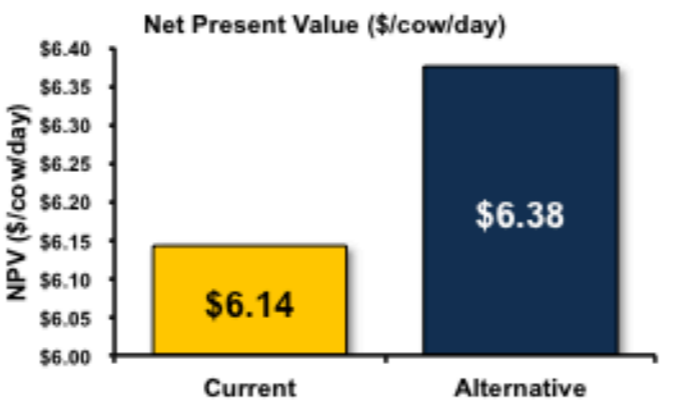
  

**Expected change by switching to the ALTERNATIVE program**

21d-PR, %	8
21d-SR, %	18
Avg. CR, %	5
DO, d	-7
PCI, mo	-0.7

**Net Present Value (\$/cow/day)**



**Profit (\$/herd/year) made by switching to the ALTERNATIVE program**

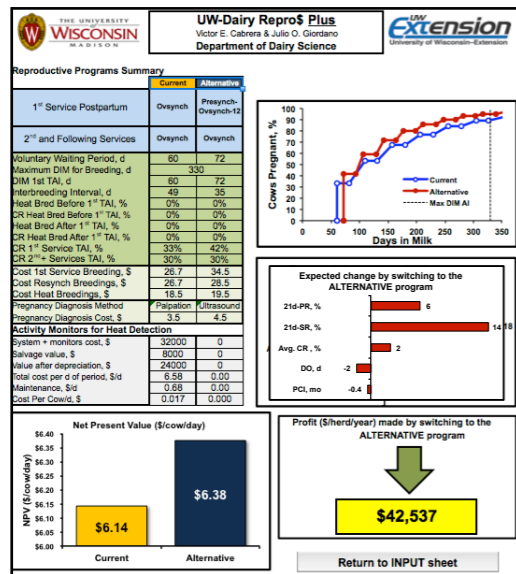
↓

\$42,537

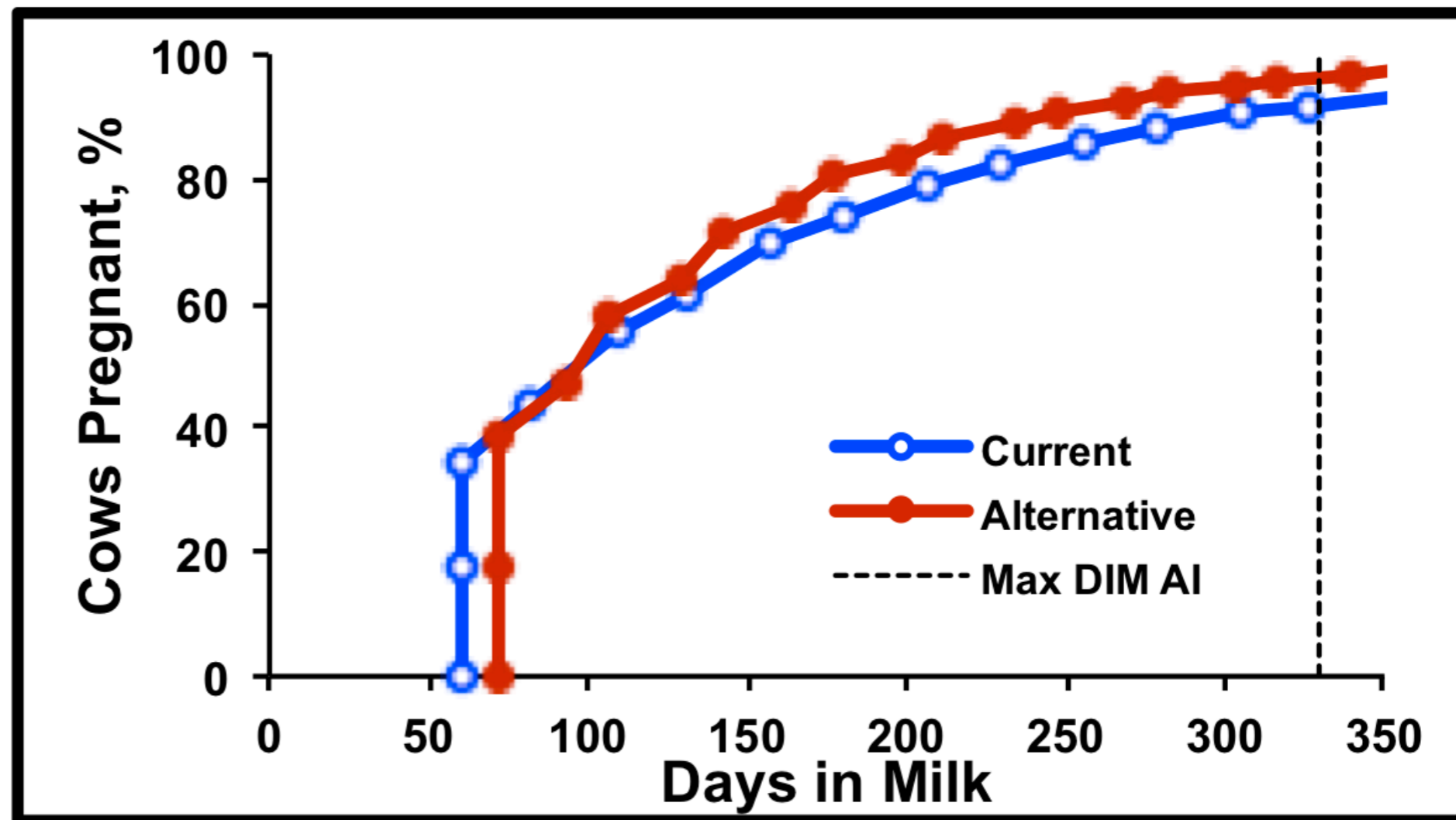
[Return to INPUT sheet](#)

# UW-DairyRepro\$Plus

## Examine results

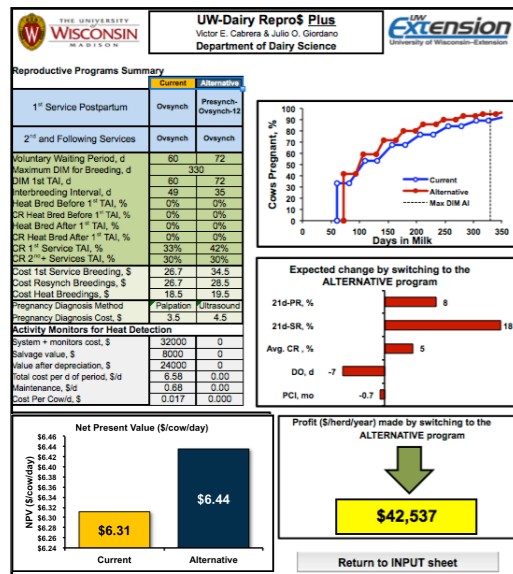


## Reproductive performance



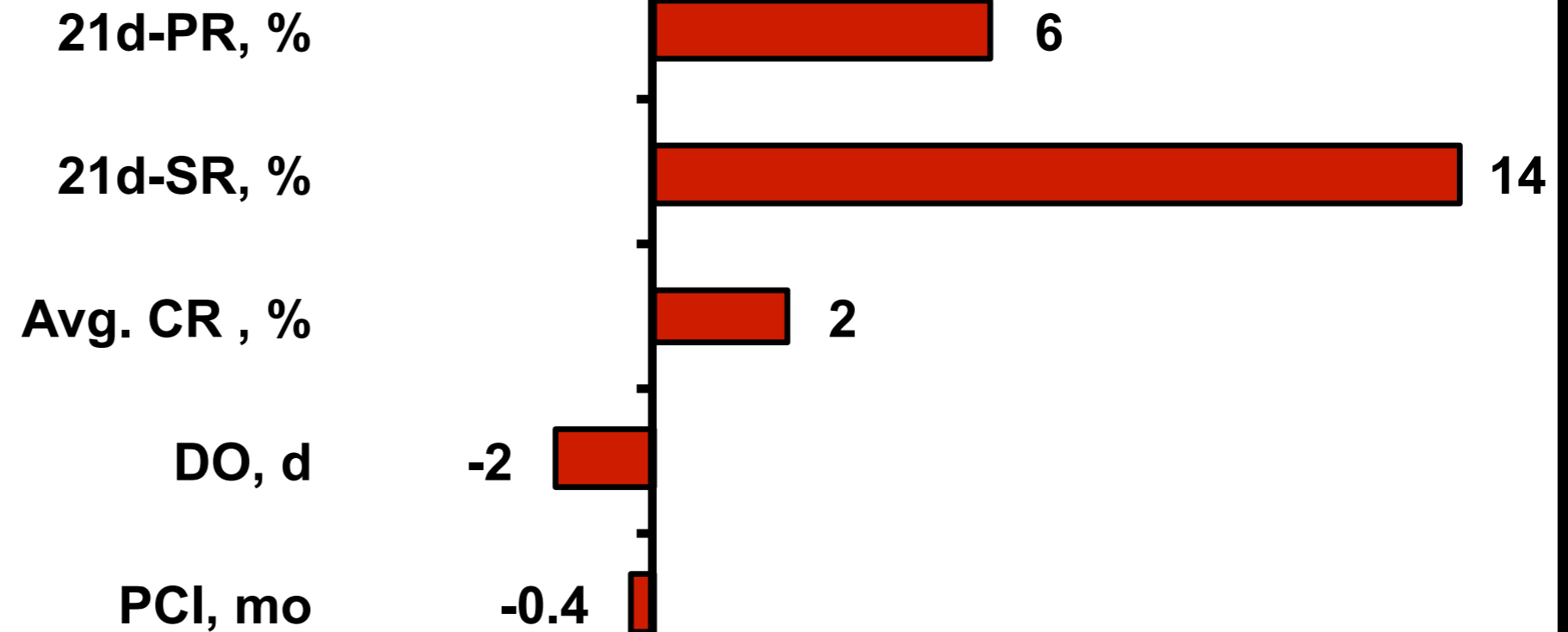
# UW-DairyRepro\$Plus

## Examine results



## Reproductive performance

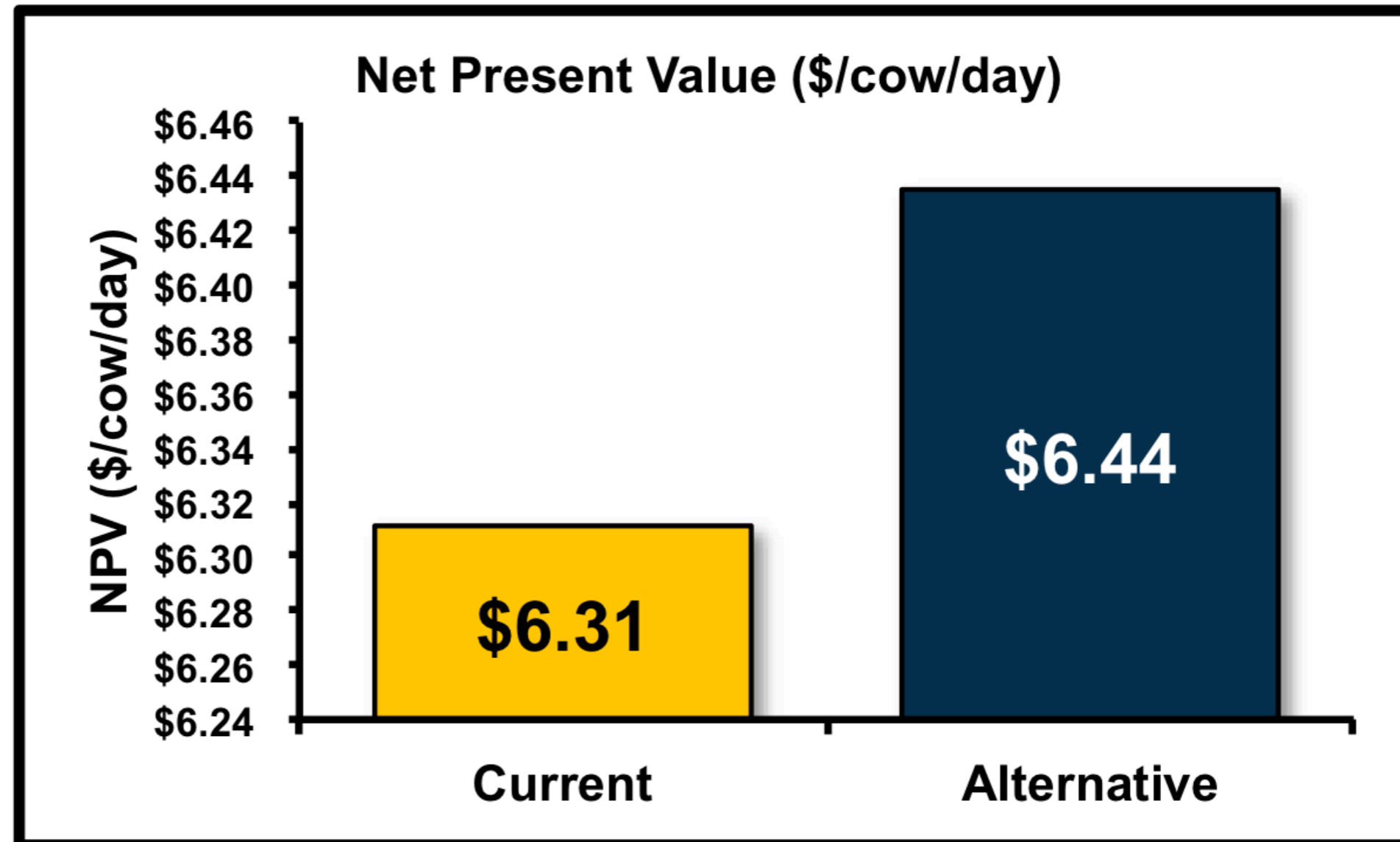
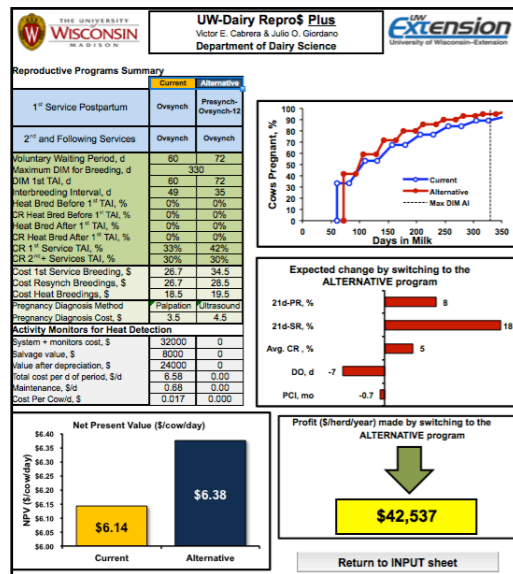
### Expected change by switching to the ALTERNATIVE program



# UW-DairyRepro\$Plus

## Examine results

### Economic difference of programs



**\$0.13 = \$47/cow per year net gain**

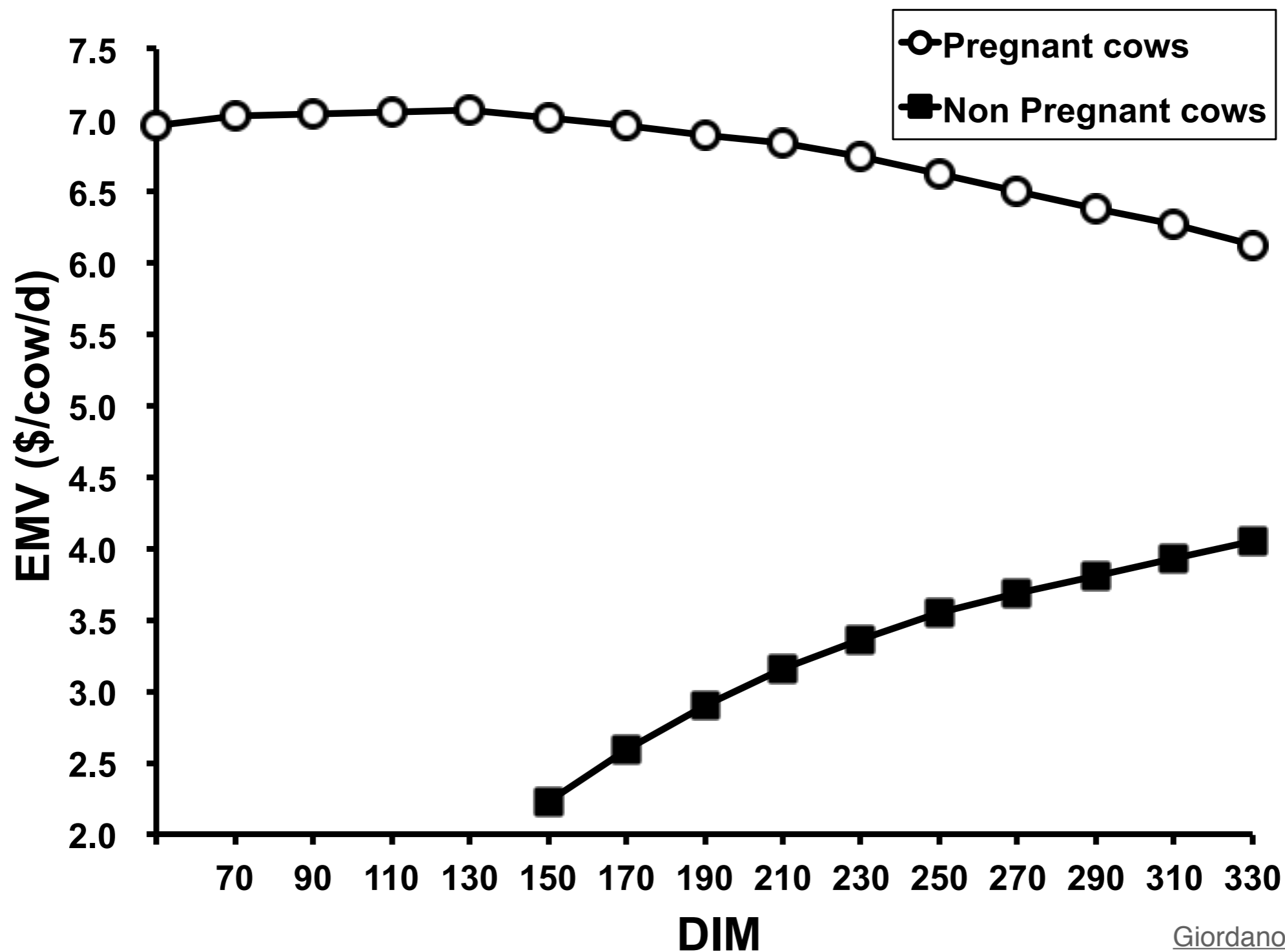
# UW-DairyRepro\$Plus

## An investigation

	A	B	C
1 <sup>st</sup> Service	Double-OvSynch		Heat detection
2 <sup>nd</sup> + Services	ReSynch-D32	Double-OvSynch	Heat detection
Voluntary waiting period, d	82	82	50
Interbreeding interval, d	42	49	21
CR at 1 <sup>st</sup> service, %	45	45	33
CR at 2 <sup>nd</sup> + services, %	30	39	30

# UW-DairyRepro\$Plus

## Economic results





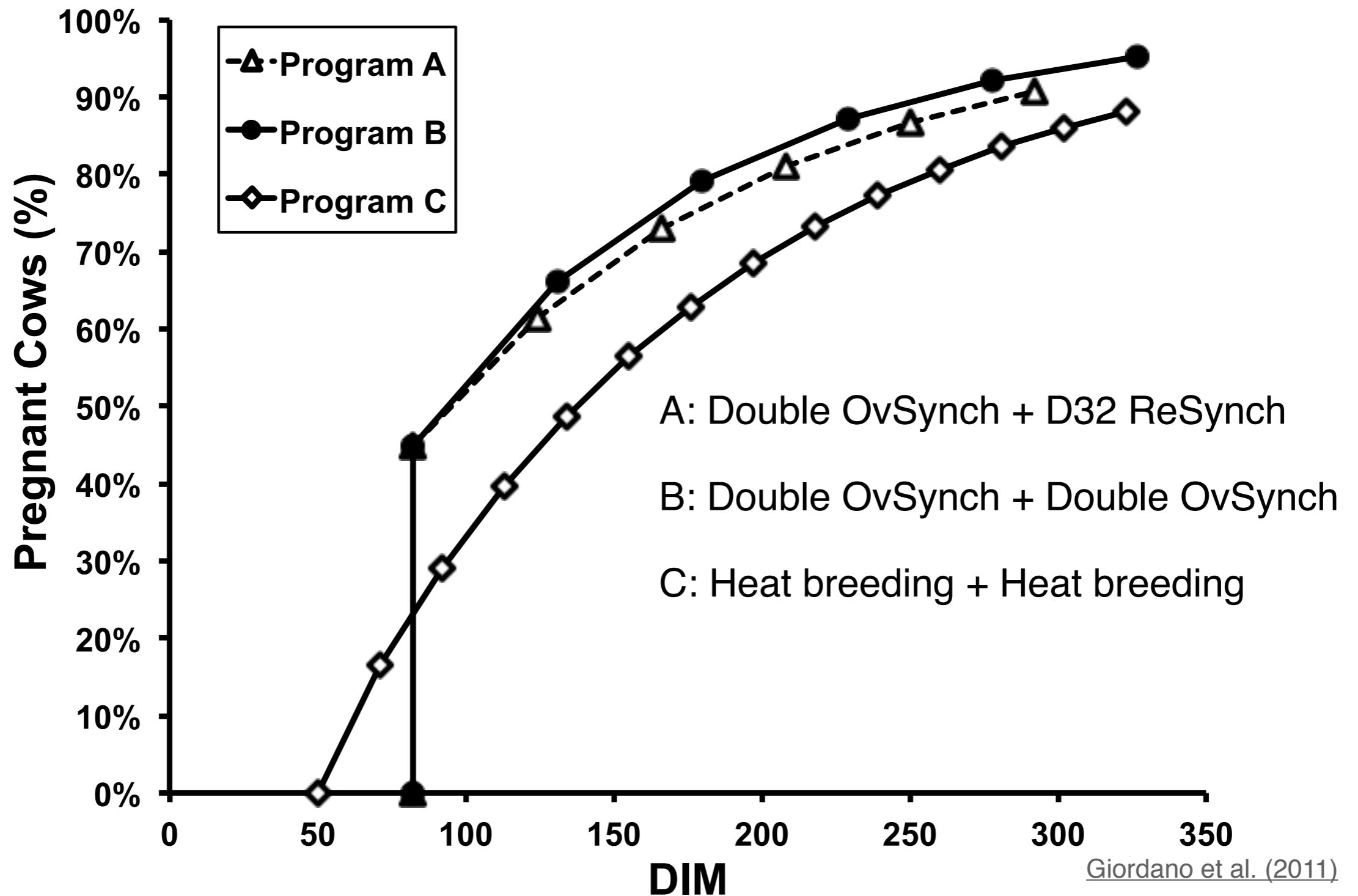
# UW-DairyRepro\$Plus

## Reproductive results

	A	B	C
1 <sup>st</sup> Service	Double-OvSynch		Heat detection
2 <sup>nd</sup> + Services	ReSynch-D32	Double-OvSynch	Heat detection
21-d PR, %	22	25	15
21-d SR, %	62	60	50
Average CR, %	38	42	32
Average days open, d	131	136	151
Projected CI, months	14.1	14.0	14.9

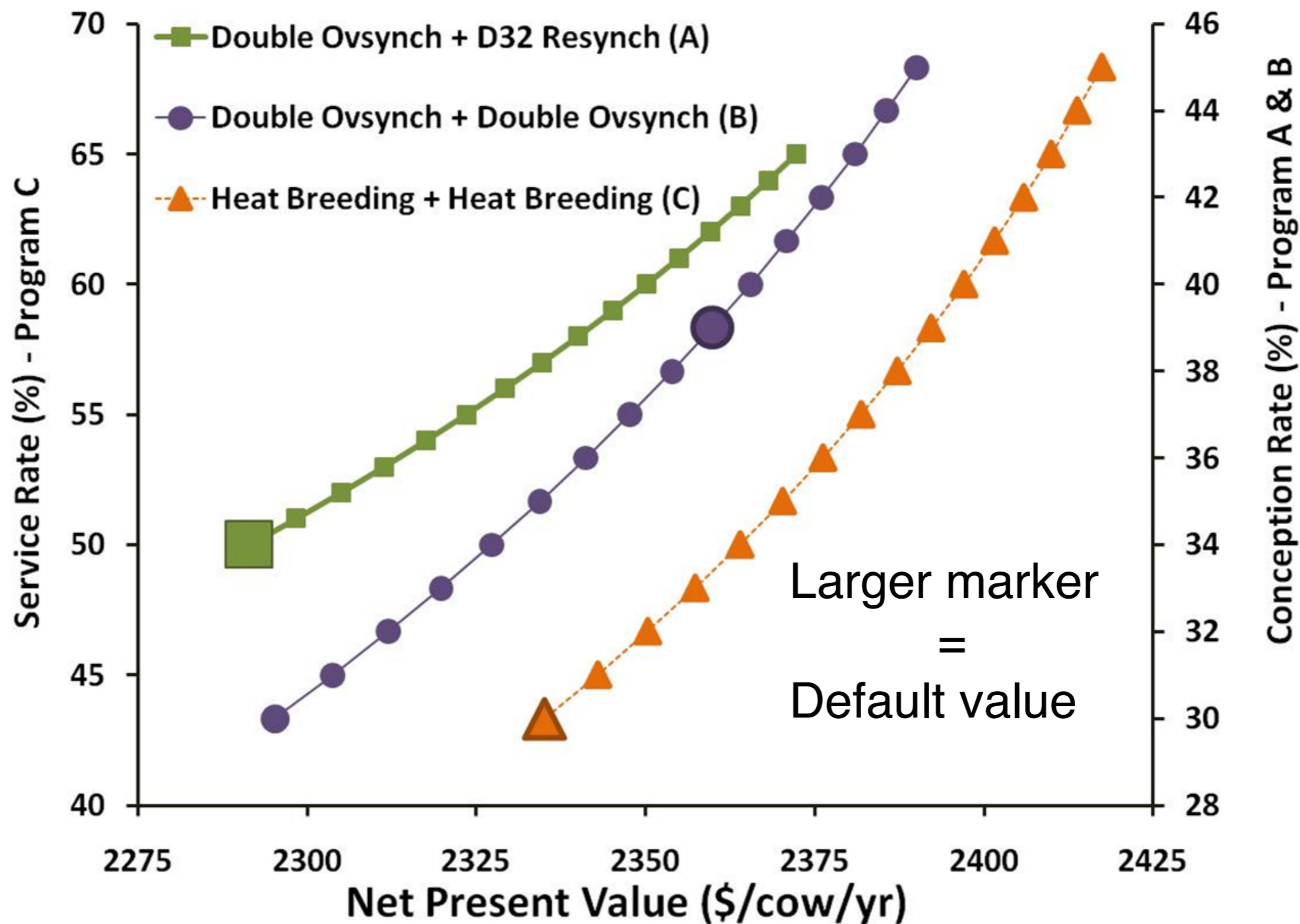
# UW-DairyRepro\$Plus

## Reproductive results



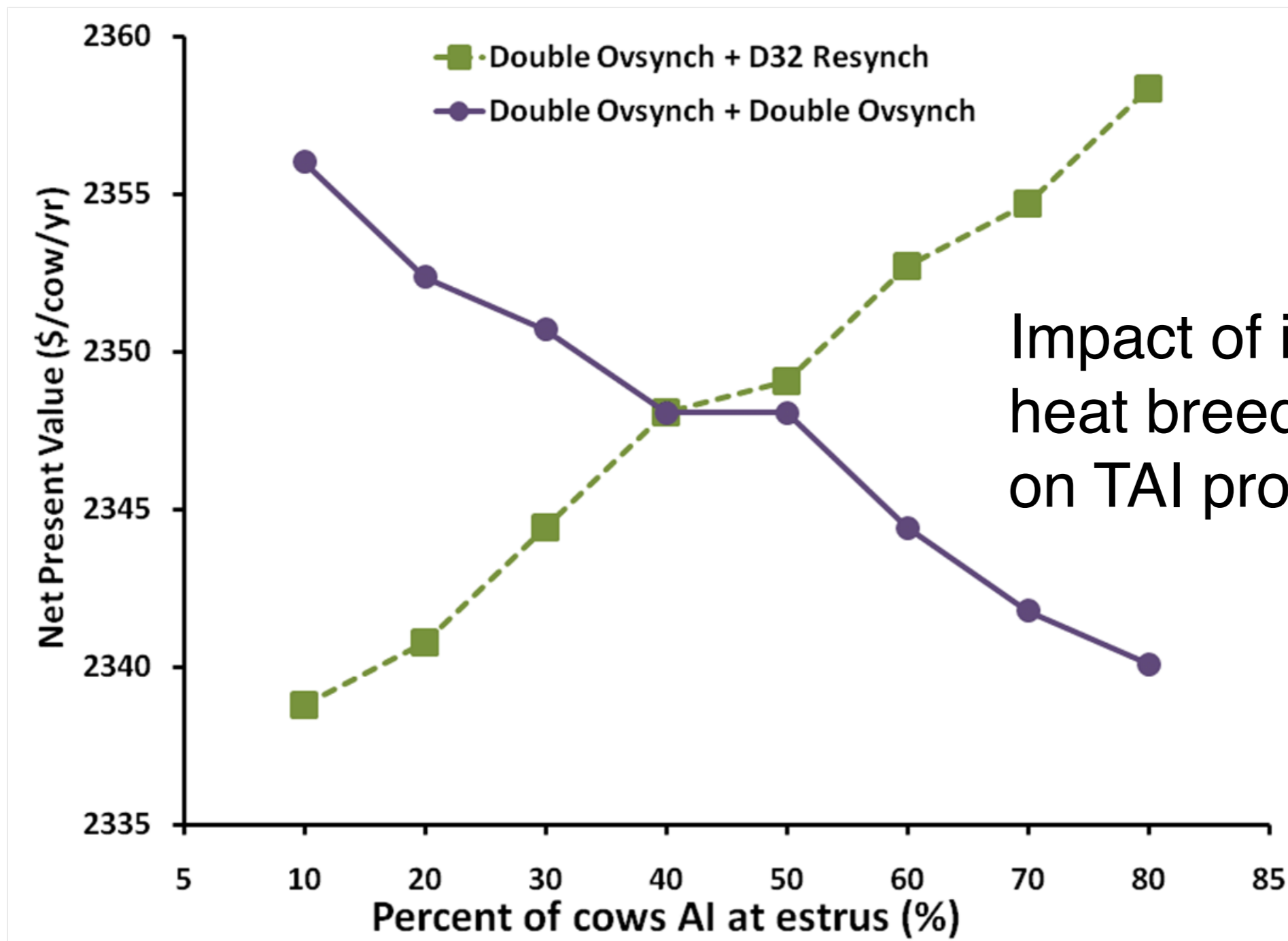
# UW-DairyRepro\$Plus

## Analysis



# UW-DairyRepro\$Plus

## Reproductive results



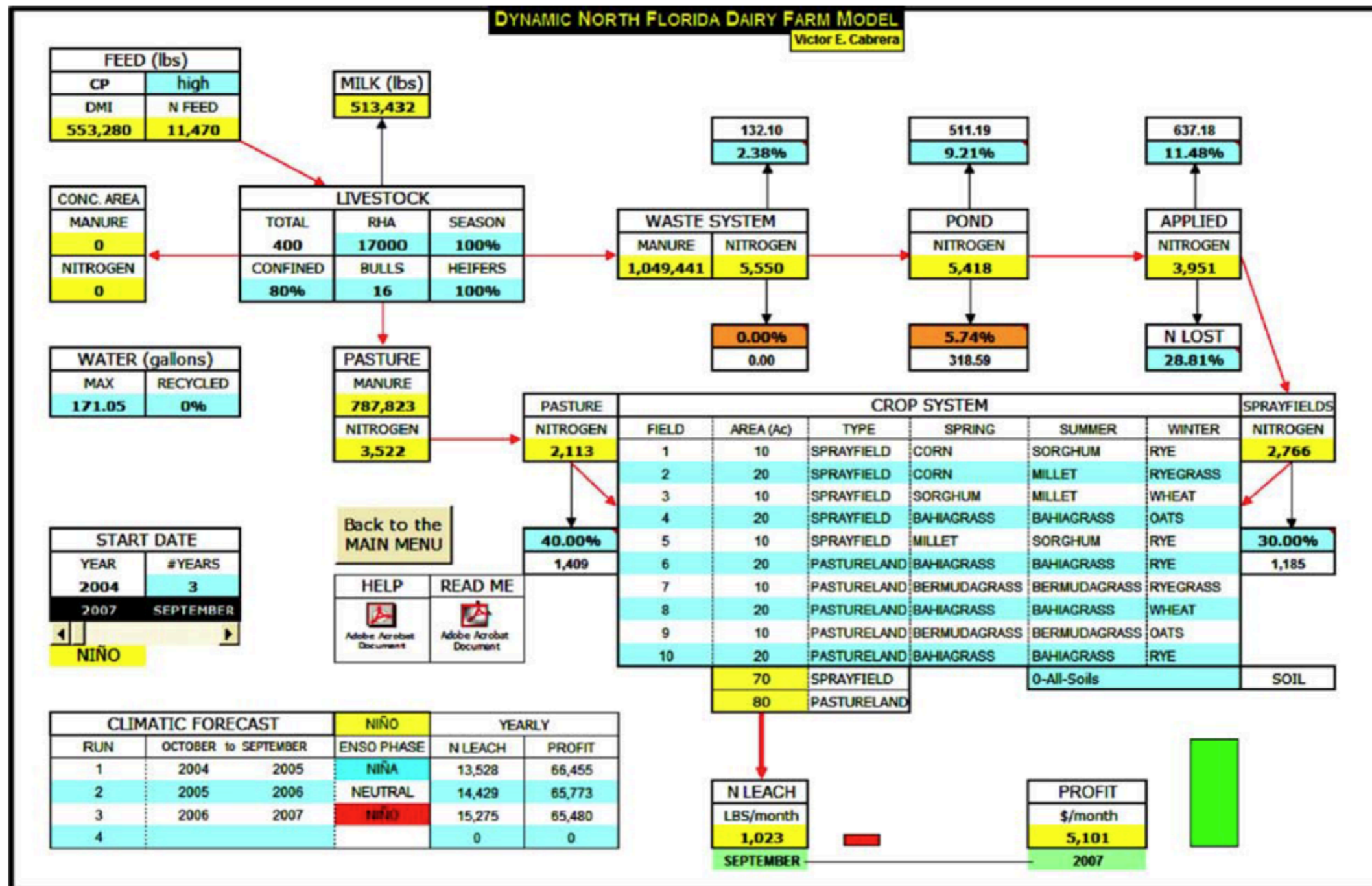
Impact of including heat breeding on TAI programs



# Dynamic dairy farm model

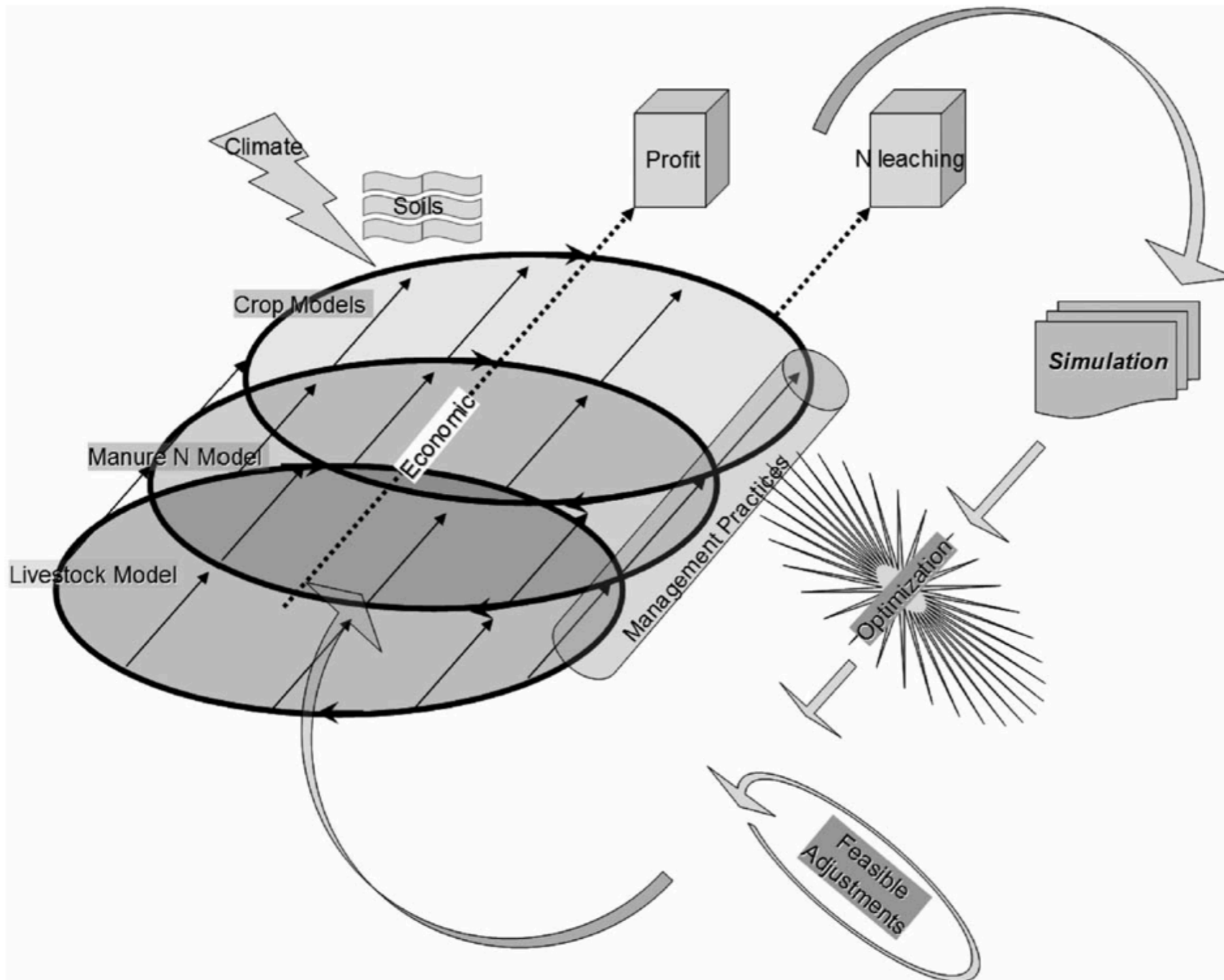
# Dynamic dairy farm model

## Whole farm system approach



# Dynamic dairy farm model

## Whole farm system approach



# Dynamic dairy farm model

## Whole farm system approach

DyNoFlo-Victor E. Cabrera MAIN MENU

START | LIVESTOCK | NITROGEN | SOIL | CROP | CLIMATE | ECONOMICS | OPTIMIZE

Total Number of Cows  (Head) Adult Productive Group

Total Number of Bulls  (Head) Reproductive Bulls

Percent Heifers Raised  0%=Not Raised, 100%=All Raised

Rolling Herd Average  (lbs) 12-month Production/Cow

Percent Seasonality  0%=The Least, 100%=The Greatest

Amount Crude Protein  NRC Standards (low=13.9, high=15.0)

Annual Confined Time  % Time Spent on Concrete

Concentrated Areas  % Time Spent in Concentrated Areas

Note: Highlighted cells are more important

Select Farm Size  View

Adjust  
Livestock  
Practices



# Dynamic dairy farm model

## Whole farm system approach

DyNoFlo-Victor E. Cabrera      MAIN MENU

START | LIVESTOCK | NITROGEN | SOIL | CROP | CLIMATE | ECONOMICS | OPTIMIZE

Field #    Area     SPRAYFIELD    DELETE  
                 ACRES    91.714     PASTURELAND

SPRING/SUMMER    SUMMER/FALL    FALL/WINTER    DELETE all

CORN    SORGHUM    RYE    ENTER

MAR APR MAY JUN JUL AUG SEP OCT NOV DEC JAN FEB MAR

FIELD	AREA	TYPE	SPRING	SUMMER	WINTER
1	91.714	SPRAYFIELD	CORN	SORGHUM	RYE
2	183.43	SPRAYFIELD	CORN	MILLET	RYEGRASS
3	91.714	SPRAYFIELD	SORGHUM	MILLET	WHEAT
4	183.43	SPRAYFIELD	BAHIAGRASS	BAHIAGRASS	OATS
5	91.714	SPRAYFIELD	MILLET	SORGHUM	RYE
6	272.5	PASTURELAND	BAHIAGRASS	BAHIAGRASS	RYE
7	136.25	PASTURELAND	BERMUDAGRASS	BERMUDAGRASS	RYEGRASS
8	272.5	PASTURELAND	BAHIAGRASS	BAHIAGRASS	WHEAT
9	136.25	PASTURELAND	BERMUDAGRASS	BERMUDAGRASS	OATS
10	272.5	PASTURELAND	BAHIAGRASS	BAHIAGRASS	RYE

Note: If these do not represent your farm, DELETE all. Then, describe your farm field by field, clicking ENTER after defining each field to populate the table.

Default

Select Farm Size: -MAKE A CHOICE-    View:    GRAPHs    MAIN    RUN

Select crop practices

# Dynamic dairy farm model

## Whole farm system approach

DyNoFlo-Victor E. Cabrera    MAIN MENU

START | LIVESTOCK | NITROGEN | SOIL | CROP | CLIMATE | ECONOMICS | OPTIMIZE

SIMULATION  
Starting Date: October of     Number of Runs

ENSO PHASE  
Start Year

43-yr Average    DELETE  
 NIÑA    DELETE all  
 NEUTRAL  
 NIÑO    ENTER

RUN	OCTOBER to	SEPTEMBER	ENSO PHASE
1	2004	2005	NIÑA
2	2005	2006	NEUTRAL
3	2006	2007	NIÑO
4	2007	2008	43-yr Average

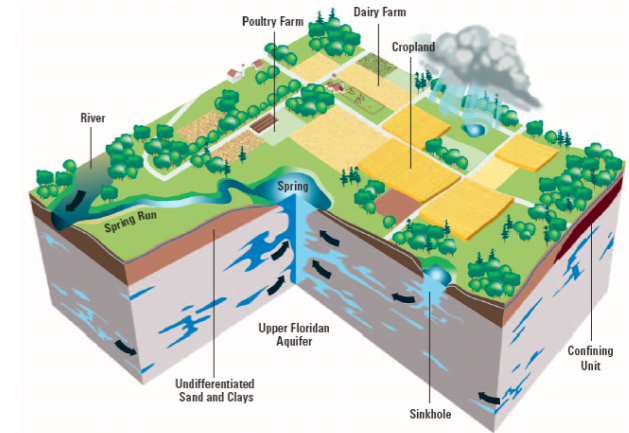
Note: If these are not the ENSO phases you want to run, DELETE all and select number of phases (runs). Then, select each desired ENSO phase and click ENTER to populate the table.

Select Farm Size     -----View-----  
       

Anticipate  
climate

# Dynamic dairy farm model

## Whole farm system approach



**DyNoFlo-Victor E. Cabrera**      **MAIN MENU**      [X]

START | LIVESTOCK | **NITROGEN** | SOIL | CROP | CLIMATE | ECONOMICS | OPTIMIZE

SPRAYFIELDS

Percent Lost Flushing	<input type="text" value="2.38"/>	% Volatilized During Flushing
Percent in Solids	<input type="text" value="6.5"/>	% Removed With Solids
Percent Lost Holding	<input type="text" value="9.21"/>	% Volatilized in Storage Pond
Percent in Sludge	<input type="text" value="5.74"/>	% Fixed in Pond Sludge
Percent Lost Spraying	<input type="text" value="16.17"/>	% Volatilized During Application
TOTAL N LOST	<input type="text" value="40"/>	% N LOST IN WASTE SYSTEM
Lost From Soil	<input type="text" value="30"/>	% Volatilized From Soil

WATER

Maximum amount	<input type="text" value="171.05"/>	(Gallons/Head/Day) Maximum Observed
Percent Recycled	<input type="text" value="0"/>	% of Water Return to Facilities

PASTURELAND

Lost From Soil	<input type="text" value="40"/>	% Volatilized From Soil
----------------	---------------------------------	-------------------------

[Default]

Select Farm Size:  [v]

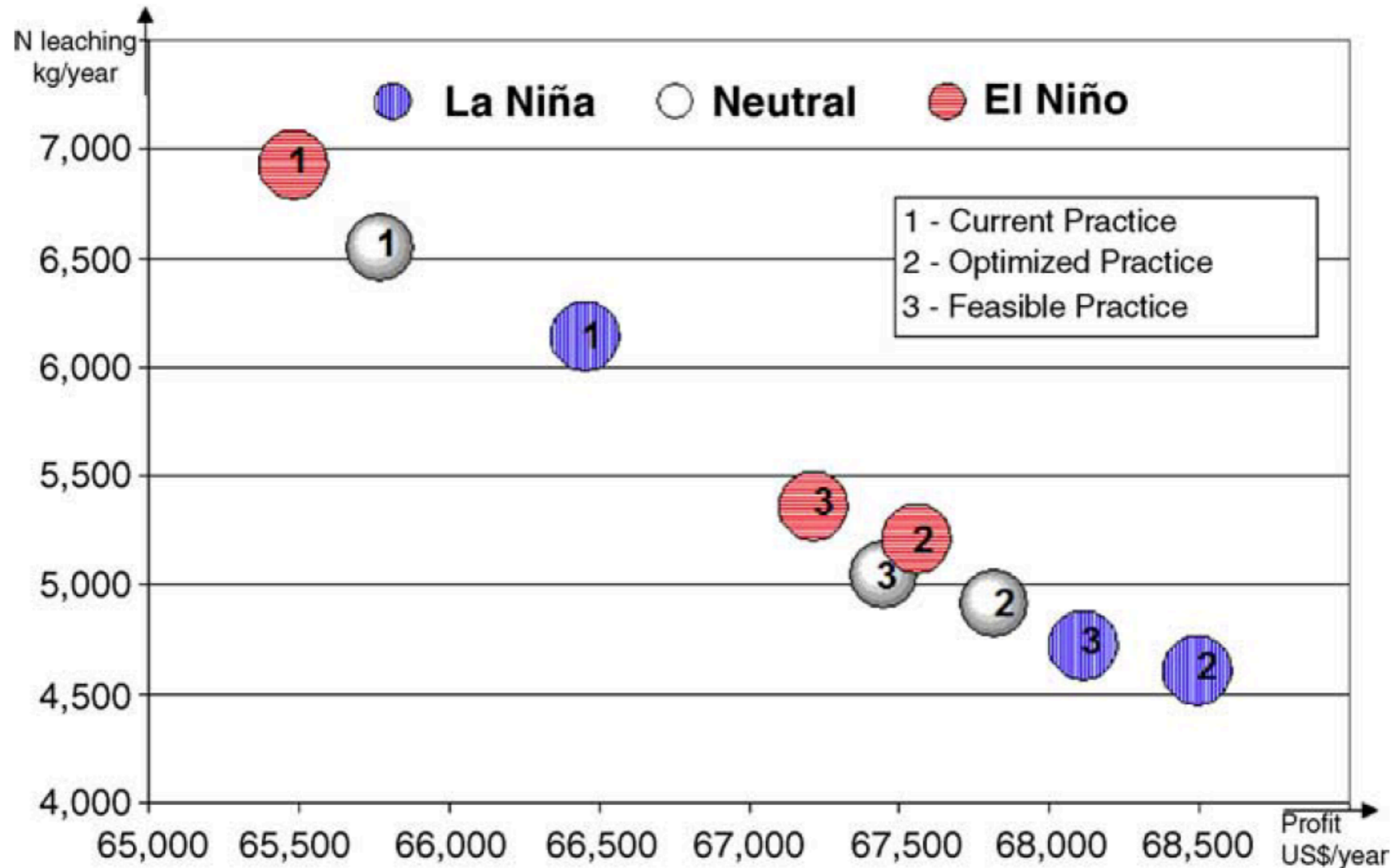
-----View-----

[GRAPHS] [MAIN] [RUN]

Control nutrient waste

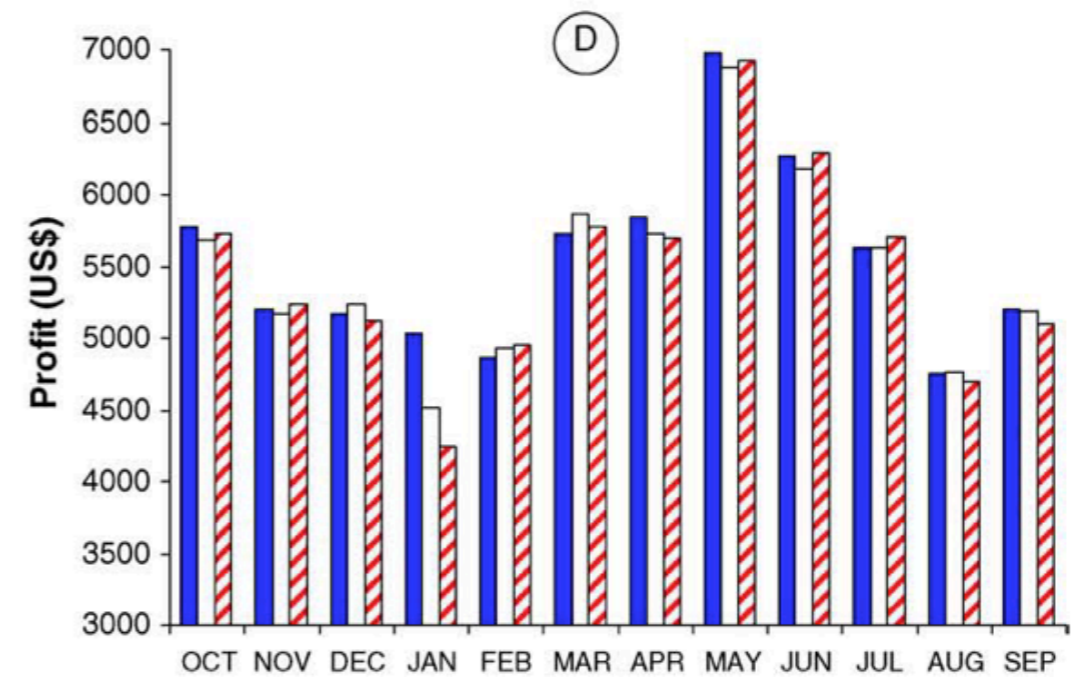
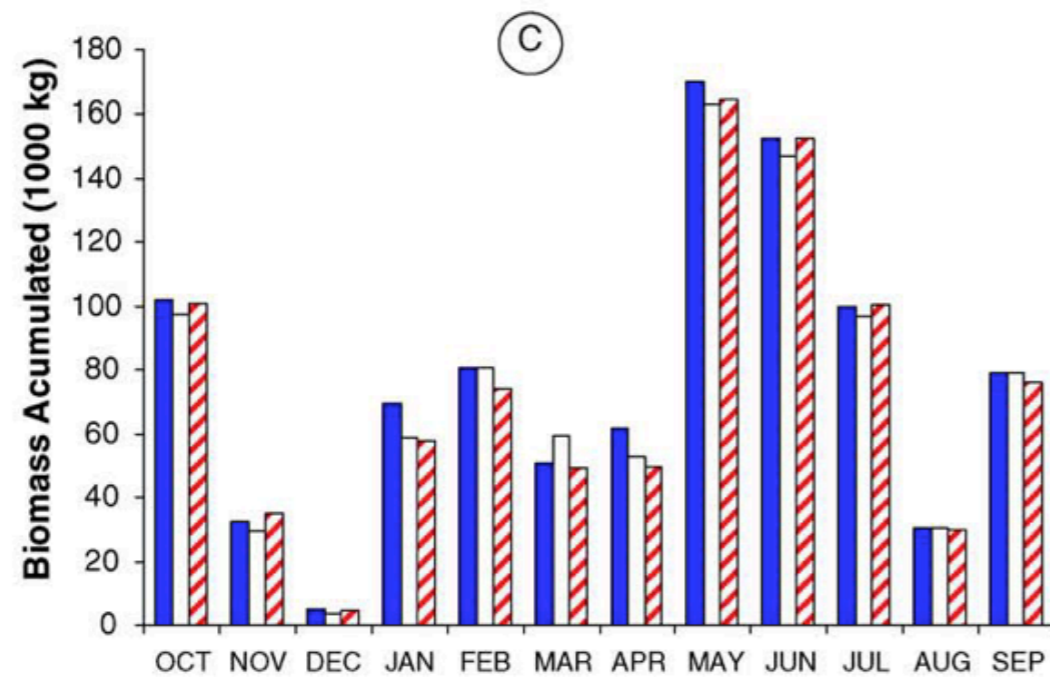
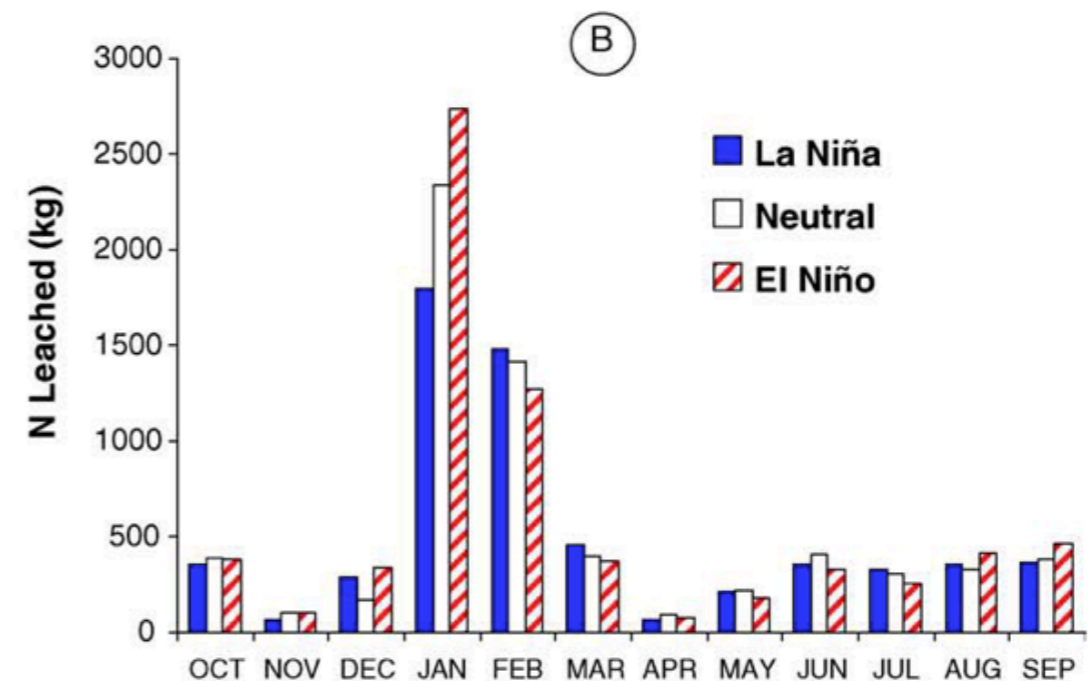
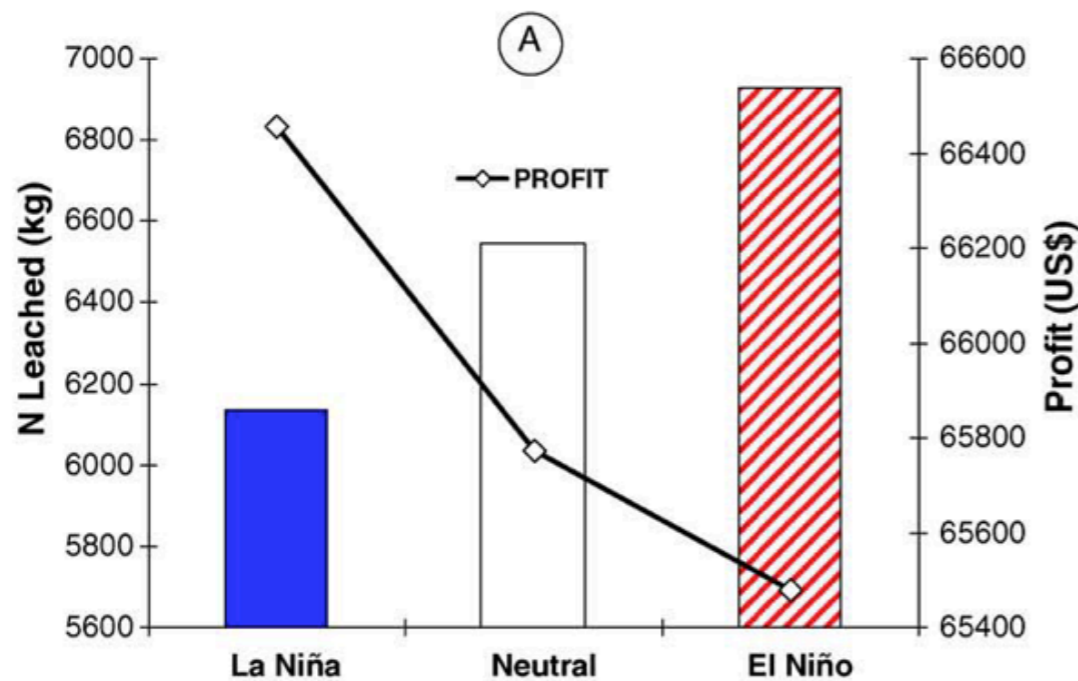
# Dynamic dairy farm model

## Applications for Florida farms



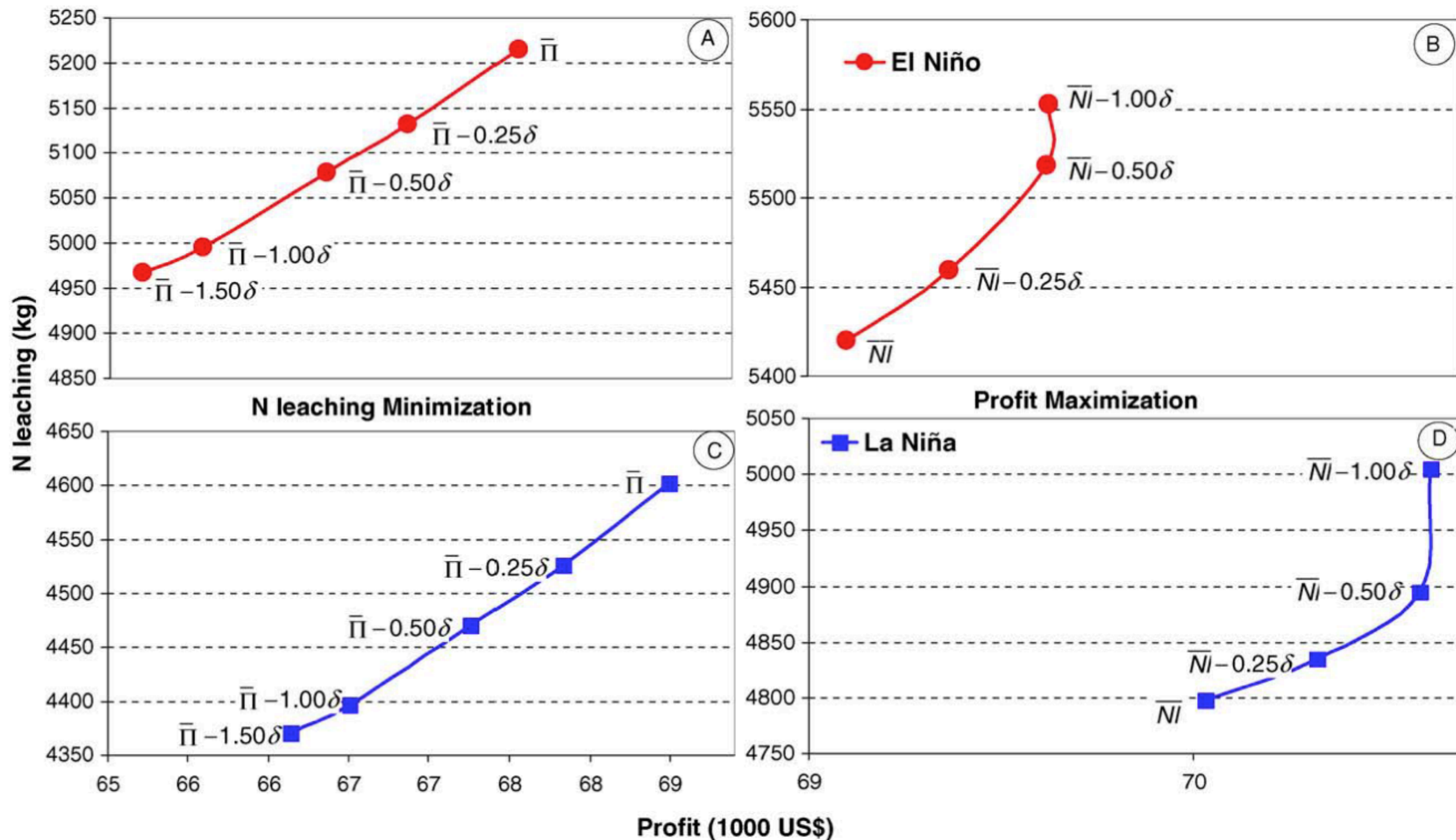
# Dynamic dairy farm model

## Applications for Florida farms



# Dynamic dairy farm model

## Applications for Florida farms



# Dynamic dairy farm model

Optimal & feasible practices

**Crude protein in diet**

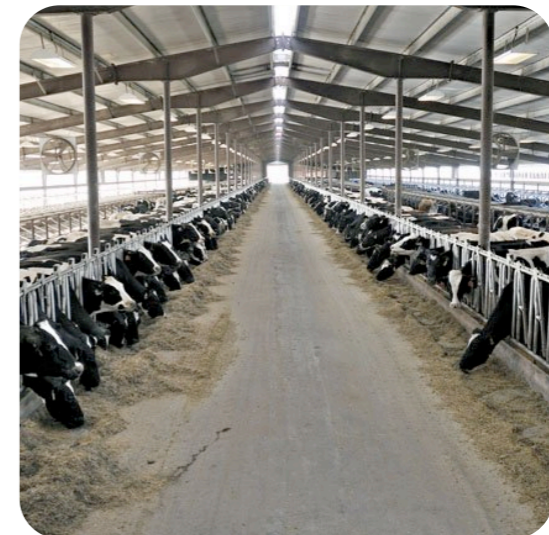
Low

**Confined time**

Between 60 and 80%

**Pasture rotation preferred**

Bermudagrass-  
bermudagrass-winter forage



# Dynamic dairy farm model

Optimal & feasible crops (ha)

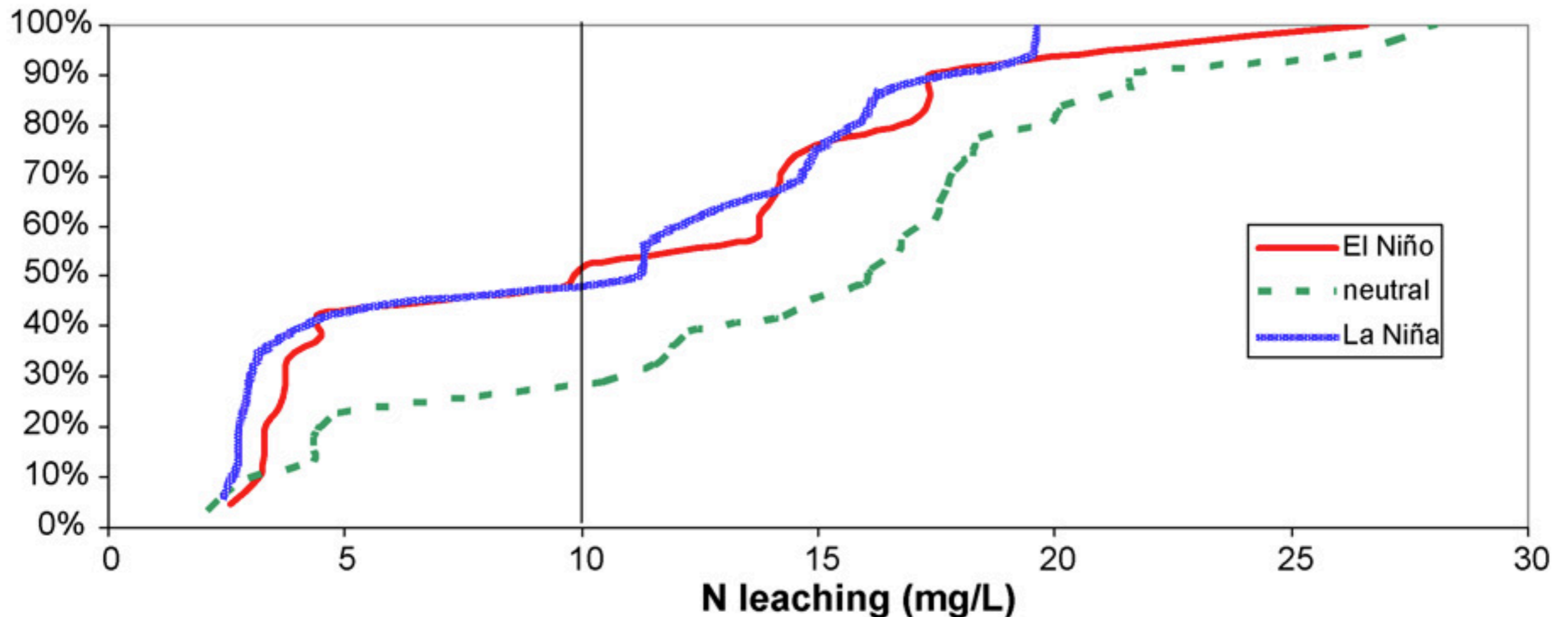
	La Niña	Neutral	El Niño
Corn-corn-winter forage	9.19	8.46	8.71
Bermudagrass-bermudagrass-winter forage	6.25	6.77	6.46
Corn-bermudagrass-winter forage	9.01	8.56	8.63
Millet-corn-winter forage	3.87	4.54	4.53



# Dynamic dairy farm model

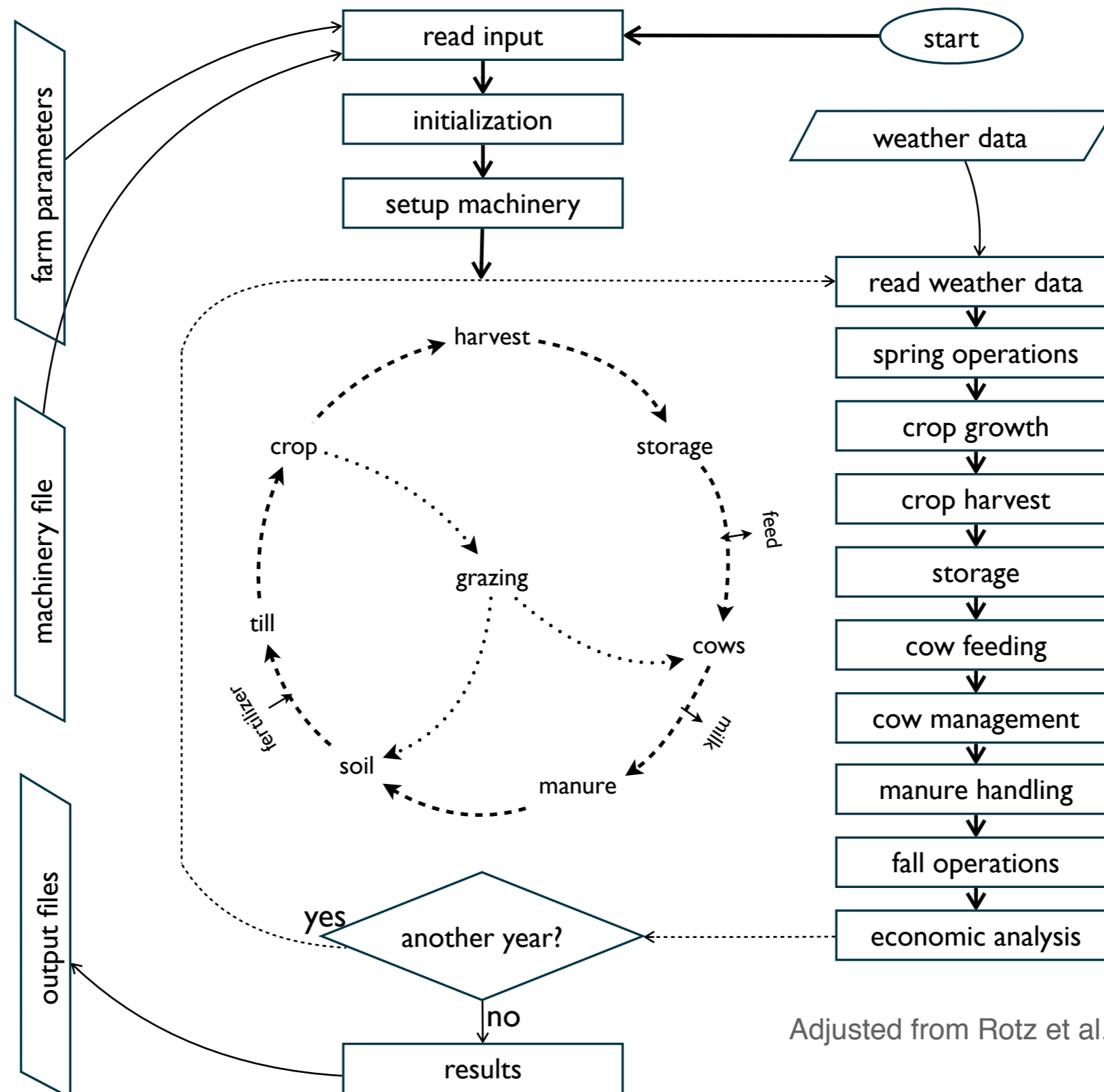
## Risk of N leaching

Probability of N leaching beyond 10 mg/L threshold with full season Bermudagrass (April-November)



# Integrated Farm System Model

Process based



Adjusted from Rotz et al. (2012)

# Integrated Farm System Model

3 Wisconsin (85-cow) systems (preliminary)

	Convent.	Grazing	Organic
Alfalfa, ha	47.4	37.7	45.5
Grass, ha	22.4	61.9	43.1
Corn, ha	42.6	16.3	16.8
Oats, ha	12.2	5	16
Soybean, ha	2.4	6.1	3.6
1 <sup>st</sup> lactation cows, %	36	30	31
Milk, L/cow per year	9,820	7,256	6,159
Milk price, \$/hL	35.99	37.52	56.2
Grazing strategy	Older heifers, dry cows	All animals	All animals
Housing facilities	Free stall	Tie stall	Tie stall
Manure storage	lined earthen	No storage	No storage

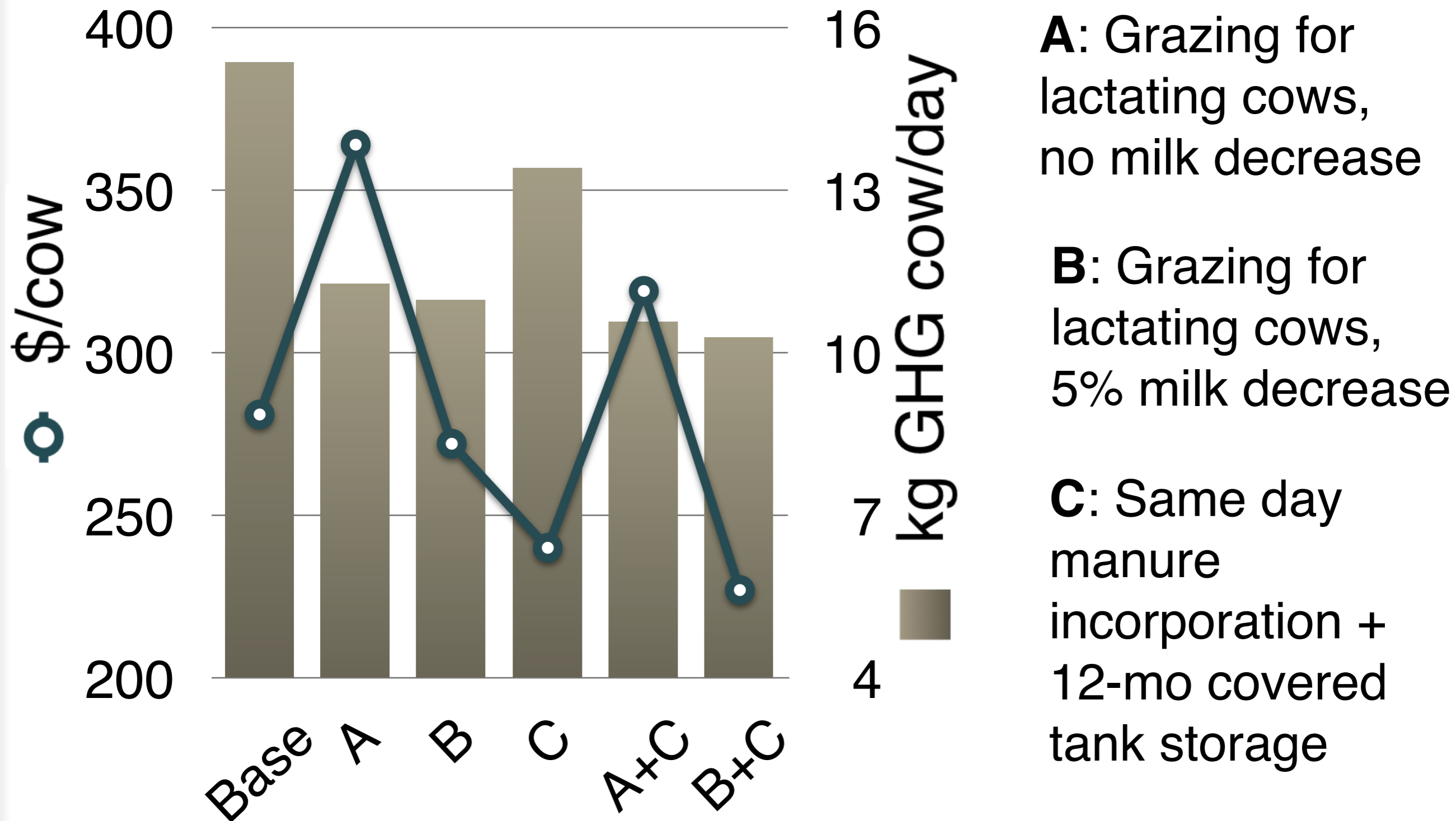
# Integrated Farm System Model

3 Wisconsin (85-cow) systems (preliminary)

	Convent.	Grazing	Organic
Milk, kg/ha	6,516	4,856	4,122
Grain bought, t DM	187	104	107
Soybean bought [sold] t DM	19	[12]	[4]
Total feed cost, \$	182,124	134,133	149,744
Milk sales, \$	297,834	231,384	294,179
Net return, \$/cow	281	170	696
Net return, \$/kg milk	0.0289	0.0234	0.1129
CO <sub>2</sub> eq, kg/cow per d	15.36	13.07	14.66
CO <sub>2</sub> eq, kg/kg milk	0.58	0.66	0.87
CO <sub>2</sub> eq, kg/year	476,623	405,565	454,780

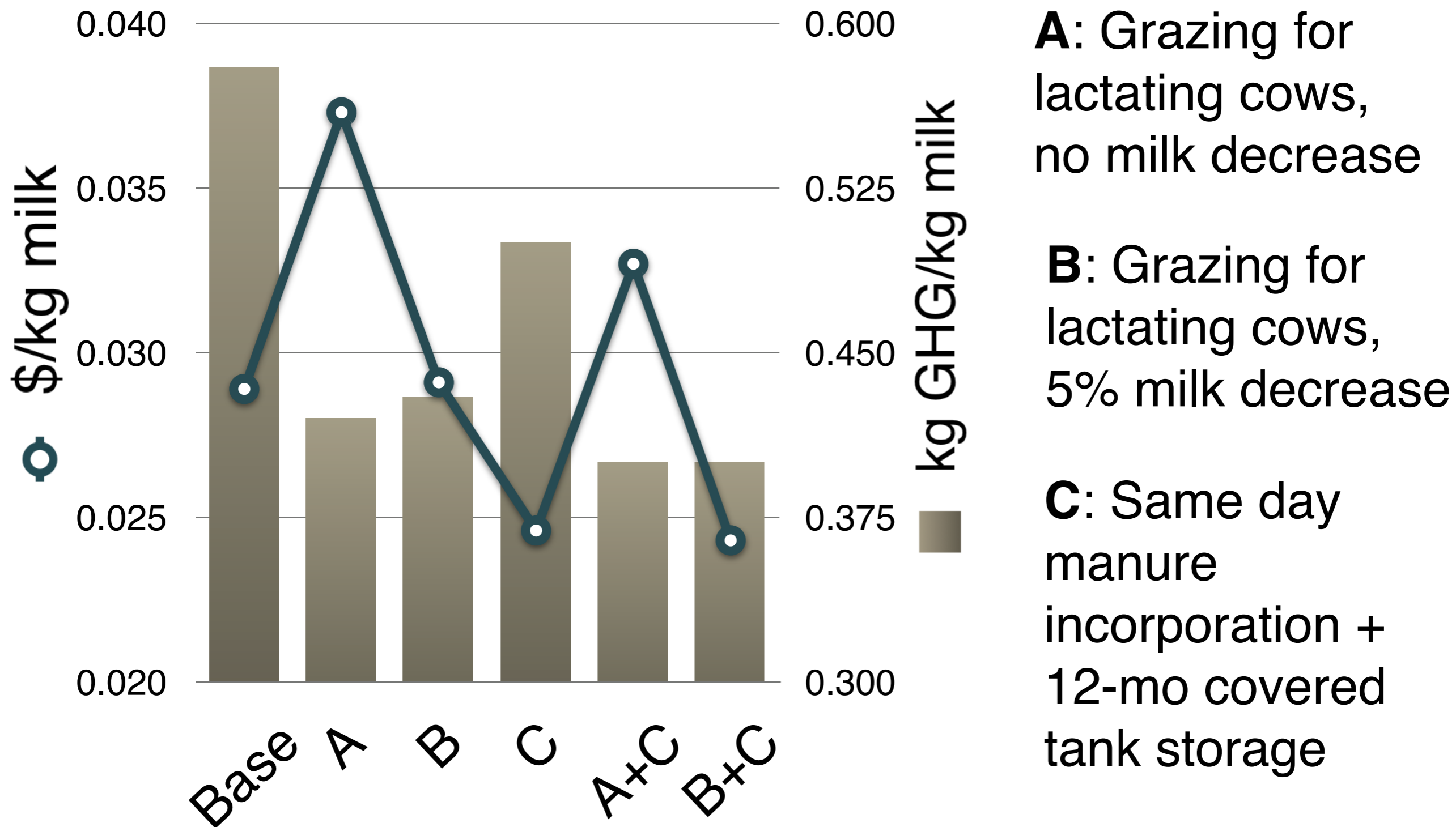
# Integrated Farm System Model

## Scenarios for conventional farm



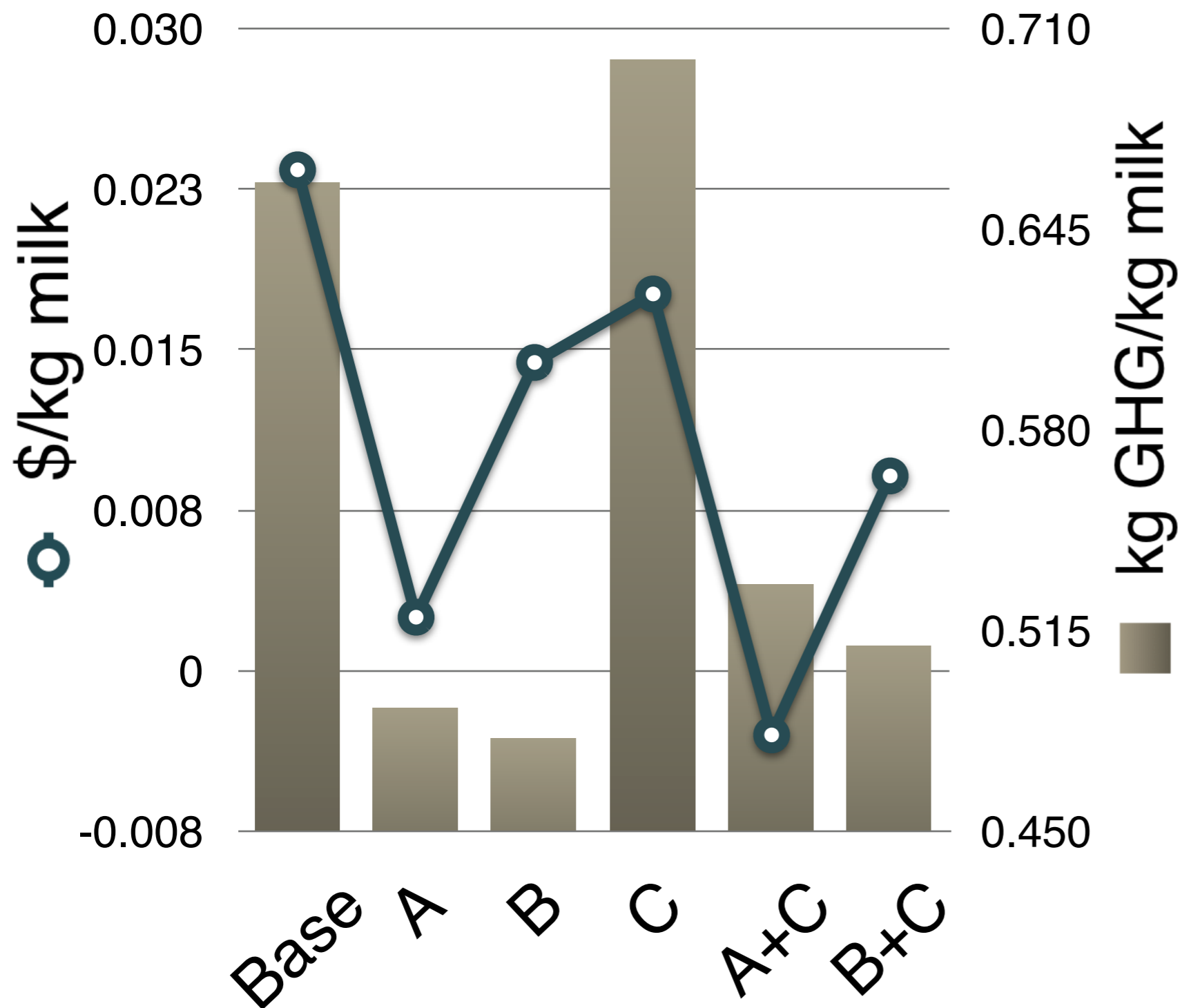
# Integrated Farm System Model

## Scenarios for conventional farm



# Integrated Farm System Model

## Scenarios for grazing farm



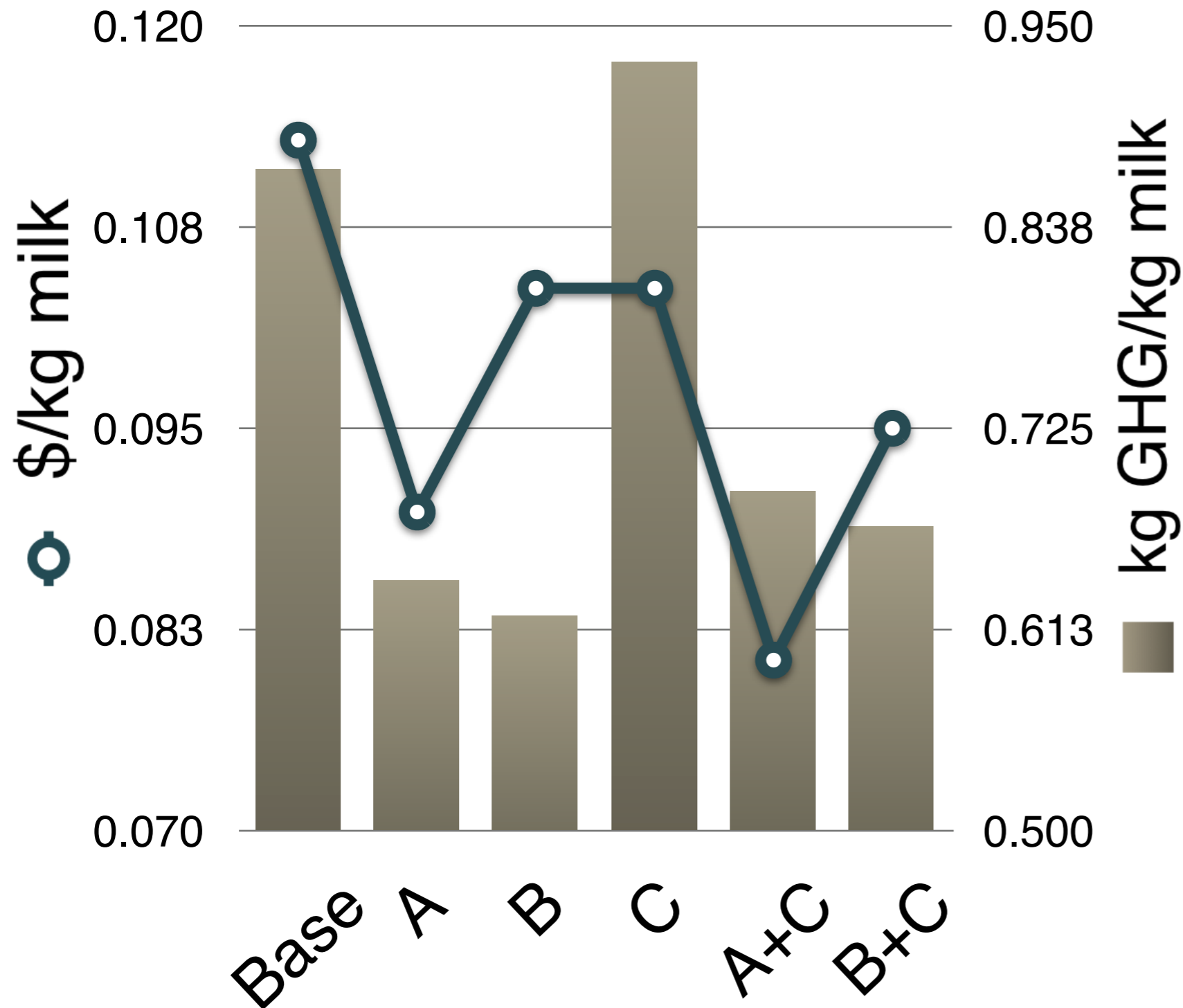
**A:** ↓ Forage:grain ratio → ↑ 5% milk

**B:** ↓ Forage:grain ratio → ↑ 10% milk

**C:** Same day manure incorporation + 12-mo covered tank storage

# Integrated Farm System Model

## Scenarios for organic farm



**A:** ↓ Forage:grain ratio → ↑ 5% milk

**B:** ↓ Forage:grain ratio → ↑ 10% milk

**C:** Same day manure incorporation + 12-mo covered tank storage





**Thanks**