GEORGIA DAIRY CONFERENCE

2023

PROCEEDINGS

DAIRY MARKET OUTLOOK
SOUTHEAST STATES

Georgia Milk Producers Association

January 16 , 2023

Calvin Covington

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OUTLINE

1. **Milk Market**
2. **Milk Supply**
3. **Milk Price**
4. **Federal Order Proposals (briefly)**

SOUTHEAST STATES MILK MARKET

Average Loads Producer Milk per Day

Year	Appalachian	Florida	Southeast	Total
2000	349	158	413	920
2010	334	161	387	883
2015	312	152	288	752
2020	**294**	**139**	**259**	**692**
2021	**293**	**135**	**254**	**682**
2022	**296**	**137**	**217**	**650**

SOUTHEAST STATES MILK MARKET

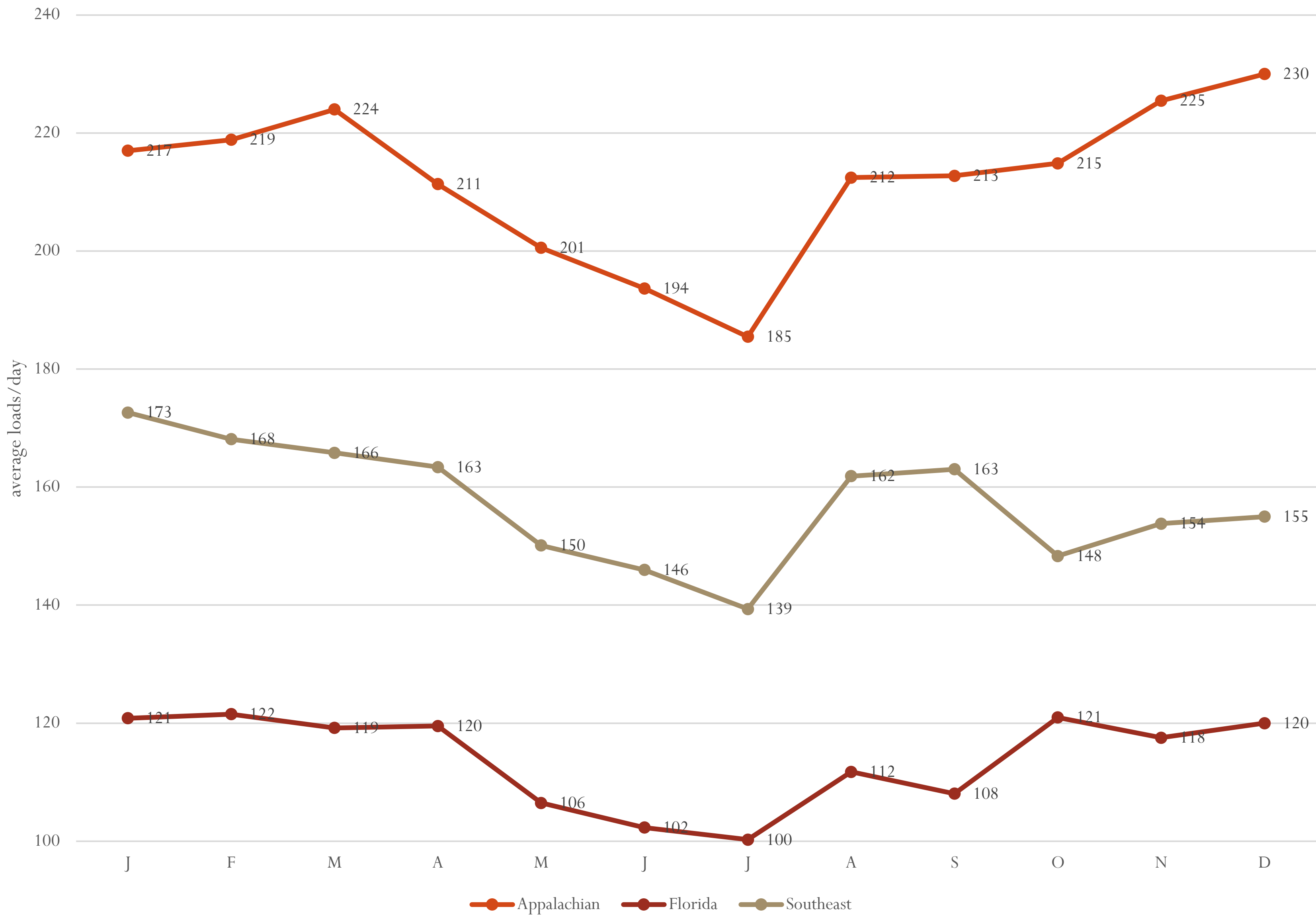
Avg. Loads Class I Producer Milk/ Day

Year	Appalachian	Florida	Southeast	Total
2000	240	139	269	648
2010	229	139	259	627
2015	214	128	216	559
2020	**217**	**114**	**179**	**510**
2021	**207**	**111**	**171**	**490**
2022	**211**	**114**	**157**	**482**

CLASS I UTILIZATION

Year	Appalachian	Florida	Southeast	All
2000	68.75%	88.09%	65.01%	70.39%
2010	68.42%	86.61%	66.90%	71.06%
2015	68.56%	84.60%	75.05%	74.28%
2020	73.88%	82.17%	68.98%	73.70%
2021	70.83%	82.24%	67.54%	71.87%
2022	**71.46%**	**83.01%**	**72.40%**	**74.22%**
2022 (November) all Federal Orders				**27.07%**

BALANCING a CLASS I MARKET

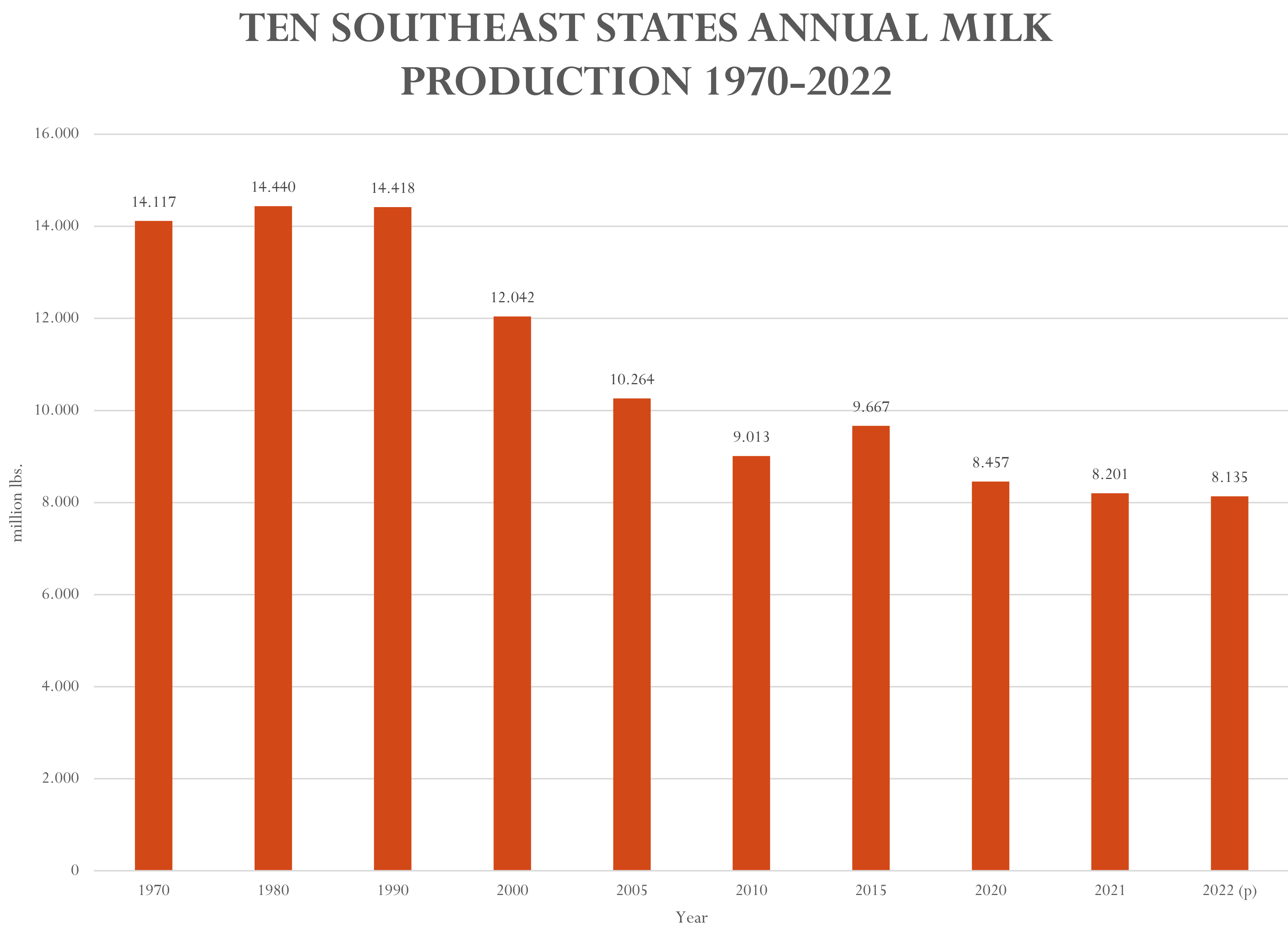


MILK MARKETS
POOL DISTRIBUTING PLANTS

Year End	Appalachian	Florida	Southeast	Total
2000	26	12	32	70
2010	20	12	25	57
2015	17	10	22	49
2020	17	10	19	46
2021	17	9	18	44
2022	**16**	**8**	**15**	**39**

LOCATION & OWNERSHIP PLANTS

State	Cooperative	Grocer	Other	Total
Florida	2	2	4	8
North Carolina	3	1	1	5
Tennessee	3	2		5
Virginia	1	1	2	4
Kentucky	1	1	1	3
Arkansas	3			3
Louisiana	1		2	3
Georgia		2		2
Missouri	1		1	2
South Carolina	1			1
Mississippi	1			1
Alabama			1	1
Indiana	1			1
Total	**18**	**9**	**12**	**39**


TEN SOUTHEAST STATES ANNUAL MILK PRODUCTION 1970-2022
16.000
14.000
12.000
10.000
8.000
6.000
4.000
2.000
0
million lbs.
14.117
14.440
14.418
12.042
10.264
9.013
9.667
8.457
8.201
8.135
1970
1980
1990
2000
2005
2010
2015
2020
2021
2022 (p)
Year

SOUTHEAST MILK PRODUCTION

State	2020	2021	2022 (p)	% of Total
	Average Number Loads of Milk per Day			
Georgia	98	100	112	**25.0%**
Florida	127	120	108	**23.9%**
Virginia	84	81	79	**17.6%**
Kentucky	52	50	51	**11.4%**
N. Carolina	50	51	50	**11.2%**
Tennessee	30	28	27	**6.1%**
S. Carolina	10	9	9	**2.0%**
Louisiana	7	7	6	**1.4%**
Mississippi	7	6	5	**1.1%**
Alabama	2	2	2	**0.4%**
Total	468	454	450	

Southeast Supply versus Demand
"STEADY"

Year	Production	Fluid Sales	Difference
		(lbs. per capita)	
2010	122	177	**-55**
2015	125	155	**-30**
2020	105	141	**-36**
2021	103	134	**-31**
2022 (p)	**101**	**133**	-32
Georgia (p)	**186**	**133**	+53

MILK MARKETS and PRODUCTION "Take Home Message"

- Less markets for milk in the Southeast. <u>39 pool distributing plants today. Next year - will be less. KY and VA only balancing plants.</u>
- Southeast milk production leveling off – concentrate in Georgia and Florida.
- Georgia is a "milk producing" not a "milk processing" state.
- Relationship between per capita production and fluid consumption – steady.
- Challenge – markets for milk.
- Increase efforts to:
  1. Expand profitable sales at existing plants
  2. Seek new dairy processing or manufacturing
- Keep a viable Southeast Dairy Industry requires a growing milk market

BLEND PRICES – Base Zone

	Appalachian	Florida	Southeast
2021			
$/cwt. 3.5% fat	$19.33	$21.30	$19.50
Butterfat $/lb.	*$1.8784*	*$1.8905*	*$1.8801*
Butterfat % of Blend	34%	31%	34%
2022			
$/cwt. 3.5% fat	$26.42	$28.42	$26.87
Butterfat $/lb.	*$3.2423*	*$3.2475*	*$3.2395*
Butterfat % of Blend	43%	40%	42%
Difference $/cwt.	$7.08	$7.13	$7.37

DAIRY PRODUCT PRICES
"Calculate Federal Order Prices"

Year	Butter	Nonfat Dry Milk Powder	Block Cheddar	Barrel Cheddar	Dry Whey
	$/lb. Dairy Products Sales Report Prices				
2018	$2.26	$0.79	$1.58	$1.47	$0.34
2019	$2.24	$1.04	$1.78	$1.70	$0.38
2020	$1.58	$1.04	$2.04	$1.77	$0.36
2021	$1.73	$1.27	$1.73	$1.60	$0.57
2022	**$2.87**	**$1.69**	**$2.10**	**$2.09**	**$0.61**
22 vs. 21	**$1.14**	**$0.42**	**$0.37**	**$0.49**	**$0.04**

PRODUCTION: Milk and Cows

Milk % Change

Quarter	2021	2022
First	1.2%	-1.0%
Second	3.7%	-0.5%
Third	0.8%	1.2%
Fourth	-0.2%	
Month		
October		1.1%
November		1.3%

Cows – Change Number

Quarter	2021	2022
First	+ 91,000	-80,000
Second	+ 146,000	-86,000
Third	+10,000	+12,000
Fourth	-69,000	
Month		
October		+32,000
November		+38,000

DEMAND –Total Solids

Quarter	Domestic	Export	Total
	Percentage Change 2022 versus 2021– total solids basis		
First quarter	0.8%	-1.4%	0.4%
Second quarter	-0.7%	4.3%	0.2%
Third quarter	1.2%	5.4%	1.9%
October	0.6%	8.4%	1.8%
YTD	**0.4%**	**3.4%**	**1.0%**
Five- year average % Change (2017-2021)	**1.5%**	**6.7%**	**1.8%**
	2021	2022	
Export % of Total	**16.8%**	**17.5%**	

DAIRY DEMAND by Products

Product	Domestic	Export	Total	Export % 2022
	Percent Change 2022 vs. 2021 (J-O) Commercial Disappearance			
Butter	-6.0%	43.5%	**-3.7%**	6.8%
Dry Skim Milk Powder	-19.7%	-7.5%	**-11.2%**	72.9%
American Cheese	-0.6%	38.3%	**0.7%**	4.6%
Other Cheese	2.8%	5.0%	**3.0%**	6.0%
Dry Whey	3.6%	-3.1%	**0.0%**	52.0%
Fluid Milk (November)			**-2.3%**	

DAIRY PRODUCT INVENTORY

Product	November 2020	November 2021	November 2022	Change
	(million lbs.)			(%)
Butter	252	210	200	**(5.1%)**
Nonfat Dry Milk Powder	250	227	256	**12.9%**
American Cheese	762	835	816	**(2.2)%**
Dry Whey	68	60	73	**22.0%**

2023

- Production up to 1% increase

  lower margins

  higher interest rates

  fewer dairy replacements – more beef on dairy

- Demand – challenge

  inflation – higher prices – smaller package and serving sizes

  recession – worldwide

  China's economy

2023 PROJECTIONS
FO BLEND PRICES – Base Zone

	Appalachian	Florida	Southeast
2022			
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Butterfat $/lb.	*$3.2423*	*$3.2475*	*$3.2395*
Butterfat % of Blend	43%	40%	42%
2023			
$/cwt. 3.5% fat	**$22.84**	**$24.83**	**$23.07**
Butterfat $/lb.	*$2.7676*	*$2.7856*	*$2.7740*
Butterfat % of Blend	42%	39%	42%
Difference $/cwt.	**($3.57)**	**($3.59)**	**($3.80)**
Third highest	**blend price.**		

Final Words – Price Projections

- Best estimate, as of today, based on the information available.
- A small change in supply or demand makes a larger change (up or down) in milk prices.
- My projections are <u>federal order blend prices</u> not <u>mailbox prices.</u>
- Not including any potential federal order changes.

Federal Order Changes

- Southeastern Orders – proposals submitted
  - Update "inter-order" transportation credits
  - Implement "intra-order" transportation credits
  - Assembly credit

- All Federal Orders – areas under consideration:
  - Class I Mover "Higher of"
  - Update Class I Differentials
  - Increase make allowances
  - Eliminate barrel cheese from formula
  - Update milk component levels

BE INVOLVED

STUDY

ASK QUESTIONS

IT is YOUR MILK CHECK and MARKET BEING IMPACTED

THANK YOU FOR THE OPPORTUNITY

QUESTIONS

Key Principles and Concepts Required to Navigate Your Dairy and Feed Markets”

Carl Babler

16 January, 2023

2023
Georgia Dairy Conference

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Risk Disclosure

Risk in purchasing options is the option premium paid plus transaction. Selling futures and/or options leaves you vulnerable to unlimited risk. Atten Babler Commodities LLC uses sources that they believe to be reliable, but they cannot warrant the accuracy of any of the data included in this report. Past performance is not indicative of future results. Unless otherwise stated the information contained herein is meant for educational purposes only and is not a solicitation to buy futures or options.

Transaction Cost used throughout this presentation is commission plus fees.

For customers trading options, these futures charts are presented for informational purposes only. They are intended to show how investing in options can depend on the underlying futures prices; specifically, whether or not an option purchaser is buying an in-the-money, at-the-money, or out-of-the money option. Furthermore, the purchaser will be able to determine whether or not to exercise his right on an option depending on how the option's strike price compares to the underlying future's price. The futures charts are not intended to imply that option prices move in tandem with futures prices. In fact, option prices may only move a fraction of the price move in the underlying futures. In some cases, the option may not move at all or even move in the opposite direction of the underlying futures contract. The author of this piece currently hedges for his own account and has financial interest in the following derivative products mentioned within: corn, soybean, lean hogs and natural gas.

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Thank You

2023

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Dairy Producer Opportunities I see….

Product "Milk"

Commodity "MILK"

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Dairy Food Chain Commodity/Product, Producer/Processor Divide

Agenda

- 4 Keys Principles and Concepts Required…

1. Understanding Price
2. Price has reoccurring Behavior
3. Price is the focus of Marketing
4. Identify Price Risk first step in Marketing

Plus: The Observed Characteristics of a Successful Marketer

Commodity Prices you Care About

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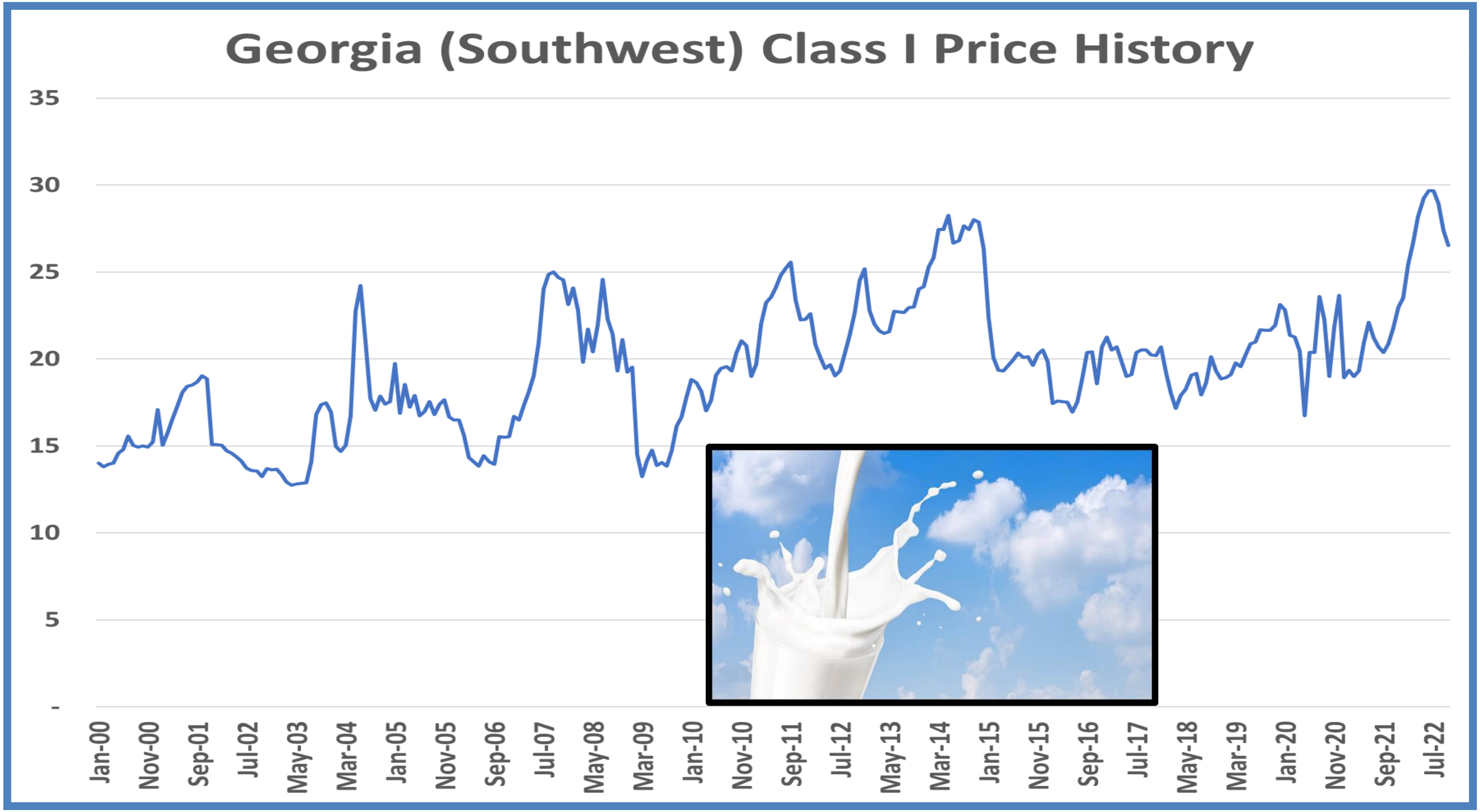

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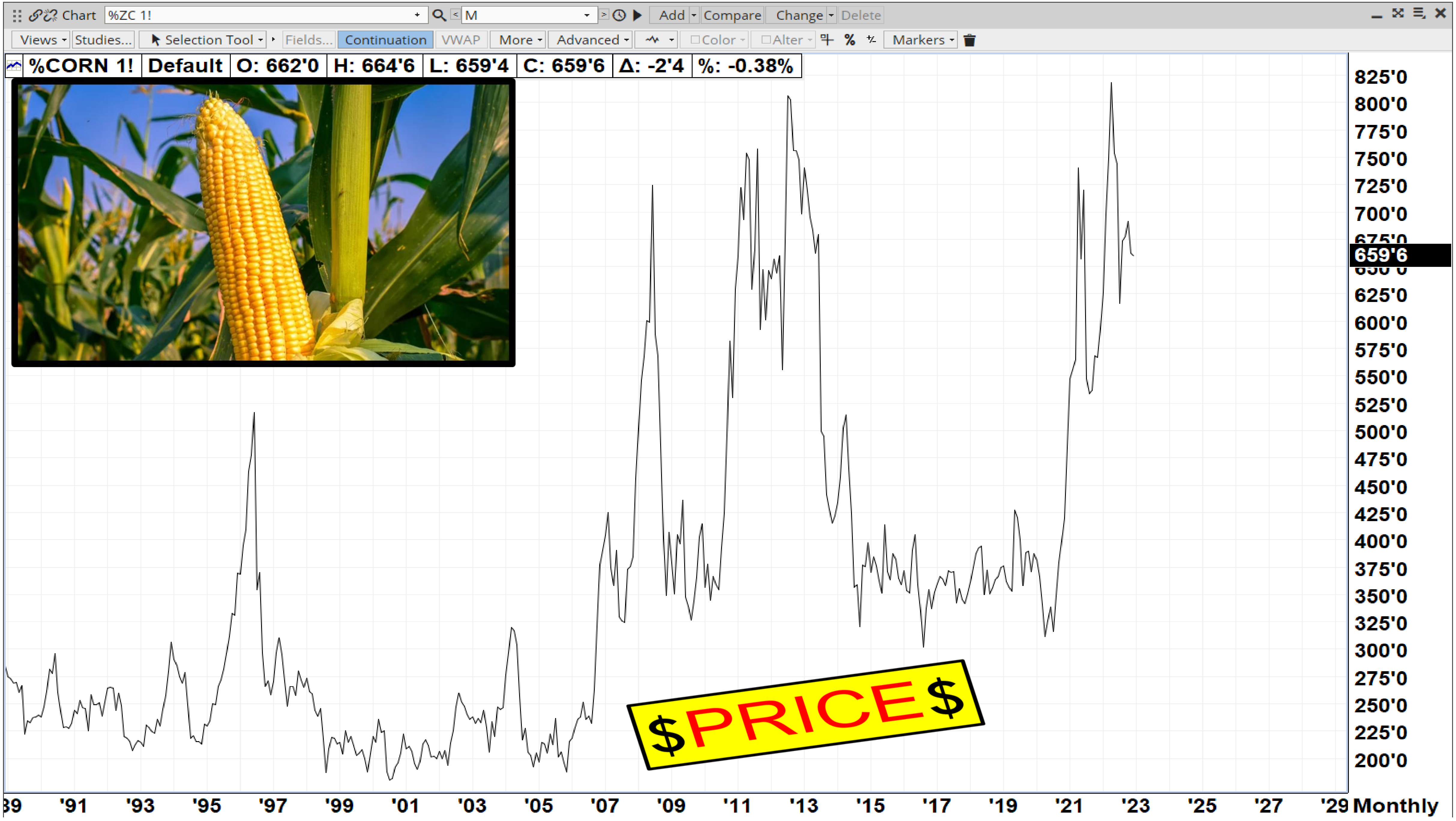

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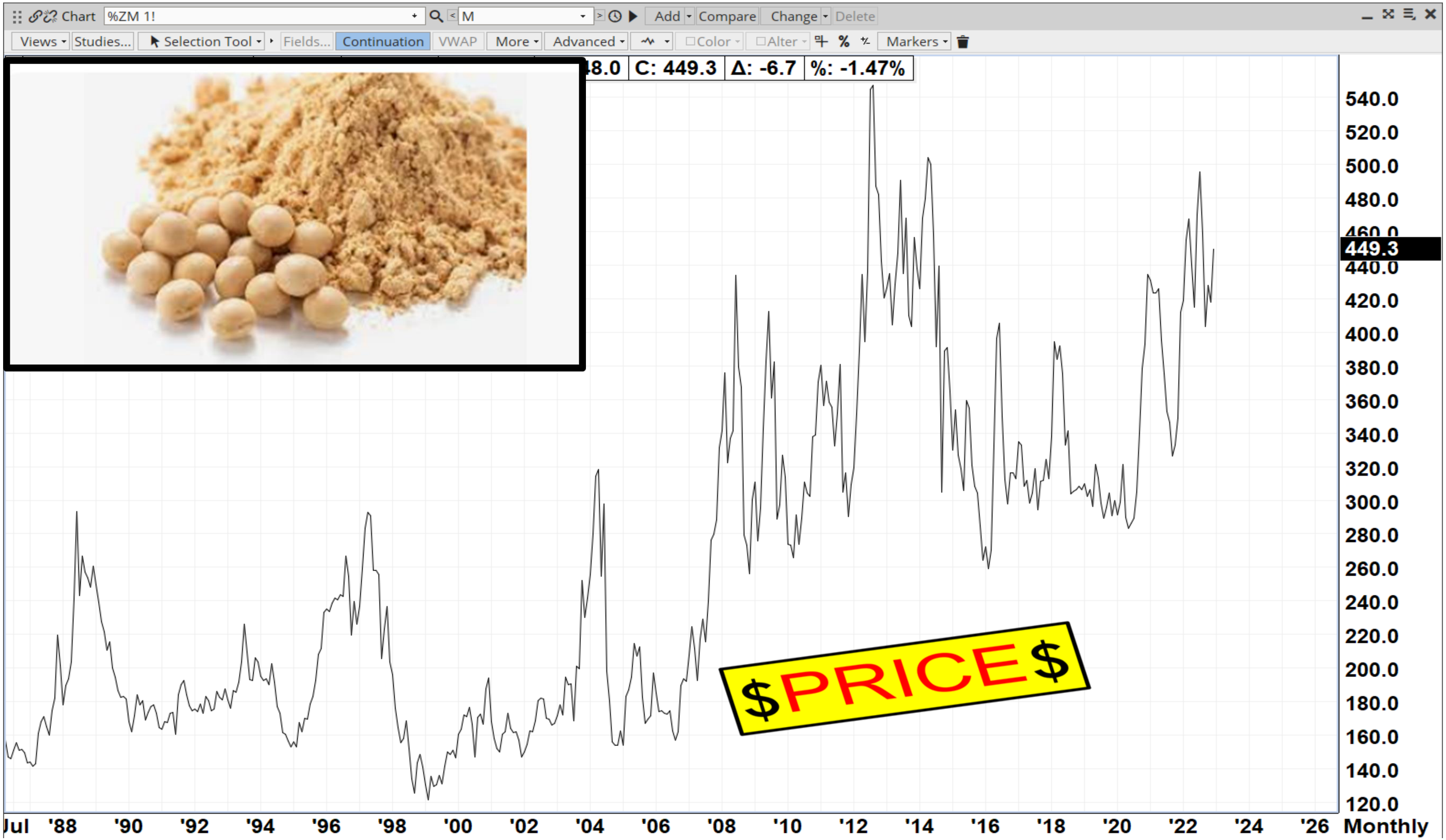

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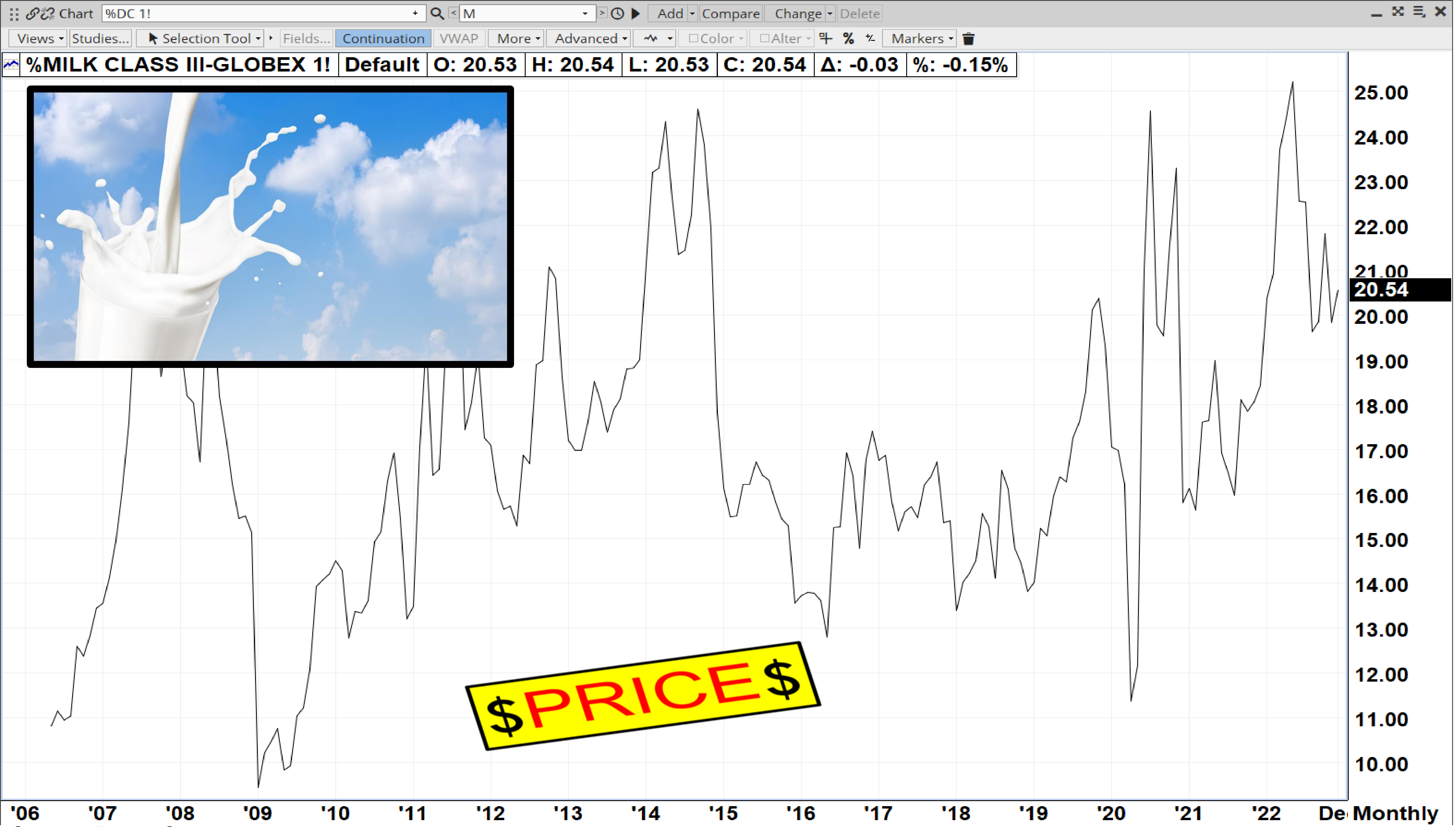

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- Price is not Random
- Price is not fixed, set, or mandated
- Price is discovered. Buyers and Sellers, both emotional “basket cases” meet and nervously agree to a price.
- Prices relate one to another
- Price has patterns of “Behavior” trends, consolidation, cycles, seasonal direction,

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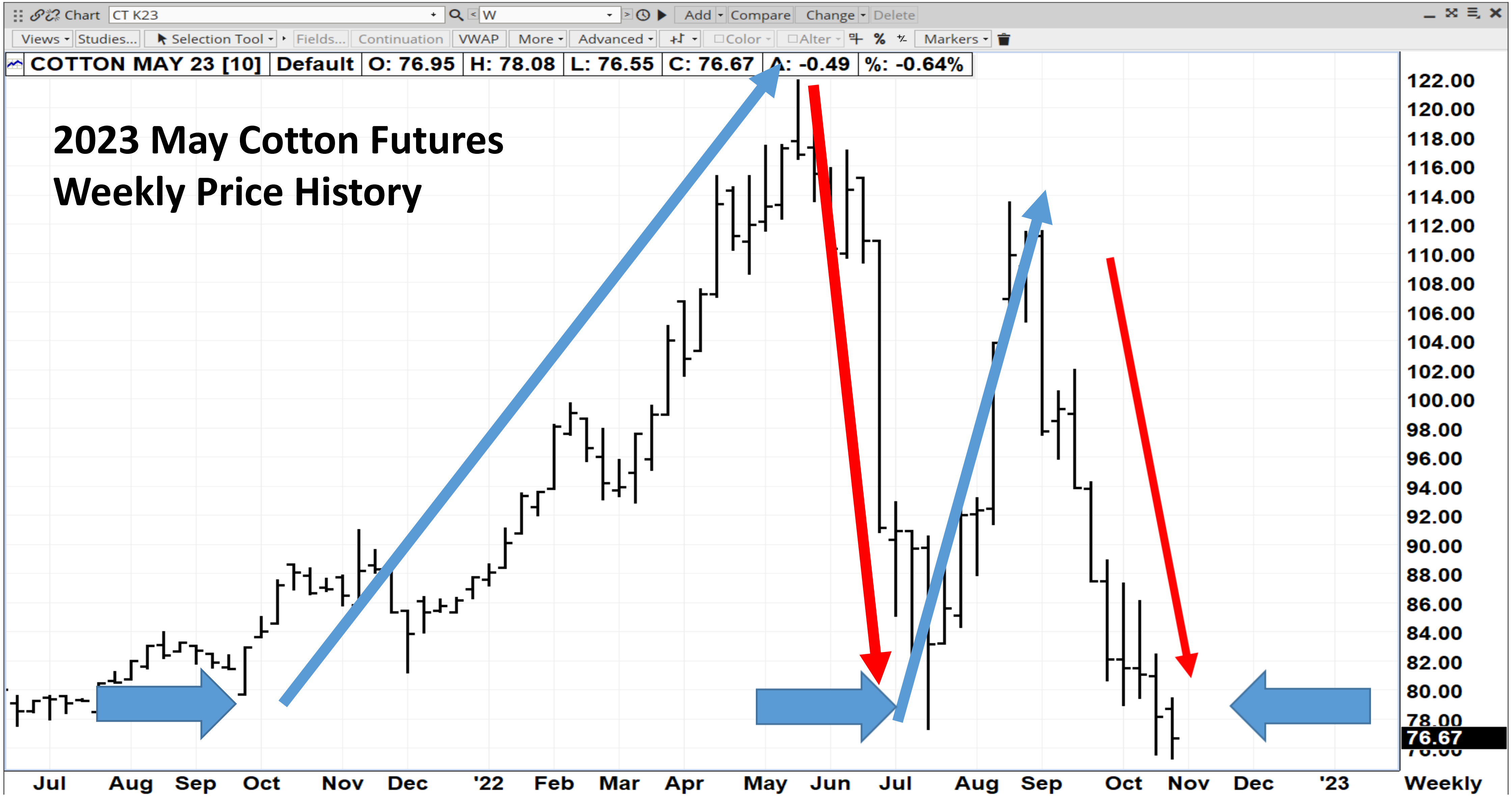
Price has Behavior…….



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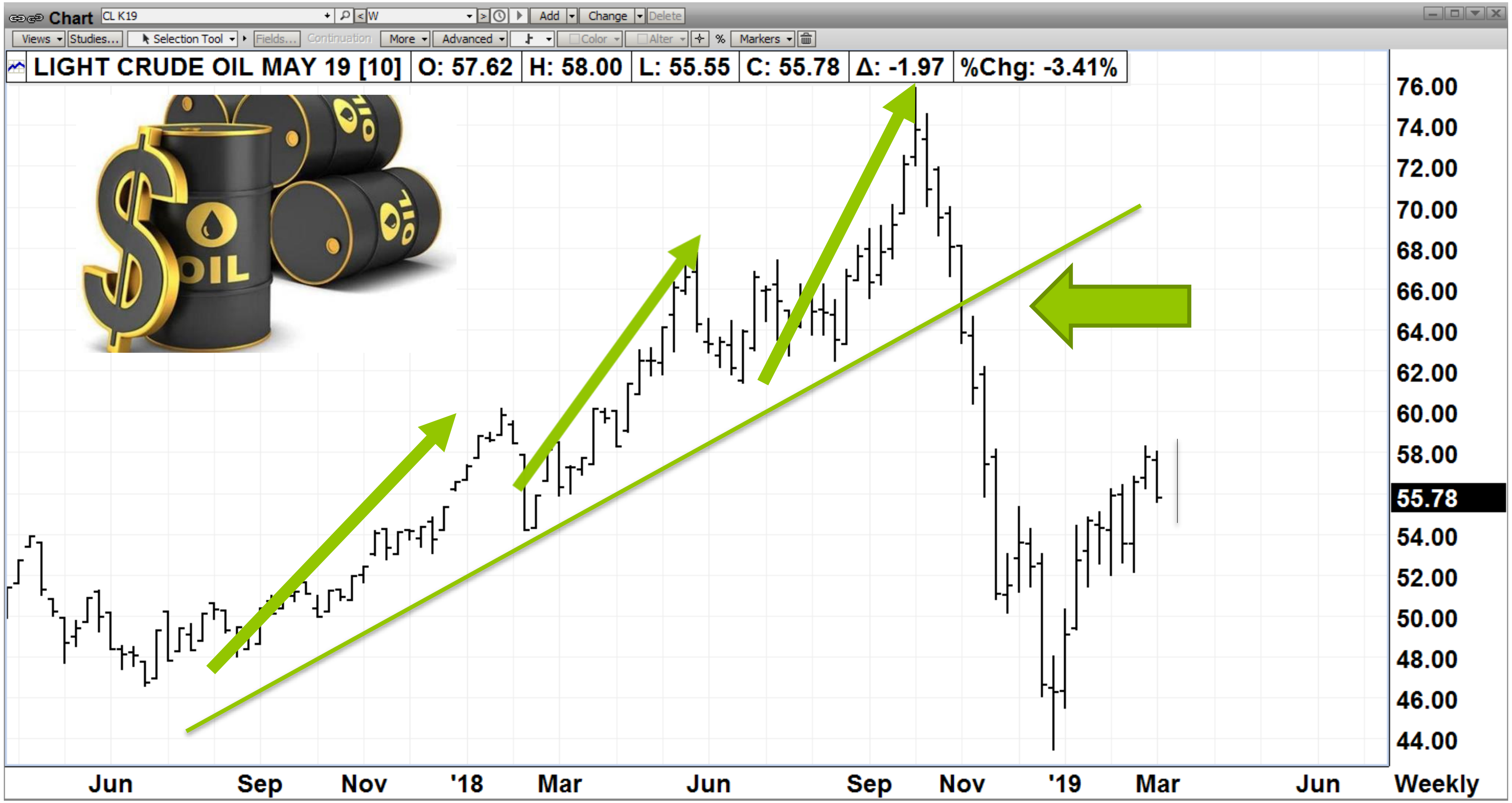
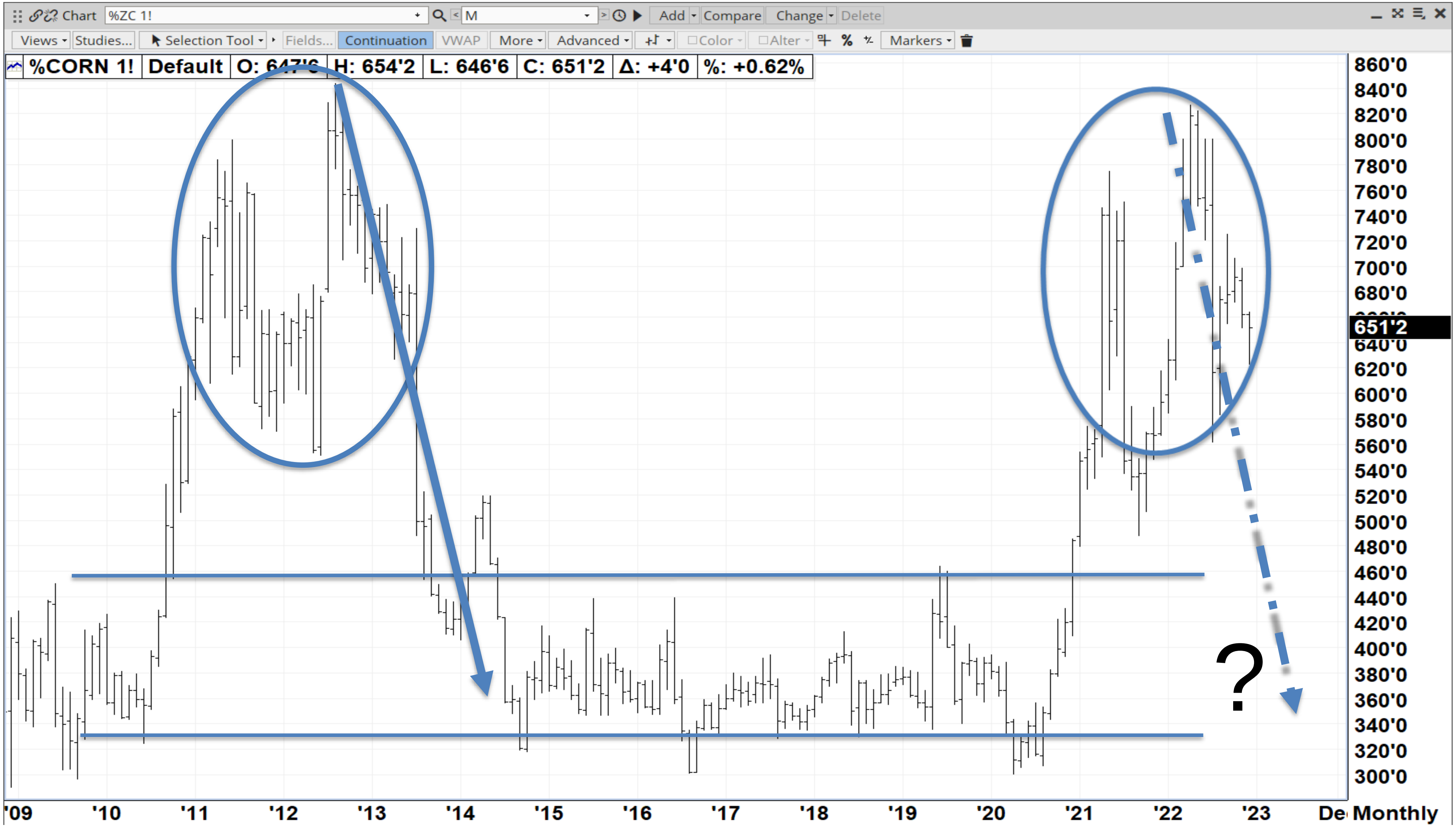
Price has Behavior….



Source; FutureSource

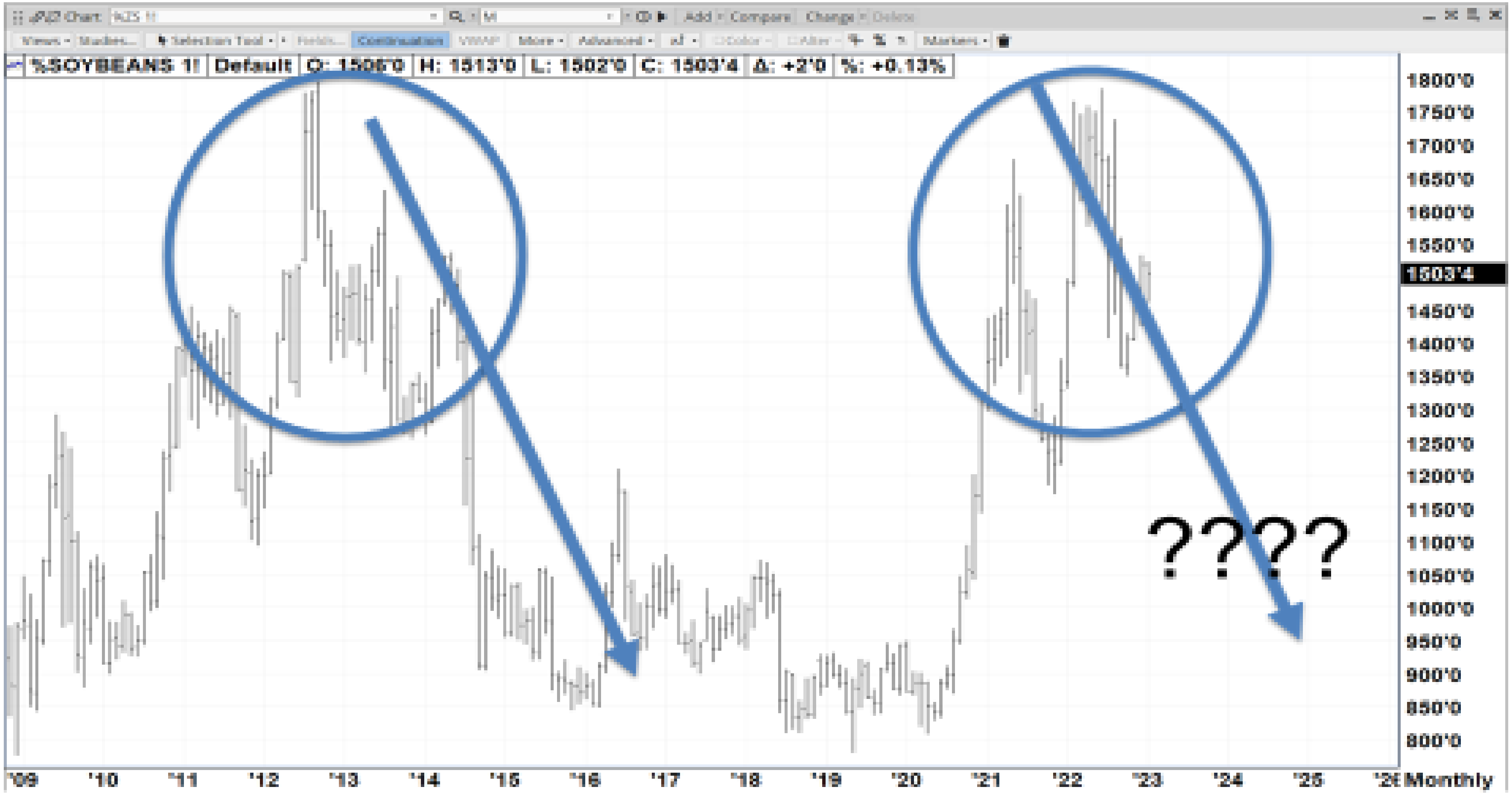
Commodity Market Prices have Behavior

Monthly Continuous Corn Futures Price Chart



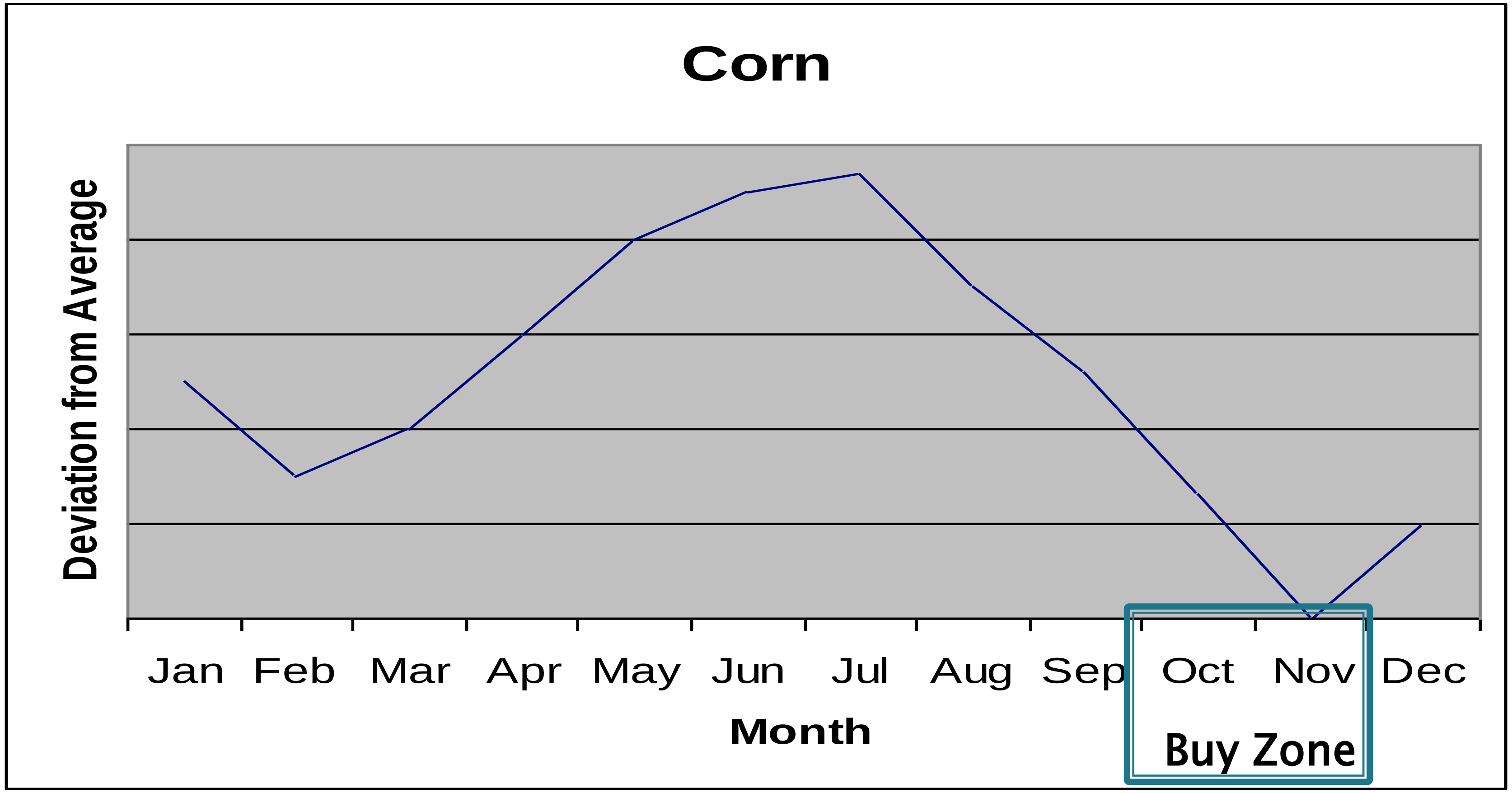
Source:FutureSource

Monthly Continuous Bean Futures price

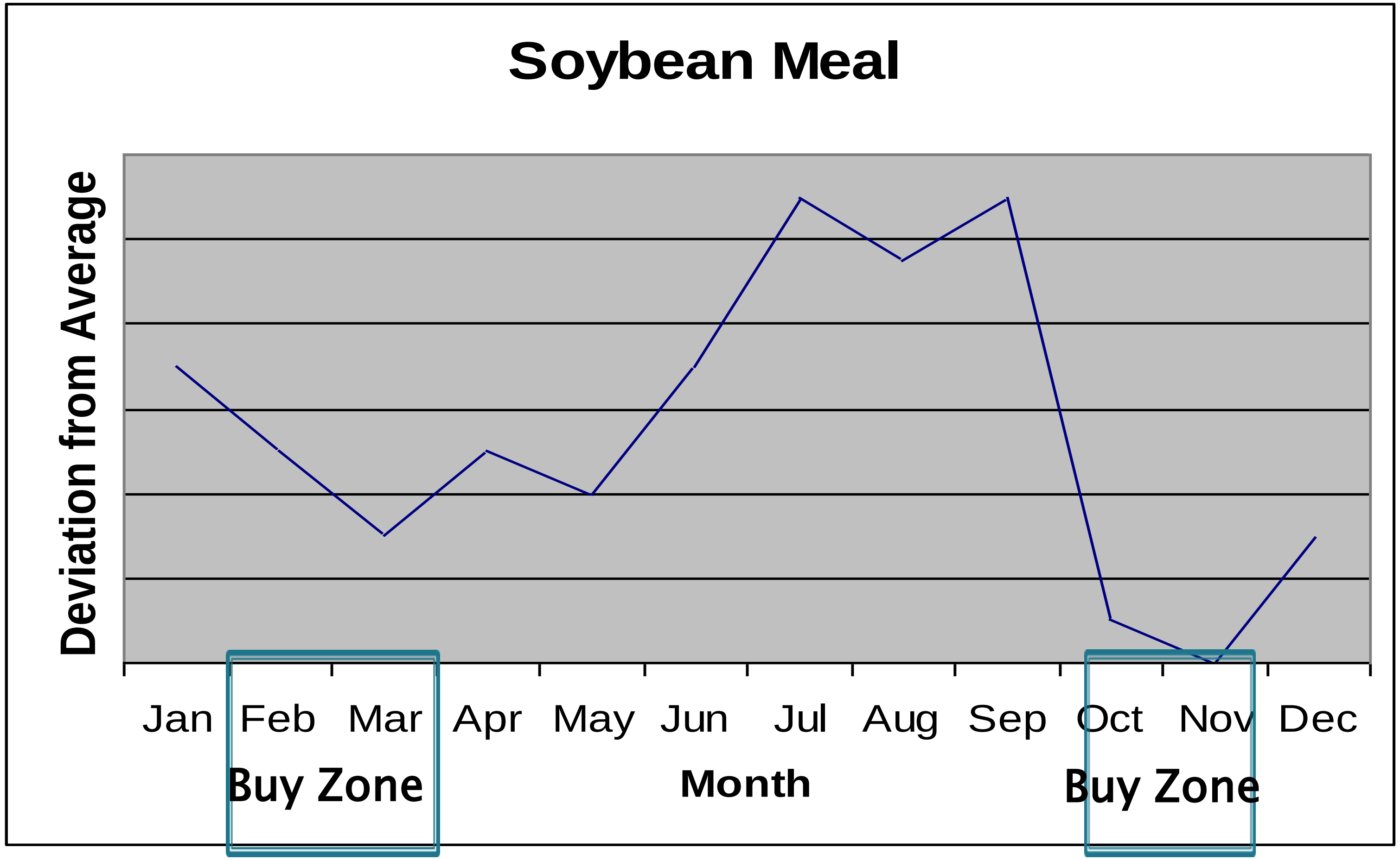


Source;FutureSource

SEASON PRICE PATTERN



SEASON PRICE PATTERN



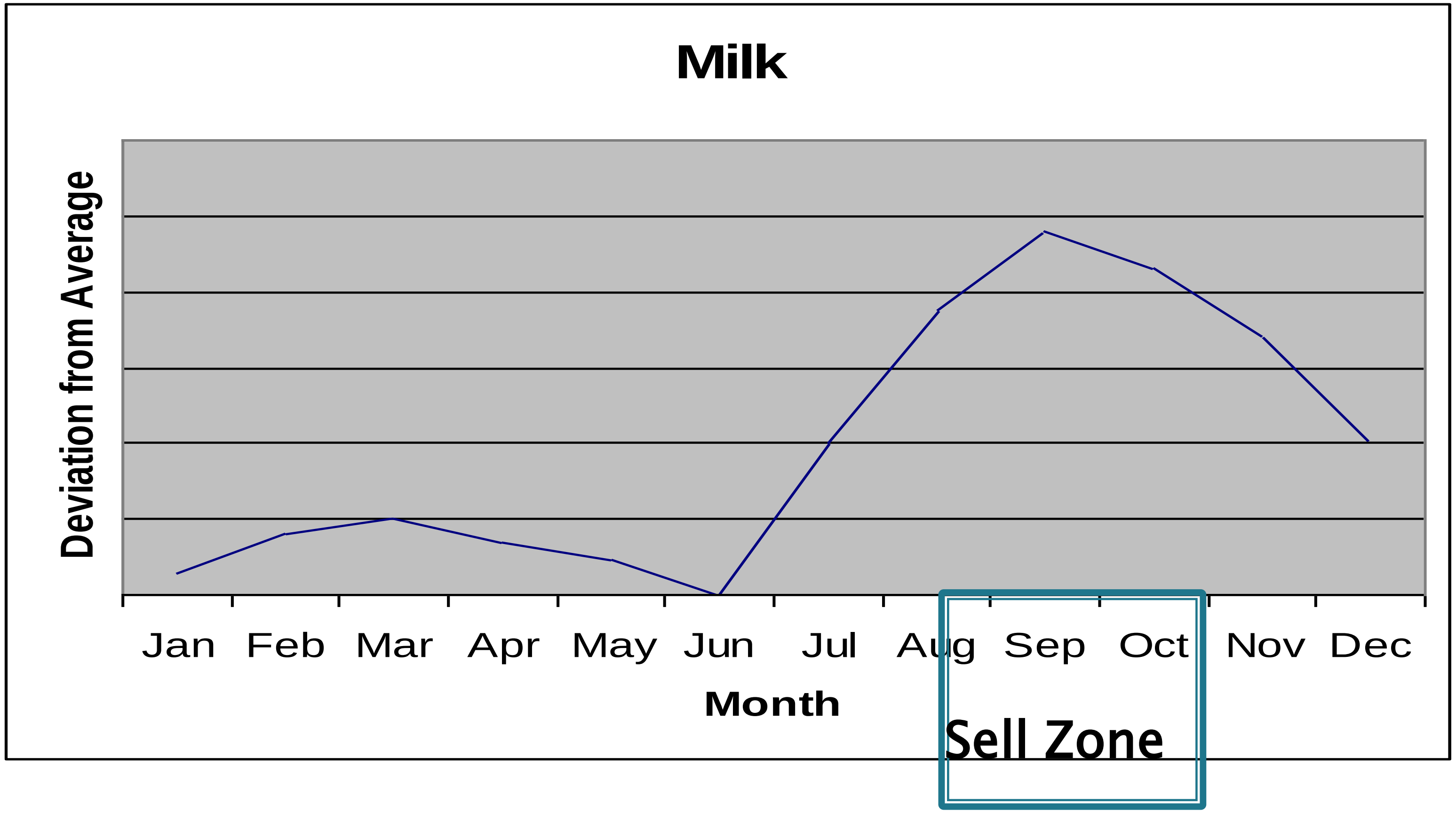
Seasonality???

First Market Consideration

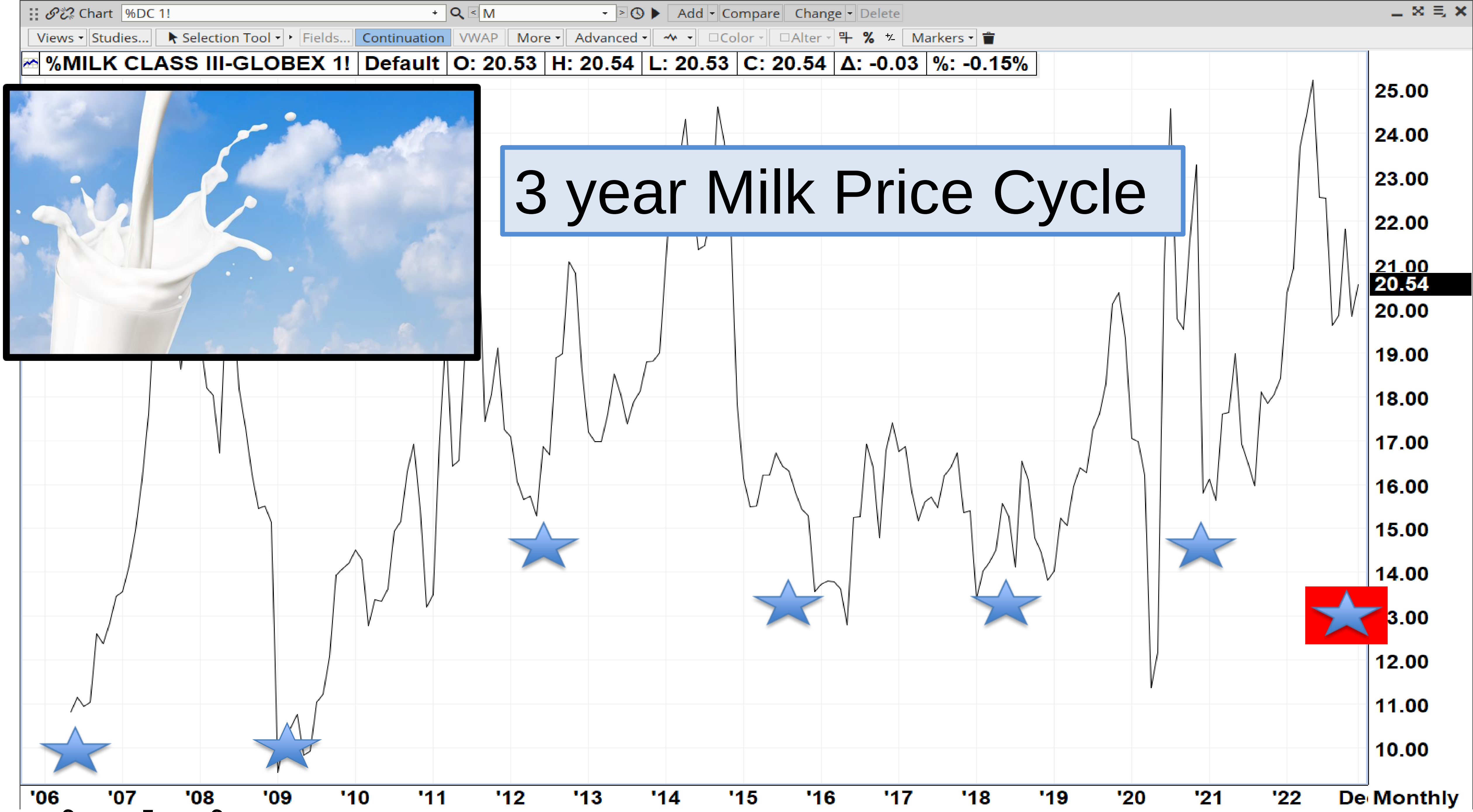
Trust Required

Source:FutureSource

SEASON PRICE PATTERN




MILK CLASS III-GLOBEX MAR 23 | Default | O: 18.22 | H: 18.40 | L: 18.10 | C: 18.40 | Δ: +0.18 | %: +0.99%
Seasonality???
First Market
Consideration
Trust Required
Sell Zone
Source:FutureSource
Weekly



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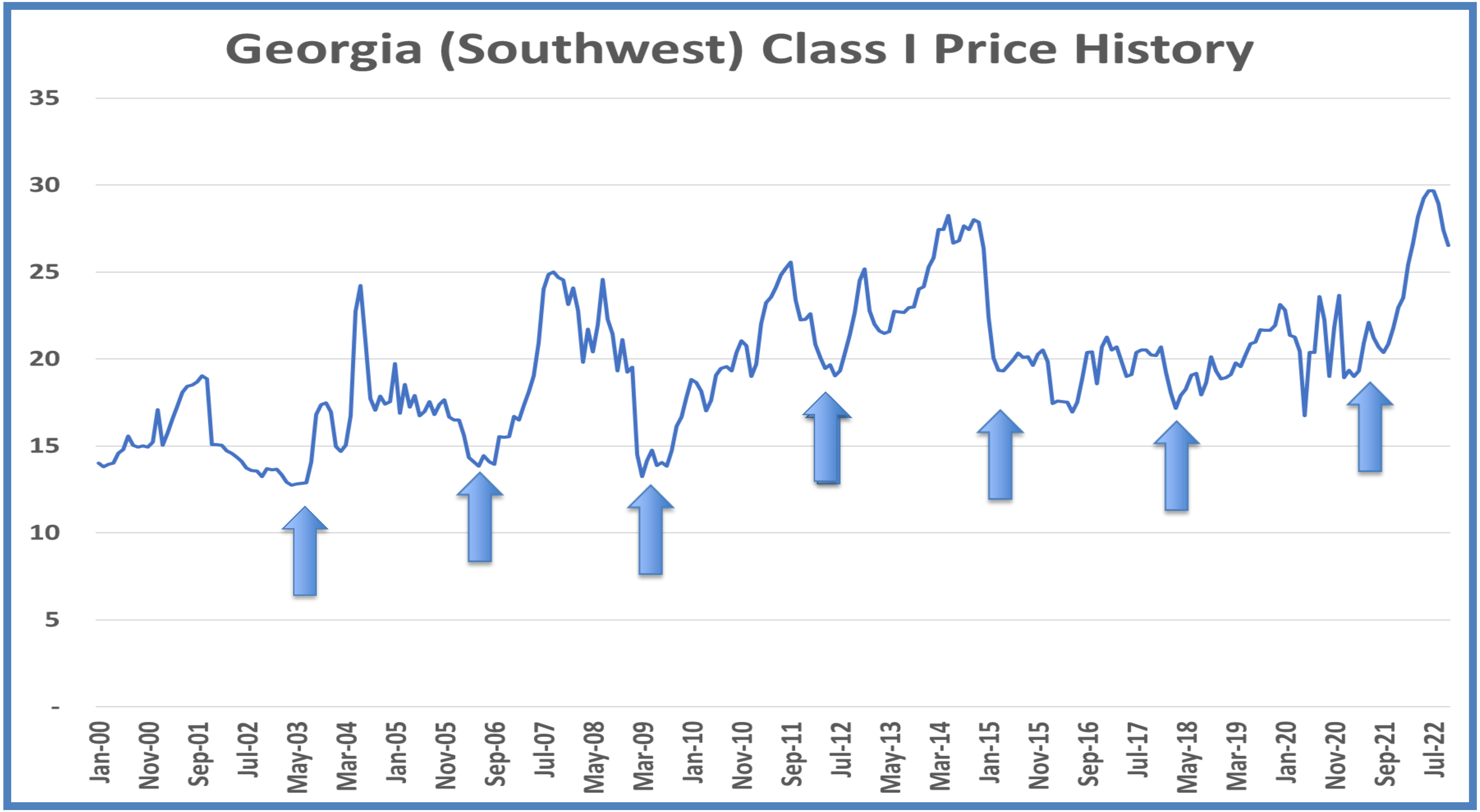
Georgia (Southwest) Class I Price History
35
30
25
20
15
10
5
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Jan-00
Nov-00
Sep-01
Jul-02
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Mar-04
Jan-05
Nov-05
Sep-06
Jul-07
May-08
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Jan-10
Nov-10
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Jul-12
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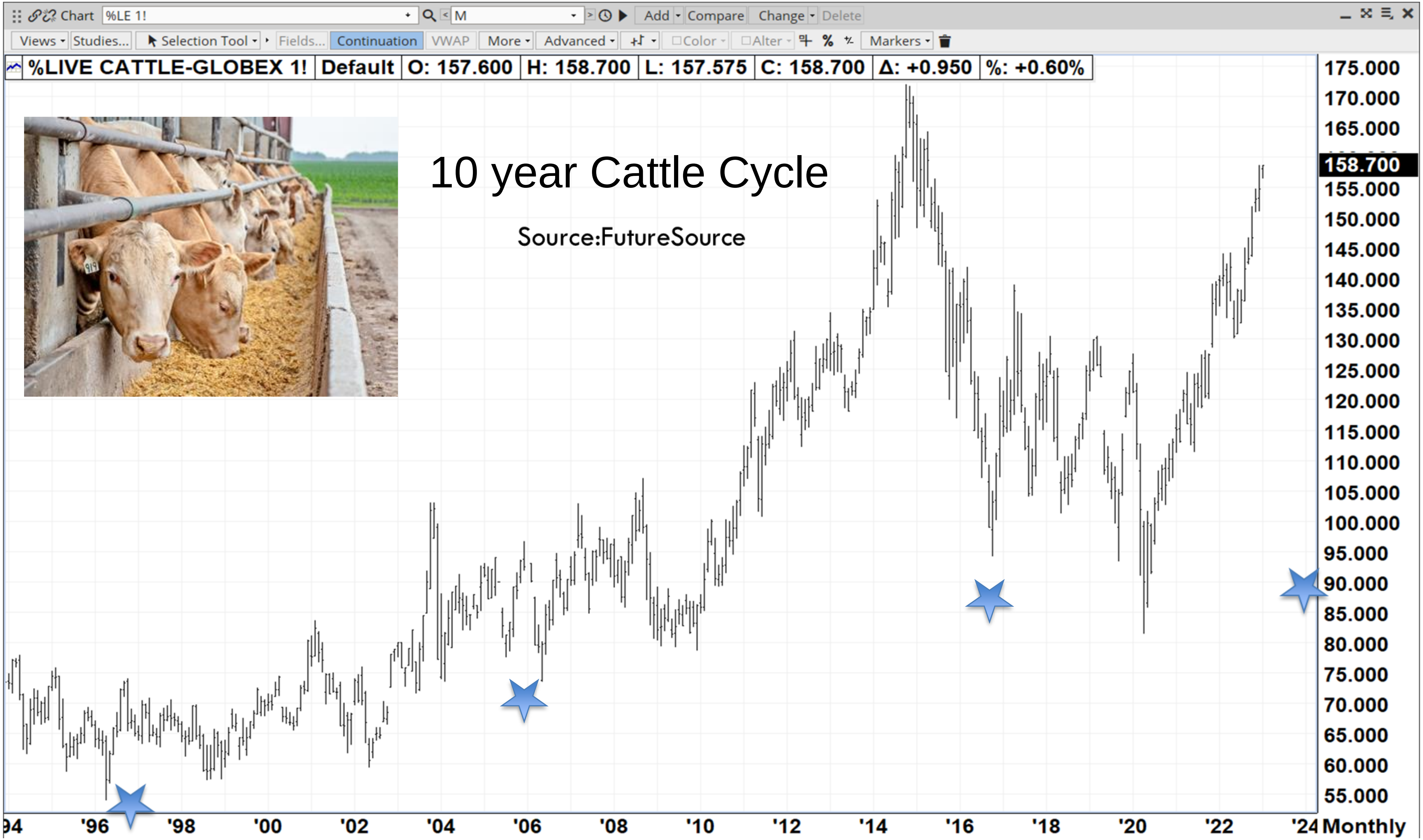
May-18
Mar-19
Jan-20
Nov-20
Sep-21
Jul-22



Chart
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%LIVE CATTLE-GLOBEX 1! | Default | O: 157.600 | H: 158.700 | L: 157.575 | C: 158.700 | Δ: +0.950 | %: +0.60%
10 year Cattle Cycle
Source:FutureSource
175.000
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85.000
80.000
75.000
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60.000
55.000
94 '96 '98 '00 '02 '04 '06 '08 '10 '12 '14 '16 '18 '20 '22 '24
Monthly

Key Principle/Concept

- Nobody knows where the Price is going
- But everyone should know where Price
  Could go.   Acknowledge Risk

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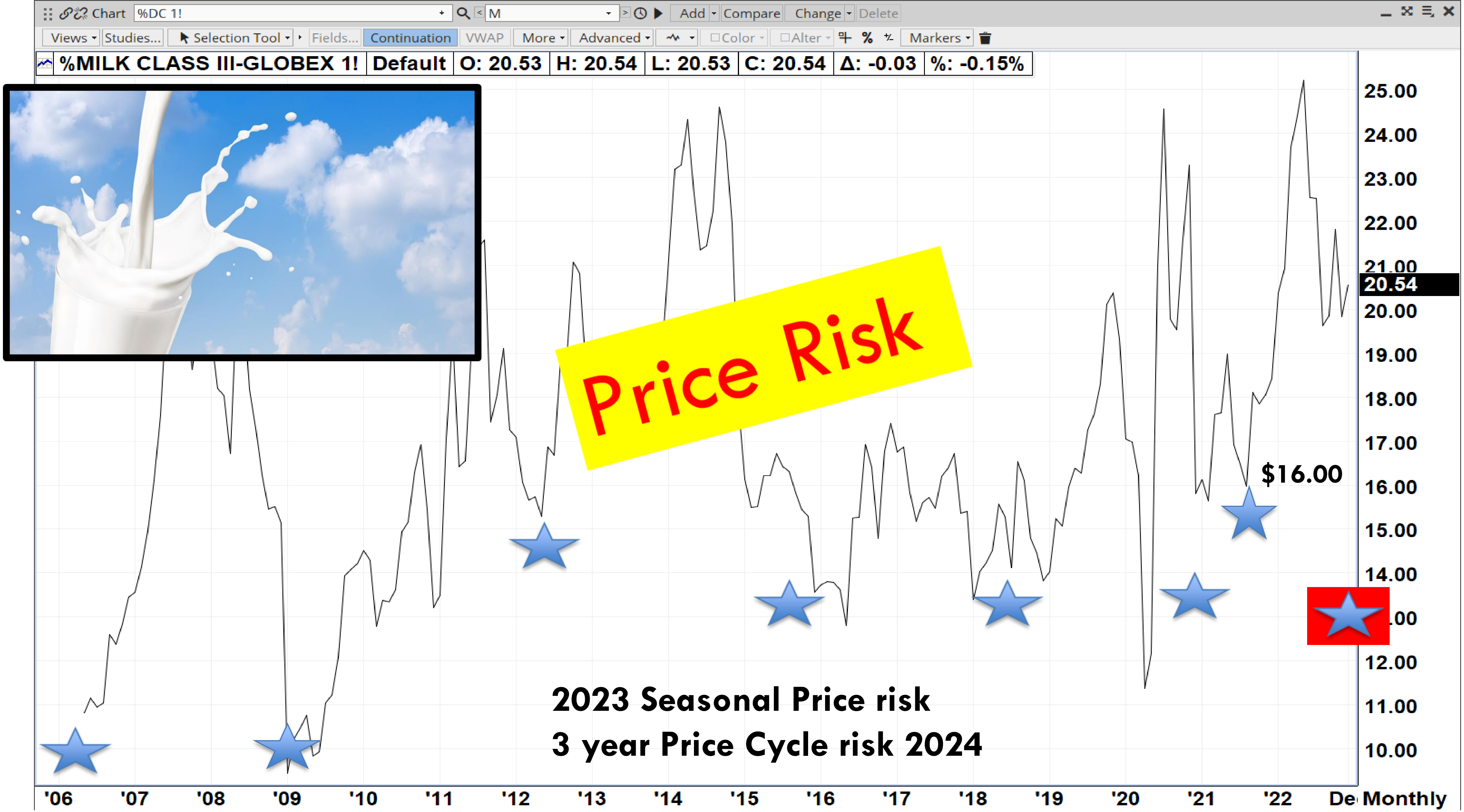
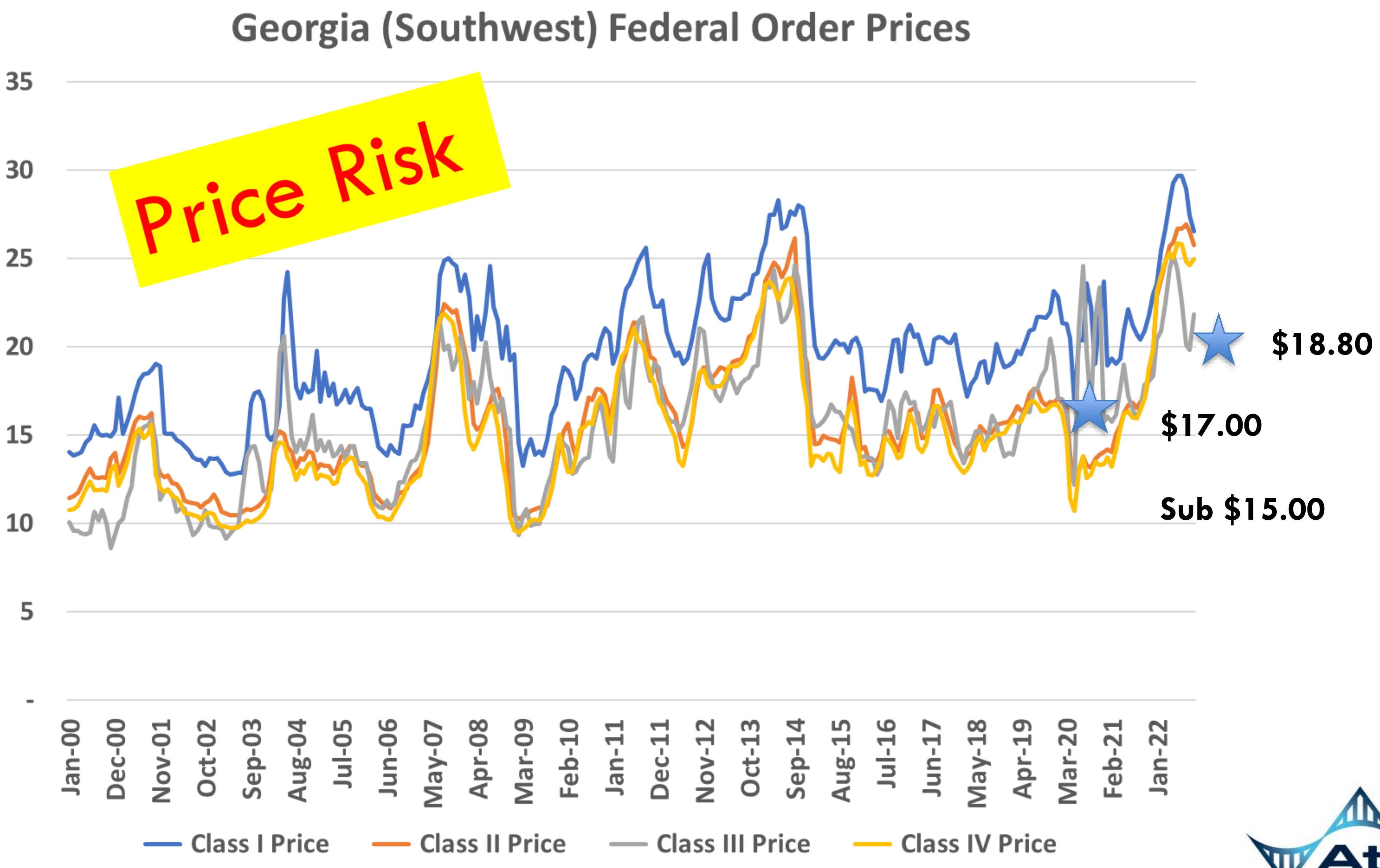
Source:FutureSource

Source:FutureSource



Source:FutureSource

Class Pricing



Your Price Risk

$8.00

$550

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What is Marketing?

MARKETING:

Efforts involved in pricing and or protecting price of commodities in advance of their production or use.

"Doing Something with Price"

For Dairy Net Margin is 62% dependent on Markets

Observed Characteristics of Successful Marketer

- Fully Acknowledging Price Risk forward
- Have a written management approved Plan/Policy/System
- Forward Modeled Price/Revenue/Margin drive Strategy
- Have Funding/ Budget for marketing action.
- Employ consistency/decisiveness/systematic approach

- Successful Marketer

  Never “Doubts” a market

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Our Approach is "PRINCIPLES based"

- We focus on Price currently offered not what we hope it to be.
- We admit to not knowing where price is going
- We acknowledge Price Risk as it applies to each client
- We appreciate Price Patterns of Behavior
- We are not surprised that Prices go up Prices go down
- Risk is framed around Price going back to where it came from
- We coach clients through Marketing Plan development
- We understand Marketing requires Funding/ Budget
- Price/Revenue/Profit drive Strategy
- We promote Systematic Market action consistency/decisiveness
- We Never "Doubt" a market

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Dairy’s Future is Very Bright

- Milk Nutritious and Safe
- Milk can be processed into wide variety of products
- Dairy Production and Processing infrastructure is highly developed
- Technology continues to develop through out industry
- Dairymen can leverage their comparative advantages
- Mature Markets and Marketing Tools are available.

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Conclusion

Have Fun !!!!!

Thank You

Georgia Dairy Producers

…k

…ples,

…epts, and Tools.

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Direct Number 815-402-3859

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Management Tools to Improve Milk Quality & Profitability

David A. Reid, DVM

Rocky Ridge Dairy Consulting, LLC

Hazel Green, WI

dreiddvm@gmail.com

612-963-1457

Whenever You Lose Interest in being Better at Something, Chances are You've Already Stopped Being Good At It!

Typical Milk Quality Issues

There is a gap between knowledge and action.

A plan with no action is a **dream**, action without a plan is a **nightmare**!

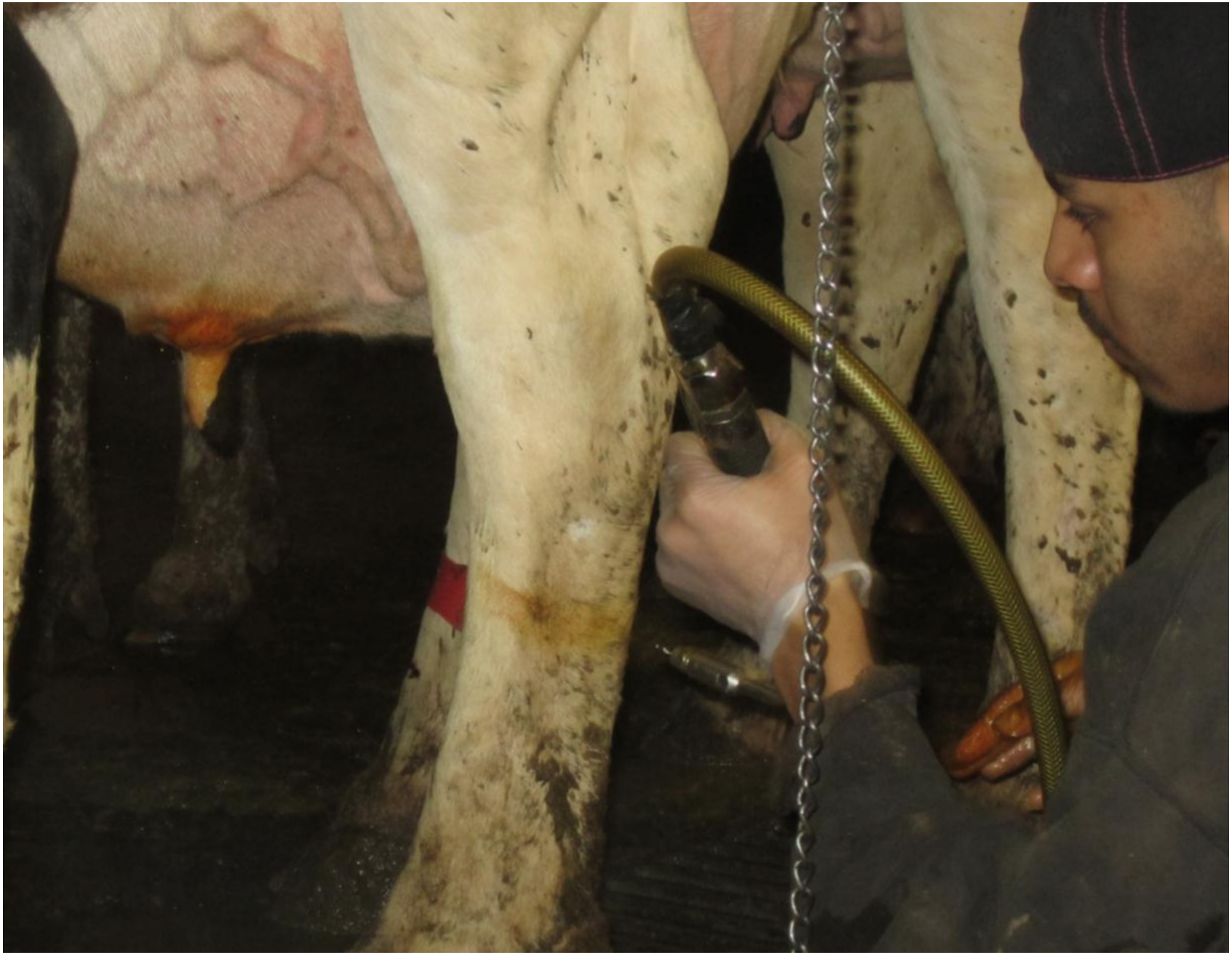
"Change the dip because of increased clinical mastitis!"

Principles of Milk Quality

- Keep cows clean, dry, & comfortable
- Milk clean, dry, stimulated teats
- Use a quality post dip on every cow
- Properly maintain & analyze milking equipment on a schedule
- Promptly treat clinical mastitis
  - Maintain records of treated cows/qtrs
- Cull Chronic cows

Principles of Milk Quality

- Most of you have a good working knowledge of these Principles
- Many of you will violate as many as possible & still want milk quality!



Dairy Profitability Key Factors

1. Milk as many cows as you can in your parlor

2. Maximize milk quality

3. Achieve the highest milk yield while minimizing input costs.

Interesting Reid Observation

Low SCC herds typically have more consistent udder preparation & more relaxed cows in the barn or parlor

Consistency between technicians & milking to milking

Milking 1 Sunday am

PEN	Total Milk	Milk /Hr	Milk /Cow	Cows	Cows /Hr	Total Time	Start Time	Stop Time	Avg $/m	Avg Dur
1	5138	662	36	141	18	7:45	7:50	15:36	7.6	4.9
No ID	5497	682	24	228	28	8:03	7:50	15:54	6.5	3.6
2	3330	912	24	140	38	3:39	8:09	11:49	5.4	4.3
3	4978	5635	26	189	213	0:53	9:32	10:26	6.6	3.9
4	5465	6831	28	193	241	0:48	10:24	11:12	7.0	4.0
10	56	373	28	2	13	0:09	10:59	11:09	6.0	4.6
5	4704	5644	27	176	211	0:50	11:11	12:02	6.6	4.1
6	5139	6166	30	172	206	0:50	12:04	12:54	6.7	4.4
9	5011	5466	25	202	220	0:55	12:52	13:48	6.5	3.8
7	5196	7993	27	190	292	0:39	13:47	14:26	7.1	3.8
8	6709	6822	37	183	186	0:59	14:20	15:19	7.6	4.9
1	3527	5161	32	110	160	0:41	15:16	15:58	7.3	4.5
2	89	485	44	2	10	0:11	15:41	15:53	9.1	5.0
Total	54839	6756	30	1928	237	8:07	7:50	15:58	6.8	4.1

Description	Pen	1	0	2	3	4	5	6
% Units were attached	32	2	3	5	27	31	28	30
Milk / stall / hour	135	13	13	18	110	136	110	123
Cows / stall / hour	4.7	0.3	0.5	0.7	4.2	4.8	4.1	4.1
"Peak" Flowrate	9.5	11.6	1.1	7.8	10.1	10.8	10.3	11.0

Milking 1 Monday am

PEN	Total Milk	Milk /Hr	Milk /Cow	Cows	Cows /Hr	Total Time	Start Time	Stop Time	Avg #/m	Avg Dur
1	6443	847	39	167	21	7:36	8:17	15:54	8.3	4.7
No ID	6713	885	25	266	35	7:35	8:17	15:53	7.1	3.4
2	3050	3812	23	131	163	0:48	8:59	9:48	6.5	3.6
3	4900	6837	26	185	258	0:43	9:47	10:31	7.2	3.7
4	5611	7481	30	187	249	0:45	10:28	11:13	7.3	4.0
5	4575	5718	25	185	231	0:48	11:12	12:01	6.8	3.6
6	4828	4598	27	178	169	1:03	12:00	13:03	7.1	3.8
7	4608	2684	27	173	100	1:43	12:57	14:40	7.4	3.6
9	5157	6726	30	174	226	0:46	13:00	13:47	8.1	3.7
8	5583	5153	35	161	148	1:05	14:26	15:31	8.3	4.2
1	1808	4520	32	57	142	0:24	15:29	15:54	8.0	4.1
Total	53276	7010	29	1864	245	7:36	8:17	15:54	7.4	3.8

Description	Pen	1	0	2	3	4	5	6
% Units were attached	31	3	3	19	31	33	27	21
Milk / stall / hour	140	16	17	75	133	149	113	91
Cows / stall / hour	4.8	0.4	0.7	3.2	5.0	4.9	4.5	3.3
"Peak" Flowrate	10.4	12.8	1.2	9.5	11.5	12.2	10.8	11.7

Sunday am

PEN	Total Milk	Milk /Hr	Milk /Cow	Cows	Cows /Hr	Total Time	Start Time	Stop Time	Avg #/m	Avg Dur
Total	54839	6756	30	1928	237	8:07	7:50	15:58	6.8	4.1

Description	Pen	1	0	2	3	4	5	
% Units were attached	32	2	3	5	27	31	28	3
Milk / stall / hour	135	13	13	18	110	136	110	12
Cows / stall / hour	4.7	0.3	0.5	0.7	4.2	4.8	4.1	4.
"Peak" Flowrate	9.5	11.6	1.1	7.8	10.1	10.8	10.3	11.

Monday am

PEN	Total Milk	Milk /Hr	Milk /Cow	Cows	Cows /Hr	Total Time	Start Time	Stop Time	Avg #/m	Avg Dur
Total	53276	7010	29	1864	245	7:36	8:17	15:54	7.4	3.8

Description	Pen	1	0	2	3	4	5	6
% Units were attached	31	3	3	19	31	33	27	21
Milk / stall / hour	140	16	17	75	133	149	113	91
Cows / stall / hour	4.8	0.4	0.7	3.2	5.0	4.9	4.5	3.
"Peak" Flowrate	10.4	12.8	1.2	9.5	11.5	12.2	10.8	11.

Interesting Reid Observation

- Many producers want to improve parlor performance with equipment adjustments and/or purchase of new equipment.

- Much easier and less stressful than training people!

Goals

1. Healthy Cows Are Profitable
2. Control Inputs
3. No Management Belief Is Beyond Questioning
4. Make No Changes Without First Establishing How Their Effect will Be Measured.

Dr. John Ferry 1993

Key Milking Time Focus Points

- Bring Clean, Calm cows to the parlor
- Excellent pre-milking teat end sanitation & stimulation
- Adjust machines to come off in a timely manner
- Effective complete post milking teat dip coverage

Mastitis “FACTS!”

The new mastitis infection rate is directly related to the number of bacteria on teats when units are attached

The best udder preparation will only reduce the number of bacteria on teats at unit attachment by 80 to 85%

Evaluate Manure Splash & Cow Cleanliness

What can be done to bring cleaner cows to the parlor or barn.


2006 3 23

What is wrong with this picture?

Move against the cows to move them forward in the parlor

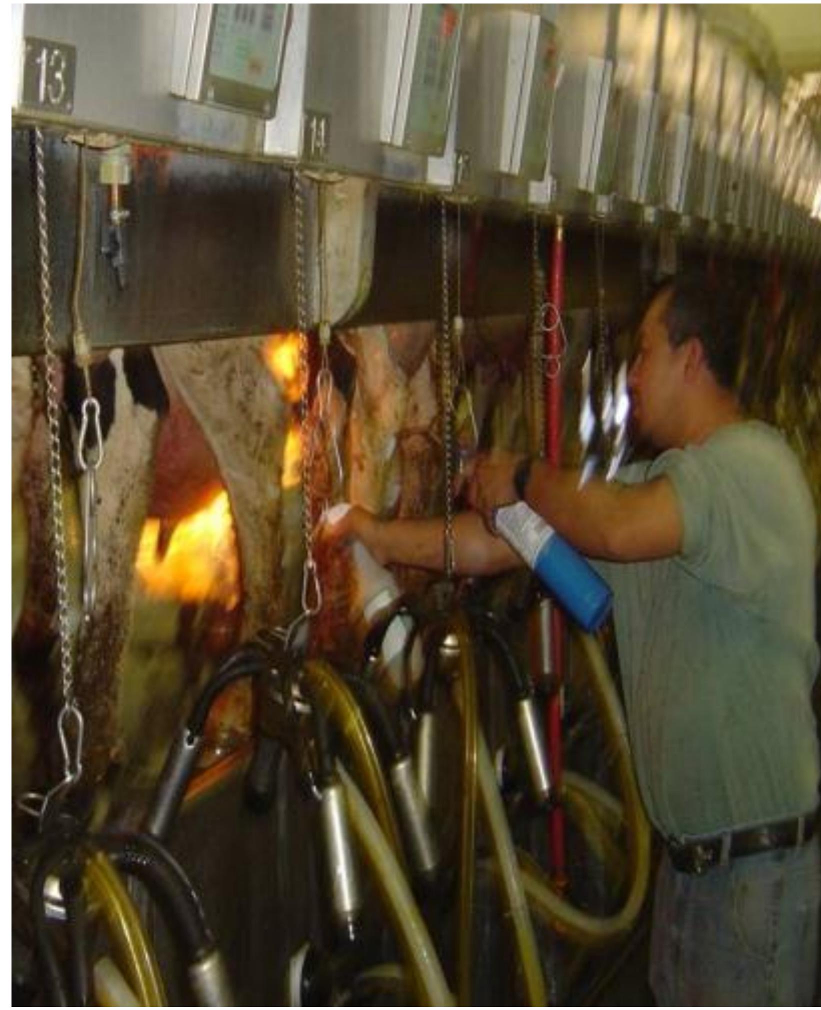
Research?

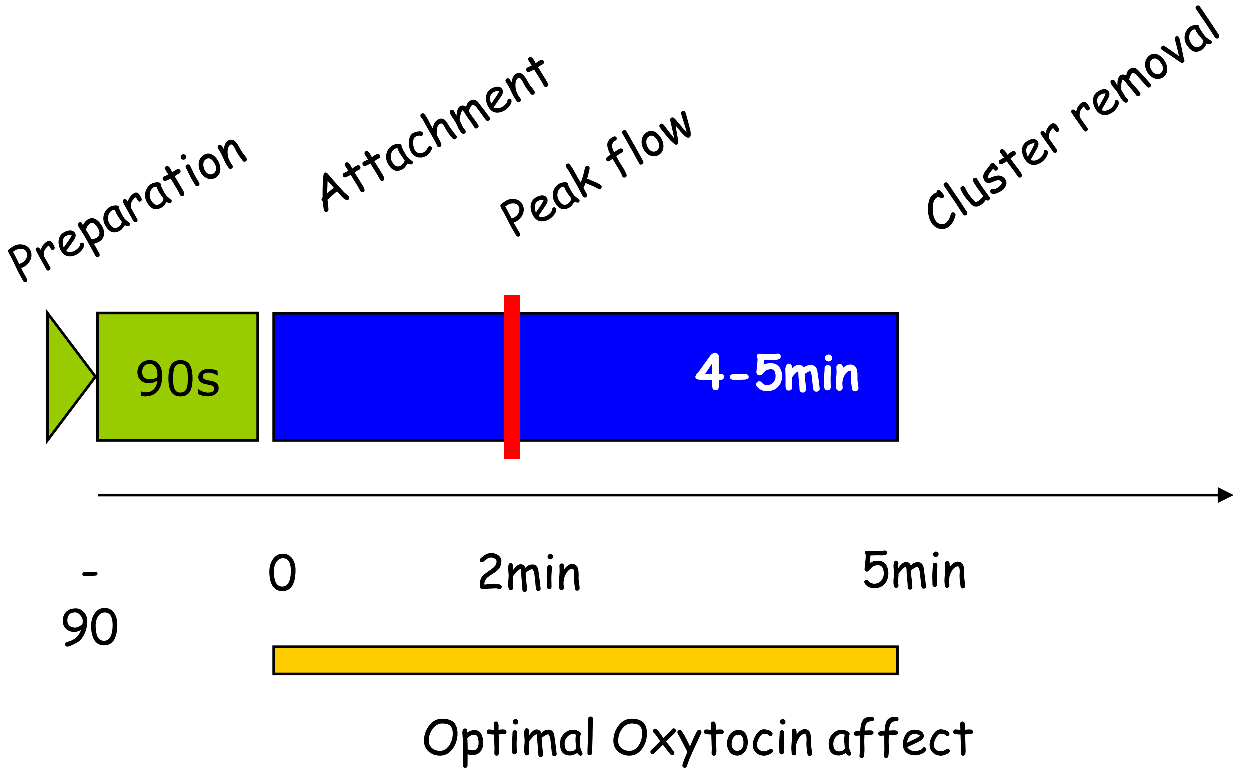
- Tail docking makes no difference to cow cleanliness.

- Firing udders does not lower SCC

Does someone from management trim tails for an entire milking monthly?

Firing; Isopropyl Alcohol Method





Timing Goals

10-12 seconds of stimulation or teat contact time

20-30 seconds of contact time for pre-dip

90 seconds from beginning of teat contact time to unit attachment

Milking Routine

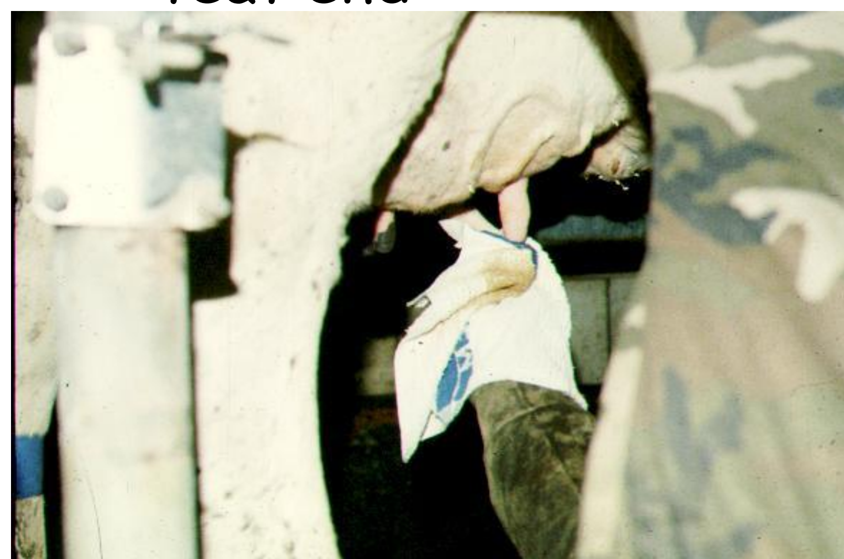
If contact times are low during stripping, rubbing and/or drying

- Devise a routine that allows the procedures to be performed during one stop at the cow
    - i.e. Dip 5 cows, now back to the first cow to strip two streams of milk form each teat, then rub each teat end, then dry each teat. This allows all the contact times to be immediately after one another resulting in better primary oxytocin letdown.

Milking Procedures:
Drying Teats is the Key Factor for reduced bacteria on teats at unit attach

Dry with 1 circular motion

Flip the towel & aggressively pinch teat end

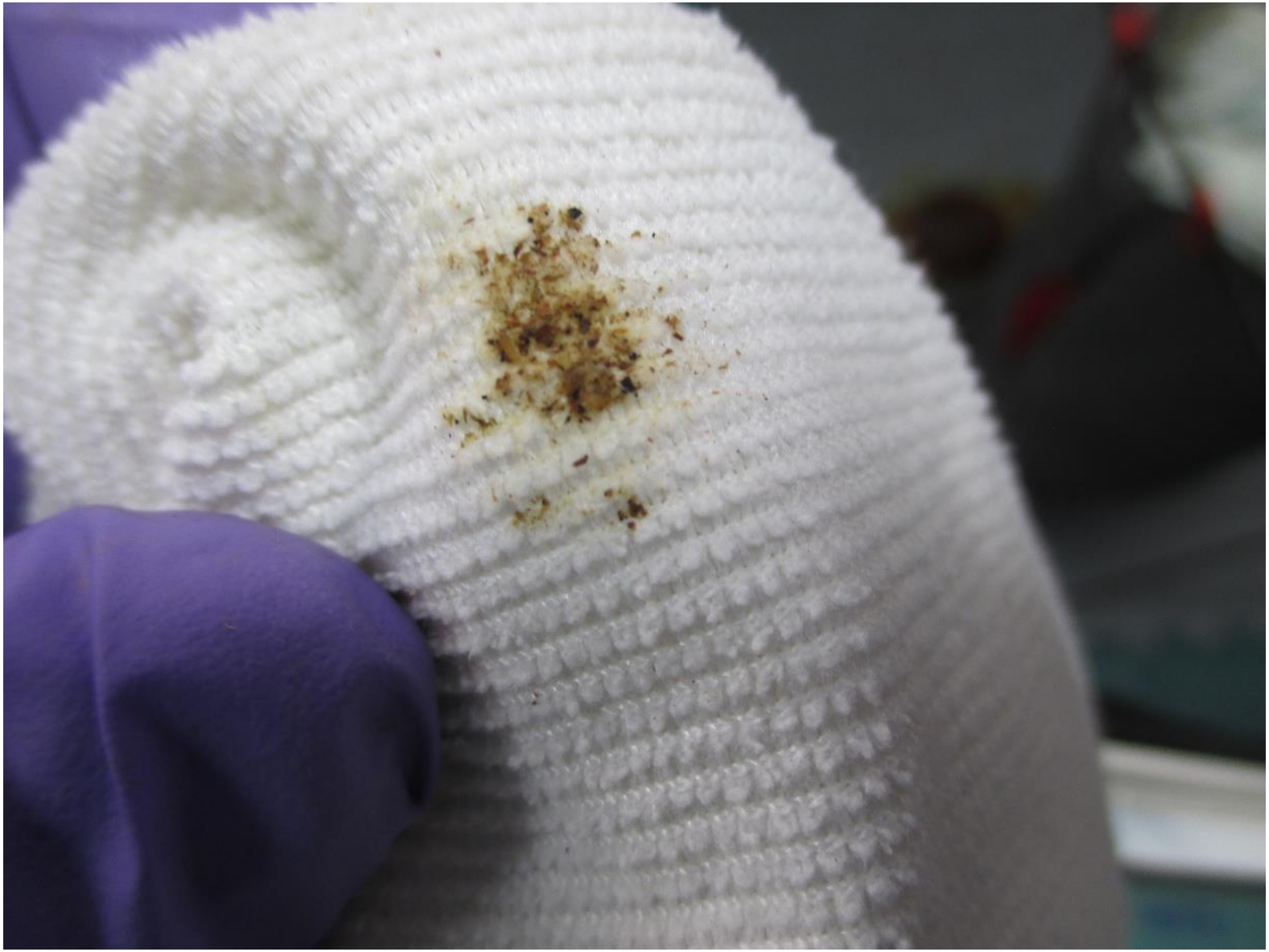


Milking

- Milking time is harvest time!
- Why are so many people in a hurry to get milking finished?
- What other business can you do a better job today and get a raise tomorrow!

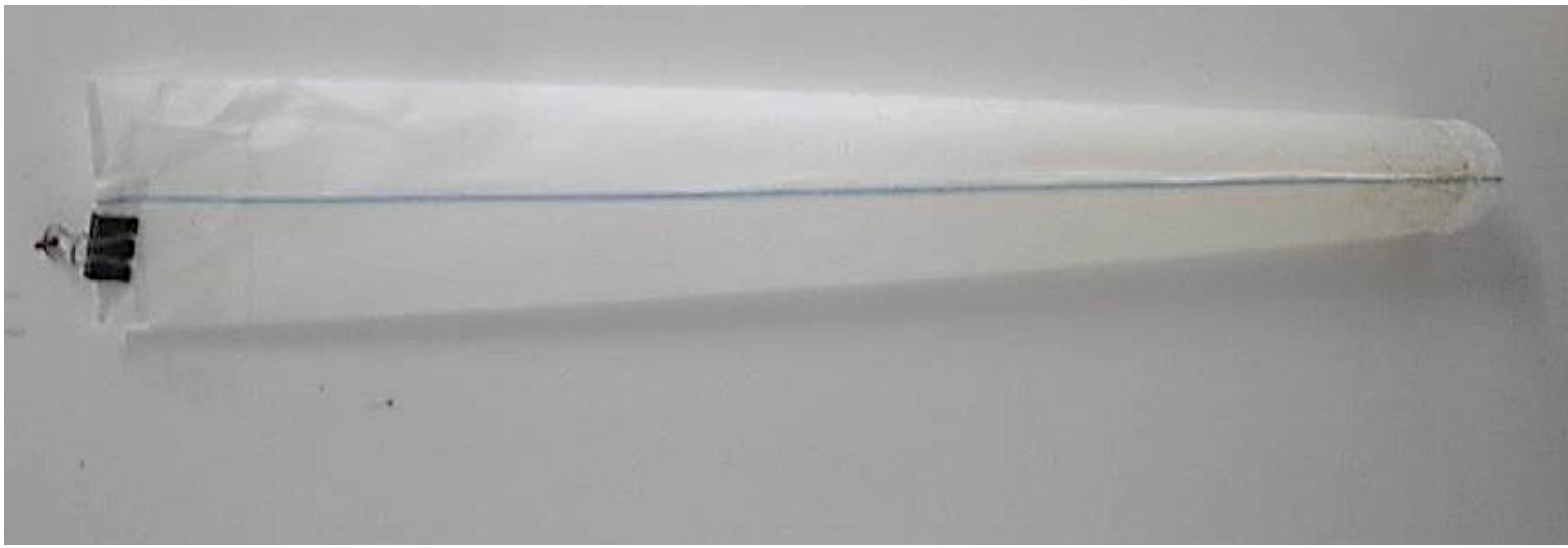
Teat Cleanliness Scoring

1 2 3 4

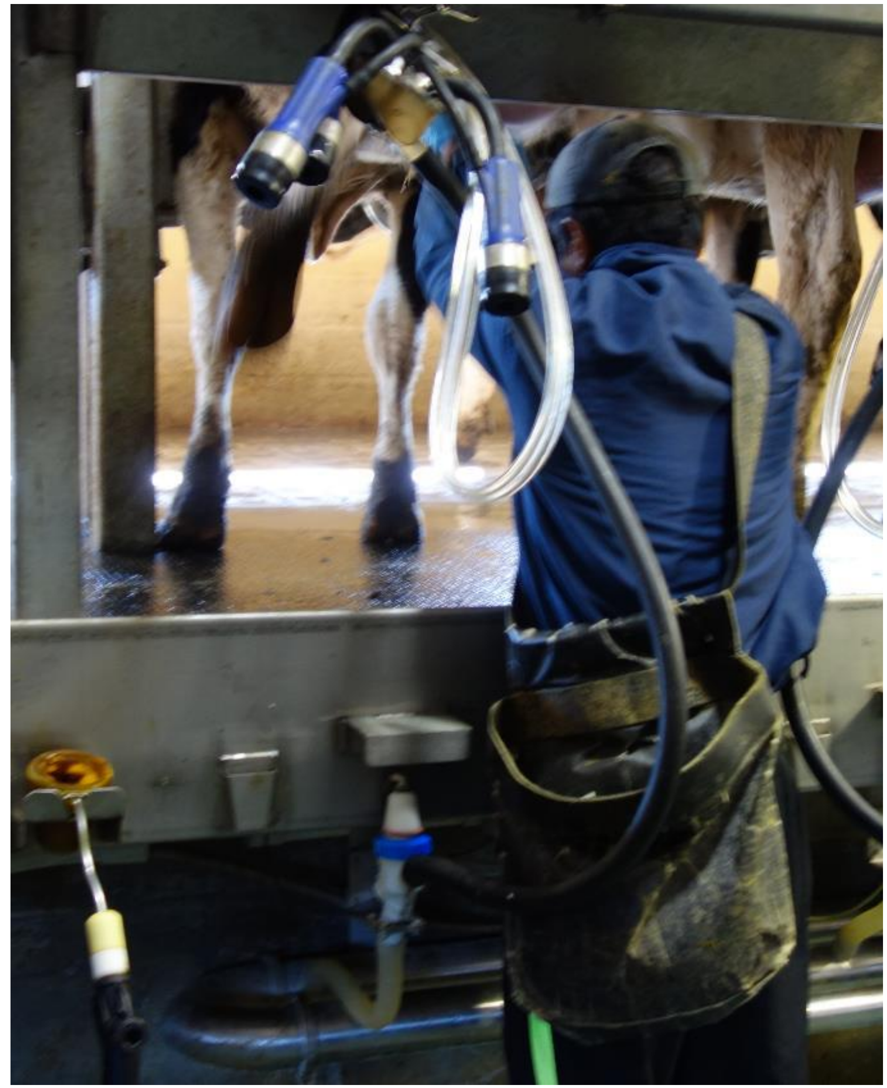


What do Your filter socks look like?

500 cows



Is this normal in your herd?



More Reid Observations

- Low SCC and low Clinical mastitis levels only mean you are milking clean cows!

- Many producers are reluctant to change parlor settings, because **"we have always done it this way!"**

Stripping Milk Testing

- Hand strip into 500 ml measuring cup
- Strip immediately after unit removed
- Examine teat color, swelling, ringing
- Note resistance to stripping and volume of stripping milk
- Do test uneven or 3 quarter cows!

Stripping Milk Testing

100 to 250 ml from all 4 quarters with some higher. (.5# - 225ml)

Less than 1# (454mL) is considered milked out & will not impact the next milking's yield.

Fast milking, high production cows will always have minimal stripping milk!

Stripping Milk Testing

Monitor volume and resistance of the cows to hand stripping

Parlor Performance: greatly influenced by the attitude of the Milk Harvest Technicians!

What can you do to make it easier for technicians to do their job?


PUSH
2007 1 3

The right tools help Milk Harvest Technicians follow the Protocols

Have you considered outside vendor to supply clean towels?

How often do you move cows to maximize parlor use?

Parlor Performance

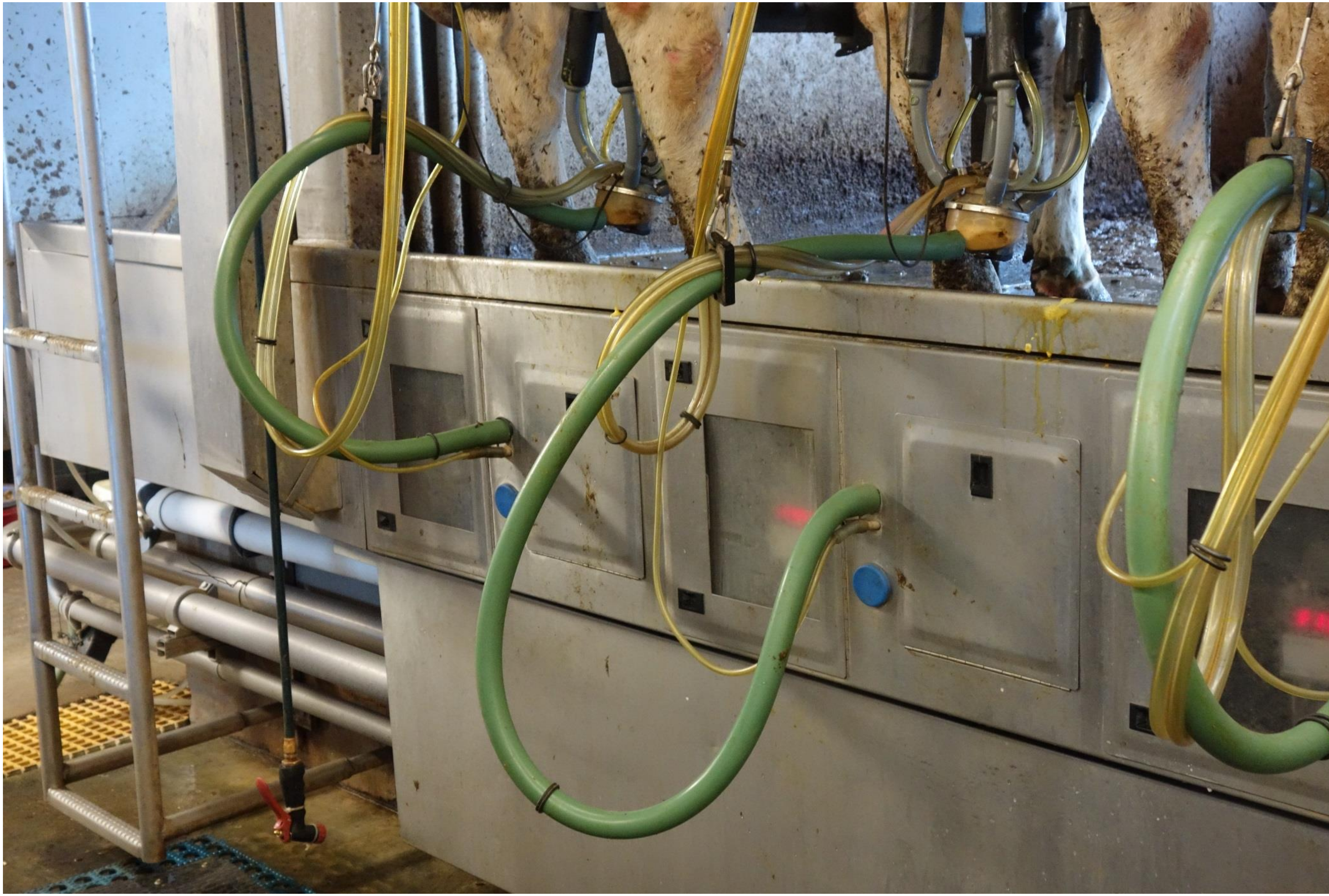
- Consider utilizing maximum unit on time if your system has this option

- Don't be afraid to have technicians remove the last 1 or 2 units if the side is being held up; manually remove and post dip!

Vacuum drop is a function of both hose length and hose lift

Lifting this hose = .5” increase in claw vacuum
What happens if the hose is now cut off?

.3” difference in claw vacuum




2006 7 24


41

System Maintenance

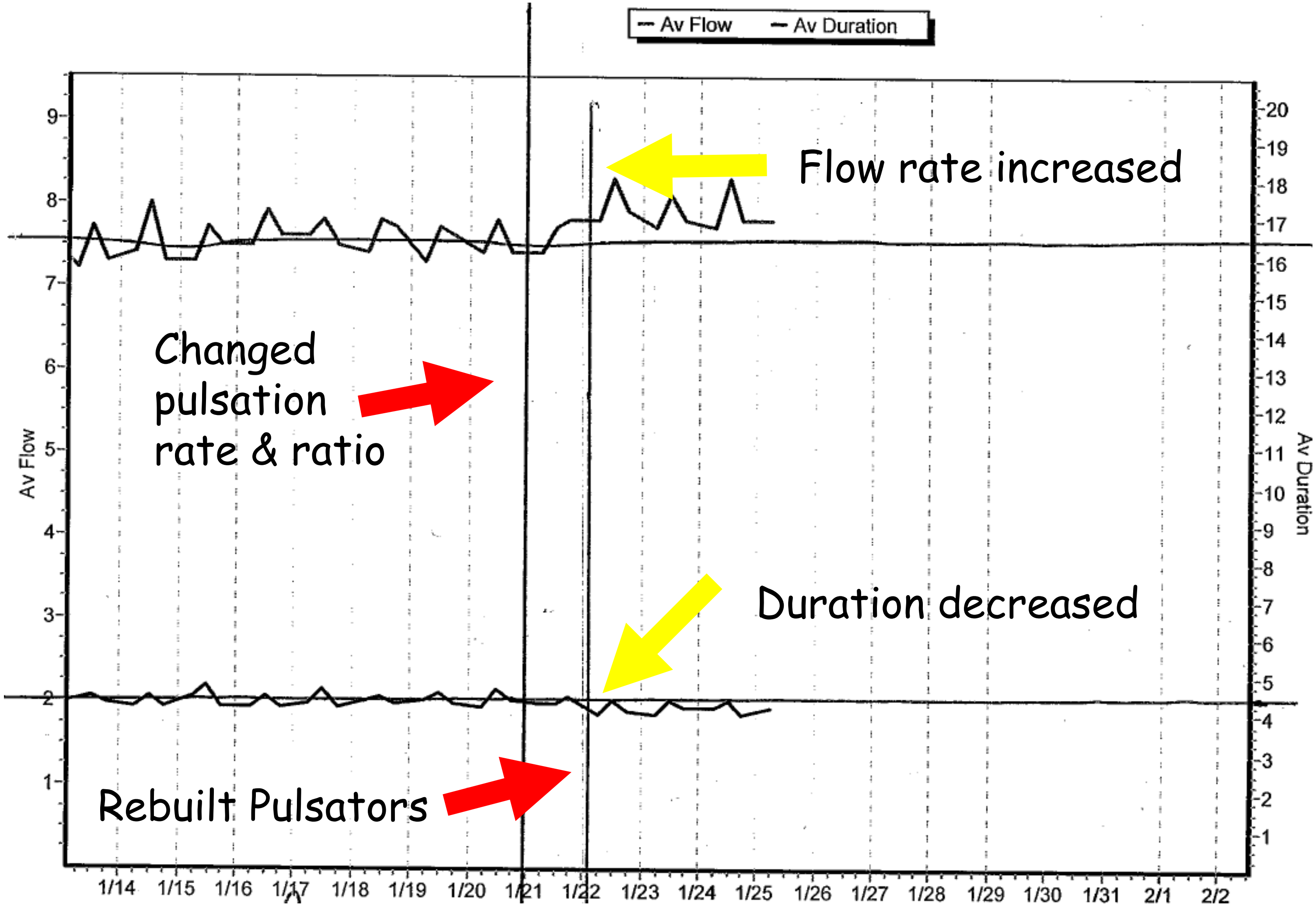
- Check vacuum daily
- Change short air tubes every 2 months maximum!
- Change all upper milk hoses 6 months maximum
- Change all upper long dual pulsation hoses 6 months maximum
- All other hoses every 12 months

System Maintenance

- Liners at recommended milking
  - Commonly 1200, 1800, 2500, or with silicone up to 6000
  - If performance changes with new liners, then used to long or chlorine levels above 150 in wash cycle
- Pulsators at factory recommendations

  Read the manual, follow completely!
- Pulsation filters; check monthly replace as needed

Is pulsator performance important; What Happened?



System Washing Issues

- Low hot water capacity at some wash cycles
- Partial failure of pump shaft seals
  - Rebuilt every 3 months maximum
- Failure to change diaphragms in air injectors – 6 month maximum
- Poor hose maintenance on peristaltic chemical pumps
- Cheating on cycles when get behind in milking

Sometimes, even with the best of training, some individuals just don't get it!

Why was the cow lying backwards?

“What do you See”


BouMatic
16.04.2009

What did you really SEE?


BouMatic
16.04.2009

What did you really SEE?


19393
19393

Environmental Footprinting to Support Sustainable Dairy Production

Georgia Dairy Conference, January 2023

Kristan Reed, PhD

Cornell University

Agriculture and the Environment

- All agriculture has an impact on the environment
  - Cultivating the land will alter immediate and surrounding ecosystem
- The goal is to understand and manage the impact and resources in sustainable ways

What are the *potential* environmental impacts of dairy production?

Climate
- Global Warming Potential

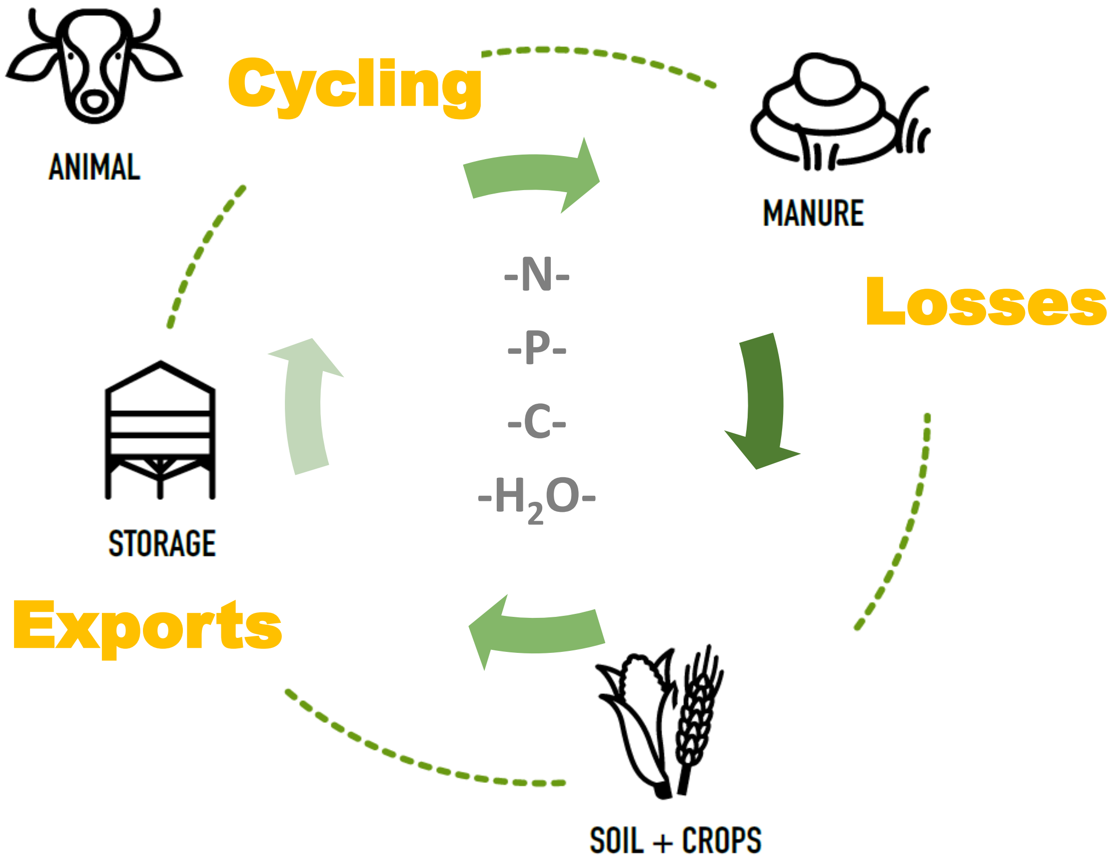
Water Quality
- Freshwater and Marine Eutrophication
- Groundwater Contamination

Air Quality
- Odors
- Particulate Matter
- Ammonia

Soil Health
- Soil Carbon
- Microbiome

Non-Renewable Resource Use
- Fossil Fuels
- Minerals
- Metals

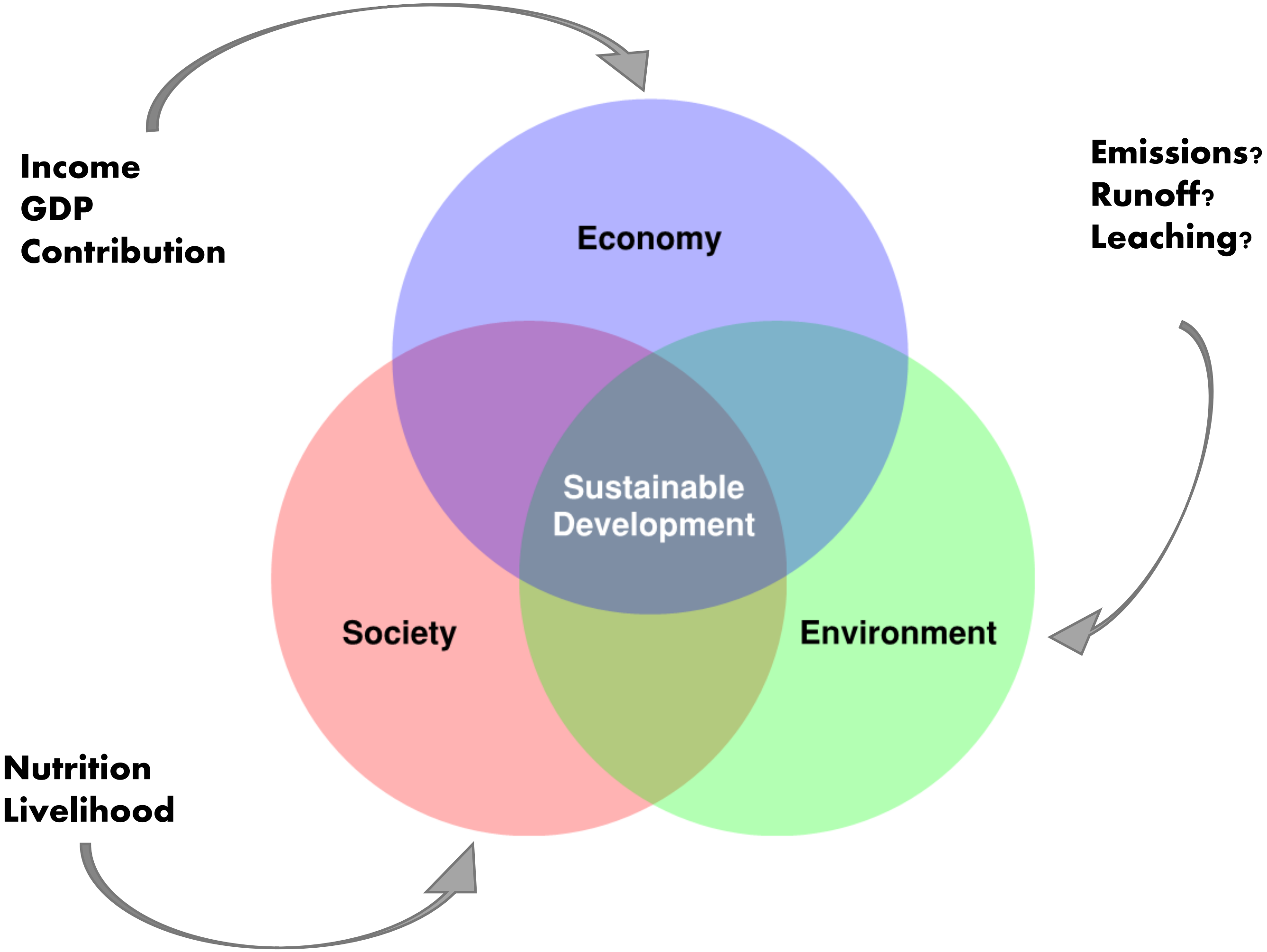
Biodiversity
- Insects
- Birds
- Rodents

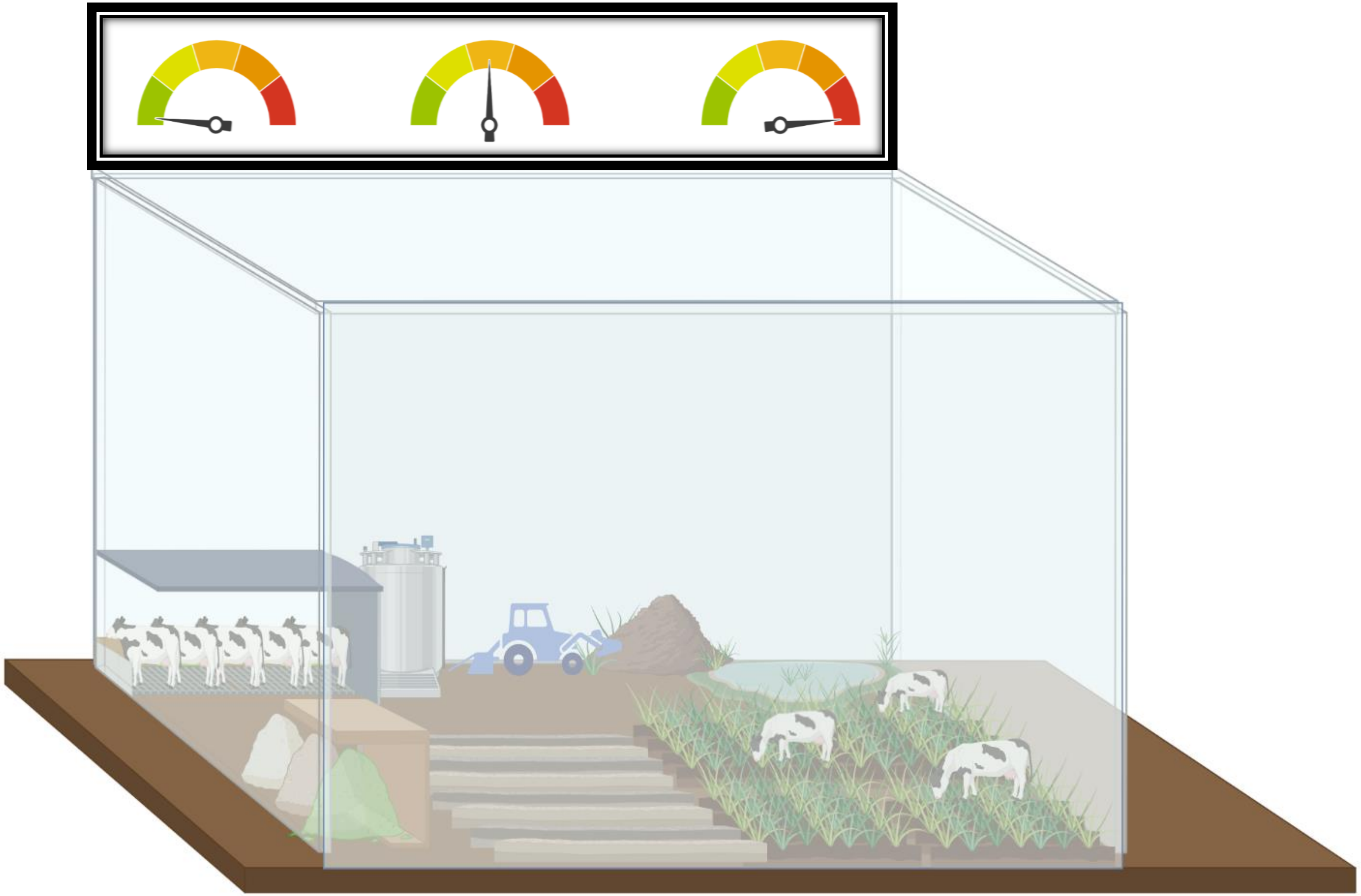


Sustainable Production is more than the environment…

Agriculture that…

- Continues to provide sufficient quantity and quality of food and fiber
- Preserves and enhances conservation of natural resources
- Efficiently uses non-renewable resources
- Maintains economic viability of farmers
- Enhances the quality of life in rural societies





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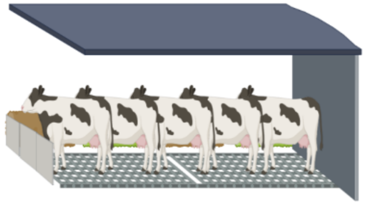
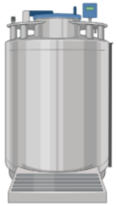
$$CH_4\ (MJ/d) = 2.94 + 0.0585 \times ME\ intake\ (MJ/d) + 1.44 \times ADF\ (kg/d) - 4.16 \times lignin\ (kg/d).$$



+

$$CO_2\left(\frac{kg}{d}\right) = 0.42\,\frac{kg}{kW} * 9.14^{-5}\,\frac{kW}{kg\ milk}$$

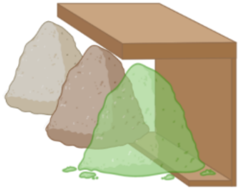


+

$$Methane_{liquid} = \left[\left(\frac{24 * VS_d * b_1}{1000}\right) * e^{\ln(A) - \frac{E}{R * T_R}}\right] + \left[\left(\frac{24 * VS_{nd} * b_2}{1000}\right) * e^{\ln(A) - \frac{E}{R * T_R}}\right]$$

+

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6H_2O + 6CO_2 + \text{HEAT}\ (2870\ kJ/mole)\ \ldots\ldots$$



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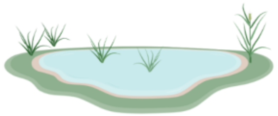
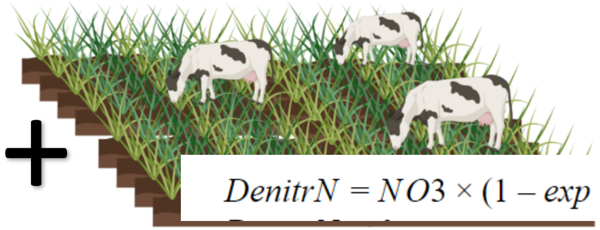


$$N2O_{strg-dir-daily} = N_{strg-pa} * \varepsilon_{MMS} * \epsilon_{N20-dir} * \sigma_{N-N2O}$$

[MS.5.B.II.a.1]

+

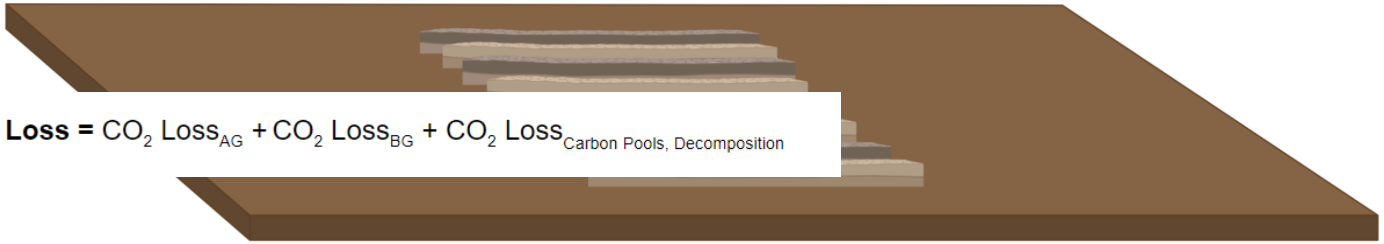


$$DenitrN = NO3 \times (1 - exp\{- deNrate \times TempFac \times OrgC\})$$

+

$$CO_2\left(\frac{kg}{d}\right) = 8.9\,\frac{kg}{gal} * 13.6\,\frac{gal}{hr} * 8\,\frac{hr}{d}$$

+



Total CO_2 Carbon Loss = $CO_2\ Loss_{AG} + CO_2\ Loss_{BG} + CO_2\ Loss_{Carbon\ Pools,\ Decomposition}$

Two Approaches

Inventory

Objectives:
- Establish baseline
- Track Progress
- Set Goals

Features:
- Static, retrospective
- Longer Intervals
- Large Spatial Scales

Decision Support

Objectives:
- Predict Current & Future Outcomes
- Inform Decisions

Features:
- Static or dynamic
- Smaller scale (farm, field, animal)

Most impact estimates you hear about are from Inventories

Climate Change + Animal Ag News

MENU **nature** Subscribe Search

NEWS · 08 AUGUST 2019 · CORRECTION 08 AUGUST 2019, UPDATE 08 AUGUST 2019, CORRECTION 12 AUGUST 2019

Eat less meat: UN climate-change report calls for change to human diet

The report on global land use and agriculture comes amid accelerating deforestation in the Amazon.

Quirin Schiermeier

The Counter

The misbegotten promise of anaerobic digesters

by Jessica McKenzie
12.03.2019, 9:30am

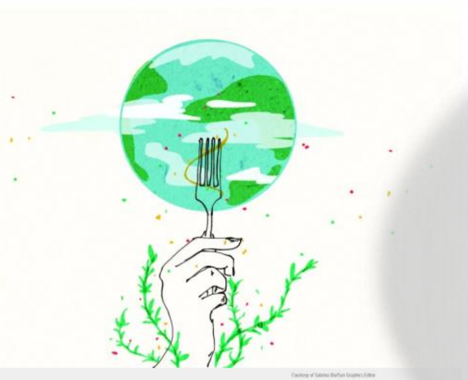
Environment

Meat And Agriculture Are Worse For The Climate Than Power Generation, Steven Chu Says

Jeff McMahon Contributor
Green Tech
From Chicago, I write about climate change, green technology, energy.

The Cornell Daily Sun

News Opinion Sports Arts & Entertainment Science Dining Multimedia Projects Sunspots



What if the World Went Vegan?

THE AGENDA

CLIMATE

Opinion | The Cow-Shaped Hole in Biden's Methane Plan

Agriculture emits more methane than any other sector of the economy. So why is it getting a pass?

Keeping carbon in check: Carbon farming to address a changing climate

A two-pronged approach — one that reduces and reverses emissions — might be the answer.

The Salt WHAT'S ON YOUR PLATE

FOOD FOR THOUGHT

To Slow Global Warming, U.N. Warns Agriculture Must Change

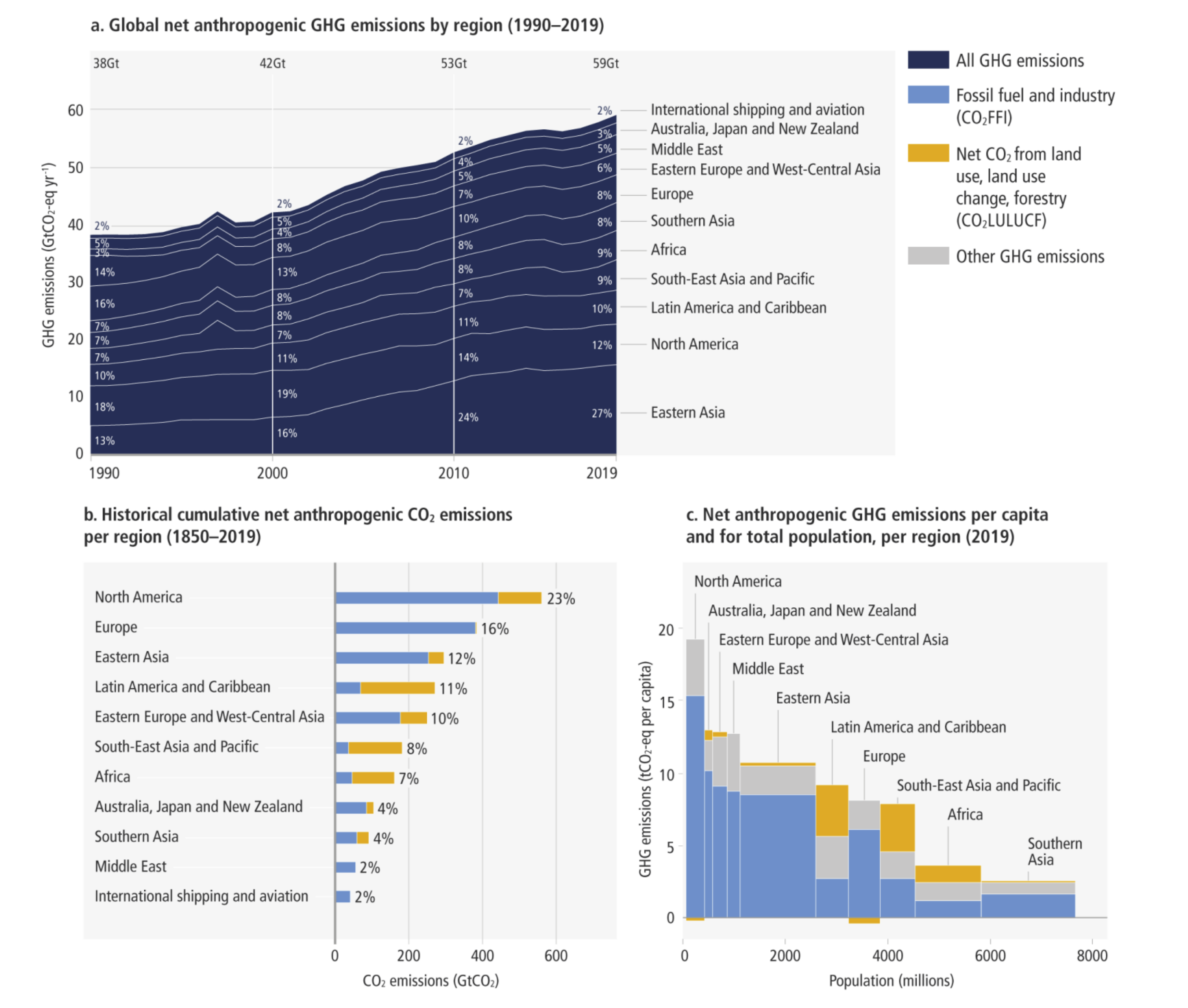
August 8, 2019 · 4:00 AM ET
Heard on All Things Considered

REBECCA HERSHER ALLISON AUBREY

Climate Adaptation

Starbucks Says Hold the Milk to Reduce Carbon Footprint

By Eric Pfanner
January 21, 2020, 9:00 AM EST *Updated on January 21, 2020, 10:15 AM EST*



Intergovernmental **P**anel on **C**limate **C**hange

6th Assessment

April 2022

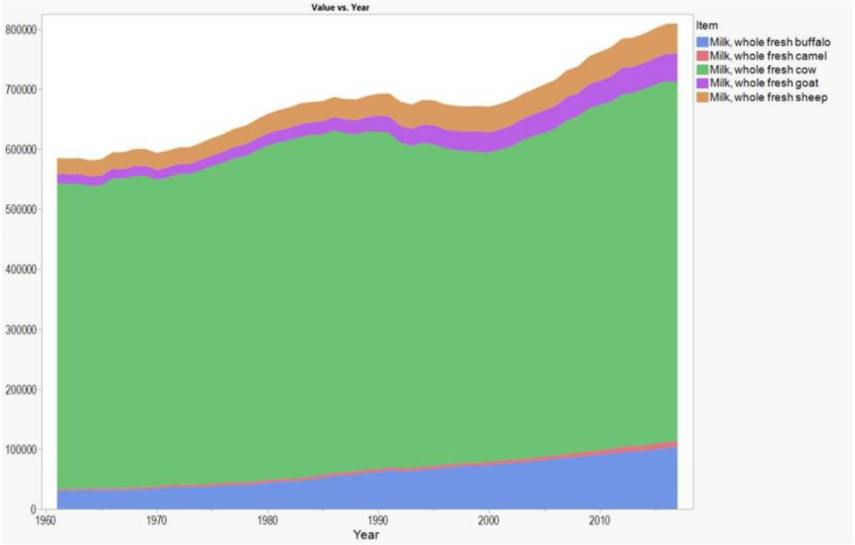
Total ***net anthropogenic GHG emissions have continued to rise*** *during the period 2010–2019, as have cumulative net CO2 emissions since 1850... but the* ***rate of growth*** *between 2010 and 2019* ***was lower*** *than that between 2000 and 2009*

https://www.ipcc.ch/report/sixth-assessment-report-working-group-3/

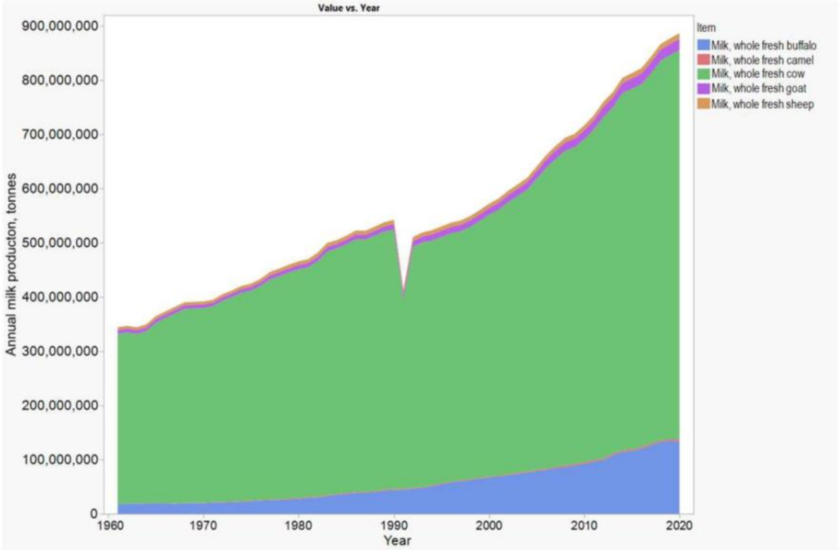
Inventories Establish Long Term Trends

Total direct emissions vs total milk production globally

1961 – 2017 increase in emissions: **+38.3%**



1961 – 2017 increase in production: **+144%**



Source: https://www.fao.org/faostat/en/#data/EI

Shared by Dr. Place Elanco

Inventories can highlight important relationships that hold true at large scales

Production

Emissions Intensity

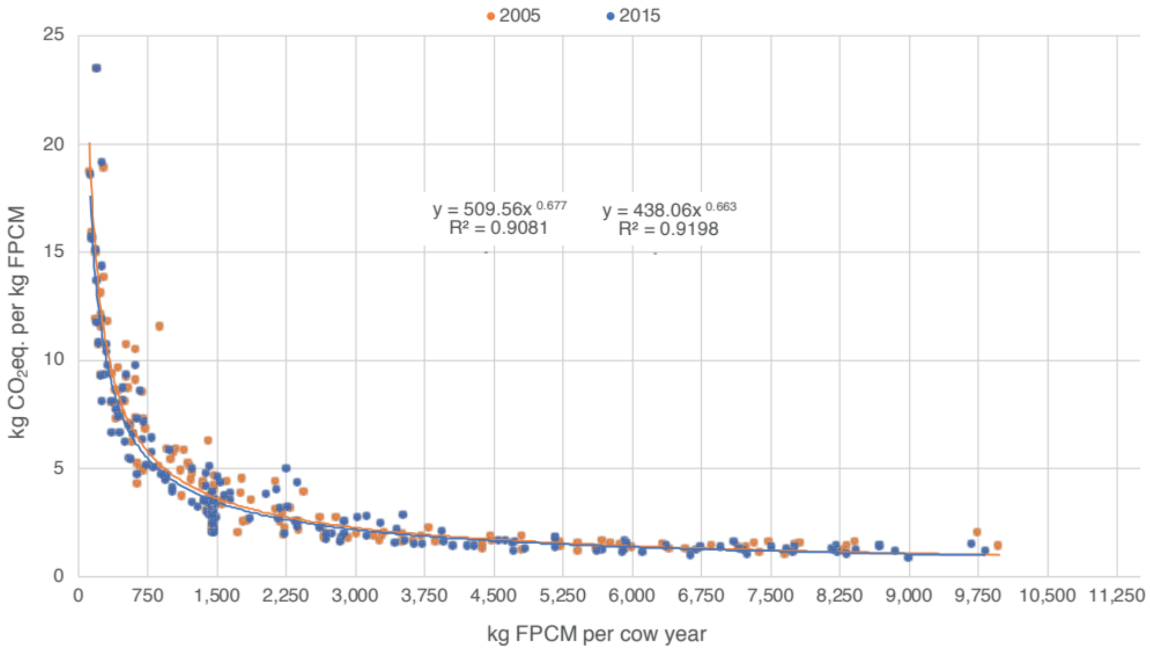


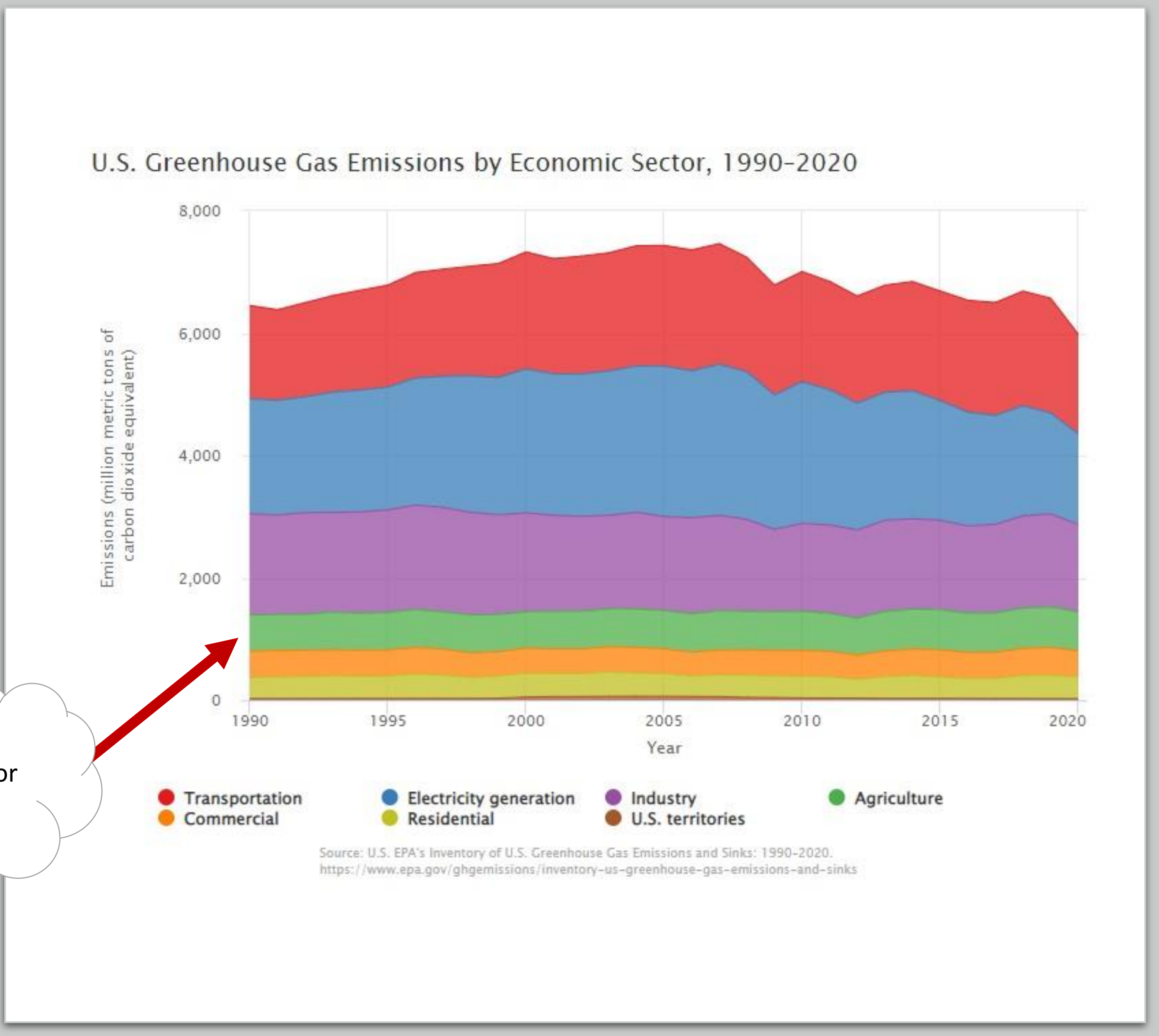
Figure 12: Emission intensity and milk yield

Note: Each dot represents a country. The fitted line clearly indicates an inverse relationship between milk yield per cow and emission intensity, i.e. as milk yield increases there is more milk to spread the emissions over.

FAO Stats: fao.org/faostat/

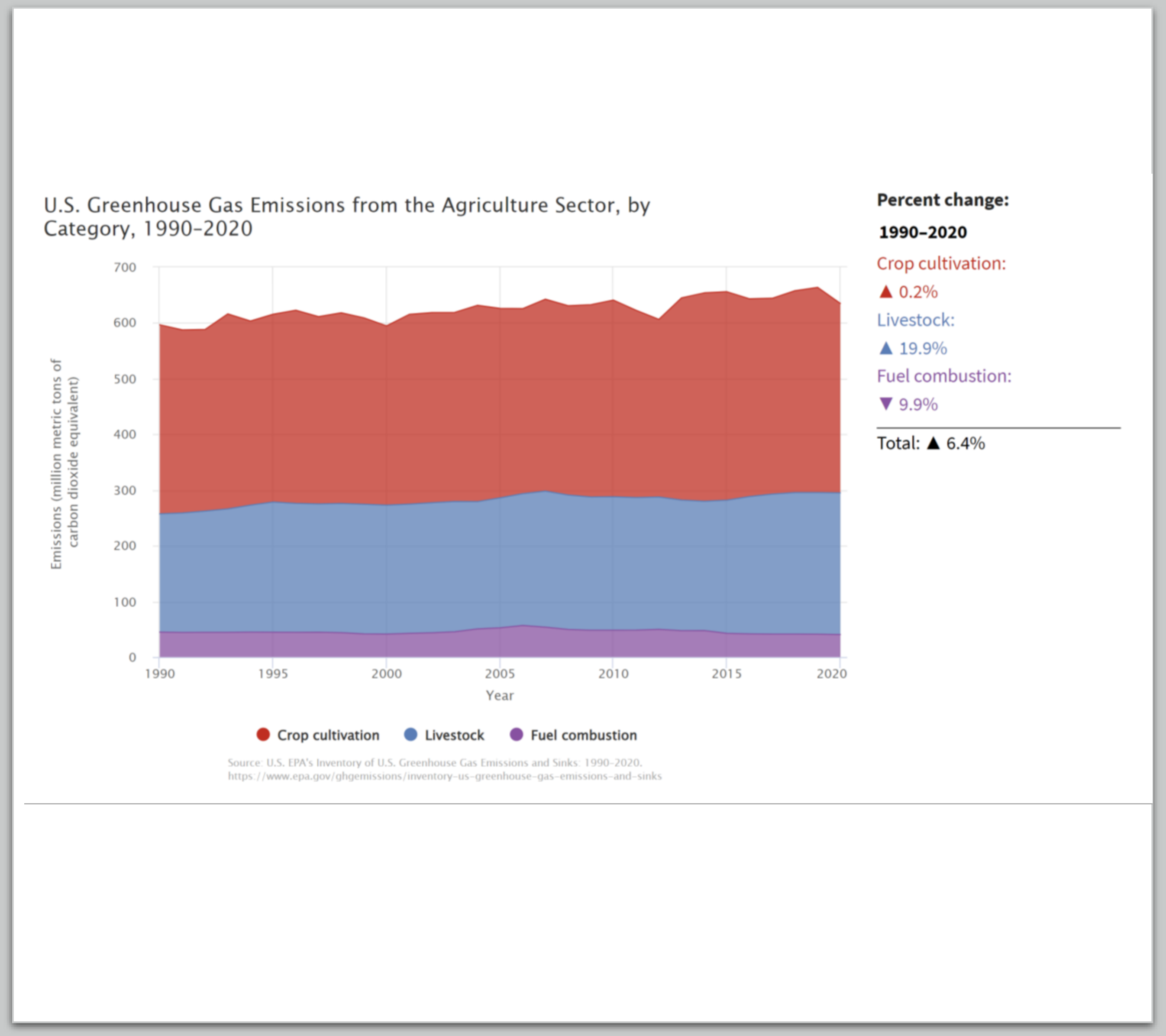
Knowledge gained from inventories will depend on the scale…

Agriculture responsible for ~11% of US emissions



EPA, 2021 https://www.epa.gov/ghgemissions/overview-greenhouse-gases

… and how total emissions are partitioned/ reported



EPA, 2021 https://www.epa.gov/ghgemissions/overview-greenhouse-gases

Methodology Matters

- Must be reproducible to enable comparisons over time
- As data availability improves so can the inventories

Capper and Cady: [doi:10.1093/jas/skz291](https://doi.org/10.1093/jas/skz291)

SUSTAINABLE ANIMAL SCIENCE AND PRACTICES

The effects of improved performance in the U.S. dairy cattle industry on environmental impacts between 2007 and 2017

Judith L. Capper,[†,1] and Roger A. Cady[‡]

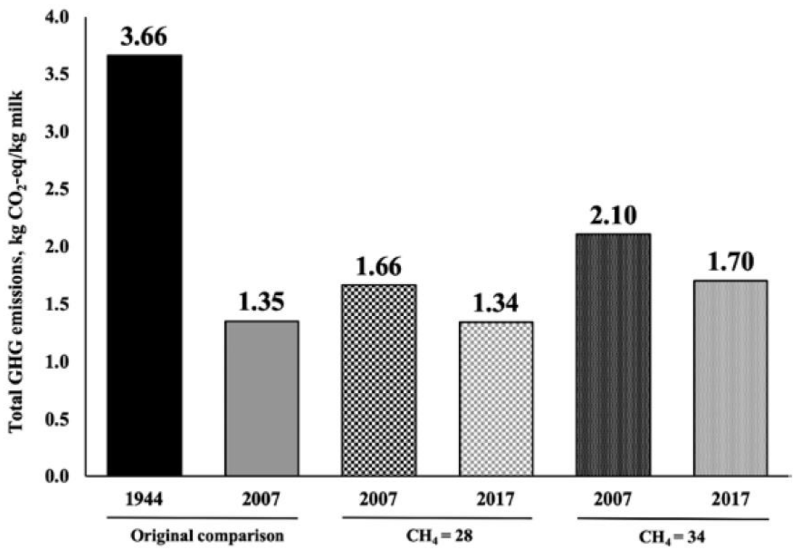
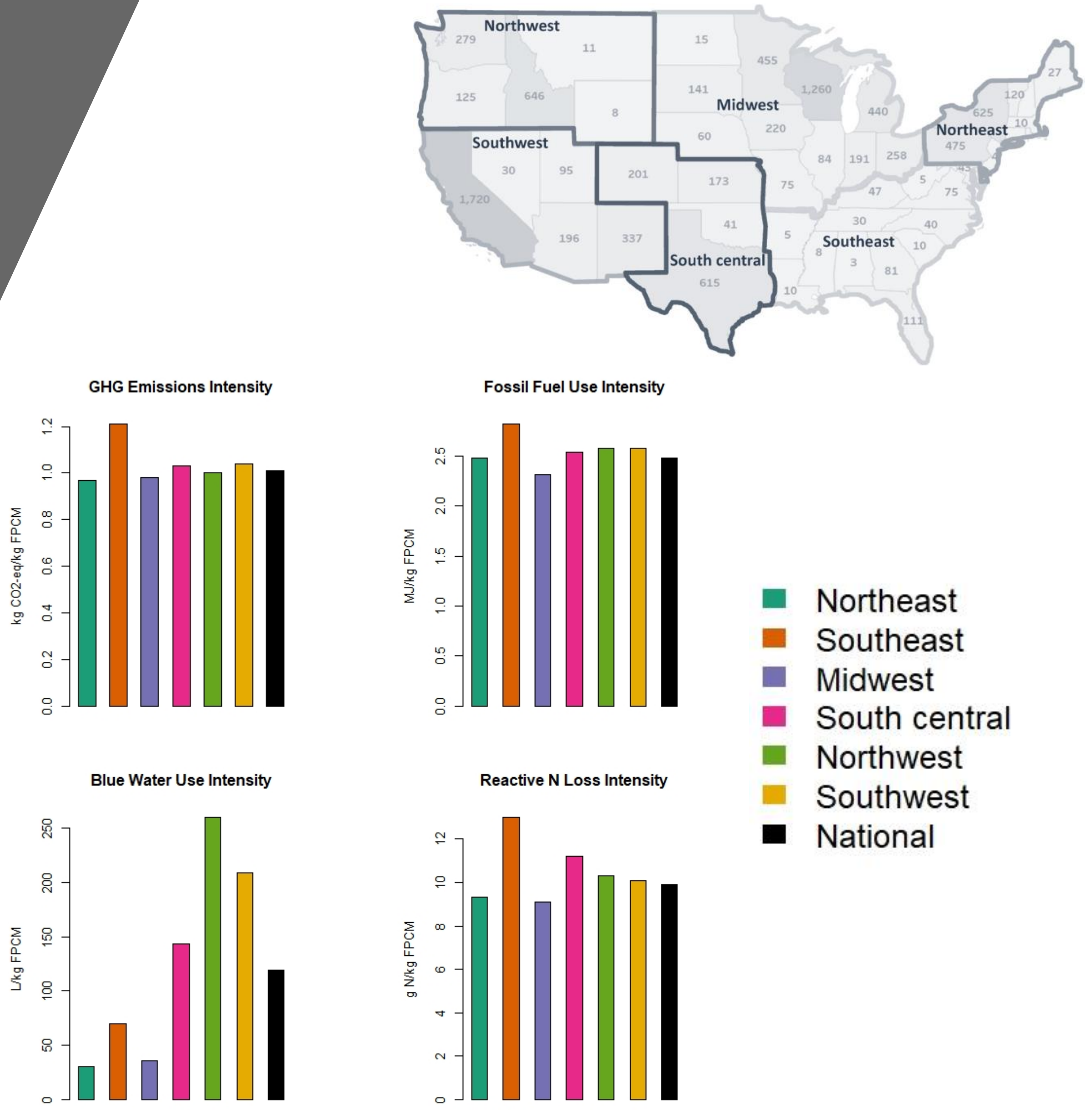


Figure 2. Greenhouse gases (CO_2-eq) per kilogram of milk in original 1944 vs. 2007 comparison (Capper et al., 2009) compared to the current 2007 vs. 2017 comparison with global warming potential values for methane set at 28 (IPCC, 2006) and 34 (IPCC, 2013).

Methodology Depends on Objectives



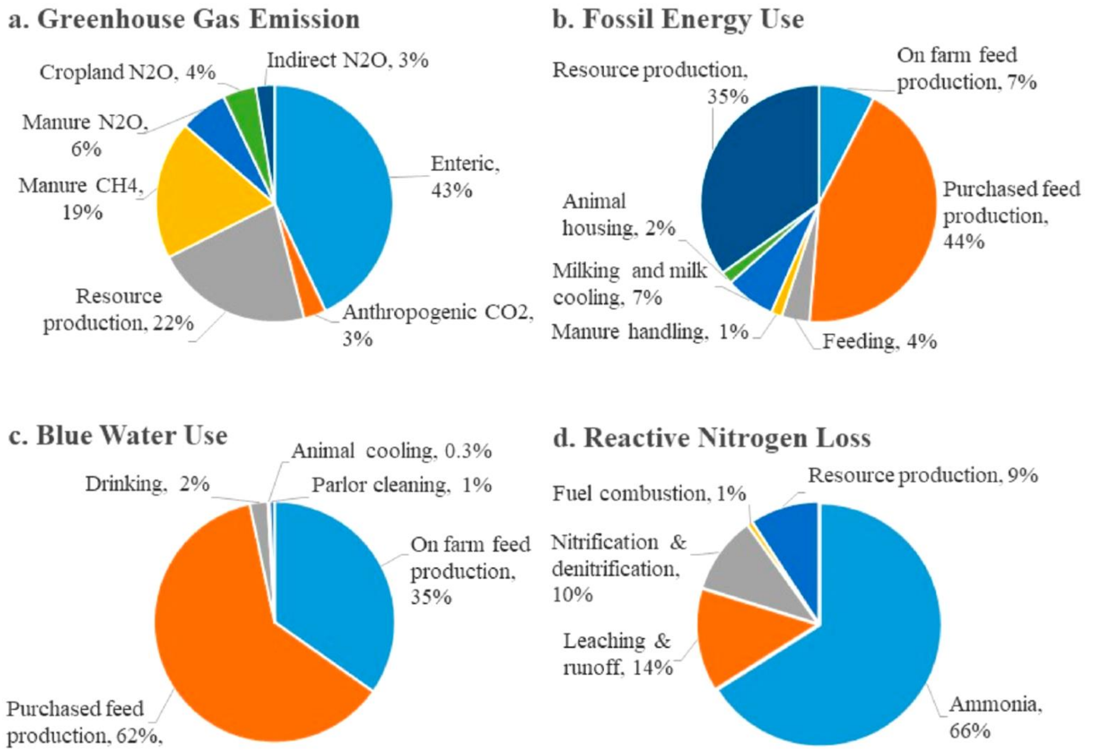
Rotz et al. (2021): https://doi.org/10.1016/j.jclepro.2021.128153

Farm level insights are possible

43% of 1.0 kg Total GHG Intensity

=

430 g Enteric Methane Intensity



Rotz et al. (2021): https://doi.org/10.1016/j.jclepro.2021.128153

IFSM can also provide more detailed estimates to compare management strategies

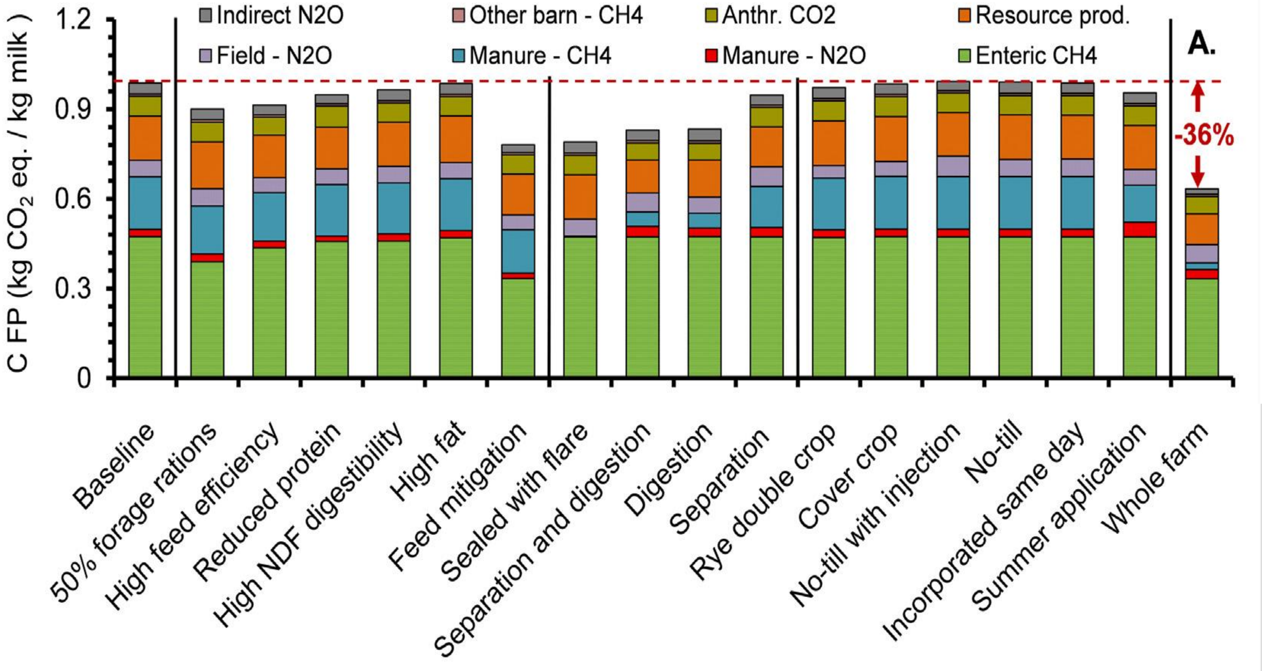
This is an example from a representative farm in NY (they haven't released a similar study for the SE yet)

Compares a Baseline farm with other BMPs

- Feed efficiency
- Double Cropping
- No till
- Anaerobic Digestion

Veltman et al Ag. Syst. 2018:

https://doi.org/10.1016/j.agsy.2018.07.005



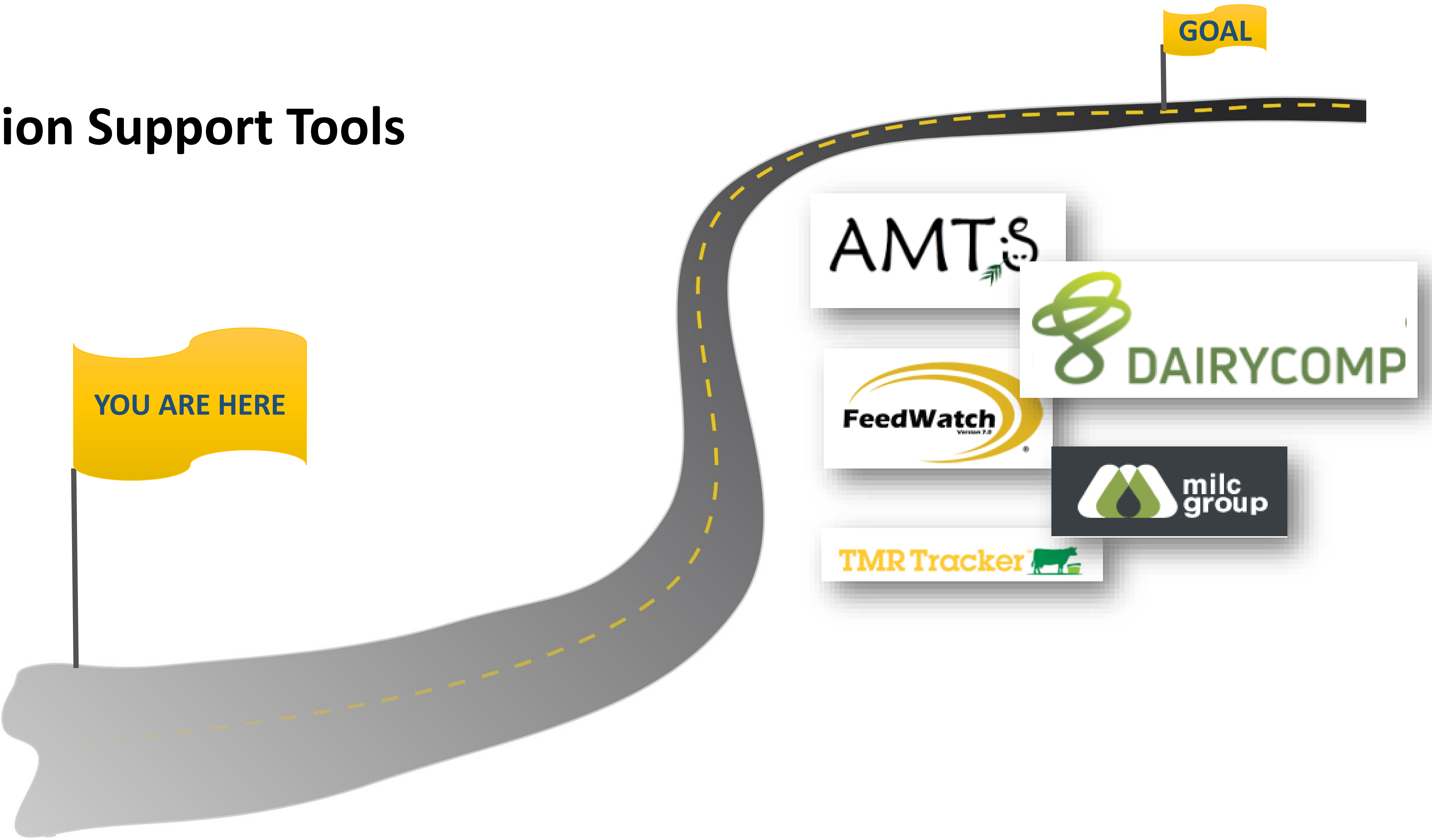
Why do we need Decision Support Models?

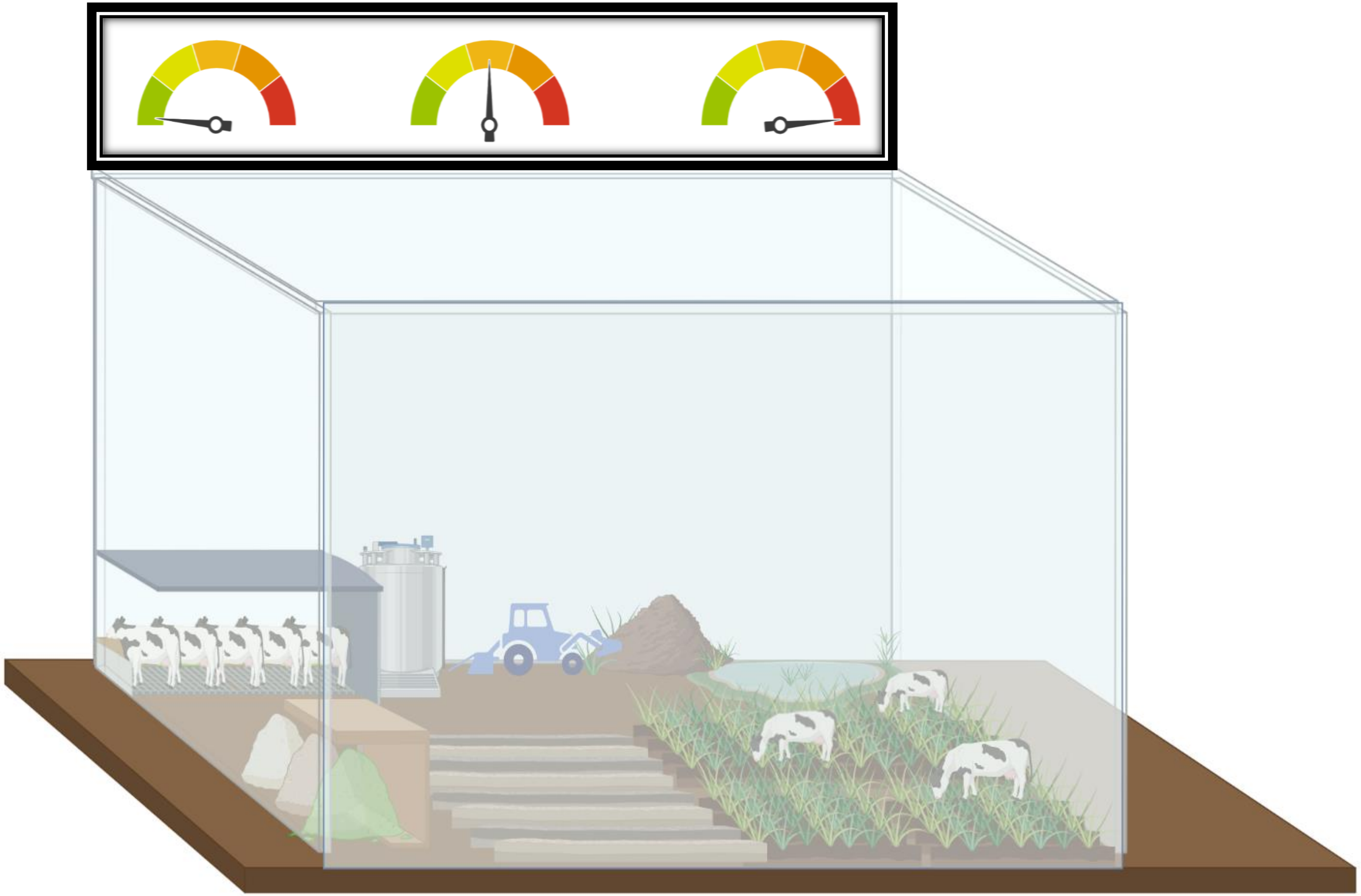
GOAL!

Inventories

YOU ARE HERE

Decision Support Tools





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Decision Support Tools

GOAL

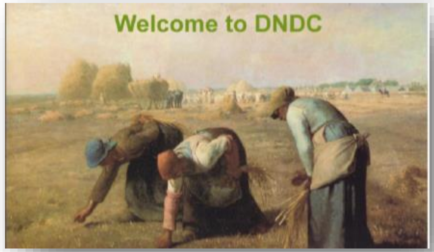
YOU ARE HERE

COMET Farm
USDA United States Department of Agriculture Natural Resources Conservation Service
Colorado State University
Whole Farm and Ranch Carbon and Greenhouse Gas Accounting System.

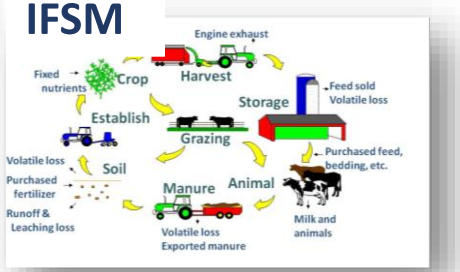
CFA COOL FARM ALLIANCE

FARMERS ASSURING FARM RESPONSIBLE MANAGEMENT

FARM Environmental Stewardship



IFSM



HISTORY

In 2009, National Dairy Farmers Assuring Responsible Management (FARM)™ Program was **created by the dairy industry**, through National Milk Producers Federation with support from Dairy Management, Inc.

DAIRY MANAGEMENT INC.™

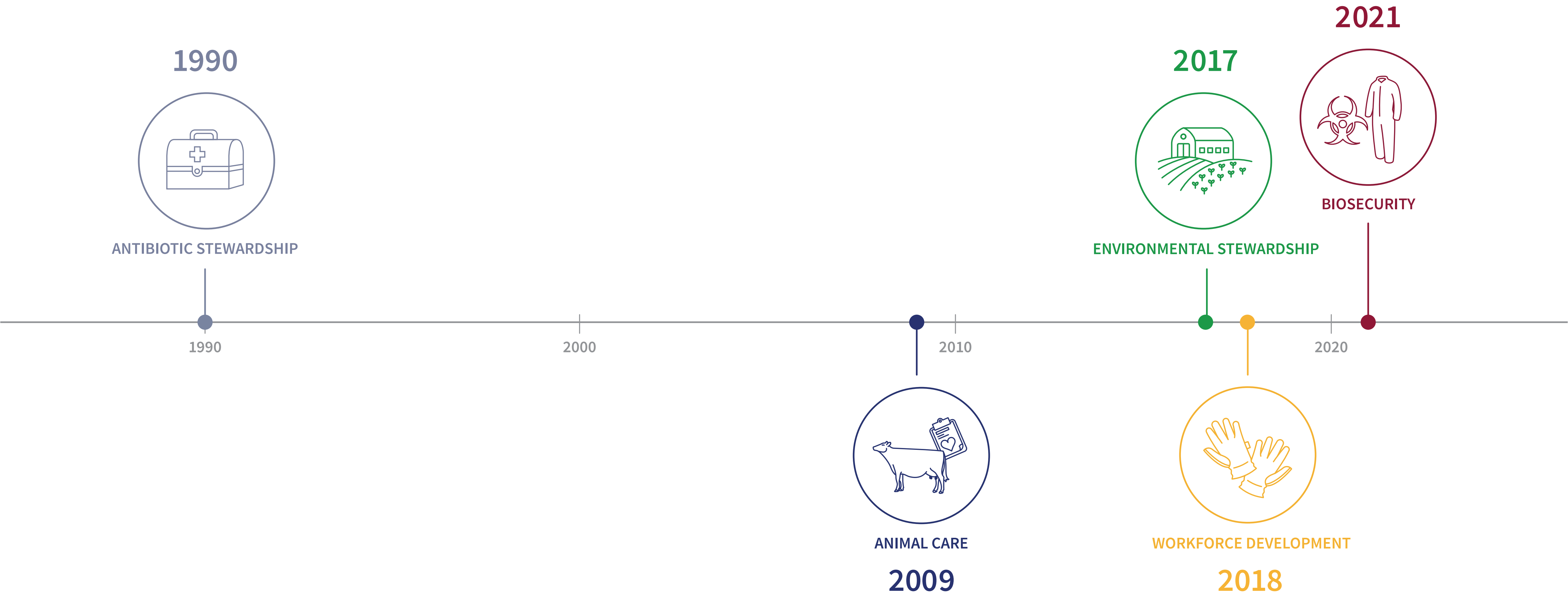
NMPF

Through the Innovation Center, the dairy community has aligned behind FARM as the **industry-wide on-farm social responsibility program**.

INNOVATION CENTER FOR U.S. DAIRY®

HEALTHY PEOPLE • HEALTHY PRODUCTS • HEALTHY PLANET

PROGRAM AREAS

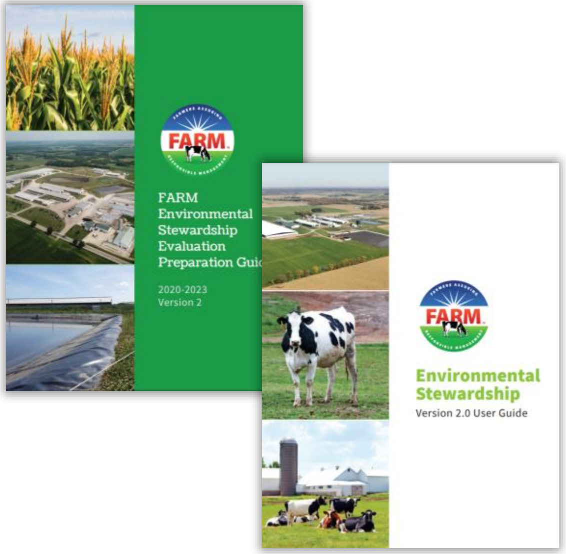


FARM Environmental Stewardship

[redacted]

Status

- **2,600+** FARM ES assessments completed since 2017
- **41** participating co-ops and proprietary processors representing **80%** of milk supply
- Trained, 2nd party evaluators
- Resources for implementation and continuous improvement



FARM ES Evaluation

Data Inputs

The data needed to estimate GHG emissions and energy use intensity include:

- Milk Production
- Herd Data
- Rations
- Manure Management
- Energy Use

Results

Footprint (lb CO2e / lb FPCM) broken down by category

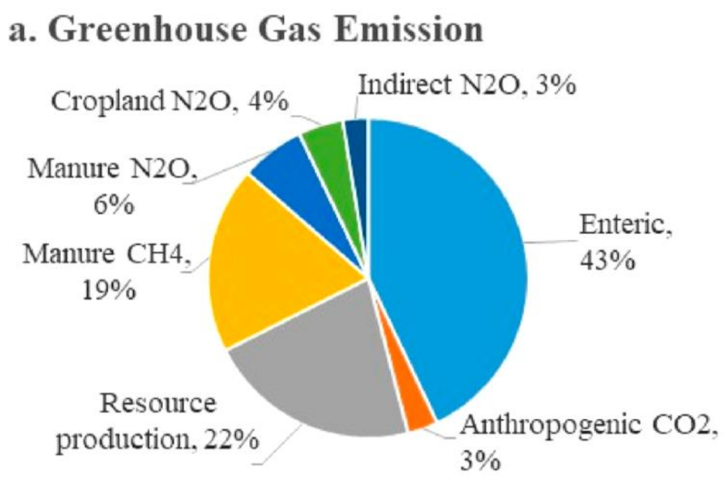
- On-Site Enteric
- On-Site Energy Use
- On-Site Manure
- Feed Production

GOAL!

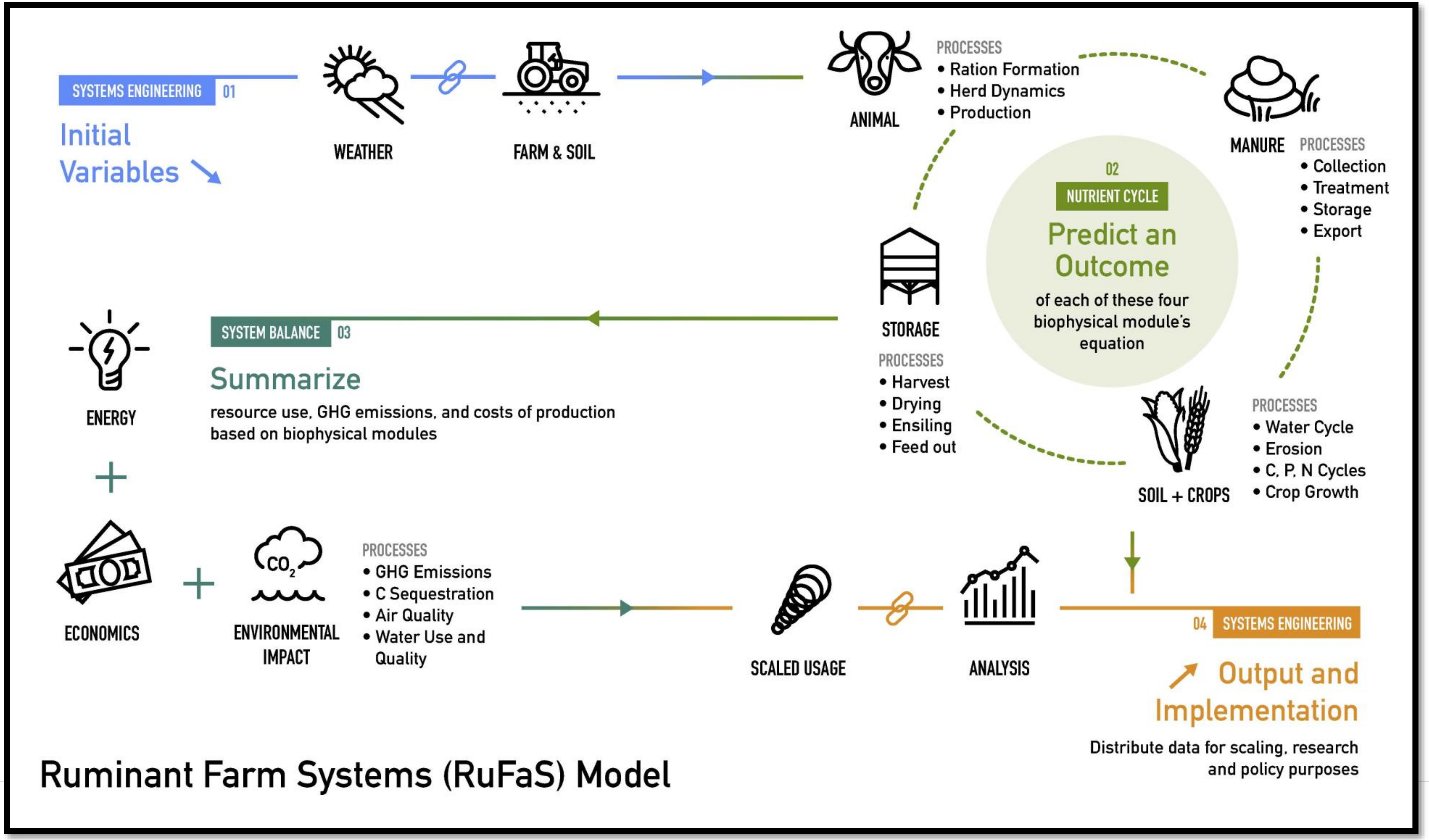
The FARM-ES program currently provides an inventory

*It provides a static, **snapshot** of the previous year's footprint from an individual farm and the dairy sector*

YOU ARE HERE



This leads us to RuFaS…



Founders

Key Stakeholders

USDA

Cornell University

University of Arkansas

UC Davis University of California

University of South Dakota

Innovation Center for U.S. Dairy
Healthy People • Healthy Products • Healthy Planet

Wisconsin University of Wisconsin-Madison

The Nature Conservancy

WWF

NEAFA Northeast Agribusiness & Feed Alliance
Advocate · Educate · Collaborate

General Mills Making Food People Love

DMI Dairy Management Inc.™

How can we use this model for decision support?

Nutrition impacts on environmental outcomes

How does forage quality impact manure and emissions outcomes?

GENERAL HERD CHARACTERISTICS	
Breed	Holstein
Herd Size	1000
TMR Diet	Corn Silage, Alfalfa Haylage, SBM, Corn Grain
Mature Body Weight (lbs/kg)	1,630 / 740

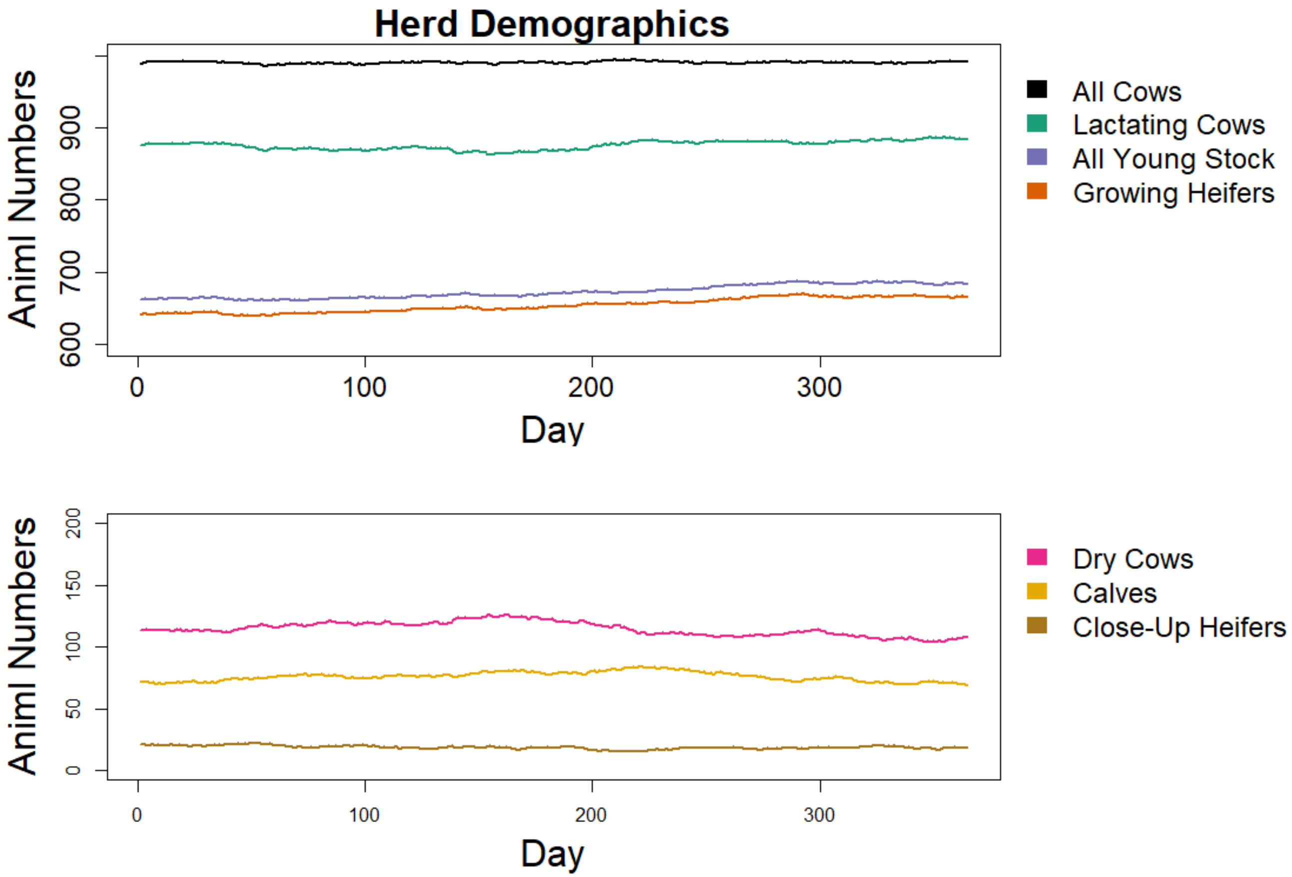
Parity	Average 305 MY
First	20,935 lbs (9,516 kg)
Second	24,476 lbs (11,125 kg)
Third+	25,481 lbs (11,582 kg)

Forage Quality Comparison

	Corn Silage				Alfalfa Haylage		
Scenario	DM	NDF	DE	Starch	DM	NDF	CP
Baseline	35.1	45	2.84	32.87	43.3	47	18.3
+Forage	34.6	38	2.99	38.18	37.5	45.6	19.0

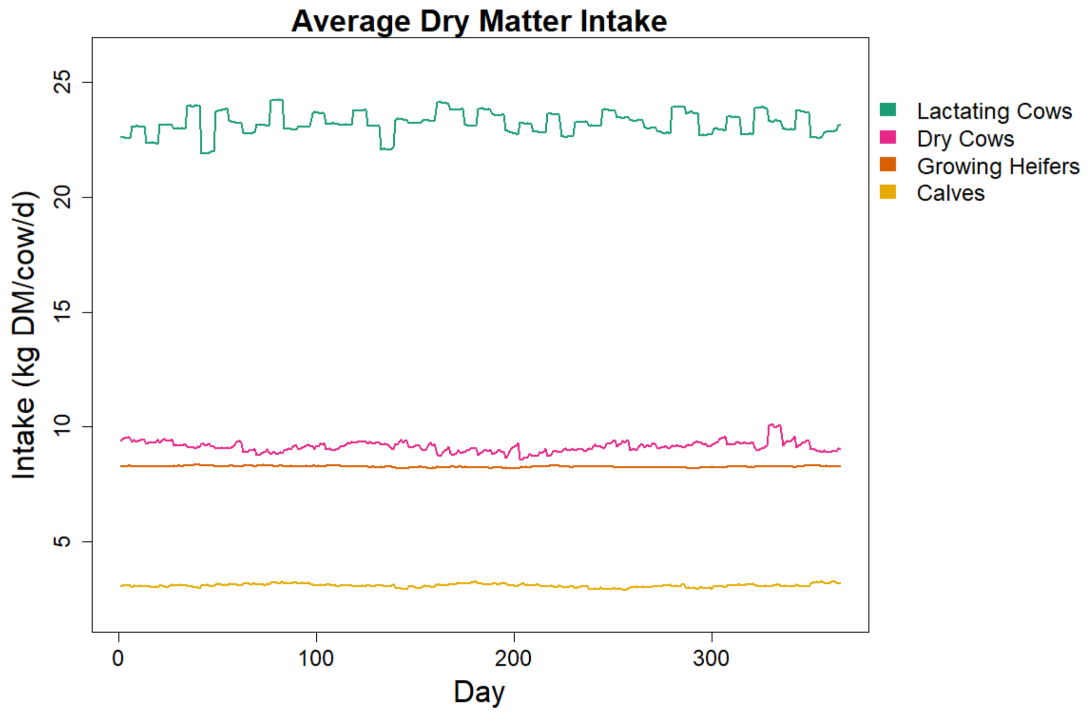
Some neat results…

Daily outputs of animal numbers



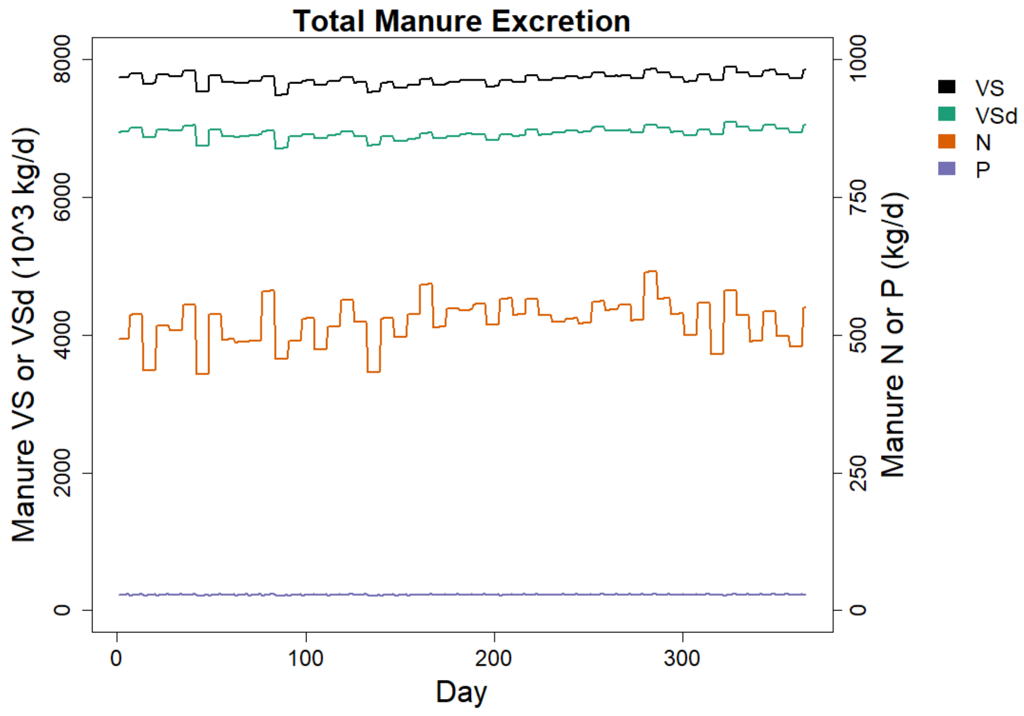
Some neat results…

Animal Intake



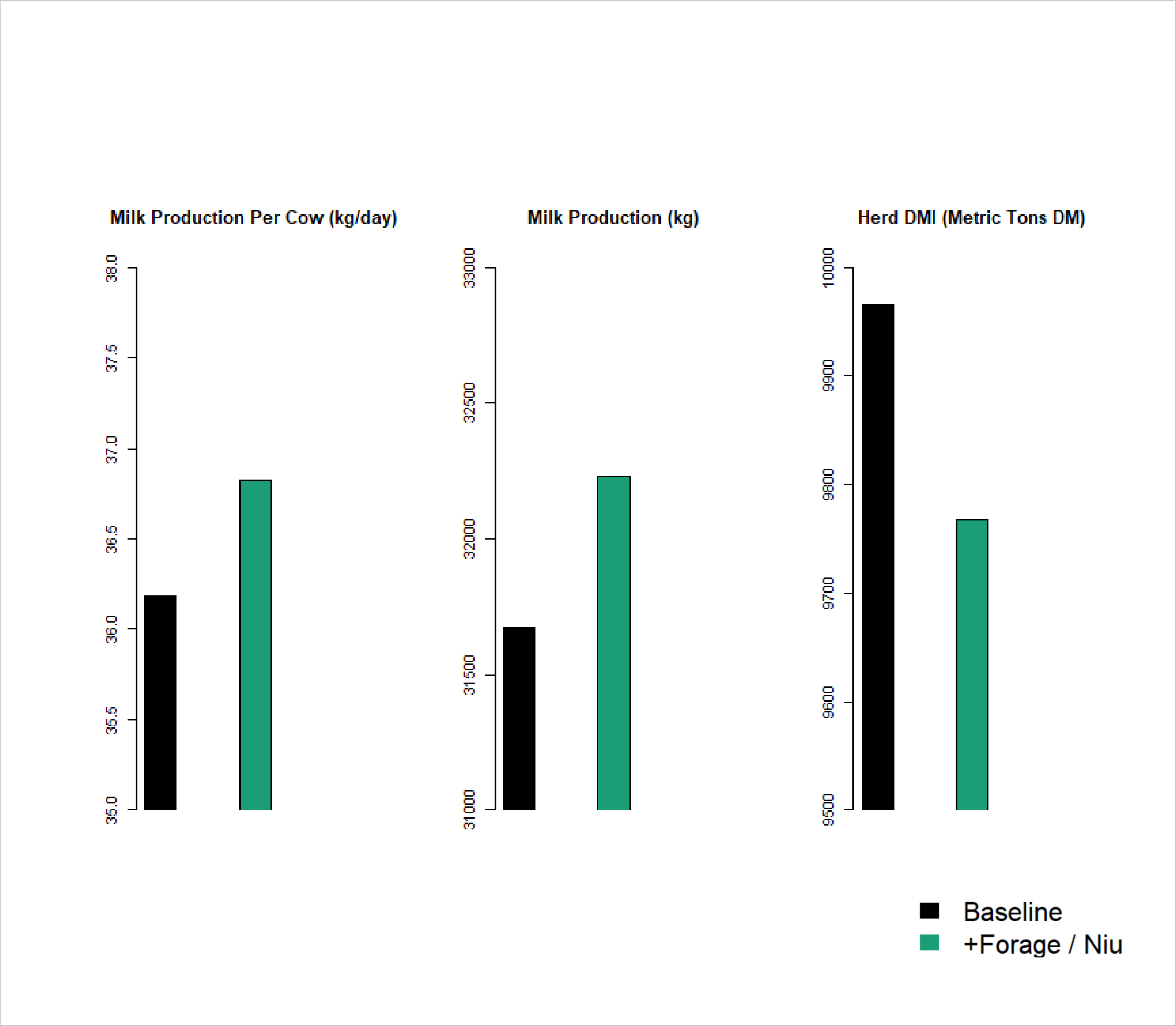
Some neat results…

Herd Manure

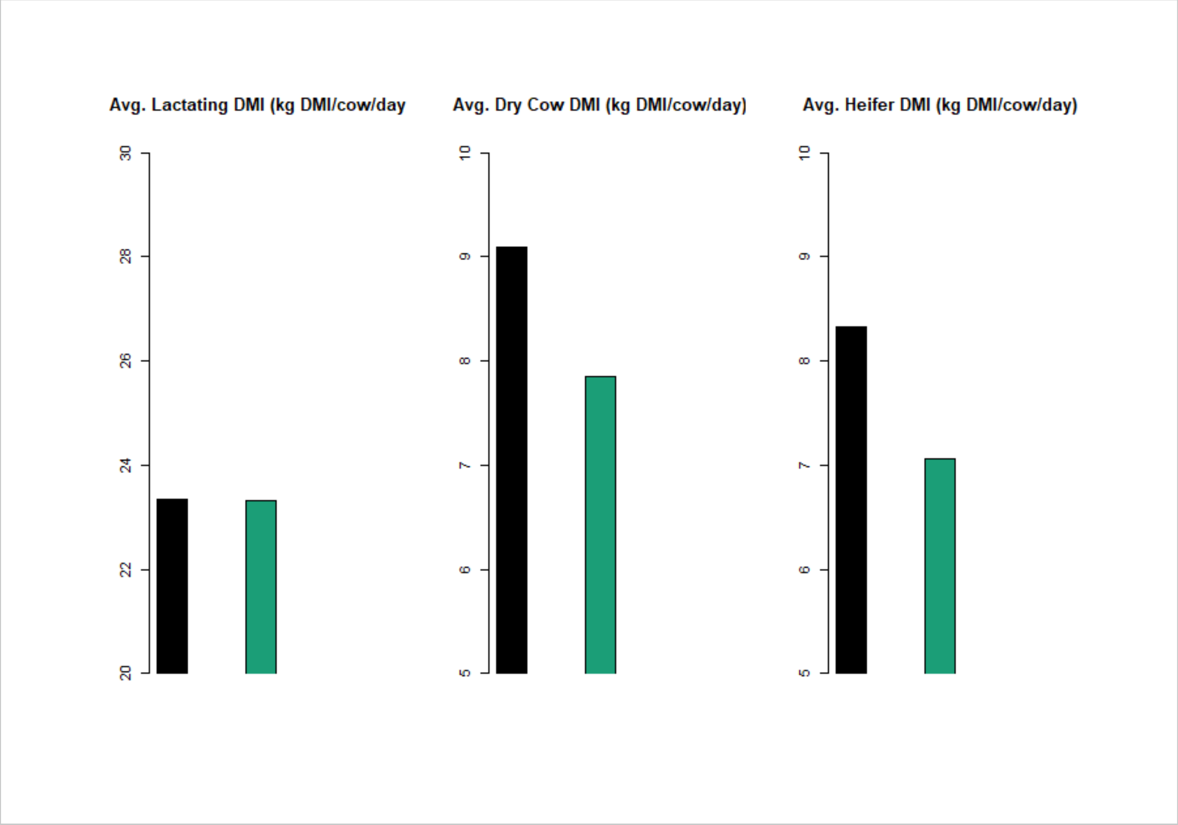


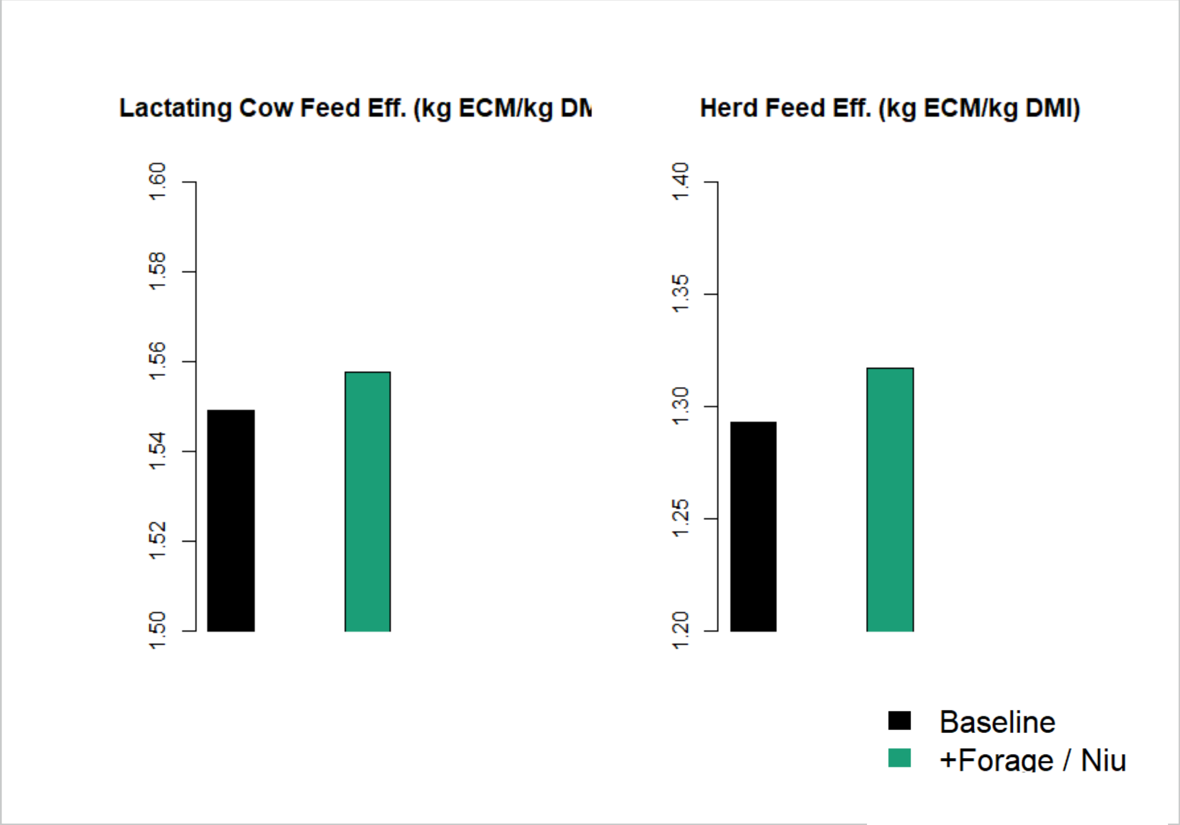
Milk Production & Intake

- Achieved increased milk production response to forage quality
- Reduced total intake

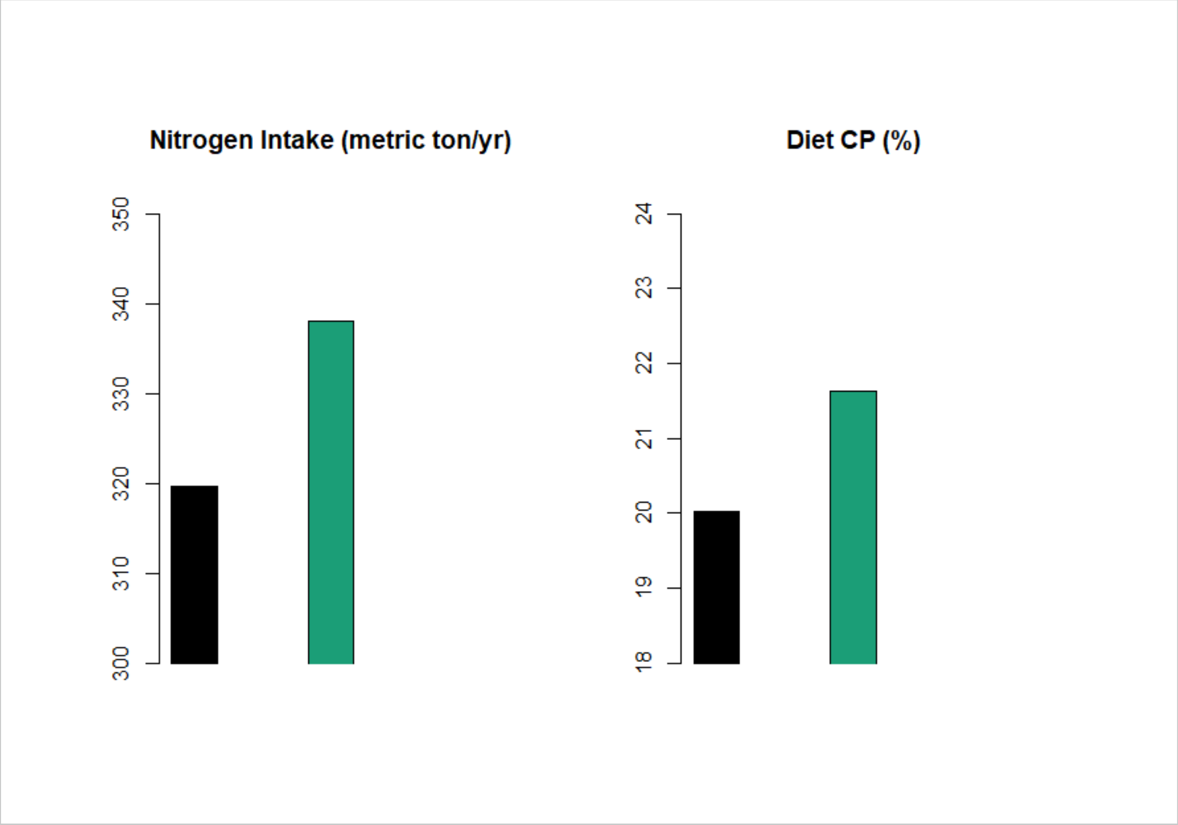


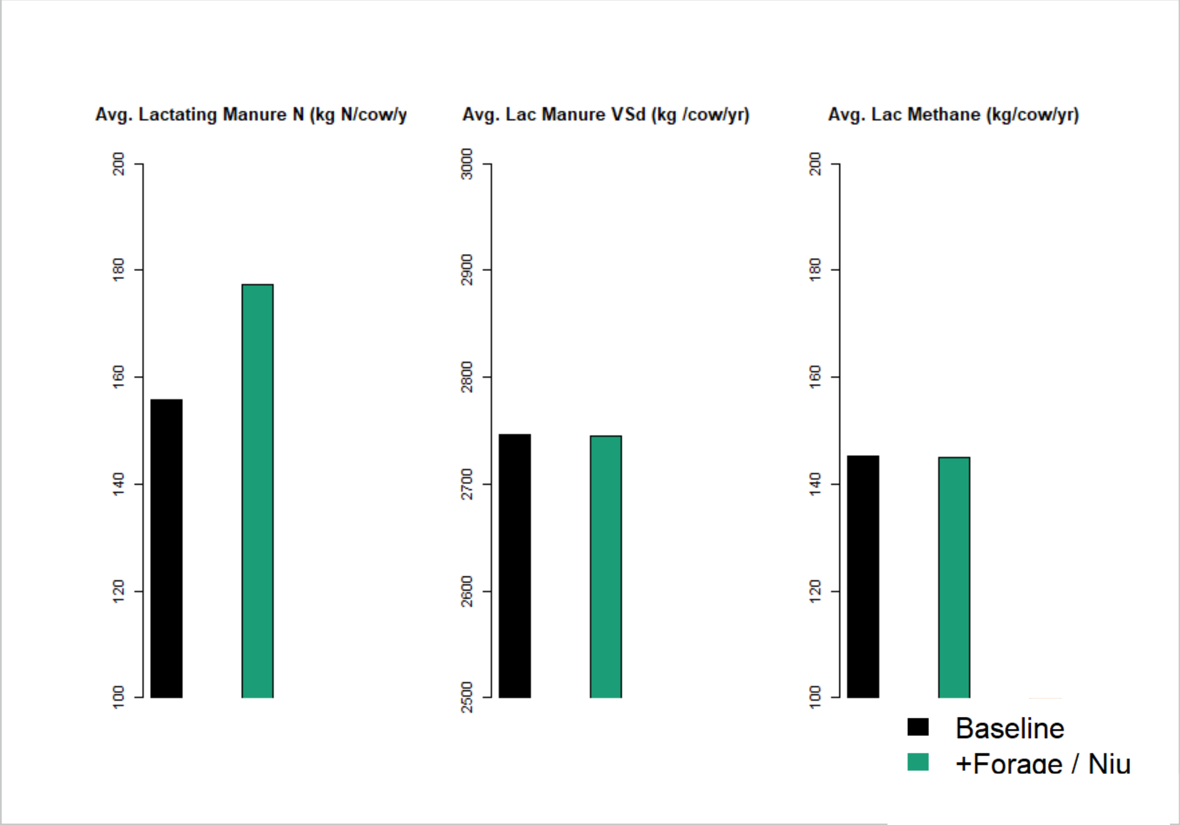
Feed Efficiency





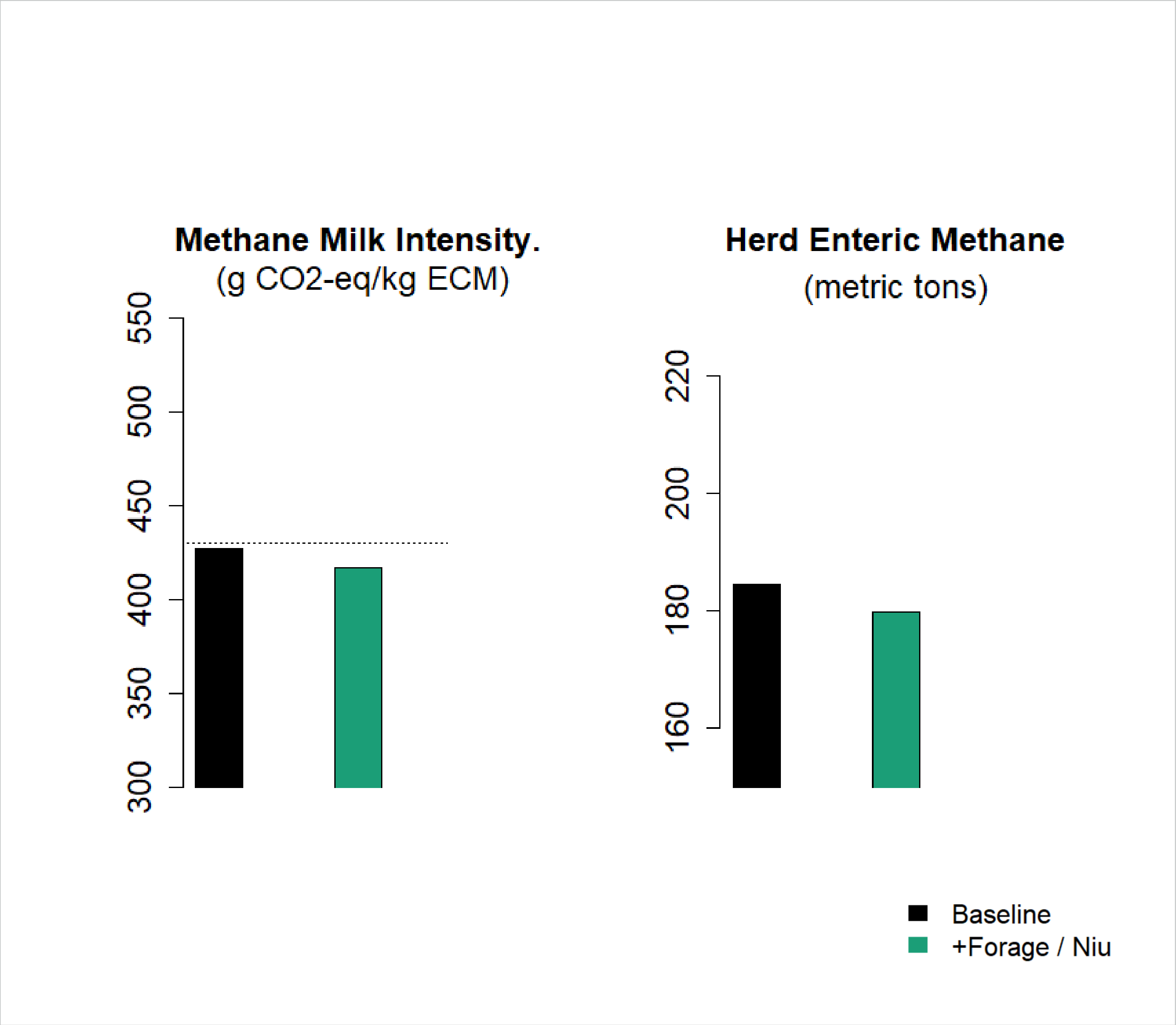
Intake and Excretion





Methane Intensity and Total Methane

- Baseline scenario is close to US National average enteric methane intensity around 430 g CO_2-eq/kg ECM
- Improved forage quality reduces intensity and total emissions
- Essential to have enteric emissions equations that are sensitive to diet composition



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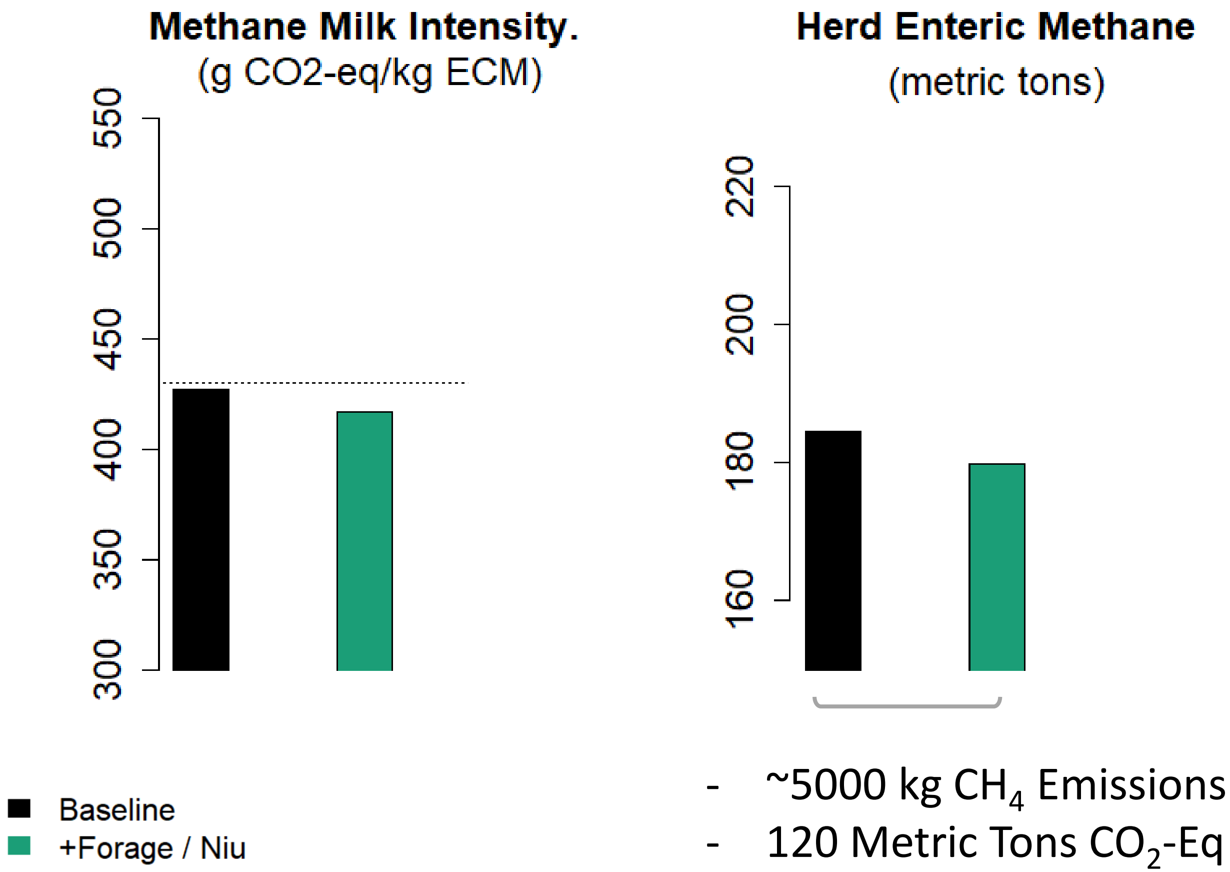
Same as taking **25** gas-powered cars off the road!



- ~5000 kg CH_4 Emissions
- 120 Metric Tons CO_2-Eq

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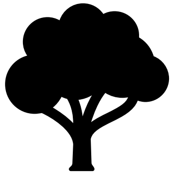
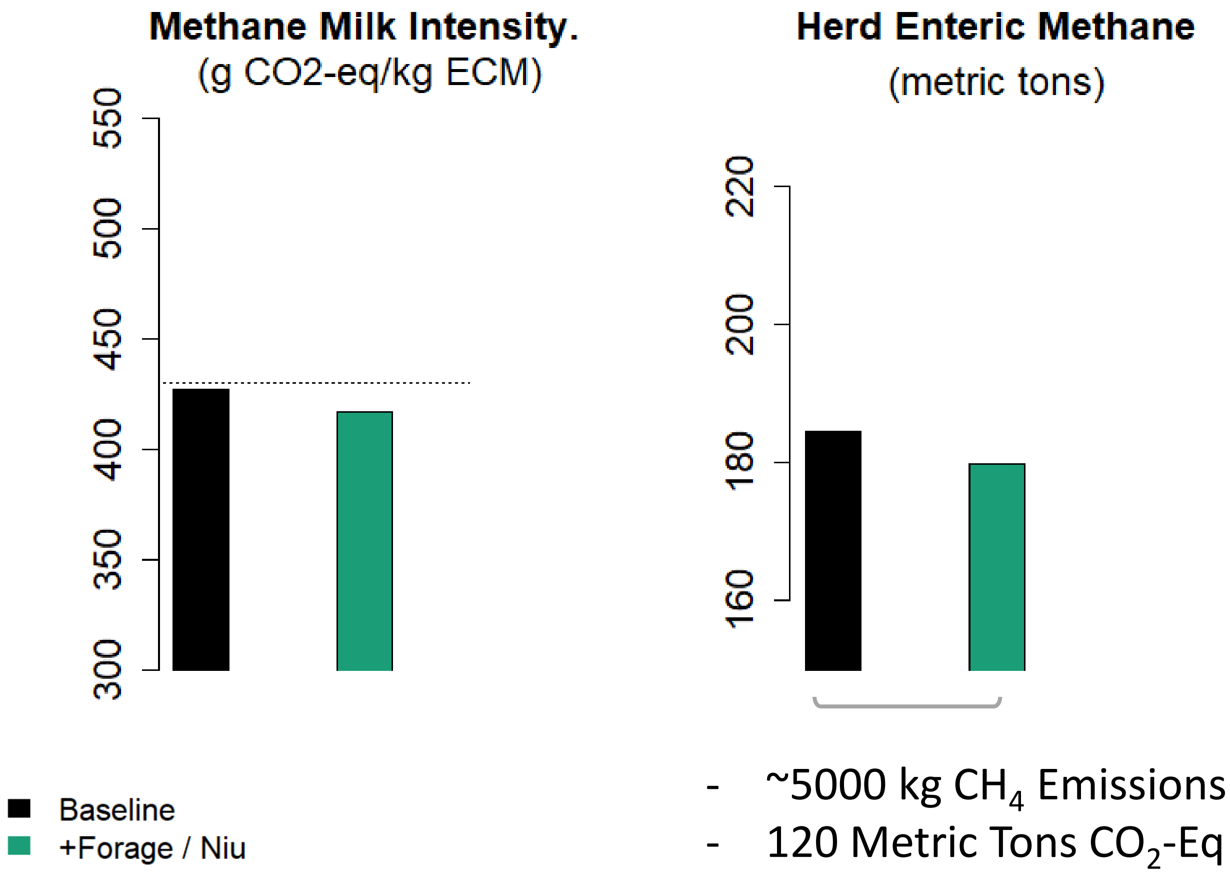


Or the amount of carbon sequestered by planting over **2,000** tree seedlings and growing them for 10 years!



- ~5000 kg CH_4 Emissions
- 120 Metric Tons CO_2-Eq

RuFaS, a process-based model, as new “engine” in Version 3 (2024)

Account for physical, chemical, and biologic cycles

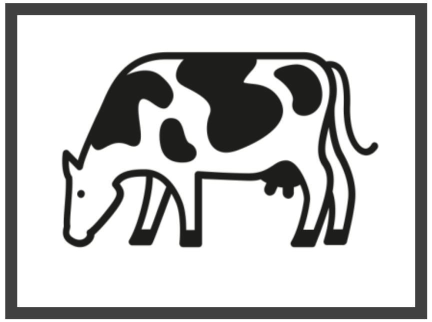
Provide ability to extrapolate beyond known conditions (“what-if” scenario analysis)

Generate environmental and economic analysis of multiple management scenarios

FARM ES, as it’s built today, cannot complete these more complicated calculations

Slide courtesy of Kaitlyn Briggs (DMI) and Nicole Ayache, NMPF

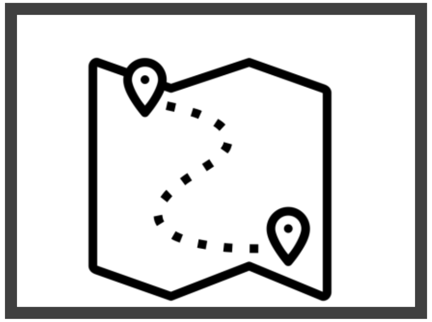
Vision of Success



Created by Rutmer Zijlstra
from Noun Project

Footprinting

Calculate baseline estimates of current farm outputs and environmental outcomes



Created by Aficons
from Noun Project

Planning

Identify management practices that will generate progress towards your sustainability goals

Created by mynamepong
from Noun Project

Implementation

Implement management plan, track progress, strive for continuous improvement

Created by Made x Made
from Noun Project

Impacts

Achieve industry-wide progress towards sustainable dairy production

NIFA AWARD # 2020-68014-31466

Thanks for listening!

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Dairy Opportunities, Challenges and Innovation: the KEYS to the kingdom

MaryAnne Drake

NC STATE UNIVERSITY

01 MARKET TRENDS

02 WINDS OF CHANGE

03 CHALLENGES

04 OPPORTUNITIES

05 RESEARCH PLATFORMS

Dairy Beverage Trends

Conscious consumption

High-protein products

New processing technologies

Green consumerism continues to grow…

Sustainability includes more than just carbon footprint for consumers

Differences in how industry and consumers define sustainability,
and lack of transparent information leaves consumers guessing on how to factor sustainability into their purchases

Schiano and Drake, JDS 2021

ANIMAL-FREE

(cell-based) dairy proteins are a new emerging category

MANY PROTEIN SOURCE OPTIONS

PLANT-BASED proteins have increased in popularity

WINDS OF CHANGE

Consumers have a lot of choices today…

DAIRY is still leading, but....

Increasing pressure for SUSTAINABILITY

there is competition from PLANT protein & ANIMAL-FREE dairy protein and a **shift** in PROTEIN TYPE IMPORTANCE

and gaps in consumer KNOWLEDGE

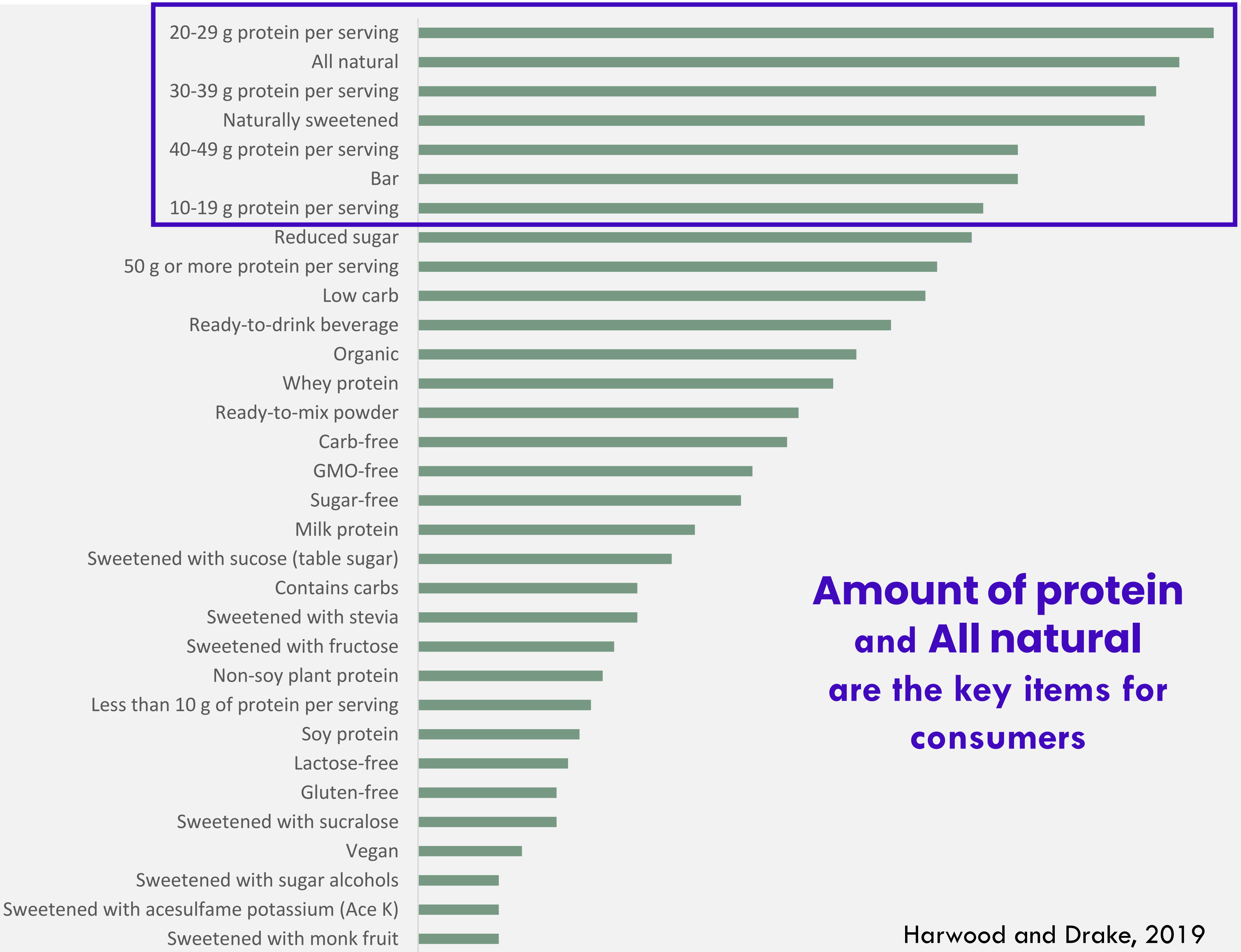
In this changing market… what are the Challenges and Opportunities for DAIRY?

Changes in Consumer Attitudes

MaxDiff scaling exercise for protein product characteristics

2018

N=1012 consumers



Amount of protein and All natural are the key items for consumers

Harwood and Drake, 2019

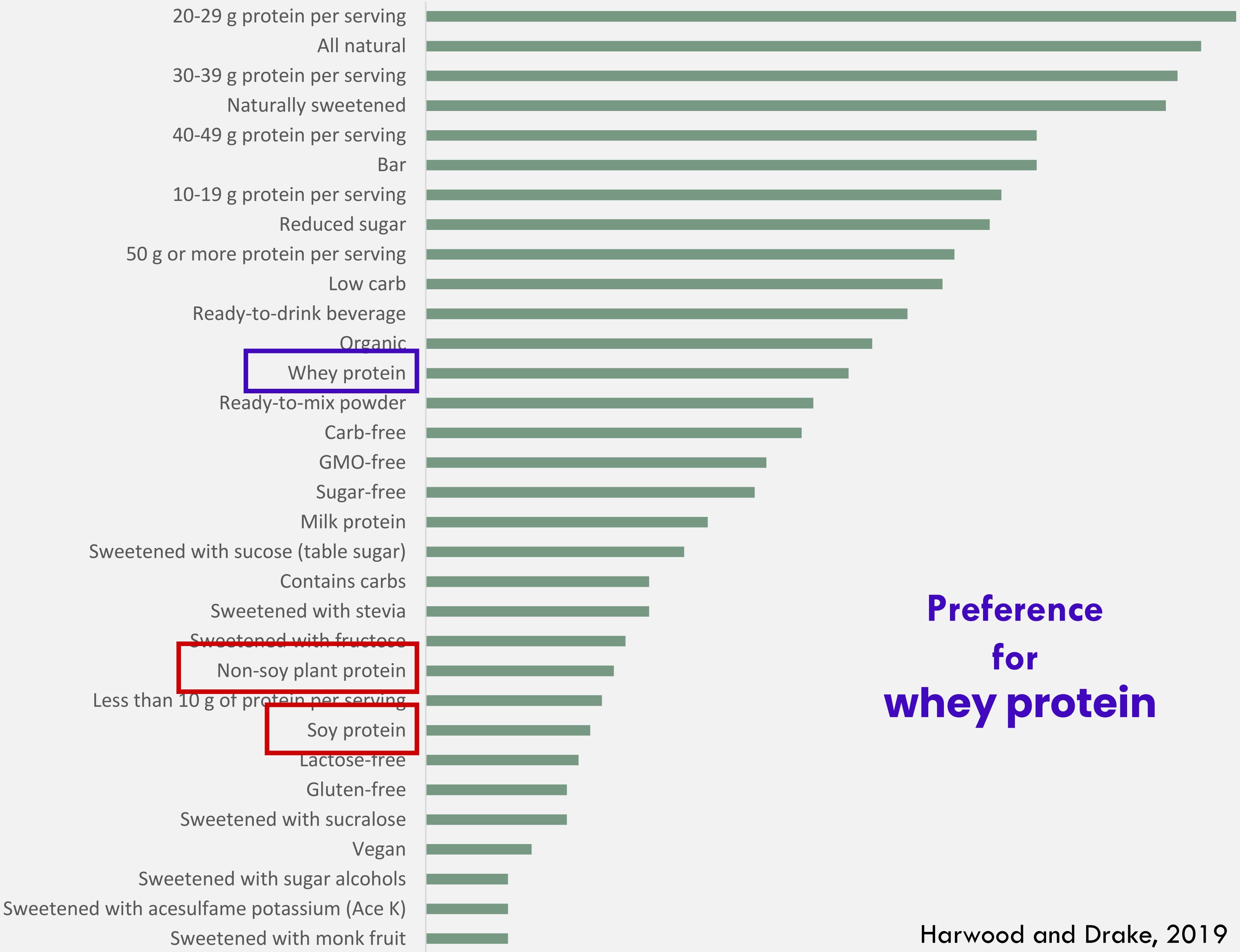
Changes in Consumer Attitudes

MaxDiff scaling exercise for protein product characteristics

2018

N=1012 consumers

<u>Protein type</u> was a differentiating attribute for consumers



Harwood and Drake, 2019

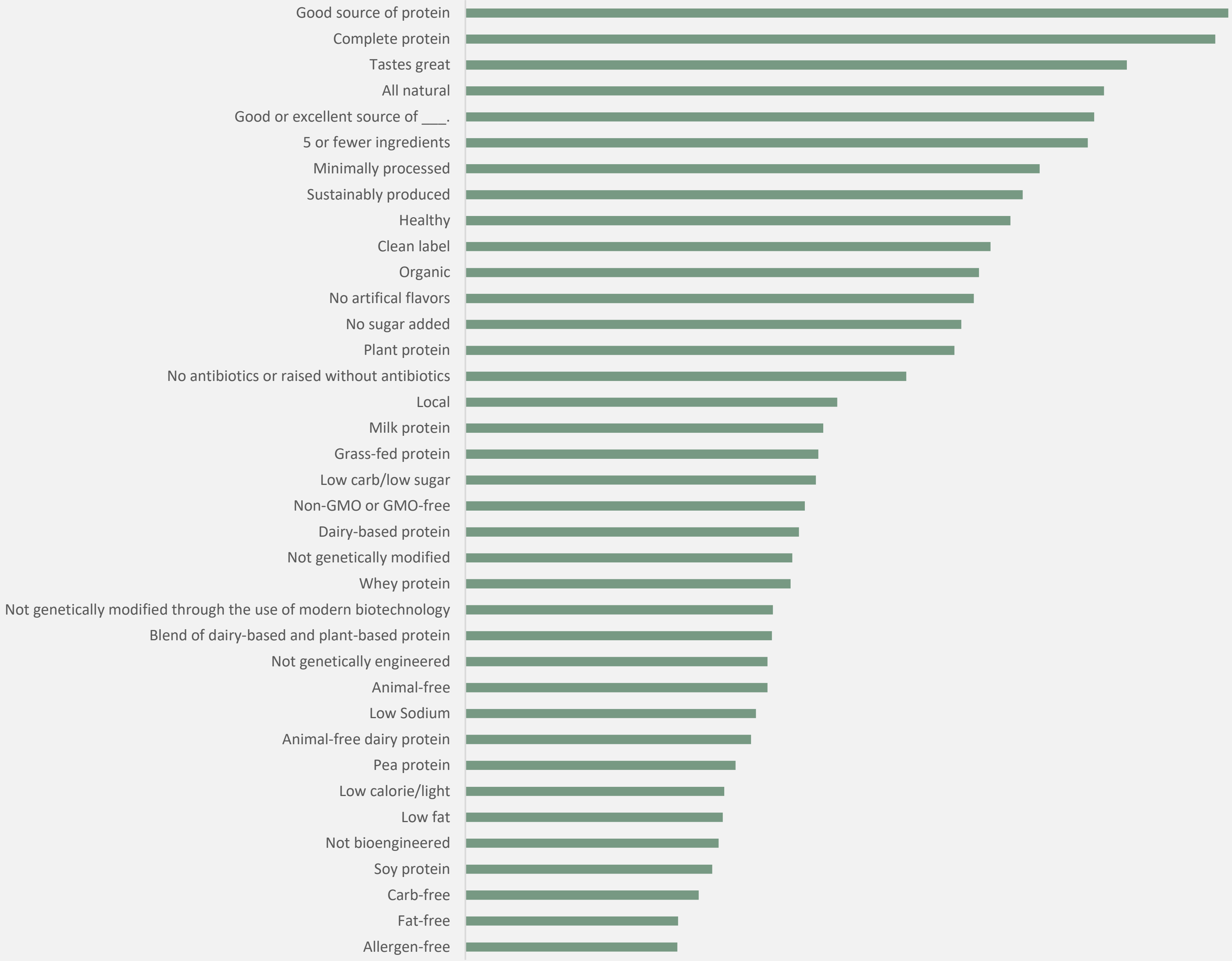
Changes in Consumer Attitudes

MaxDiff scaling exercise for appealing food product attributes

2021

N=536 consumers

<u>Health and Flavor</u> were top of mind in 2021, sustainability emerges



Changes in Consumer Attitudes

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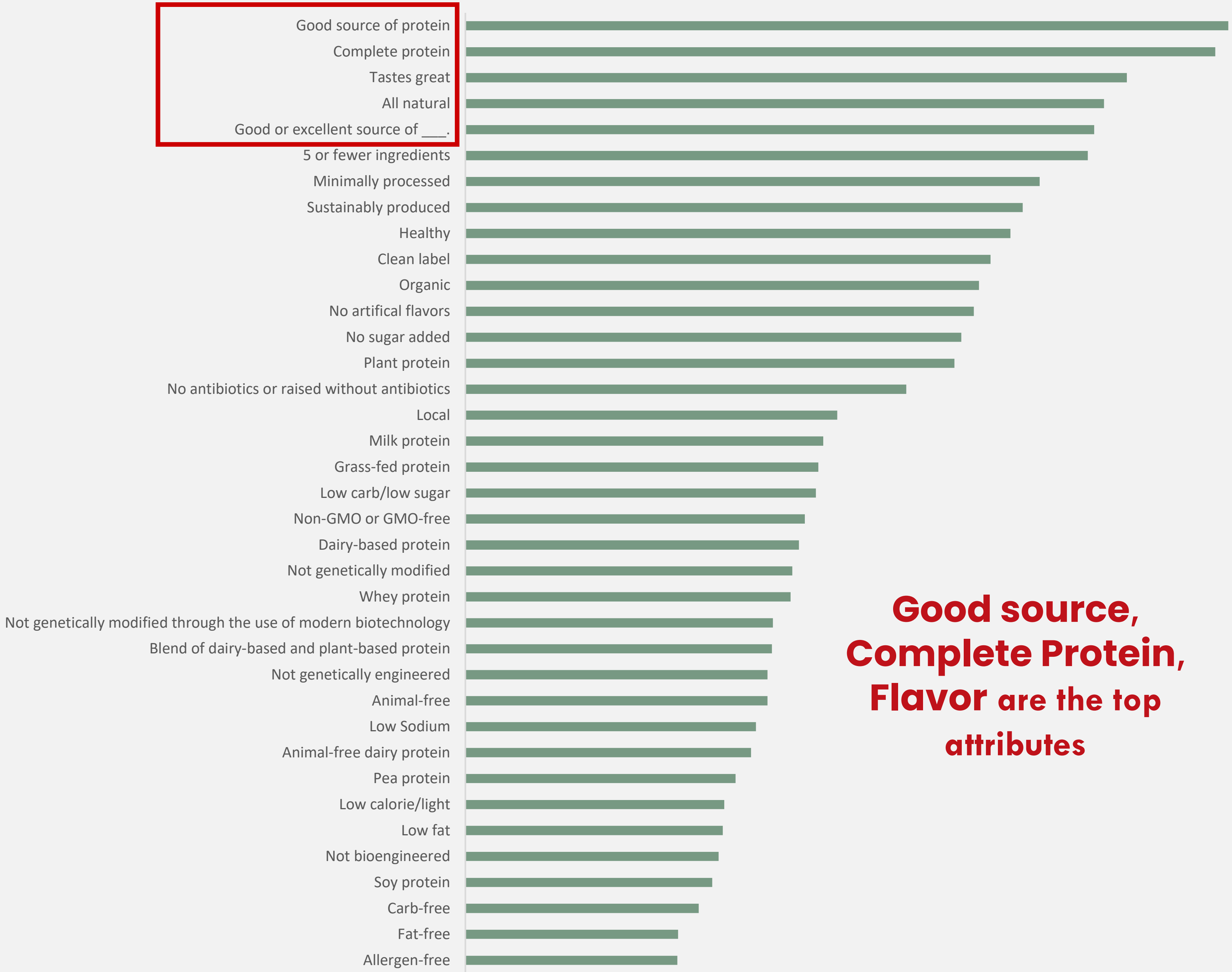


Good source, Complete Protein, Flavor are the top attributes

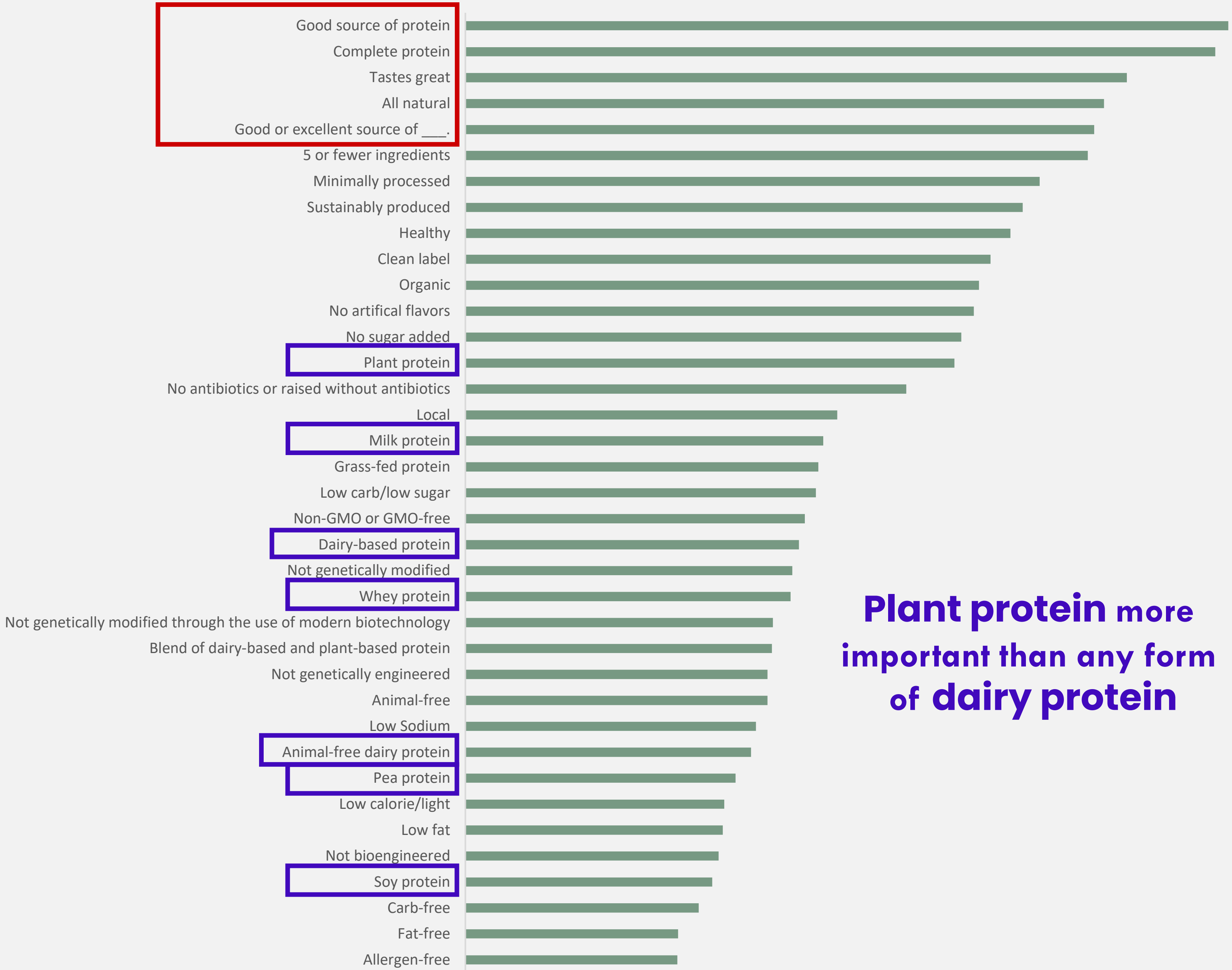
Changes in Consumer Attitudes

MaxDiff scaling exercise for appealing food product attributes

2021

N=536 consumers

Health and Flavor were top of mind in 2021, sustainability emerges



Plant protein more important than any form of dairy protein

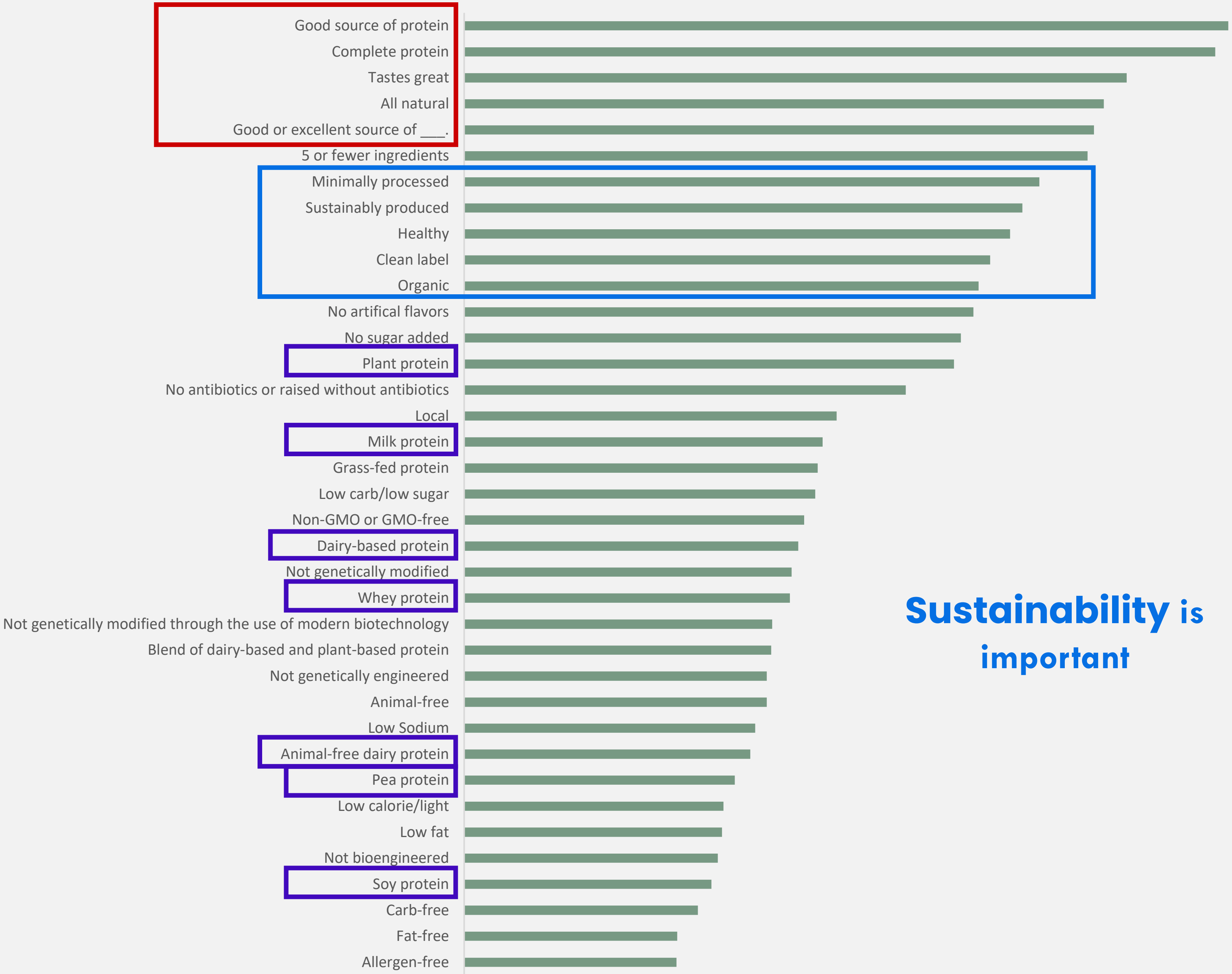
Changes in Consumer Attitudes

MaxDiff scaling exercise for appealing food product attributes

2021

N=536 consumers

<u>Health and Flavor</u> were top of mind in 2021, sustainability emerges



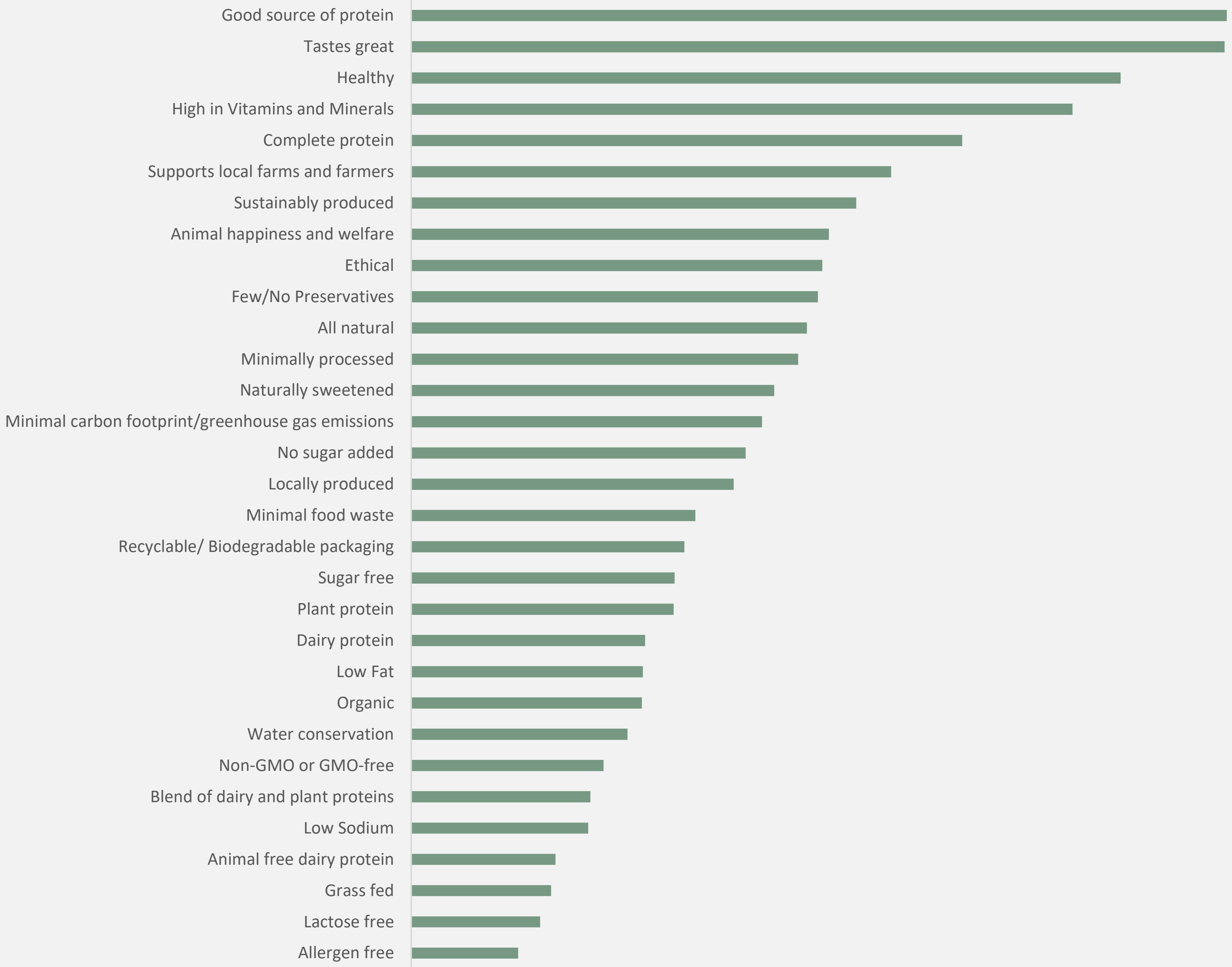
Sustainability is important

Changes in Consumer Attitudes

MaxDiff scaling exercise for protein product characteristics

2022

N=541 consumers



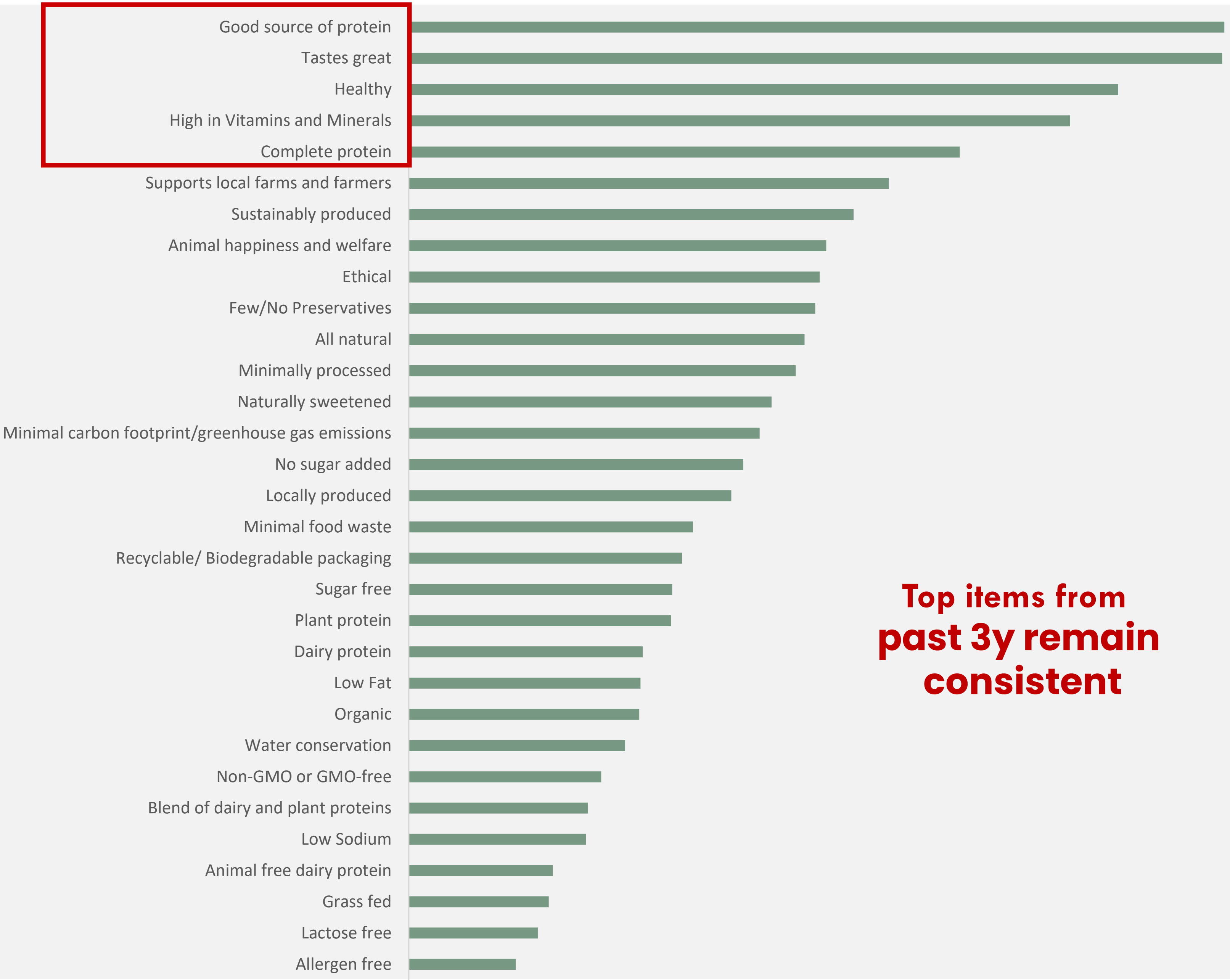
Changes in Consumer Attitudes

MaxDiff scaling exercise for protein product characteristics

2022

N=541 consumers

Nutrition, Health and Flavor are still important



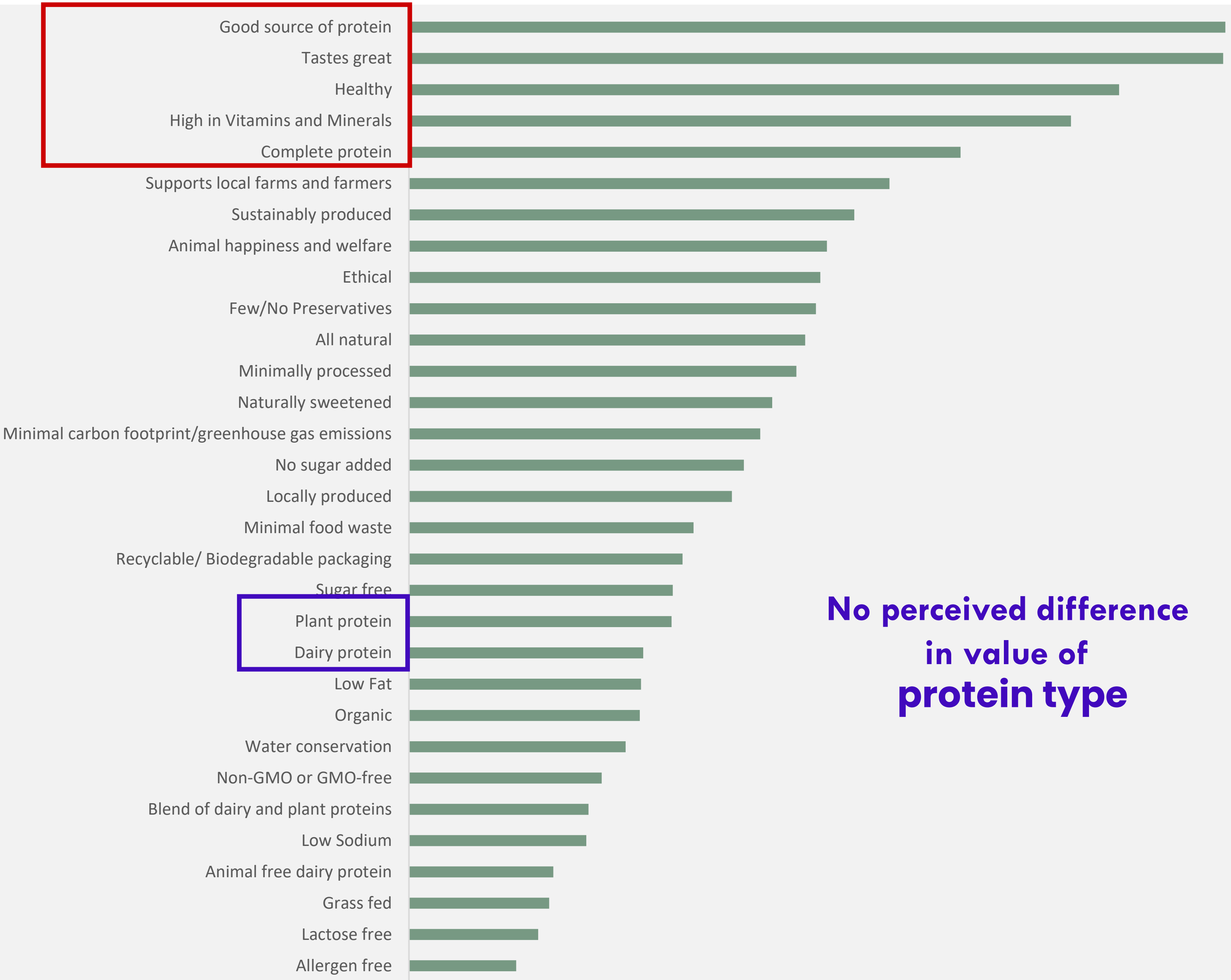
Changes in Consumer Key Protein Product Attributes

MaxDiff scaling exercise for protein product characteristics

2022

N=541 consumers

Nutrition, Health and Flavor are still important, but plant vs dairy protein are equal



No perceived difference in value of protein type

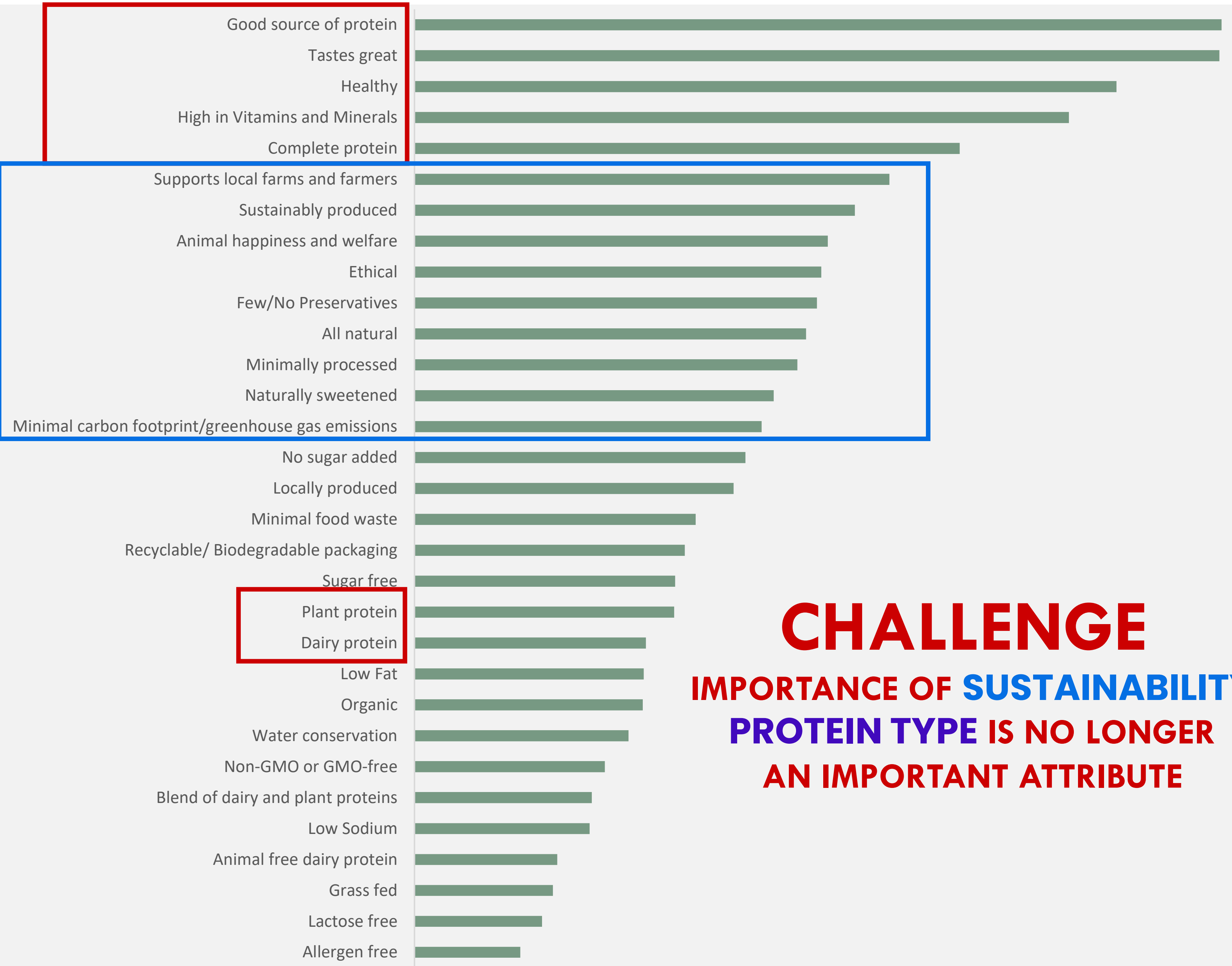
Changes in Consumer Key Protein Product Attributes

MaxDiff scaling exercise for protein product characteristics

2022

N=541 consumers

Increased interest in **sustainability**



CHALLENGE

IMPORTANCE OF SUSTAINABILITY

PROTEIN TYPE IS NO LONGER AN IMPORTANT ATTRIBUTE

CHALLENGES

Challenge: Rising interest in sustainability plays to plants

What is sustainability to the consumer?

Packaging

Animal Welfare

Environmental Impacts

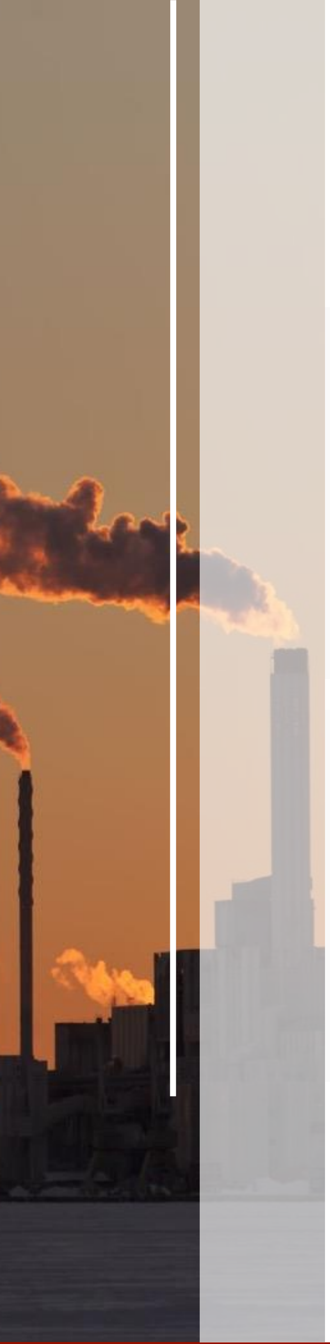
Simple/Minimal Ingredients

Organic more sustainable than conventional

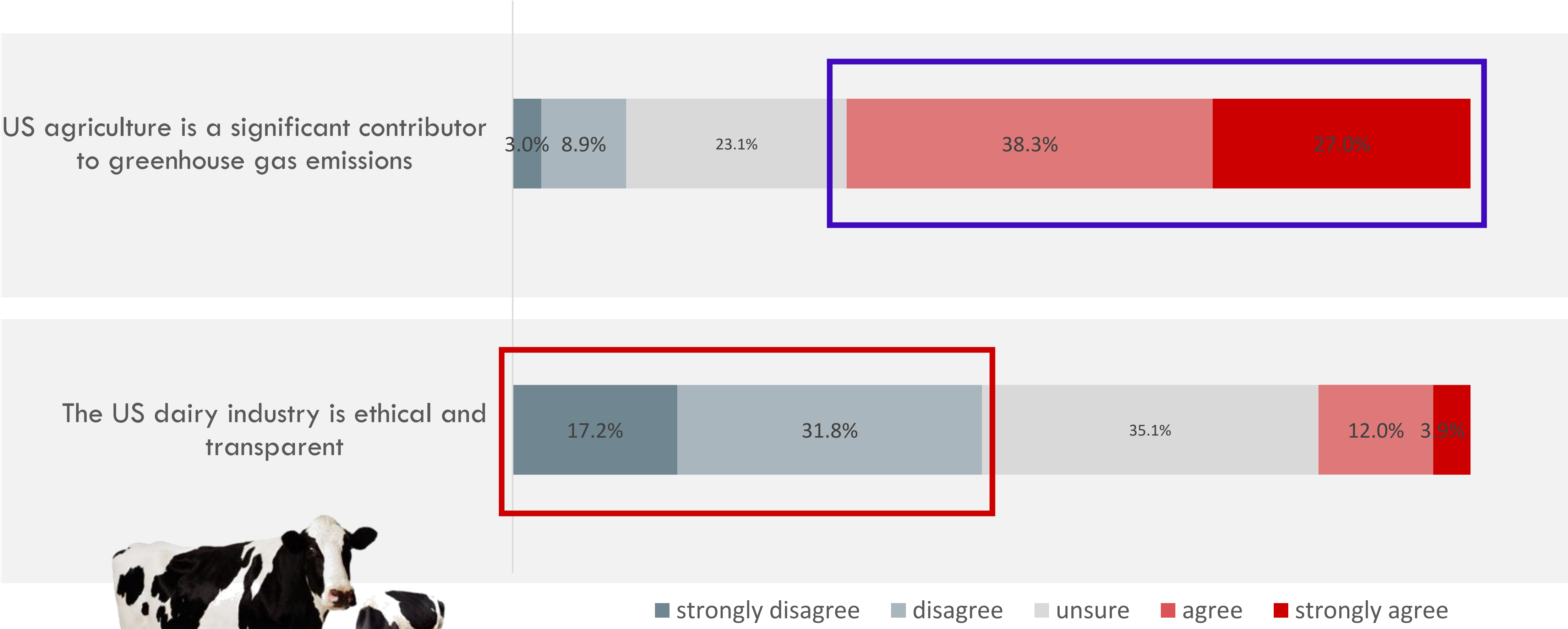
Plant source universally perceived as more sustainable

No effect for GMO/non-GMO

Schiano et al. 2020 JDS



Challenge: What consumers believe…



N=541 consumers, 2022

Challenge: What Consumers don't know

2%

of consumers know **fluid milk composition**

36%

of consumers think **Whey protein** is **Plant Protein**

22.7g

consumer belief of '**Good Source** of Protein' (5-9.5g)

29.6g

consumer belief of '**High Source** of Protein' (10g)

?

consumers cannot define **Complete Protein**

N=1210 consumers, 2020

N=536 consumers, 2021

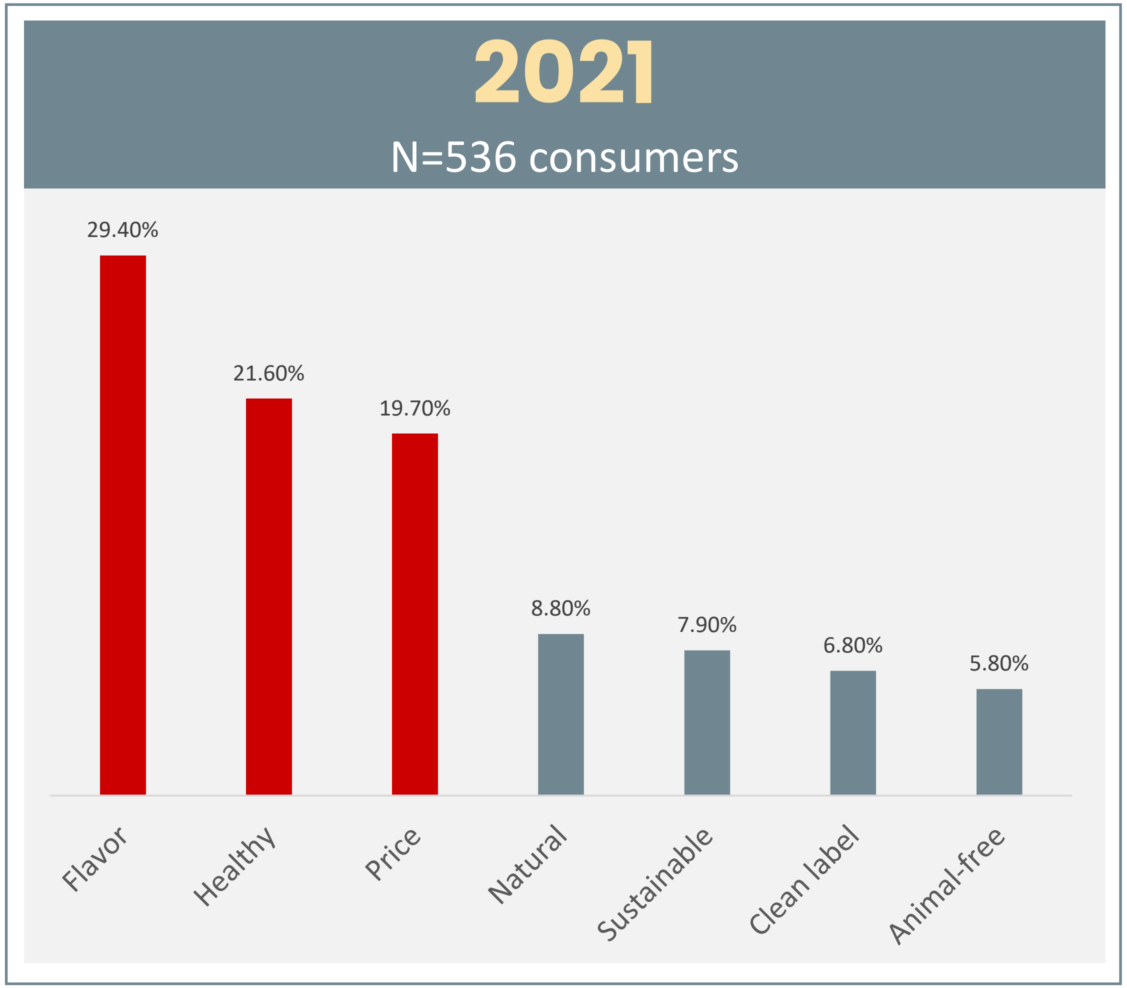
Age demographics correlate with dairy knowledge

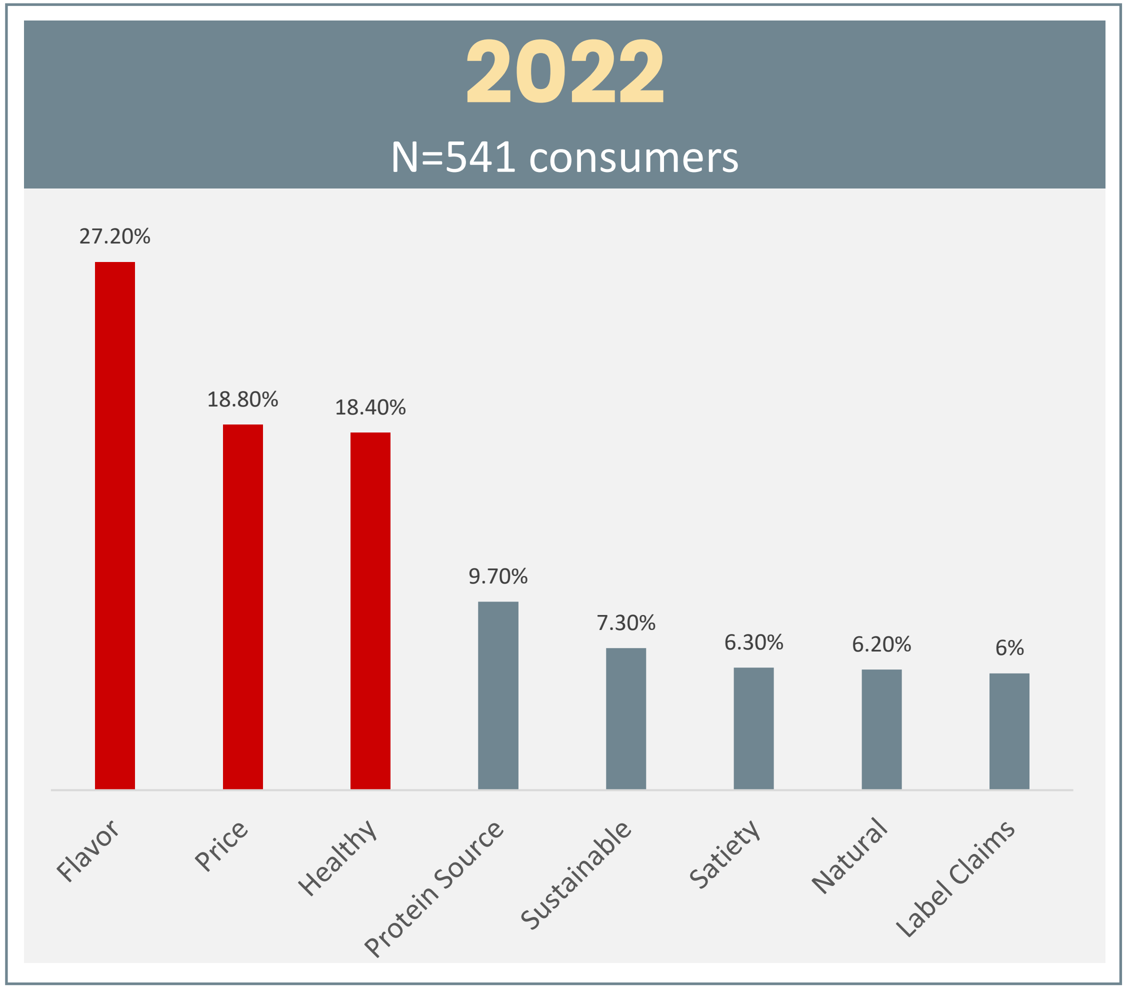
Older consumers (Boomers/Silent Generation members) and **consumers with advanced or professional degrees** have a better understanding of dairy products and dairy proteins

CHALLENGE

Call to action for younger consumers

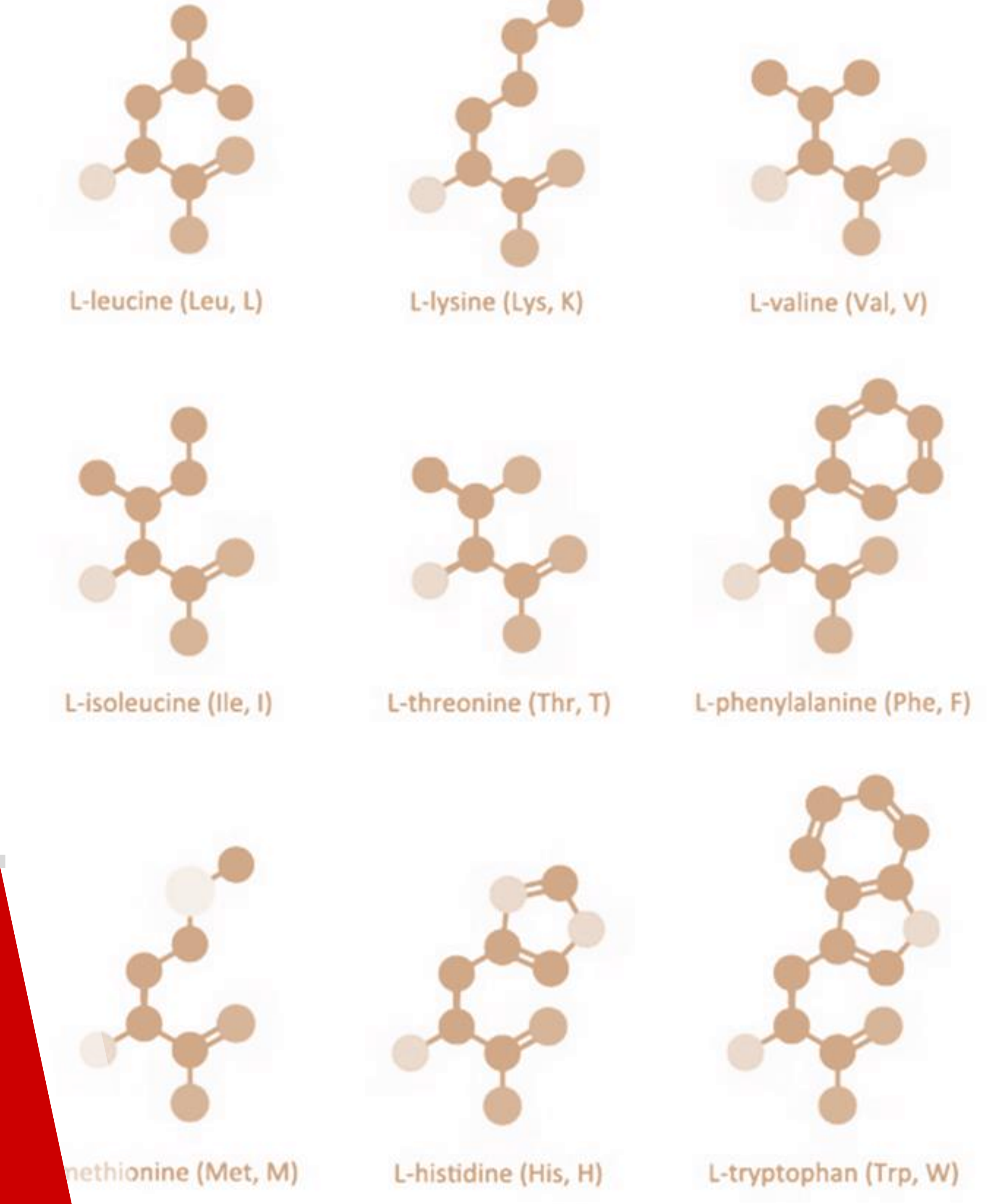
Flavor, price and healthy still rule at the end of the day ……. For now





Chip allocation questions: averages are based off a total sum of 100% for the combined attributes.

OPPORTUNITIES



‘Got Milk’ is only getting us so far…

… there are many positive benefits INHERENT to Dairy we need to focus on and actively educate and promote

Roadmap for DAIRY Opportunities

'play to strengths'

NUTRITION

Dairy is a complete protein and offers more nutritional benefits

EDUCATE

Consumer trust increases with increased knowledge and transparency

CALMING / IMMUNE

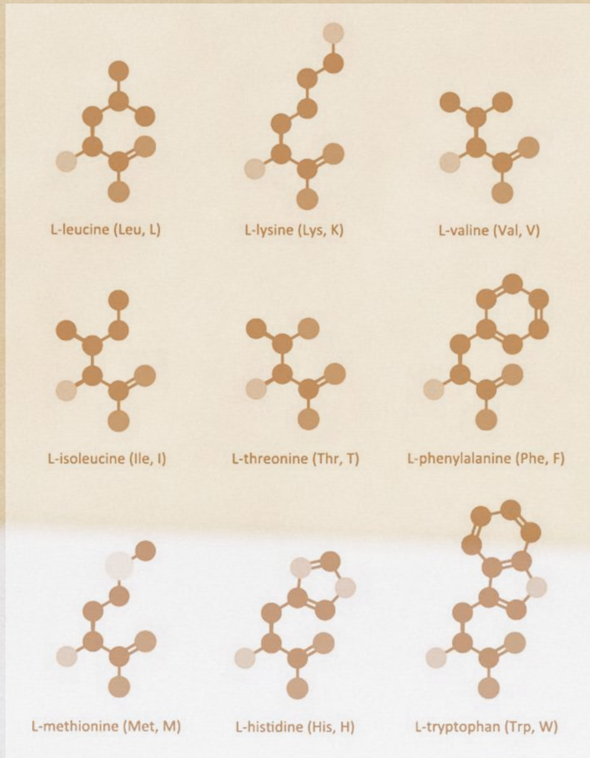
Capitalize on calming and immune benefits for milk and whey proteins in beverages

CLEAN LABEL

Capitalize on dairy protein functionality to minimize ingredient decks on beverages

OPPORTUNITY:

Complete Protein



- *'All the proteins on the market are complete. I don't think there are any incomplete proteins floating around.'*
- *'I kind of know, but I don't know how it's healthier. Does it really matter if this is complete?'*
- *'Maybe not processed. No additives make it complete. I don't know.'*
- *'I was an athlete. I don't remember. For some plants, they are not complete. '*
- *'I look for protein supplements. Don't think it matters on my choices.'*
- *'That's the amino acids. 7 or 9 amino acids. To be complete, you have to have all of them to be labeled as complete.'*

focus groups 2022

Complete Protein is a valuable indicator for dairy protein once consumers are educated of the definition

Opinion prior to Research

- *'I don't think there is technical definition. I think it's a marketing term'*
- *'If it comes from an animal (dairy) then it probably is more complete than a plant'*
- *'Because milk is [initially] for a calf and they need a lot to grow, I am assuming it is complete unless some of that is removed then making it into whey protein'*
- *'My friends who are really into protein always look at the back of labels and tell me that a mix of different proteins are healthier'*

Opinion post Research

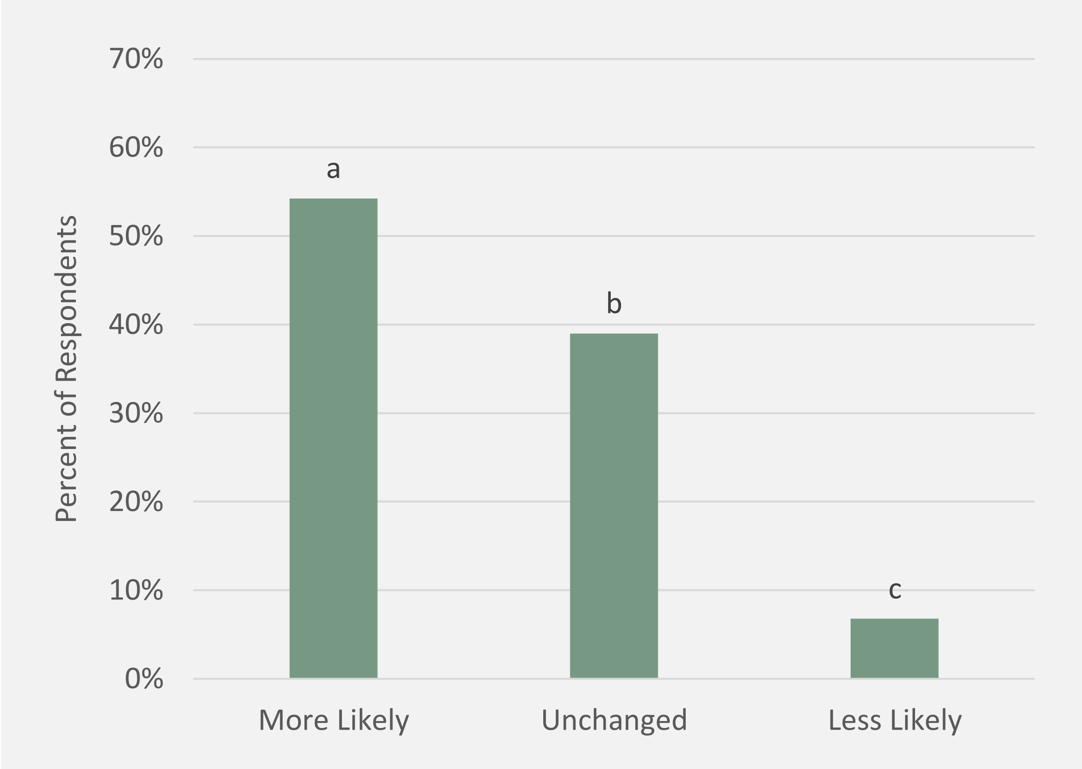
- *"Complete and incomplete it is pretty clear. There is a clear definition of it."*
- Learning that dairy is a complete protein is a positive for consumers.

focus groups 2022

OPPORTUNITY: Education impacts beliefs

Post-Definition beliefs about ultrafiltered and microfiltered milk

Purchase intent for milk, cheese, or cultured dairy products assuming they would be made with ultrafiltered/microfiltered/filtered milk



N=1003 respondents unfamiliar with ultrafiltered/microfiltered milk before a definition was provided.

OPPORTUNITY:

Dairy beverages and dairy proteins can seize an opportunity in the current immune/calming need-state landscape

80% of Americans seeking immune boosting foods and supplements
(New York Post – SWNS, 2021)

1/3 of Americans have displayed clinical signs of anxiety, depression since pandemic began. (US Census Bureau, 2020)

A **third** of consumers currently use dairy products for immune health.

Yes, I use dairy products to improve my immune health	30.9%
No, I use other products to improve my immune health	31.0%
Not currently using dairy products to improve immune health, but I would like to use dairy products for this benefit	23.6%
I am not trying to improve my immune health	14.5%

A third of consumers currently use dairy products for immune health.

Major opportunity lies with the 50%+ of dairy consumers who don't seek dairy for this purpose.

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When it comes to dairy, a product that consumers feel is nutritional, **consumers want to learn more about the nutritional components that are inherently present** rather than ingredients added for Immune benefits.

Specifically for immune health, consumers need assurance that the **messages are coming from a credible source.**

Most motivating feature to encourage dairy consumption for immunity (n=410)

Recommended by My Doctor	9.6a
Contains Immune-Boosting Protein (lactoferrin, immunoglobulins (IgG), etc.)	7.4b
Scientific Article	7.3b
Contains Antioxidants	7.2b
Contains Live and Active Cultures	6.4c
Contains Prebiotics	5.3d
Fortified with Vitamin C	5.1de
Fortified with Calcium	4.7ef
Recommended by a Friend	4.6f
"Immune-Boosting" Label	4.5f
Contains Extra Protein	4.4f
Contains Herbal Ingredients (Turmeric, Ginger, Ginseng, Chamomile, Lavender, etc.)	3.7g
Contains Folate/Folic Acid	3.4gh
"Anti-Inflammatory" Label	3.1hi
Fortified with Zinc	2.9i
Contains Tea Ingredients (Green Tea, Oolong Tea, Black Tea, Assam Tea, etc.)	2.7i
Contains Honey as an Ingredient	1.9j
Contains DHA	1.6jk
Newspaper/Magazine Article	1.5jk
Online Article	1.5kl
Contains Melatonin	1.1lm
TV News Show Segment	0.9mn
Contains Capsaicin	0.7no
YouTube Video	0.3op
Recommended by a Social Media Personality	0.2p

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“Immune-Boosting” Label	4.5f
Contains Extra Protein	4.4f
Contains Herbal Ingredients (Turmeric, Ginger, Ginseng, Chamomile, Lavender, etc.)	3.7g
Contains Folate/Folic Acid	3.4gh
“Anti-Inflammatory” Label	3.1hi
Fortified with Zinc	2.9i
Contains Tea Ingredients (Green Tea, Oolong Tea, Black Tea, Assam Tea, etc.)	2.7i
Contains Honey as an Ingredient	1.9j
Contains DHA	1.6jk
Newspaper/Magazine Article	1.5jk
Online Article	1.5kl
Contains Melatonin	1.1lm
TV News Show Segment	0.9mn
Contains Capsaicin	0.7no
YouTube Video	0.3op
Recommended by a Social Media Personality	0.2p

Calming is personal, so the anticipated enjoyment and stress relief comes from sensory cues rather than messaging.

But messages around ingredients consumers know to be calming like herbs, tea, and melatonin can be positive, as long as the messages are coming from a credible source.

Most motivating feature to encourage consumption of dairy foods for calming (N=458)

Recommended by My Doctor	10.5a
Recommended by a Mental Health Professional	9.6b
Scientific Article	7.8c
Tastes Great	**7.8c**
Contains Herbal Ingredients (Turmeric, Ginger, Ginseng, Chamomile, Lavender, etc.)	**6.8d**
Recommended by a Friend	6.1e
Tastes Indulgent	5.8e
Contains Melatonin	**5.7ef**
Contains Tea Ingredients (Green Tea, Oolong Tea, Black Tea, Assam Tea, etc.)	**5.3f**
Contains CBD (Cannabidiol)	4.3g
Contains Live and Active Cultures	4.3g
Contains Spice Ingredients (cinnamon, nutmeg, etc.)	4g
Contains Prebiotics	3.5h
Contains Honey as an Ingredient	3.3h
Creamy Mouthfeel	3.2h
Contains Alcohol	1.8i
Newspaper/Magazine Article	1.7i
Online Article	1.7i
TV News Show Segment	1.1j
YouTube Video	0.5k
Recommended by a Social Media Personality	0.2k

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Contains Alcohol	1.8i
Newspaper/Magazine Article	1.7i
Online Article	1.7i
TV News Show Segment	1.1j
YouTube Video	0.5k
Recommended by a Social Media Personality	0.2k

OPPORTUNITY: Capitalize on the inherent properties of dairy foods

IMMUNE BOOSTING

NEW FORMATS

Connect flavor offering with unique nutritional ingredients

Focus on whole health with high protein, fiber, low calorie +vitamins & minerals

'Real' fruit (crispy not fruit prep) + dairy combos

NEW MESSAGING

Avoid over commitment

Claims congruency with brand image is critical for immune boosting

Elaborate on credibility

LINE EXTENSIONS

Elderberry

Honey

Turmeric

Probiotics

Kombucha

Ginger

Brand Specific Current Products

CALMING

LINE EXTENSIONS

Chai

Cheesecake

Semi-sweet

Herbal tea

Cream on top

Fruit + treat

NEW MESSAGING

Exaggerate creaminess of product

Communicate 'better' nutritionals, but avoid 'reduced'

Message for 'slow consumption'

NEW FORMATS

Unique textures ex. French, Swedish, froth

Promote slow consumption

Sparkling 'carbonated' mouthfeel

Lower fat & calorie % same taste

Calming & Immune are here to stay & there is <u>opportunity to better satisfy</u> need states with new dairy innovations.

OPPORTUNITY: High Demand on High Protein Products

- Global protein market valued at 38.5 million in 2020 and projected to grow
- Nutritional drinks market continue to grow steadily and have strong consumer penetration (Mintel, 2022)
- 42% of consumers are making eating healthy a higher priority as a result of COVID-19 (Mintel, 2020)
- 8.6 million conversations about protein (95% positive) across Instagram, Pinterest and Twitter from Oct 2019 to Sep 2020 (Infegy, 2020)

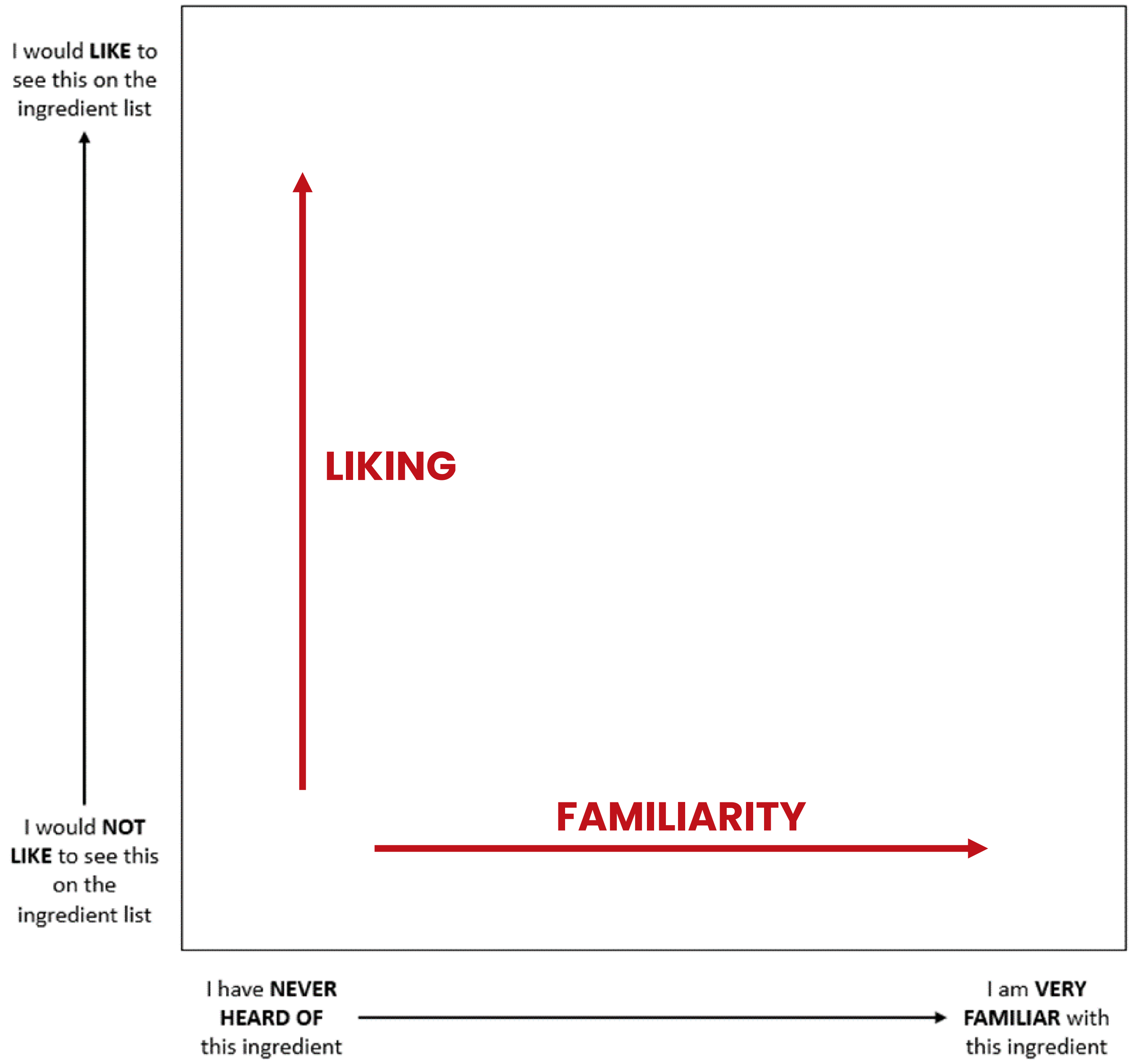
But what ingredients do consumers want in their high protein beverages?

Consumer Attitude to Protein Beverage Ingredients

MaxDiff Scaling &
Projective Mapping exercise
for appealing protein
beverage ingredients

2023

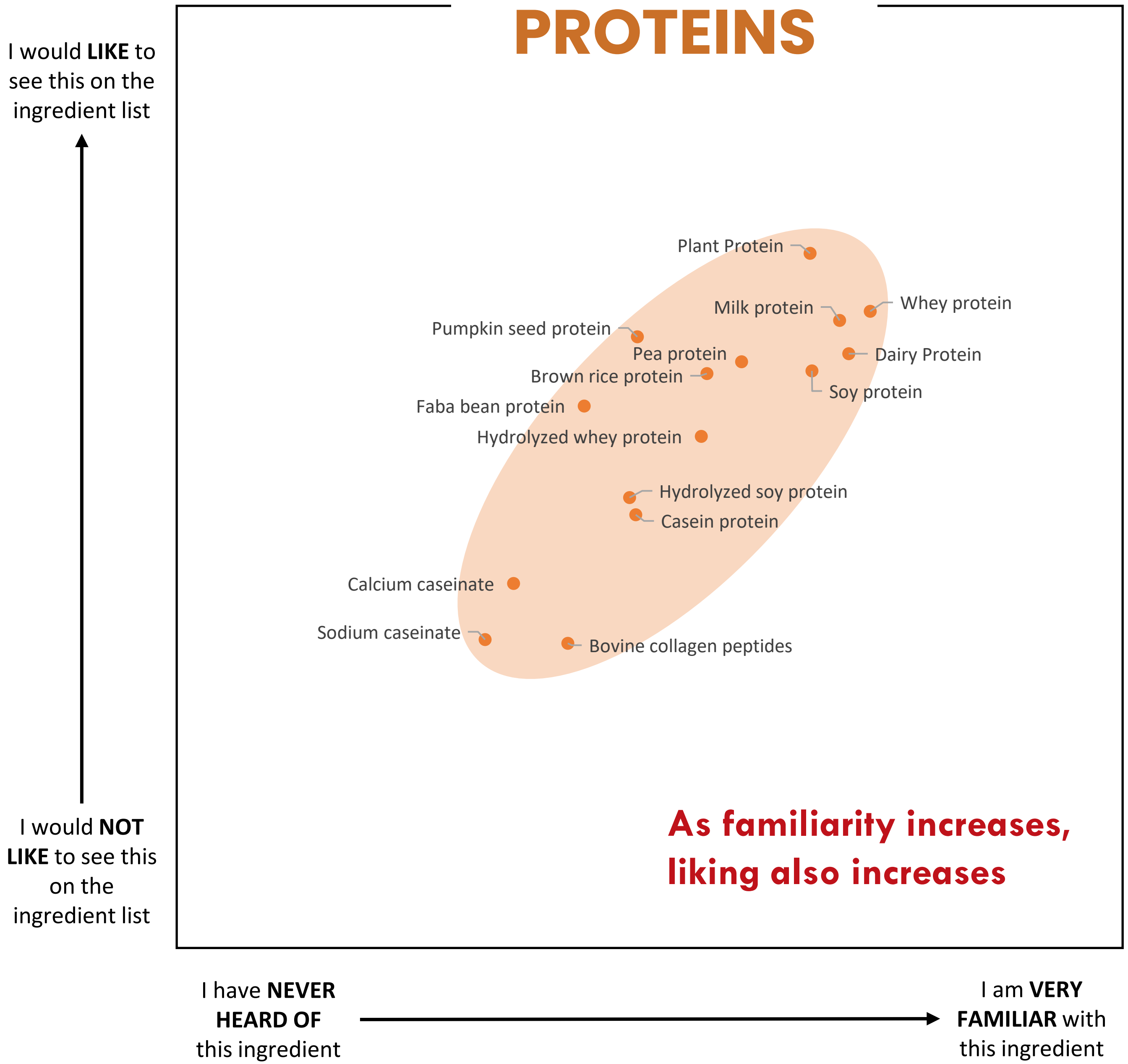
N=400 consumers



Consumer Attitude to Protein Beverage Ingredients

PROTEINS

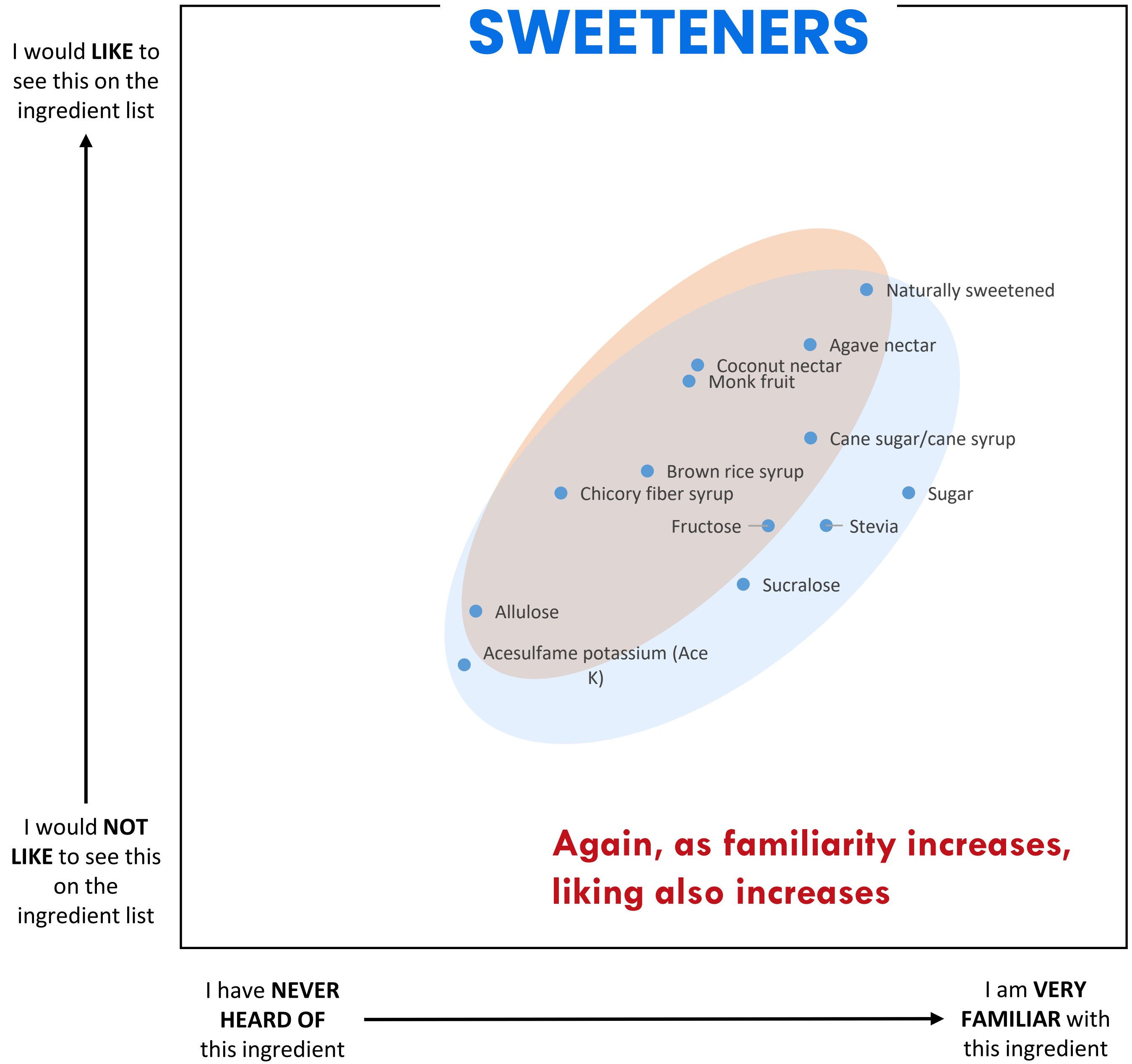
Plant protein	DAIRY & PLANT	53.6a
Whey protein		48.9b
Milk protein		43.5c
Pumpkin seed protein		42.7cd
Dairy protein		41.8cd
Pea protein		39.3de
Brown rice protein		35.8ef
Soy protein		33.6f
Faba bean protein		28.1g
Hydrolyzed whey protein		26.0g
Casein protein		20.0h
Calcium caseinate		17.3h
Hydrolyzed soy protein		16.5h
Bovine collagen peptides		8.4i
Sodium caseinate		6.5i



Consumer Attitude to Protein Beverage Ingredients

SWEETENERS

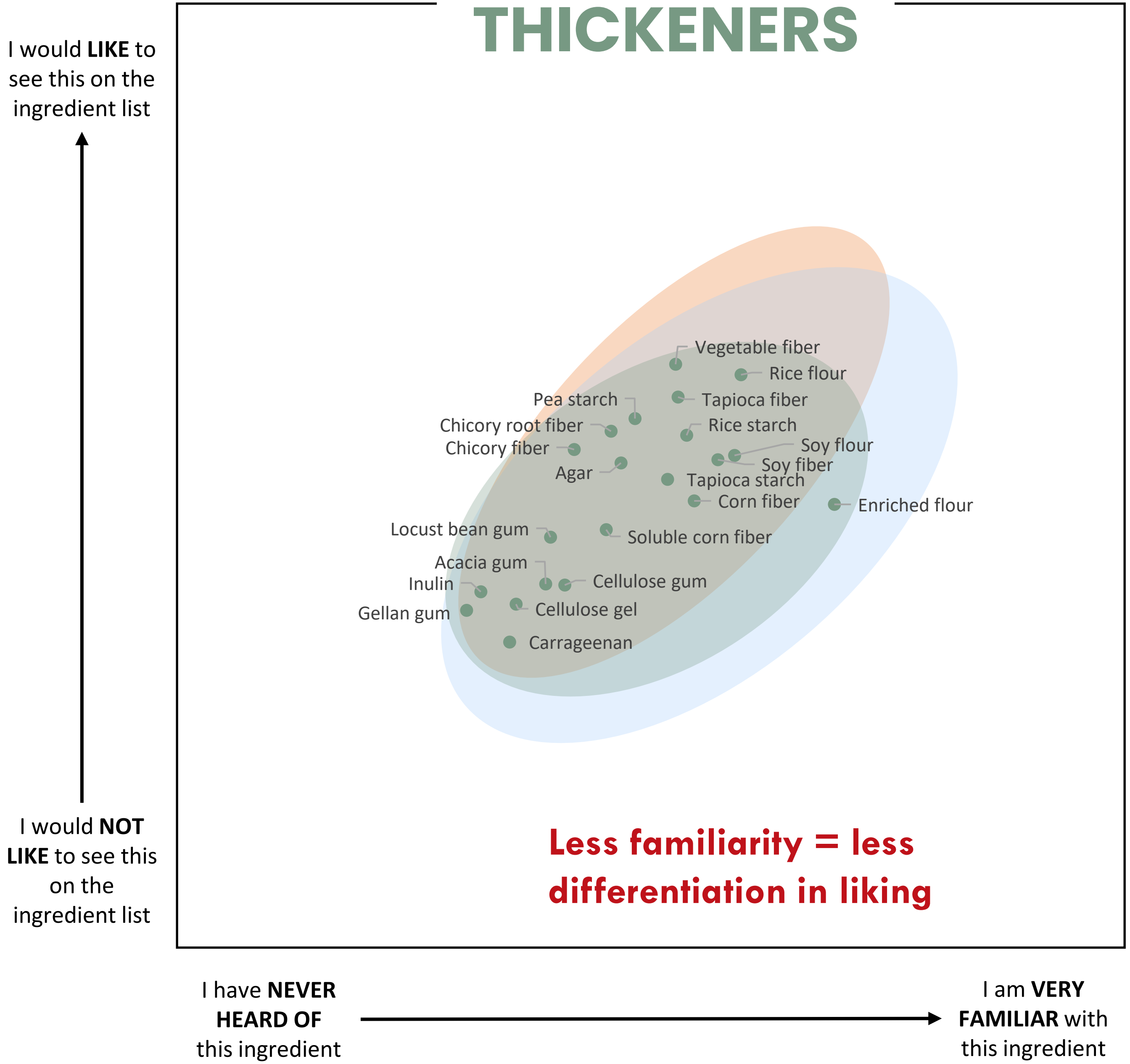
Naturally sweetened	56.8a
Agave nectar	49.5b
Monk fruit	41.6c
Cane sugar/cane syrup	39.7c
Coconut nectar	39.4c
Sugar	33.0d
Brown rice syrup	27.0e
Stevia	23.7ef
Chicory fiber syrup	20.0fg
Fructose	17.1g
Sucralose	12.4h
Allulose	12.0h
Acesulfame potassium (Ace K)	-0.2i



Consumer Attitude to Protein Beverage Ingredients

THICKENERS

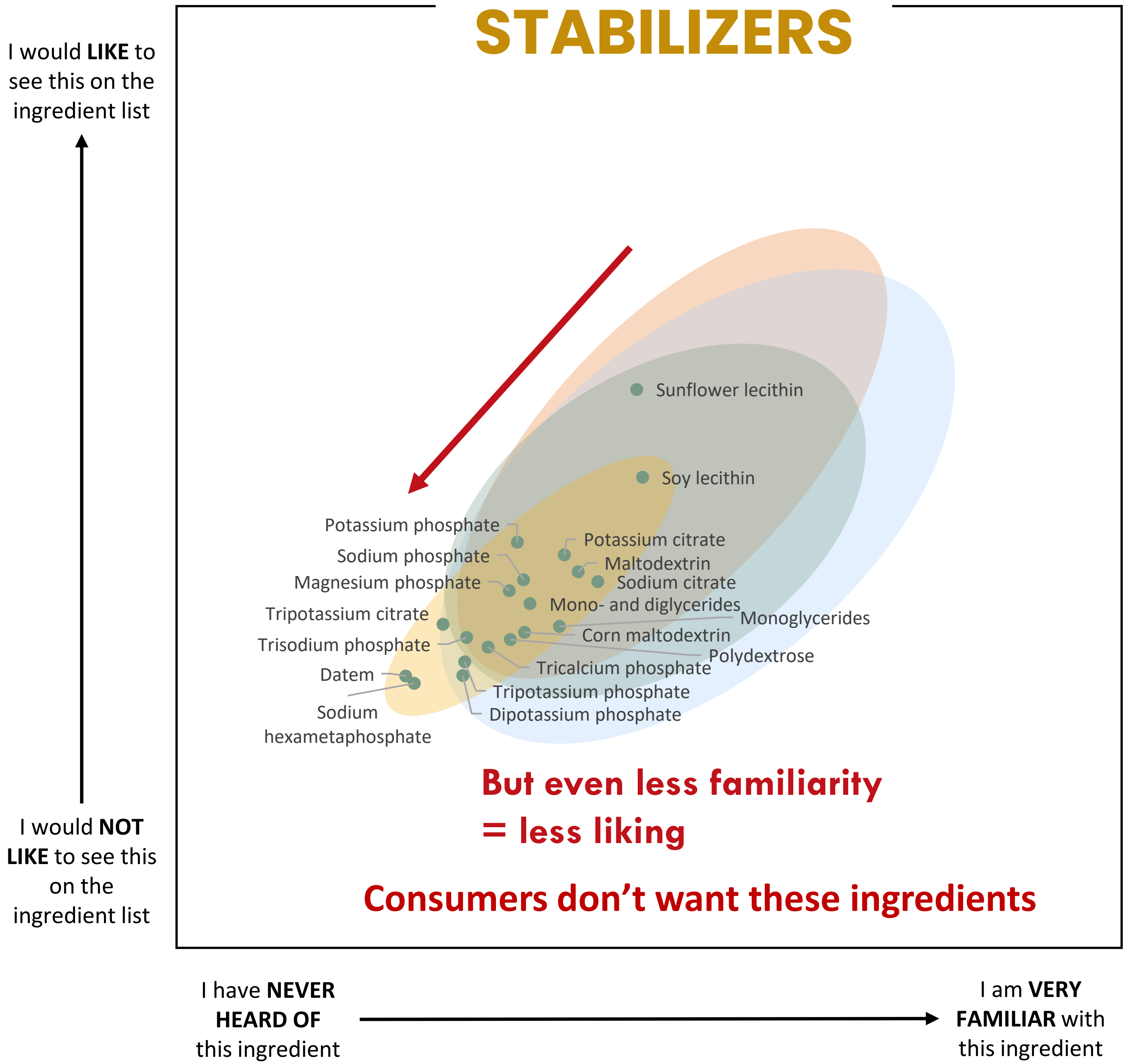
Vegetable fiber	FIBERS & STARCHES	57.4a
Tapioca fiber		49.6b
Rice flour		49.5b
Pea starch		46.5bc
Tapioca starch		46.3bc
Rice starch		43.7cd
Soy fiber		40.9de
Chicory root fiber		40.4de
Chicory fiber		39.8de
Soy flour		37.7ef
Agar		35.2fg
Corn fiber		35.2fg
Enriched flour		32.4gh
Soluble corn fiber		32.0gh
Acacia gum	GUM & GELS	29.4h
Locust bean gum		20.8i
Cellulose gum		19.8ij
Cellulose gel		19.1ijk
Inulin		17.2ijk
Carrageenan		15.9jk
Gellan gum		15.3k



Consumer Attitude to Protein Beverage Ingredients

STABILIZERS

Sunflower lecithin	68.5a
Soy lecithin	49.6b
Potassium citrate	48.2bc
Potassium phosphate	45.6bc
Magnesium phosphate	43.9c
Sodium citrate	38.9d
Monoglycerides	35.3de
Corn maltodextrin	34.5de
Tripotassium citrate	34.4def
Maltodextrin	34.2defg
Tricalcium phosphate	34.0efg
Sodium phosphate	33.6efg
Dipotassium phosphate	31.5efg
Mono- and diglycerides	31.1efg
Tripotassium phosphate	29.6fg
Polydextrose	29.4g
Trisodium phosphate	23.8h
Datem	22.5h
Sodium hexametaphosphate	12.6i
Anchor	0.0j



Protein beverages and consumer desires

- Desirable flavor, texture, appearance, and clean label/simple ingredients are key consumer attributes that dairy proteins can deliver
  - Understand how processing parameters impact **flavor** of beverages
  - Understand how processing parameters impact **functionality** of beverages
  - Understand how added ingredients affect beverage functionality and build functionality of milk components to eliminate the need for other added ingredients

Fluid Milk Beverages

Protein Beverages

Milk research continuum

A PLATFORM APPROACH

REPRESENTING THE DAIRY BEST

MILK BEVERAGE PLATFORM

Milk Beverage Platform

LOOKING BACK

- The influence of UP by indirect versus direct steam injection on skim and 2% milk (Lee et al. 2017)
- Flavor chemistry difference among milk processes by HTST or UP. (Jo et al. 2018)
- Identification of source of volatile sulfur compounds produced during thermal processing of milk (Jo et al. 2019)
- Hunter vs CIE color measurement systems for analysis of milk based beverages. (Cheng et al. 2019)
- Effects of milk fat, casein, and serum protein concentrations on sensory properties of milk-based beverages (Cheng et al. 2019)

MILK BEVERAGES

LOOKING FORWARD

- Reducing sugar in school lunch chocolate milk (Nakamura et al.)
- Milkfat preference in unflavored and chocolate milk (Keefer et al.)
- Role of packaging on unflavored and chocolate milk flavor. (Cadwallader et al.)
- Role of complete lactose removal, fat and protein on physical and sensory properties of milk beverages (Hernandez et al.)
- Role of cooling and storage on the flavor of aseptic milk (Cadwallader et al.)

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Delivering desirable milk beverages

1

Understand how reducing sugar impacts acceptance

- The role of sugar reduction on flavor and acceptance of school lunch milk

School lunch chocolate milk that tastes great and has low or no added sugar!

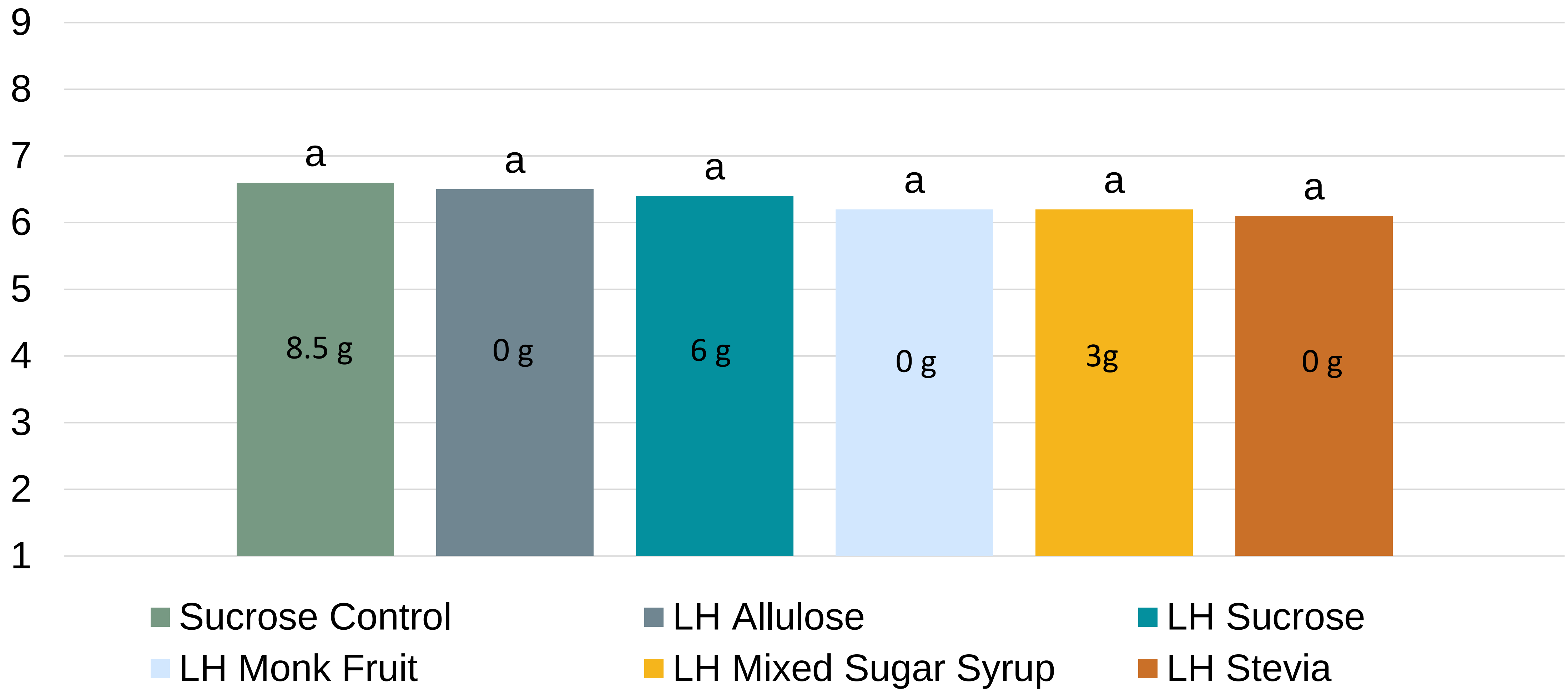
OBJECTIVE

Reduce sugar in school lunch chocolate milk

240 mL serving = 8.5 g added sugar

Consumer Acceptance of lactose *hydrolyzed* chocolate milks

School Chocolate Milk



N=160

LH = Lactose Hydrolyzed

REPRESENTING THE DAIRY BEST

Practical Application

Great tasting school lunch milk that is lactose free and has no added sugar

Delivering desirable milk beverages

1

Understand how reducing sugar impacts acceptance

- The role of sugar reduction on flavor and acceptance of school lunch milk

2

Understand how package and storage impact aseptic milk flavor

- The role of package and storage temperature on flavor of aseptic milk

REPRESENTING THE DAIRY BEST

Improving the flavor of aseptic milk

OBJECTIVE

Determine the impact of storage temperature of 1% aseptic milk on physical and sensory properties

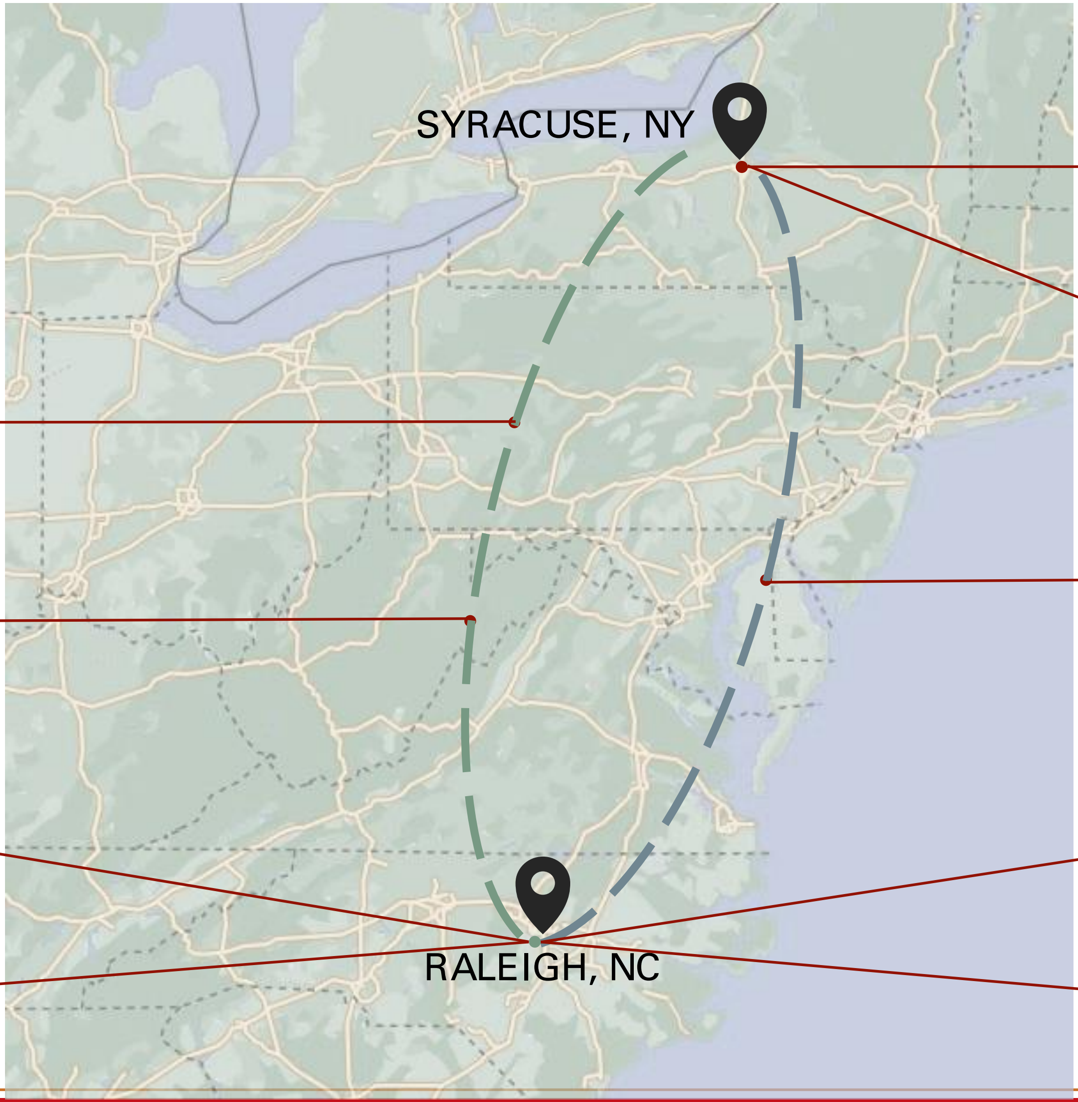
Aseptic milk receives a similar DSI time/temp to ultrapasteurized milk but tastes quite distinct

- Are the differences due to storage time or storage temperature?
- Aseptic milk is filled warm and not cooled; UP milk is filled and chilled

Accomplishing this experiment, was no small effort

Aseptic Storage Temp

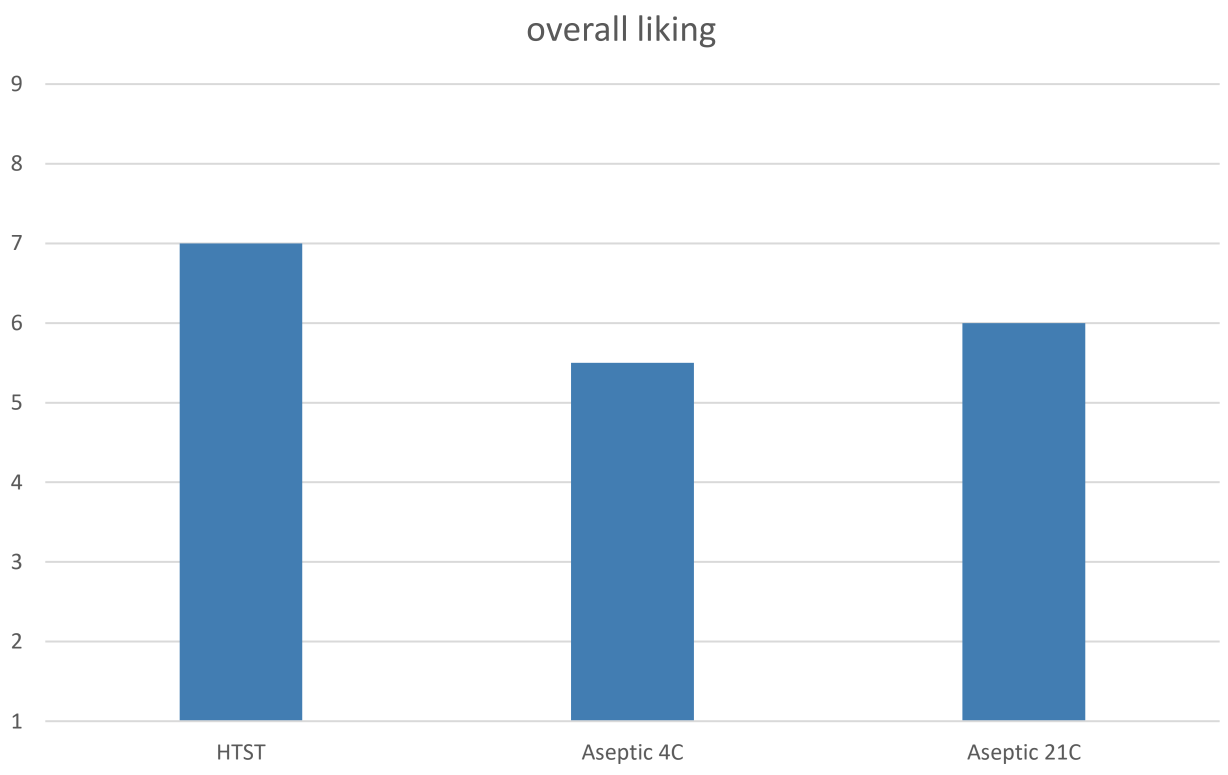
To ensure variables (time & temp post aseptic fill) were protected, special care with many dedicated man hours was required



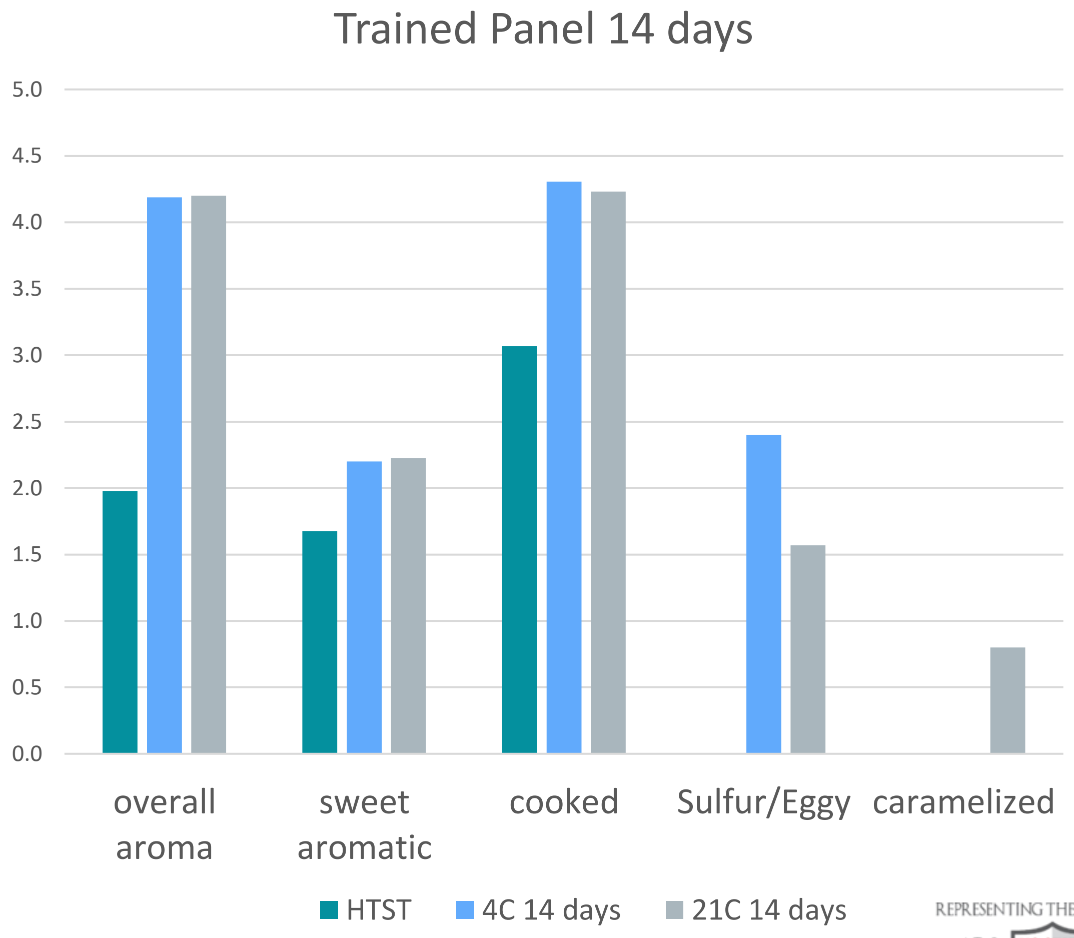
1. Identify a Supplier: Aseptic milk right from filler (Byrne Dairy)
2. Configure Logistics: 15 coolers, 1 rental van, 2 drivers, lots of snacks!
3. Wait for 'GO' call…
4. 11hr drive to Syracuse
5. Load 200 tetra bricks for 4C and RT transport
6. 11hr drive to Raleigh maintaining temp & product safety
7. Unload and store 200 tetra bricks at NCSU
8. **Repeat for REPLICATION 2!**
9. Analytical, DA & CLT for timepoints across 18m storage

Aseptic milk flavor at 14 days

Aseptic Storage Temp

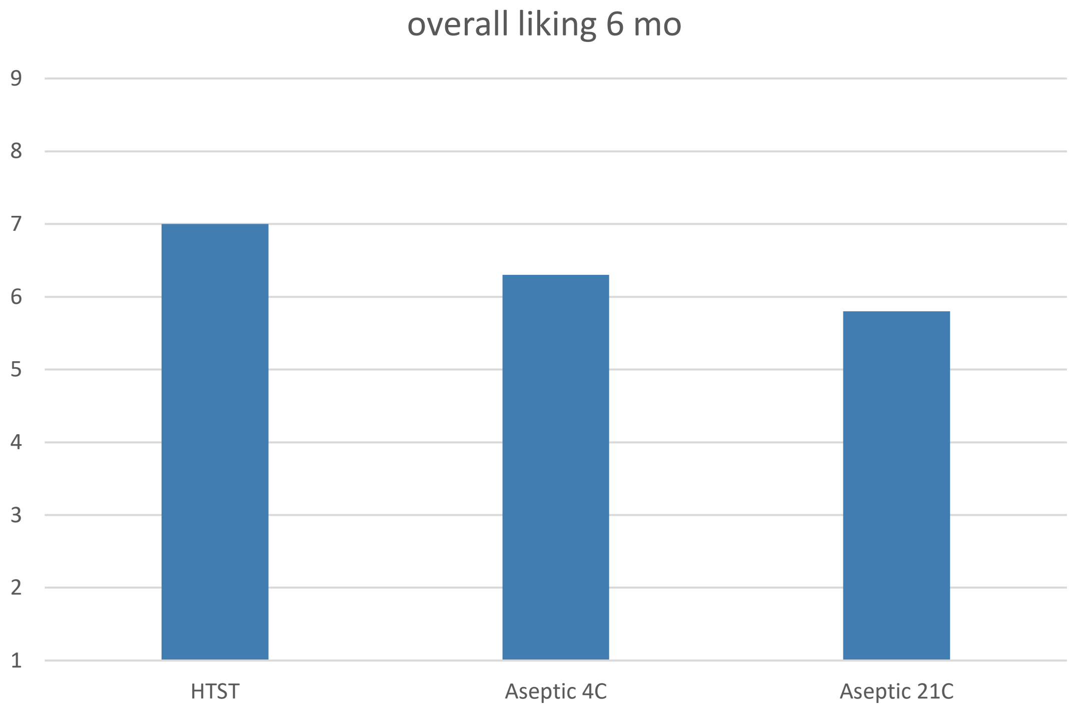


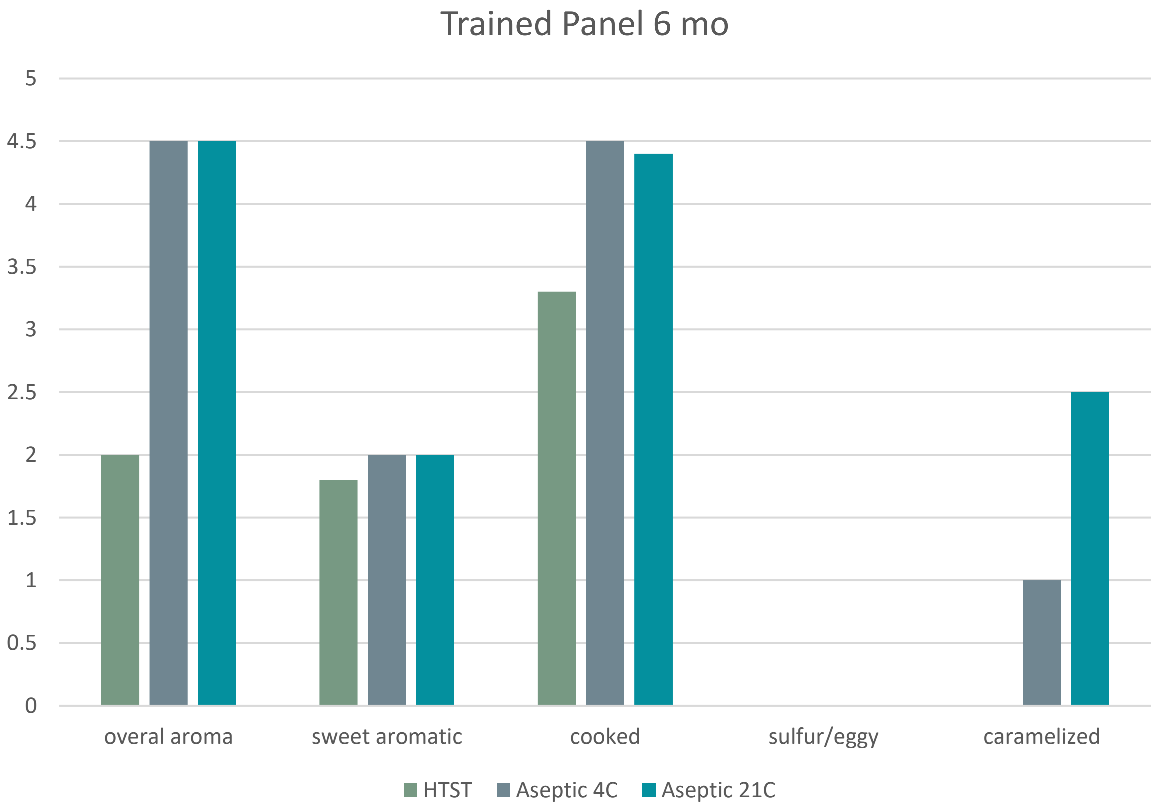
N=200 milk consumers



REPRESENTING THE DAIRY BEST

Aseptic milk flavor at 6 mo

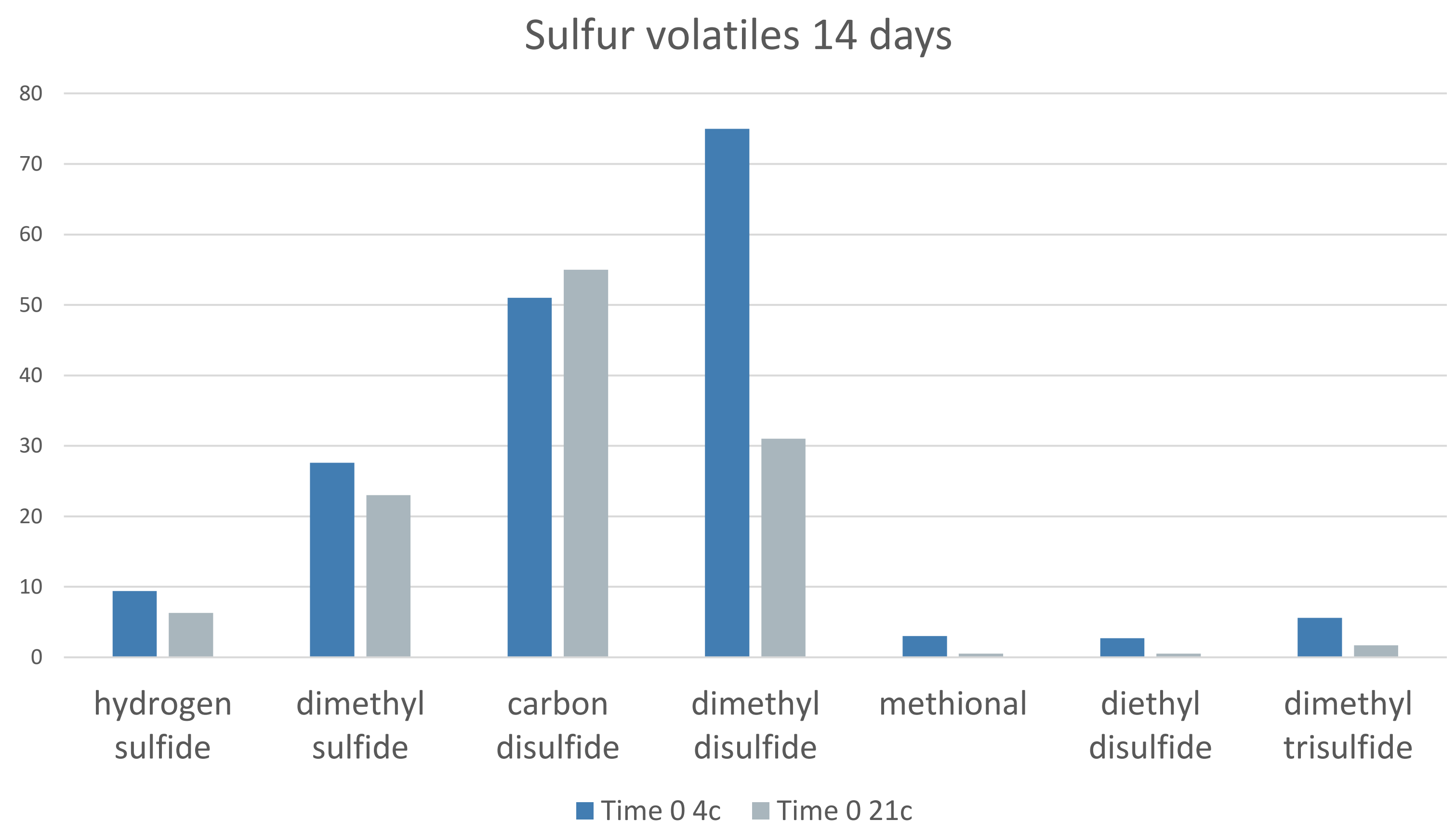




N=200 milk consumers

Aseptic Storage Temp

Sulfur volatiles impacted by storage temperature



REPRESENTING THE DAIRY BEST

Practical Application

Shelf stable milk that tastes great and meets consumer needs for convenience and sustainability

Delivering desirable milk beverages

1

Understand how reducing sugar impacts acceptance

- The role of **sugar reduction** on flavor and acceptance of school lunch milk

2

Understand how package and storage impact aseptic milk flavor

- The role of package and storage temperature on flavor of **aseptic milk**

3

Understand how processing and composition impact flavor

- The role of **complete lactose removal, fat and protein** on physical and sensory properties of milk beverages

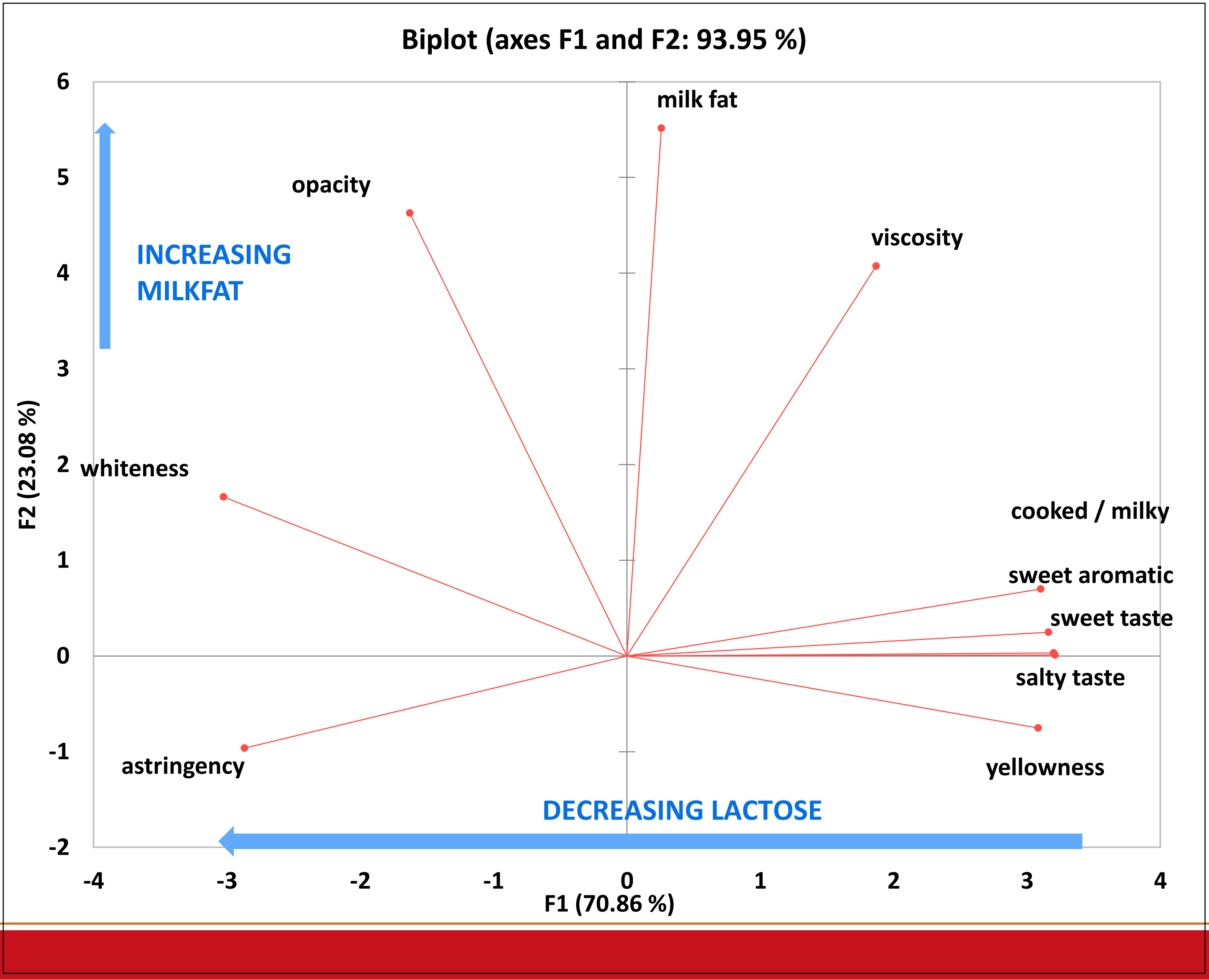
REPRESENTING THE DAIRY BEST

Milk beverages that are lactose free

OBJECTIVE

Determine the impact of full lactose removal by UF, fat and protein on sensory and physical properties of milk

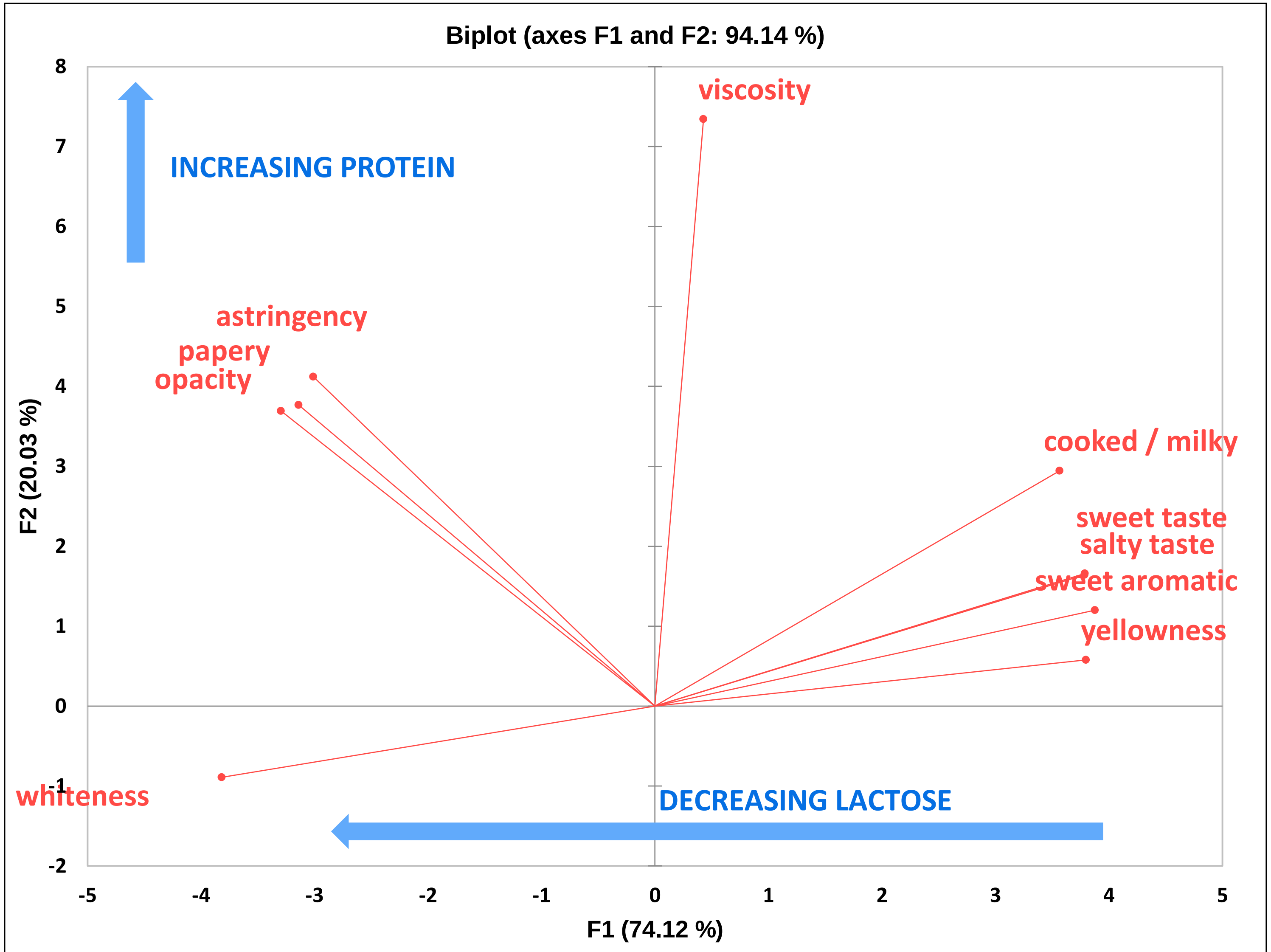
Exp. 1 – Fat impacts flavor & appearance



- **Lactose removal increased appearance/whiteness and astringent mouthfeel**
- **Lactose removal decreased cooked/milky, sweet aromatic, sweet and salty tastes**
- **As milkfat percentage increased so did milkfat, cooked/milky and viscosity**

Exp. 2 – Protein impacts flavor & appearance

Lactose Removal



- Lactose removal increased whiteness and astringency
- Lactose removal decreased cooked/milky, sweet aromatic, sweet and salty tastes
- As protein percentage increased so did opacity, papery, viscosity, and astringency

REPRESENTING THE DAIRY BEST

Practical Application

Lactose free milk beverages can be manufactured by removal of lactose using ultrafiltration (UF)

- Produce a wide range of sensory properties and nutrients to consume as-is or as a lactose free (and sugar free) base for manufacture of flavored milks.

DAIRY PROTEIN BEVERAGE PLATFORM

Dairy Protein Beverage Platform

LOOKING BACK

- Effect of dairy protein type (MPC and MCC) on beverage flavor and physiochemical properties (Vogel et al. 2021)
- Viscosity and gel formation of MCC (Dunn et al. 2021)
- Effect of MCC purity on sulfur eggy flavor in protein beverages (Whitt, Pranata et al. 2022)

DAIRY PROTEIN BEVERAGES

LOOKING FORWARD

- Role of mineral composition, pH and added minerals on heat stability of milk protein
- Dipotassium phosphate impact on milk beverage viscosity and color (Hoyt and Pranata et al.)
- The impact of hot and cold UF on mineral balance and heat stability on MPC (Truong et al.)
- Physical properties heat stability of lactose free miceller casein concentrated model beverages
- The role of retort vs. DSI UP on physical and sensory qualities of protein beverages (Liu et al.)

Delivering desirable protein beverages

1

Understand how processing impacts flavor

- Dipotassium phosphate impact on beverage physical properties

REPRESENTING THE DAIRY BEST

DKP & Viscosity

Protein Beverage Additives

Often added to improve mouthfeel and heat stability

Consumers do not want these ingredients!

Common additives

Calcium Chelators

Bind calcium and prevent protein aggregation (de Kort et al., 2012)

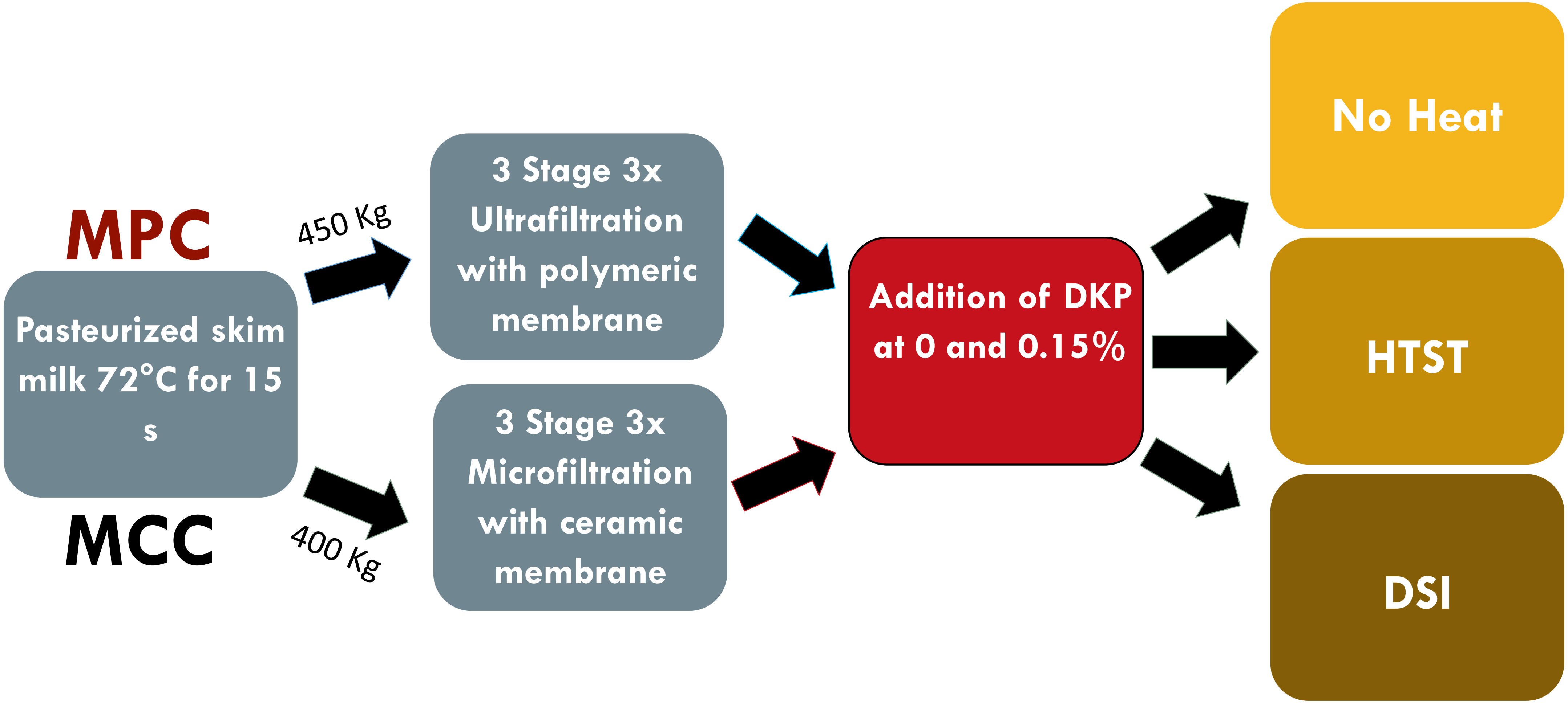
Hydrocolloids

Group of polysaccharides and proteins that either provide texture (thickening agent) or produce a gel network (gelling agent) that can suspend small particles and can increase viscosity of a food system (Fallourd and Viscione, 2009; Williams and Phillips, 2009)

Dipotassium phosphate

(**DKP**: K_2HPO_4) is a common ingredient used in dairy creamers processed under UHT conditions to prevent changes in coagulation (National Center for Biotechnology Information, 2022)

Experimental Design



These experiments were done in duplicate

REPRESENTING THE DAIRY BEST

Beverage Processing

No Heat

- Beverages received no heat treatment after filtration and addition of DKP

HTST Processing

- 72°C for 15 seconds

DSI Processing

- 140°C for 2.3 seconds

Practical application and future work

The findings from the study may be useful for beverage manufacturers in the formulation of clean label dairy protein beverages. **<u>DKP is not needed at 7.5% protein.</u>**

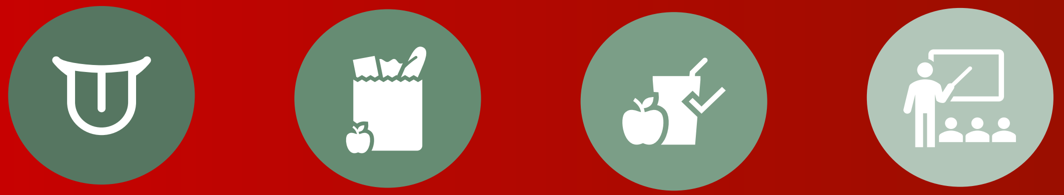
Future work

- The role of phosphates and other salts in high protein beverages
- Clean label approaches to control viscosity and protein aggregate particle size in shelf-stable high protein milk based beverages.

OPPORTUNITIES:
Moving Forward

Tremendous opportunities exist for positioning of dairy foods to deliver what consumers STILL want

- **Flavor and functionality**
- **Minimal ingredients/clean label**
- Nutrition
- Education, messaging, positioning



Dairy Beverage Platform: Moving Forward

Ongoing work:

- Clean label milk and milk protein beverages
  - Processing parameters to optimize flavor and functionality
- Consumer messaging:
  - Clean label
  - Local
  - Dairy Education (virtual vs on farm)

Acknowledgements

Collaborator:
Dave Barbano, Cornell University

MAD Lab 2022

Acknowledgements

Sensory Service Center

PIONEERS BY NATURE
dairy west

DMI
DAIRY MANAGEMENT INC.™

THE DAIRY ALLIANCE

Creating new paths forward for the Dairy Industry

Geri Berdak
Farrah Newberry
The Dairy Alliance

Cover today…

- Our role in creating new paths forward for the Dairy Industry
- And demand for our milk
- Our 2022 progress

  ….and 2023 focus

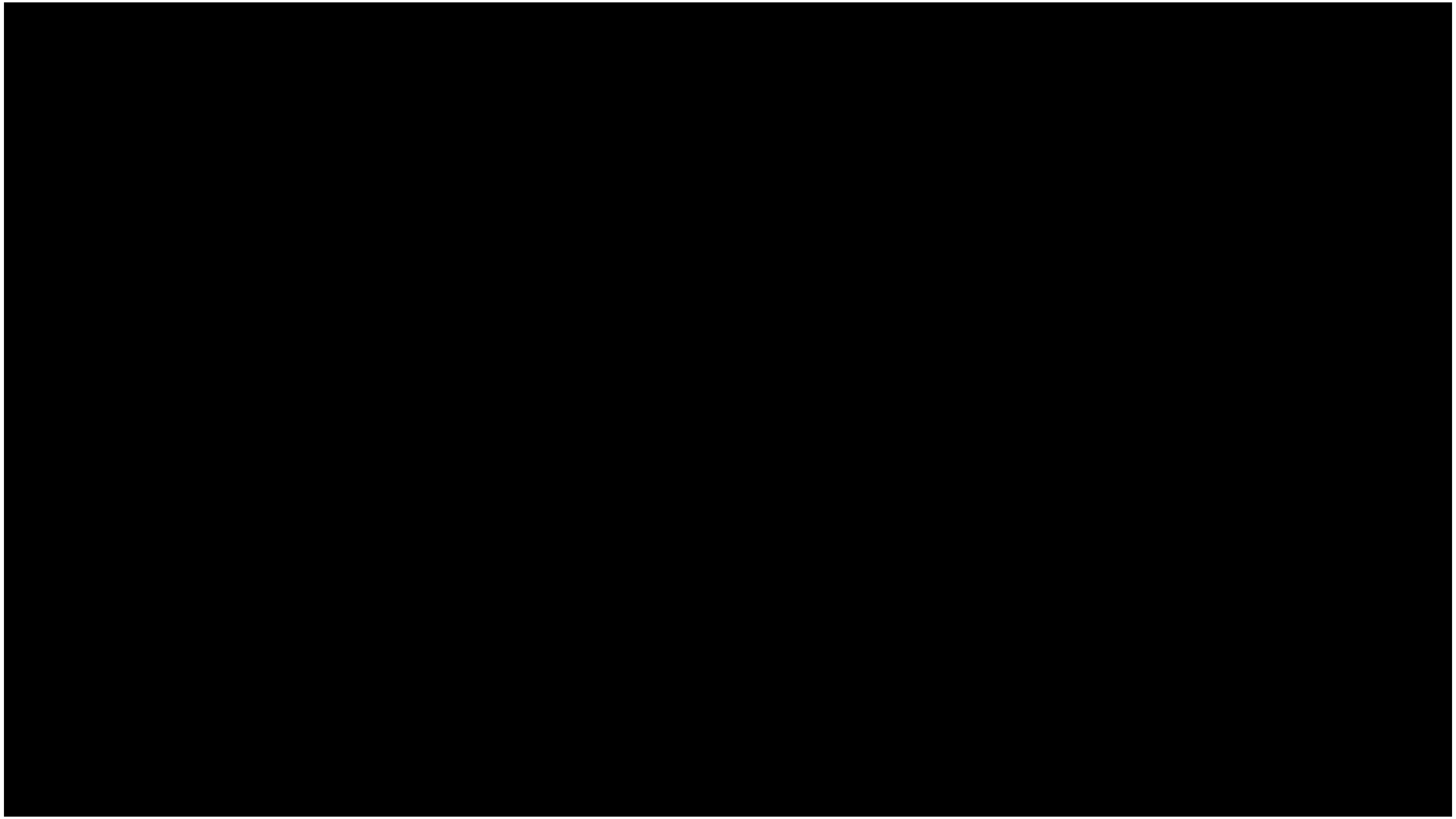
But first, How about those Dawgs?!!

The ~~Mailman~~ Milkman Delivers

We staged an event around Stetson Bennett changing his nickname from the Mailman to the Milkman, and help him launch his new persona, creating content throughout the process.

PARTNERSHIP MARKETING & BRAND COMMUNICATIONS

POWERED BY GEORGIA MILK



About The Dairy Alliance

We are not your grandma's checkoff program!

About The Dairy Alliance

OUR VALUE PROPOSITION

We are a consumer-focused and action-oriented catalyst in the Southeast driving to build a vibrant region with sustainable demand for milk and value for dairy farm families.

We are obsessed with excellence, action, impact, honesty and integrity and are focused on achieving a reputation as dairy experts, leaders and advocates in the Southeast.

OUR COMPETITIVE ADVANTAGE

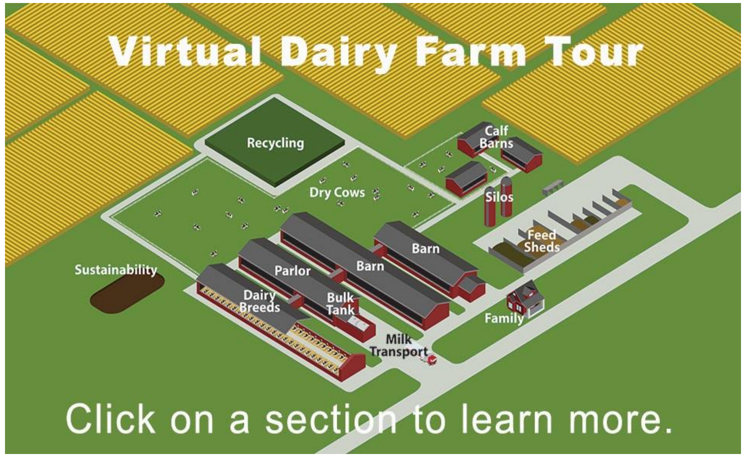
- Strategic connections, alliances & partnerships across dairy industry
- Southeast consumer insights, foodservice and marketplace trends
- Dairy category insights & innovation
- Strategic marketing and Brand expertise
- Nutrition & wellness expertise

2020 Commitment to Modernize Checkoff

From	To
Communicating	Marketing
Short term vison	Future forecasting
Nutrition	Wellness
The Dairy Alliance alone	The Dairy Alliance + Partners
Shotgun - All Consumers	Precision /Targeted consumers
Schools as a program	Youth is audience/Schools as a channel

2022 Highlights

2022 Year in Review



2022 Year in Review

2022 by the Numbers

28% Increase in school milk sales where programs were implemented in 2022 Through bulk milk dispensers, dairy optimization grants, FUTP60, trainings

2 ...paigns ...l Immunity)

11/2 11 menu/ LTO promotions
2 items developed fr...
insights and id...

...% increase in reach/impressions per campaign over last year

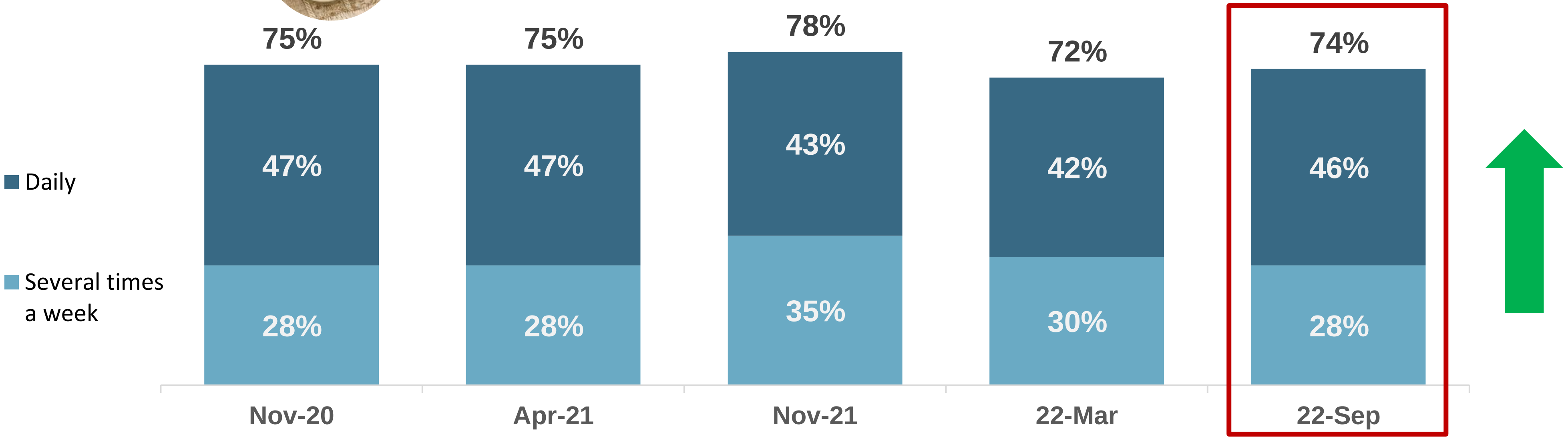
20% Reduction in operating costs in 2022 vs 2021

9,247% Increase in TDA blog visits compaired to same time 2021

2.7 M Increase in retail milk units sold in one month during the Atlanta campaign (compared to same time period YA)

Southeast Fluid Milk Volume - Daily milk consumption has risen to April 2021 Levels

How often household consumes dairy milk



Metric	Objective / Goals	2022 YTD
% HH Penetration in SE	93%	93.10%

Source: Total Respondents in Dairy Alliance Region (n=984)
*Q22 How often do you or other members of your household **consume** each of the following?*

2023 Focus Areas

Increased focus on Consumer & category intelligence

More integrated marketing campaigns focused on preserving and growing fluid milk demand

New focus on Dairy Transformation

Strategic Initiatives for 2023

Drive Milk Volume

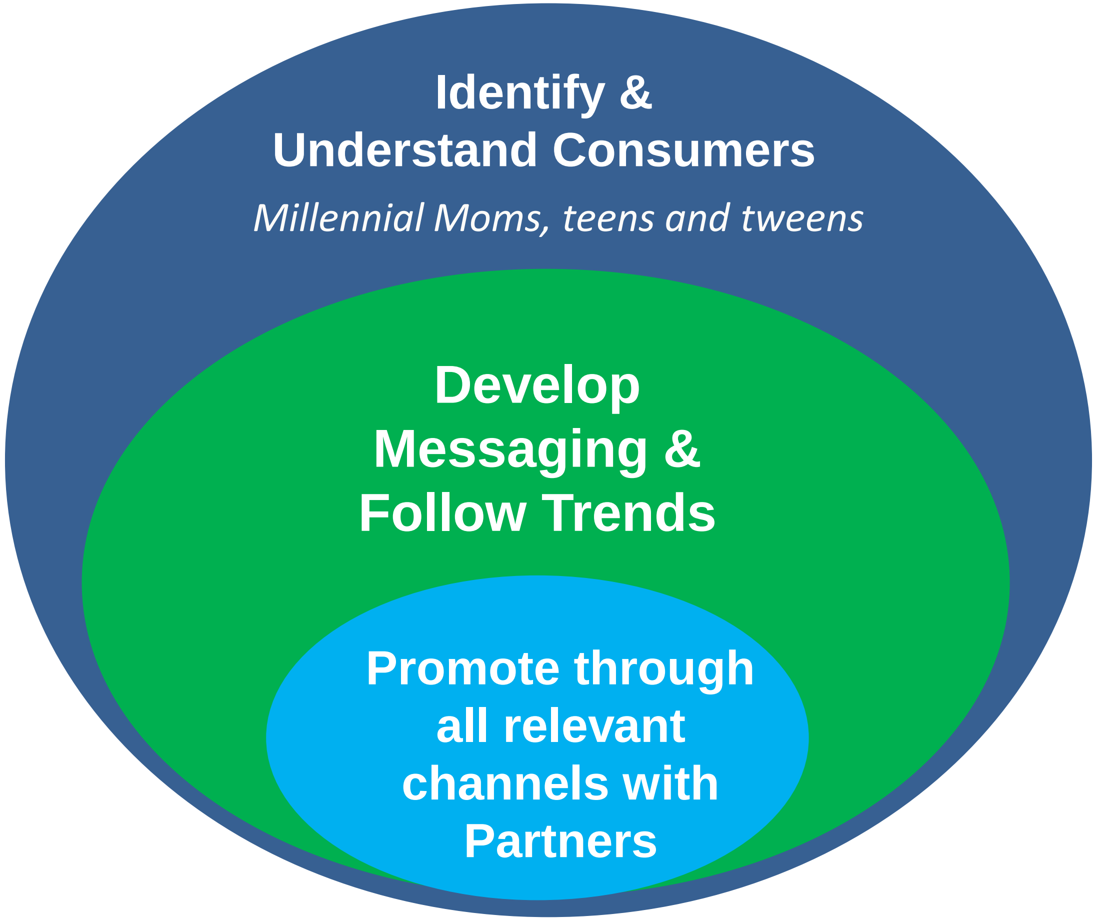
Increase Dairy's Reputation

Transform Dairy

Build Checkoff Support

Drive Milk Volume

Continued focus on a targeted integrated content marketing approach



Protect and Grow Fluid Milk Demand

Driving Fluid Milk Volume
2023 Strategies

Continue to deliver breakthrough content that influences purchase

Continue to market milk wellness claims with MilkPEP

Use new social listening to identity barriers to purchase and test messages

Proactively address consumer barriers to purchase – while promoting the benefits of milk/milk beverages

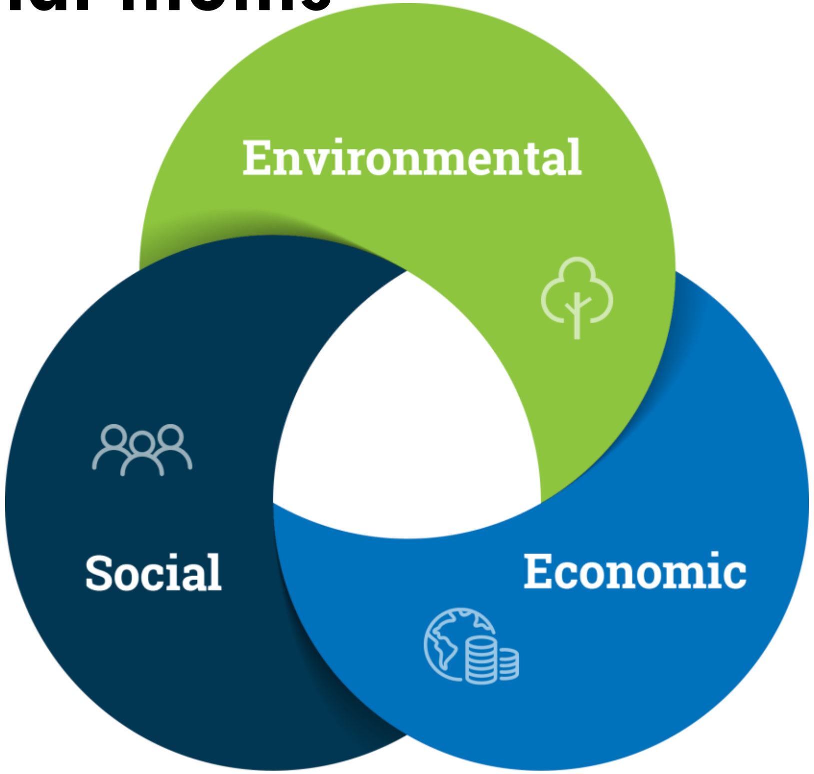
Promote The Dairy Alliance as valuable adviser to foodservice channels and retailers

Drive milk and dairy usage on menus and increase purchase at retail

Reputation

Dairy reputation

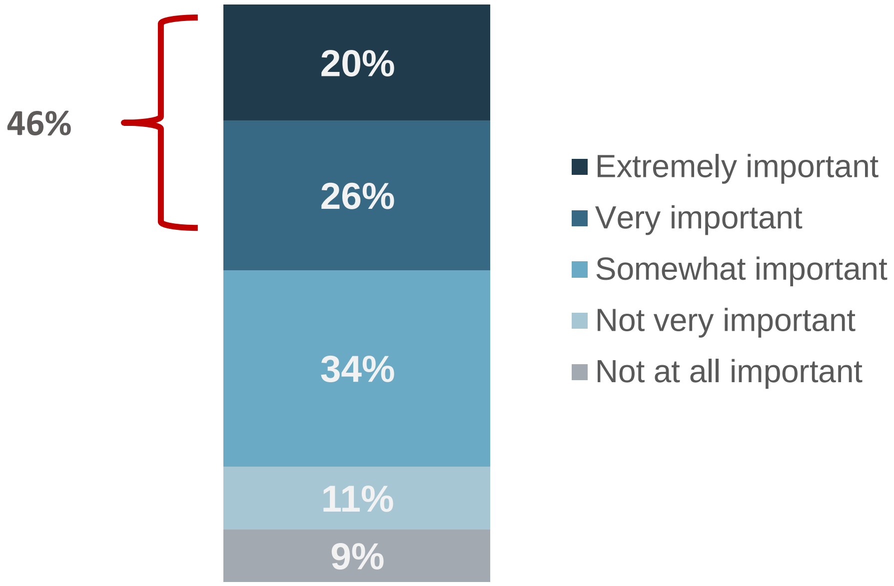
Improve perception of dairy & the dairy industry as a source of human nourishment, renewable energy among Gen Z and Millennial moms



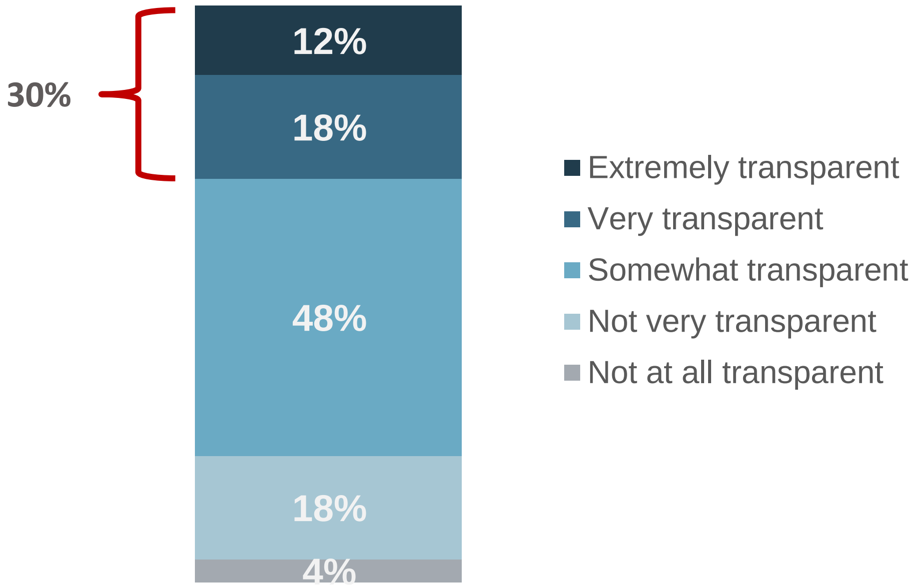
Sustainability Matters!

Just under half of those in the Dairy Alliance region find environmental sustainability important in purchase decisions, but don't always see the industry as transparent.

Importance of environmental sustainability in dairy purchase decisions



Transparency of dairy industry with regards to sustainability



Those who say extremely/very important are more likely to say extremely/very transparent (46%)

Source: Total Respondents in Dairy Alliance Region (n=984)
Q26 How important is environmental sustainability in your dairy product purchase decisions?
Q29 How transparent do you think the dairy industry is with regards to sustainability?

PD
PW

ESG/Sustainability is a Huge Opportunity for Dairy

- Environmental (Don’t overthink this – what are already doing)
  - Triple Crop, Green Grass, No Snow
- Social (employee trainings, community support)
- Governance (F.A.R.M., Certifications)

Created 3-year Sustainability Plan

- Resource Library
- Video Series
- The Dairy Truth
- Alliance for the Chesapeake Bay

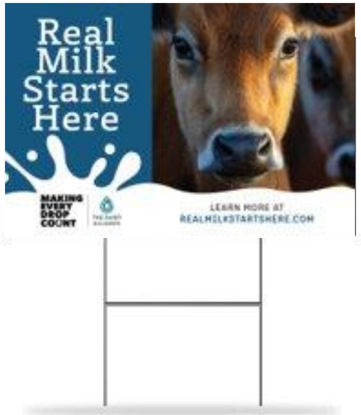
Launched on September 19th Climate week

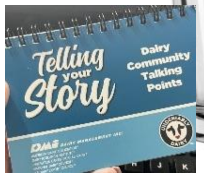
Build Checkoff Support

Making Every Drop Count

Strengthen perceived value of checkoff

Making Every Drop Count





MAKING EVERY DROP COUNT | your DAIRY CHECKOFF Dairy Management Inc. | THE DAIRY ALLIANCE

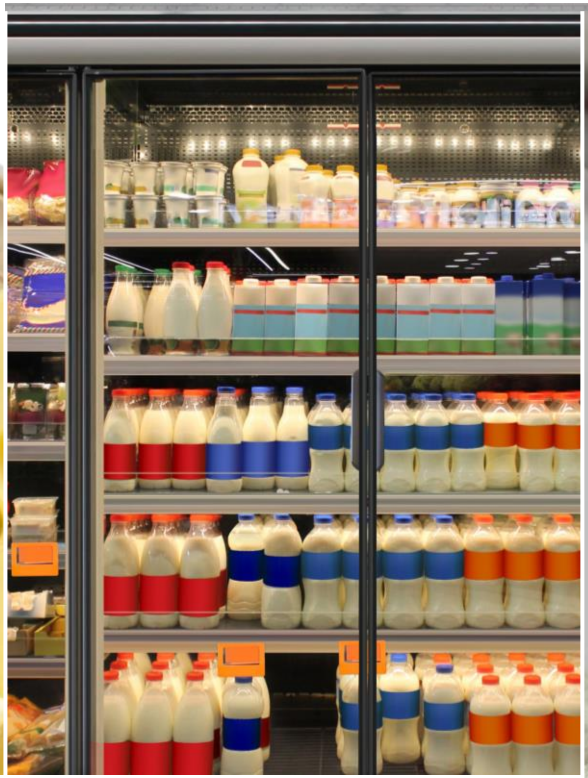
Transform Dairy

Revitalize the Dairy industry in the Southeast

Identify high-growth opportunities and stimulate, and secure outside investment technology and innovation

The Marketplace is Changing

Dairy Remains a Powerhouse Category



96%
of U.S. households contain dairy

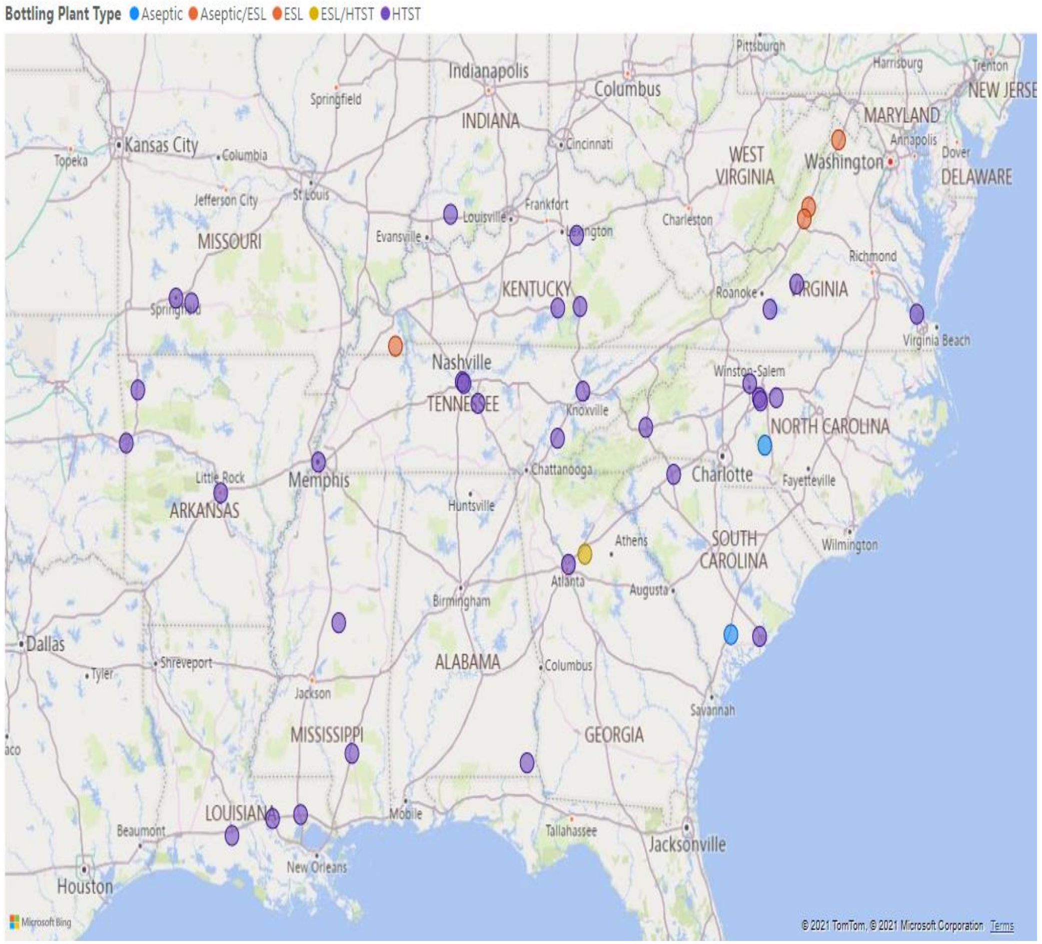
Top
edible aisle at retail

18%
milk solids moving to export

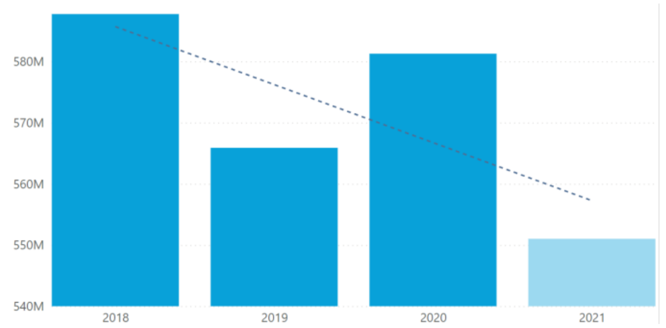
667 pounds
consumed per person in 2021

In the Southeast…

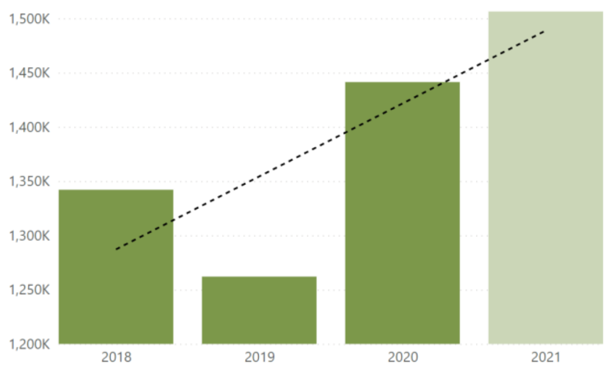
- Growing consumer population
- All states but Georgia have experienced declines
- SE dairy processing assets lack diversity
  - Most assets are dedicated to HTST milk
  - Need for processing is big
  - Plants are closing in response declining demand



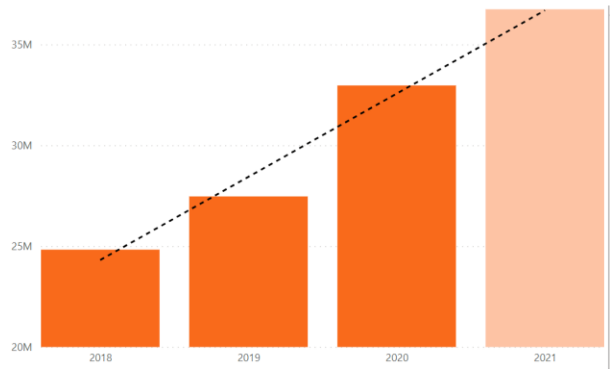
Dairy Alliance Region – Retail Milk sales (gal eq)



Dairy Alliance Region – Aseptic sales (gal eq)



Dairy Alliance Region – Lactose-free sales (gal eq)



Not all milk is created equal

- While overall milk sales are declining, there are sub-categories with growing demand.
- Most dairy cooperatives in the SE market lack processing capacity for milk beverages with a positive growth trajectory – these assets are in the hand of proprietary processors.
- **Therefore, A lot of this milk comes in from outside our market.**

ceres

Source: IRI MULO-C

Dairy is critical in the Southeast

How can we position the Southeast to capitalize on opportunities for growth?

Dairy Transformation
Strategies for 2023-2025

Invest in dairy talent and innovation through centers like North Carolina State's SDFRC

With Dairy Research centers in the Southeast, identify and capitalize on the biggest opportunities for dairy

Build a roadmap to market for processors & startups

Scout and support high potential dairy startups and processors in and to the Southeast

Attract investors

Catalyze investment through transdisciplinary conversations and planning

Strategic Outcomes

IN 3 YEARS…

More, High Value Market opportunities- unlocked for Southeast Dairy

More Commercialized Science - in claims, processing technology and differentiated milk in the Southeast

More Outside Investment - in the Southeast

More Dairy Trained Scientists – for the food and beverage industry

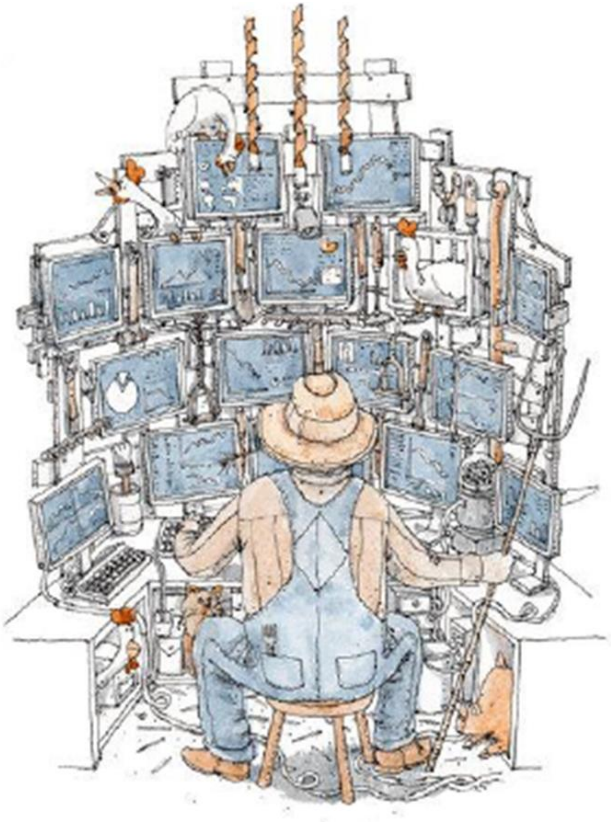
Dr. MaryAnne Drake

William Neal Reynolds Professor

Director of the Sensory Service Center

Director of the Southeast Dairy Foods Research Center (SDFRC) at North Carolina State University

Pitfalls and Opportunities of Using Farm Data for Dairy Decision Making



Michael Overton

Global Dairy Platform Lead, Zoetis

Georgia Milk Producers – January 17, 2023

zoetis

Dairy Owners and Managers are Bombarded with Many Different Sources of Data

- Data = a set of facts or figures; bits of information but not information itself

- When data are processed, organized, and interpreted appropriately, it may become useful information

- Dairy data should be used to make decisions that benefit the dairy:
  - Increase Revenue
  - Lower Expense
  - Lower Risk
  - Help Cows
  - Help Employees
  - Help Sustainability

Proper Use of Dairy Data → Driving Continuous Improvement

- How are ***we*** doing?
- Has anything changed?
- What was the cause?
- What actions do I need to take now

tomorrow

next month?

But Data Can Also Be Misused or Misinterpreted

- When data are viewed incorrectly or misinterpreted, bad things can happen:
  - Choose the wrong sire for future breeding needs
  - Fire a breeding technician for “poor” results
  - Intervene to “fix” a problem that doesn’t exist (Type I Error)
  - Fail to intervene to fix a problem because you do not realize it exists (Type II Error)
  - Draw the wrong conclusions about relationships:
    - High milk production “causes” poor reproduction – NO!
    - Mastitis causes higher milk production – NO!

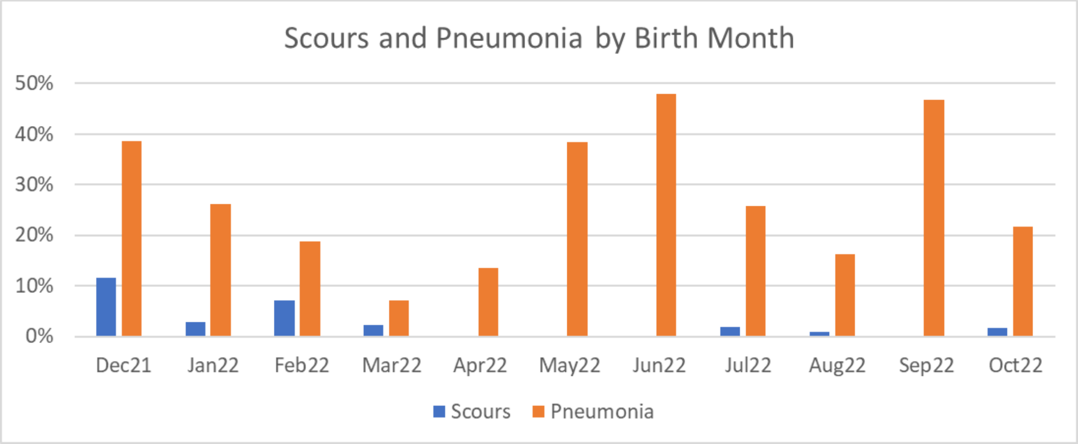
A Few "Watchouts" When Evaluating Data

- Accuracy:
  - Data quality – is it complete and representative?
  - Bias – intentionally or unintentionally missing data
  - Variation – incorrect due to random chance
- Timeliness:
  - Lag – delay between occurrence and detection or recording
  - Momentum – dampened magnitude of change due to large history of records included
- Confounding
- Beware of the "allure" of benchmarking
- Association vs. Cause and Effect (Correlation vs. Causation)

Data Quantity vs. Data Quality

- Herd Effect - Some herds report lots of diseases, some report very few.
- Example:
  - Average Scours Risk by 30-d = 3%
  - Average Pneumonia Risk by 90-d = 27%

Good or bad?



A Holstein herd that averages 166 calves born/month

- Some dairy employees are under subtle/indirect pressure to have fewer diseases *reported* or fewer cases *treated* (Impression that the owner wants fewer diseases)
  - Example: Owner wants bragging rights for low disease records but workers keep a side journal)
  - DAs, METR, MAST, KETOSIS, PNEUMONIA, SCOURS, etc.

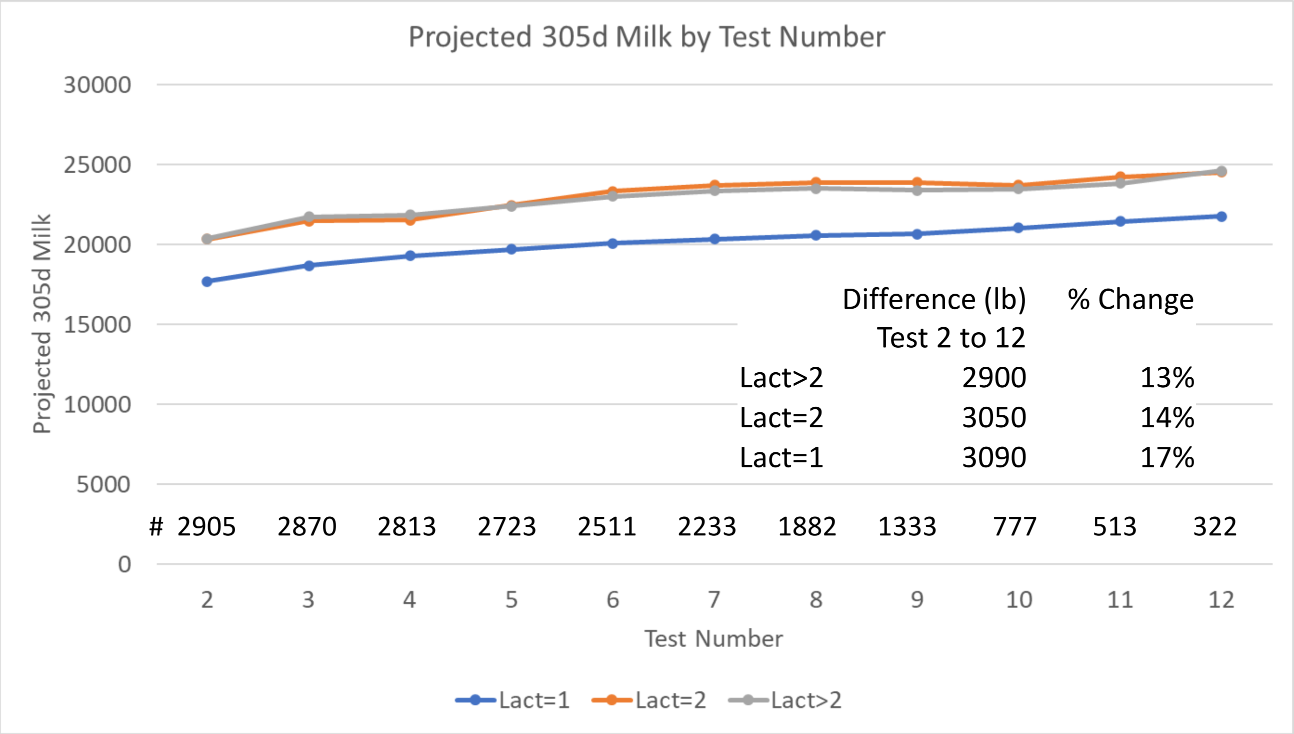
ALL Dairy Records Suffer from Some Form of Bias

Bias: a systematic error introduced into sampling, testing, or analysis by selecting or encouraging one answer over others

- Selection bias
  - Sampling bias
  - Volunteer bias
  - Exclusion bias
  - Culling bias
  - Recall bias
- Outlier bias
- Observational bias
  - Measurement bias
  - Detection bias
  - Recording bias

MASSIVE problems when benchmarking

<u>Culling Bias</u> (Survivorship Bias) = The error that occurs by not considering the effect of removing animals from the population over time



When evaluating results across lactational time or across parities – ask yourself, “might this difference be due to the removal of certain cows?

Averages can lie – an Example of Outlier Bias:

"Michael Jordan walks into a bar and everyone inside becomes a millionaire…on average."

- Average = a number expressing the central or typical value in a set of data
- 50 people are at a bar for happy hour
  - Some are college students
  - Some just got off work at a local business
  - Median net worth = $85,000, Mean net worth = $86,000
- Michael Jordan walks in, net worth ~$1.6 billion
- New average in the bar = > $31 million

Benchmarking is Seductive: "How Does My Dairy Compare?"

- Dairy farmers love to compare their performance to others.
- "Easy" to do but hard to do correctly with dairy data (and *very dangerous*)
  - No two facilities are identical (cow flow, acres farmed, cow comfort, age of facility, etc)
  - No two herds are the same (VWP, DNB strategy, genetics, milking frequency, feeding, components, etc)
  - Debt structure and Business plan – Long term? Short term?
  - Data challenges – disease detection, recording, treatments

Cognitive or Observational Bias – Seeking answers where the looking is easy

- A better approach → seek answers where they're likely to be found.

- Benchmarking seems easy
  - Gives instant feedback
  - Allows you to pat yourself on the back or beat yourself up
- Requirements for benchmarking:
  - Similar production system, geography, time run, etc.

    AND
  - Objective, consistent measurable outcomes

– But it is fraught with many challenges

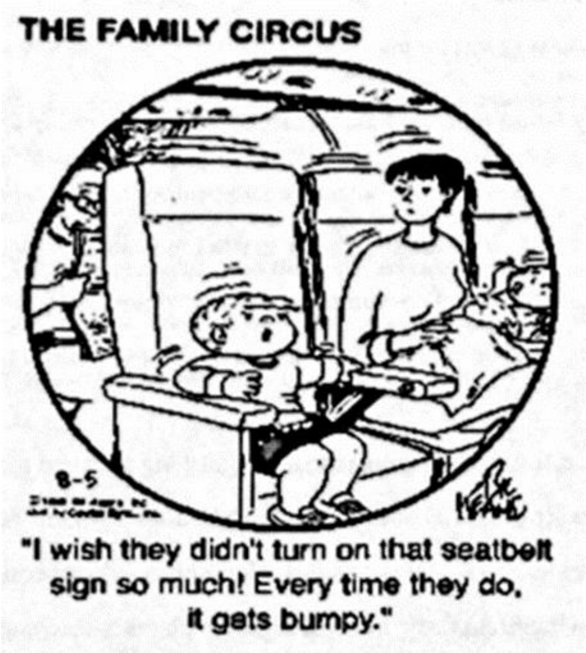
Instead of Traditional Benchmarking… Monitor Internal Performance and Processes

- Monitor internal processes to drive repro vs. comparing your 21-d PR to your neighbor’s
  - Monitor your transition performance:
    - Appropriate dry period and close-up periods
    - Proper stocking density in prefresh and postfresh pens
    - Transition disease – RP, Metritis, Ketosis, etc.
  - Monitor compliance within your TAI protocol – are cows missing out on shots?
  - Are you achieving greater than 95% of first services within your targeted timeline (i.e., 70-76 DIM for a weekly Double Ovsynch)
  - Are all cows being preg checked at the correct time?
  - Are re-insemination intervals in order?

Association vs. Cause and Effect (Correlation vs. Causation)

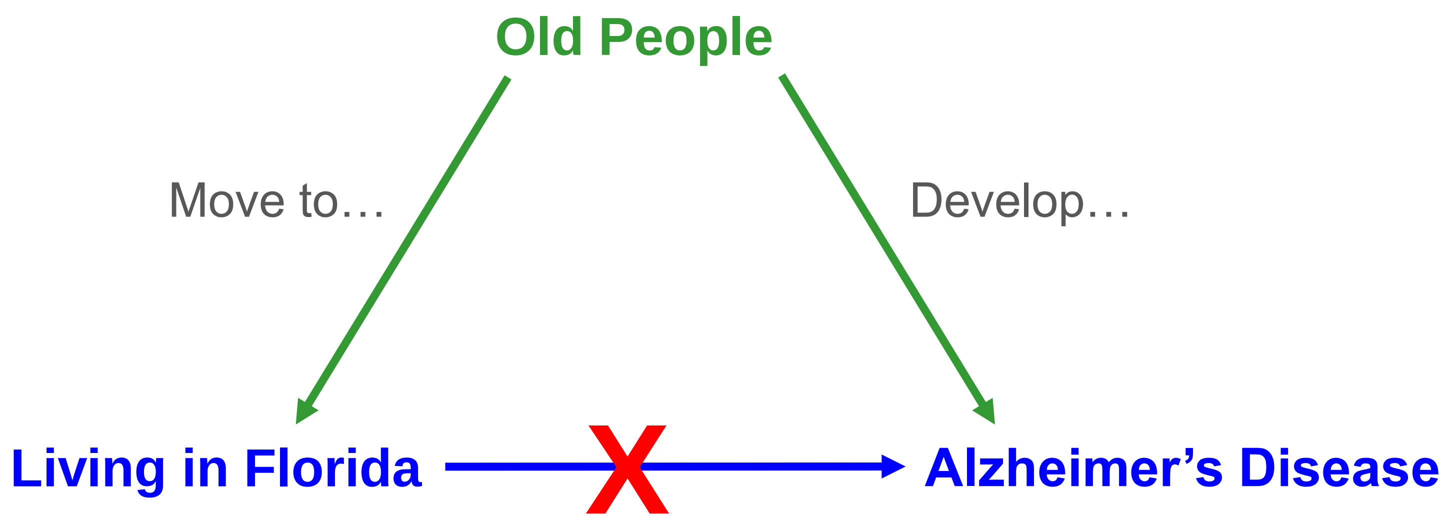
- Does A "cause" B?; Does B "cause" A?
  - Might there be a hidden factor involved?

- Examples:
  - A larger shoe size is correlated with greater reading ability
  - The more firemen and fire trucks sent to a fire, the more damage is done
  - Children who get tutored get worse grades than children who do not get tutored



Beware of Confounding Variables

- A confounding variable is an “extra variable” that you didn’t account for that is related to the outcome you’re interested in
- A confounding variable can have a hidden effect on your outcome of interest



Correlation Concerns

- People working with very large data sets are often going to find correlations but may have no clue about causality

- Example: Does Mastitis cause higher milk and longer lactations?
  - Actual results for first lactation cows in a large, US, Holstein herd:

# MAST	Avg 305M	DIM	Count
1	21,641	239	1779
2	21,973	251	398
>2	23,223	255	103

  - Why?
  - What’s the rest of the story?

- Subject matter knowledge matters

Beware of Confounding Variables:
First lactation Milk for Heifers from 2 Growers
(heifers had same breed, genetics, calving range, culling risk)

Heifer grower A:

- 574 heifers
- 20,434 lb 305M

Heifer grower B:

- 584 heifers
- 21,186 lb 305M

752 lb more milk for Grower B heifers
P=0.02
Let Grower B grow them all, right?

Not so fast…

Heifer grower A:

- Days in Close-up:
  - 21 d
- Age at Fresh:
  - 21.9 months
- Weight at 2 DIM:
  - 1269 lb

Heifer grower B:

- Days in Close-up:
  - 28 d
- Age at Fresh:
  - 23.2 months
- Weight at 2 DIM:
  - 1348 lb

More Days in Close-up => More milk
Higher Weight at Calving => More milk

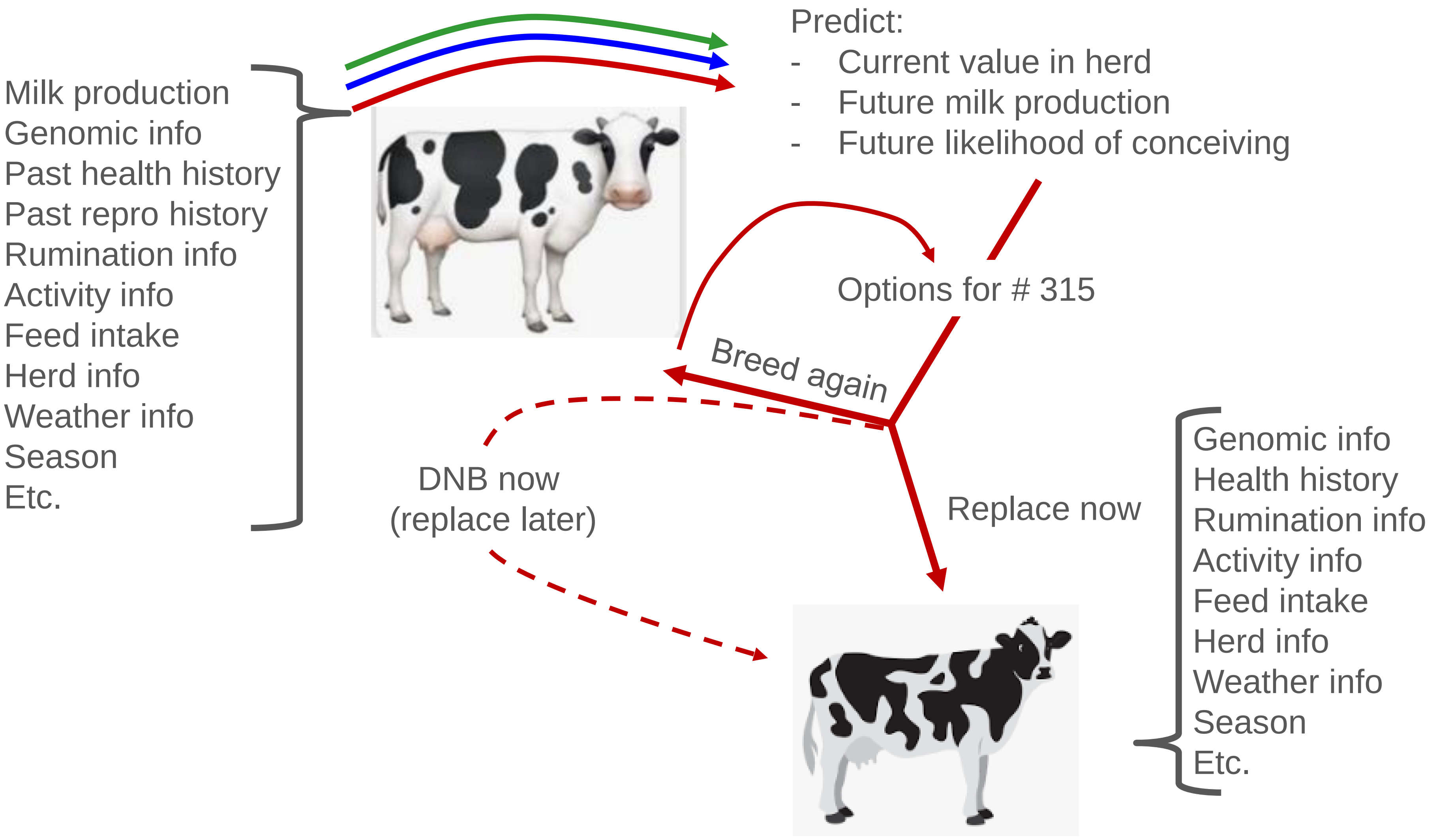
So, in the end, the growers were not really different…
But ***when*** the herd took possession of the heifers and ***how they*** managed them prior to calving differed

“Big Data” and Dairy Production

- Predictive Analytics uses “Big Data” to find meaningful patterns to forecast future events, and evaluate the attractiveness of different solutions
  - Sunday morning, got in my car and the maps feature popped up to tell me that traffic was clear and my trip to church should take 11 minutes…
  - How many times have you had an ad pop up on your phone with “You might like this…”
- Baseball – has its own branch of analytics to predict a player’s future potential value
- And, guess what… we are there/getting there with dairy as well

A Hypothetical Example: Cow # 315

- Cow #315 is a 3rd lactation cow, 155 DIM, 83 lb ECM, not pregnant



Monitoring Day-to-Day Performance Doesn’t Require Machine Learning Skills

- But it does require some forethought, planning and careful application
- Good records are important
- Need to ask the “right questions”
- Caution: When Monitoring Performance, Don’t Confuse Goals with Metrics

- **Goal**: strategic outcome you want to accomplish
  - Should be measurable
- **Metric**: key indicator you use to determine progress towards your goal

Goal: Higher Average Milk Shipped per Day

- Metrics that might be important to monitor:
  - Heifer quality – age, size, health at first calving
  - Transition cow performance - disease risk, feed intake
  - Early lactation milk – Week 4 Milk or similar
  - Reproductive performance (21-d PR) → impacts DIM for the herd
  - Variation in milk by lactation group
    - Is my feeding management too variable?
    - Am I making the right culling decisions?
  - Genetics of my herd – am I selecting heifers & sires appropriately?
- Yes, we need to measure how much milk is shipped but it is the outcome and not a monitoring metric that helps us to improve

Monitoring

- Four general approaches for monitoring herd data:
  - Exception monitoring
    - Outlier identification – who needs attention NOW
  - Historical performance
    - What has been the RECENT, historical trend in performance?
  - “Peering into the future”
    - Are there any “Leading Indicators” that point to where performance is heading?
  - Monitoring Tasks (NOT waiting for Results!)
    - Employees, Processes, etc.

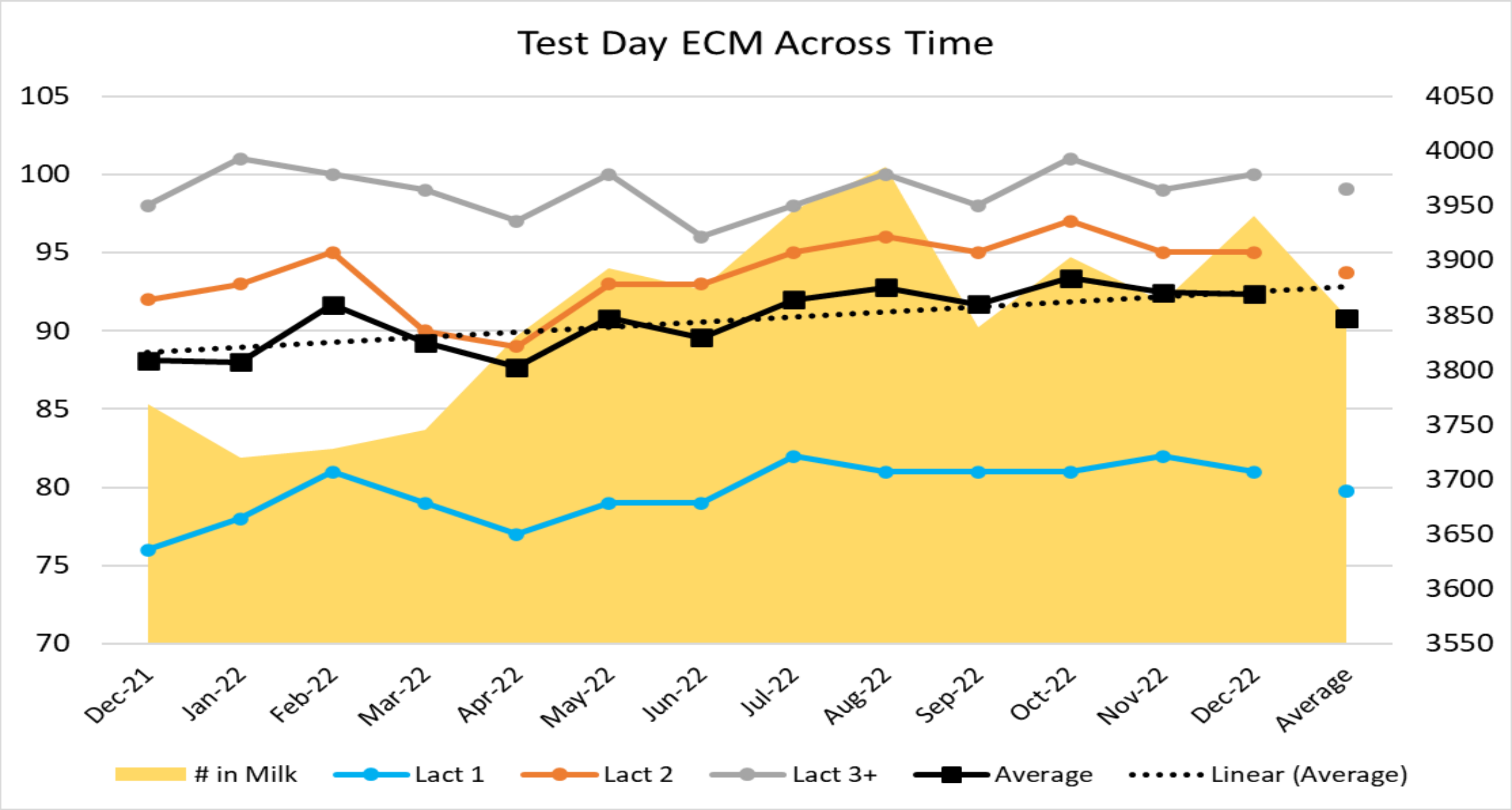
Key Areas of Importance for Monitoring

- Milk production
- Reproduction
- Transition – dry, closeup, and fresh period
- Health Issues Across Lactation – mastitis and lameness
- Youngstock
- Genetics

Milk Production

- Exception monitoring:
  - Which cows are in early lactation and underperforming?
  - Are there cows in mid to late lactation that are underperforming?
- Historical performance
  - What has been the trend in milk production (ECM)?
- “Peering into the future”
  - What is the weight/size at calving for my fresh heifers?
  - How are the fresh cows performing?
  - What are the projections for future calvings?
- Monitoring Tasks
  - Are feeders on time? Is the correct ration delivered consistently?
  - Are waterers properly cleaned/maintained?
  - Are pens milked at consistent times?

ECM by Lactation Group Across Time

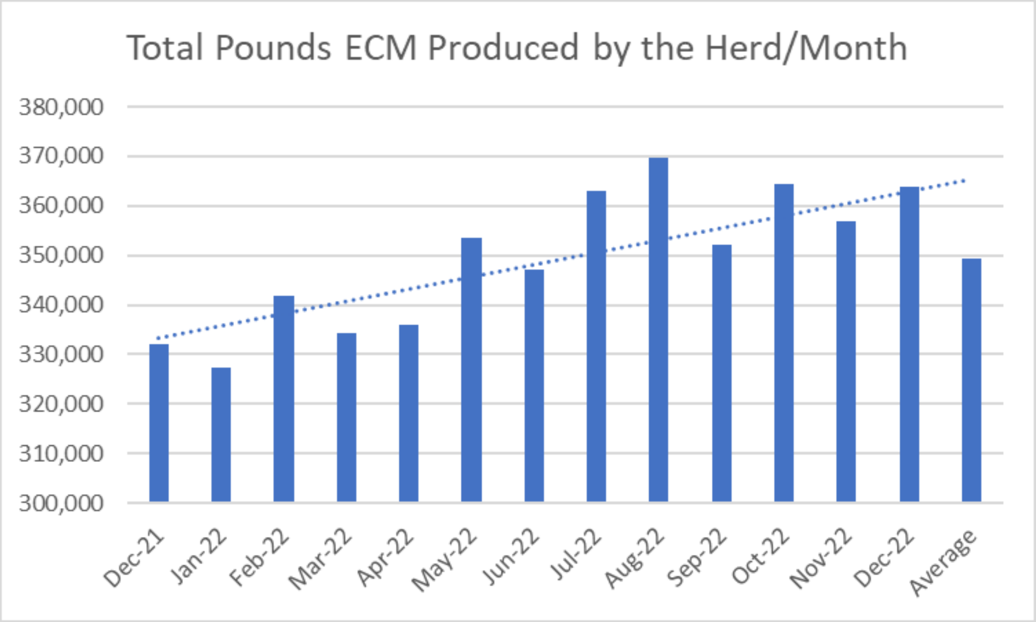


General whole herd trend is an increase in ECM over time

AND

Milking cow numbers have also tended to increase over time

Summarized View of the Previous Report: Total Production by the Herd/Month



The Goal:
More ECM Shipped

Previous 12 months averaged 3850 milking cows

Keeping slots full of healthy, productive cows is key to optimizing profitability

Projections for Milking, Calving, Drying, and Marketing:

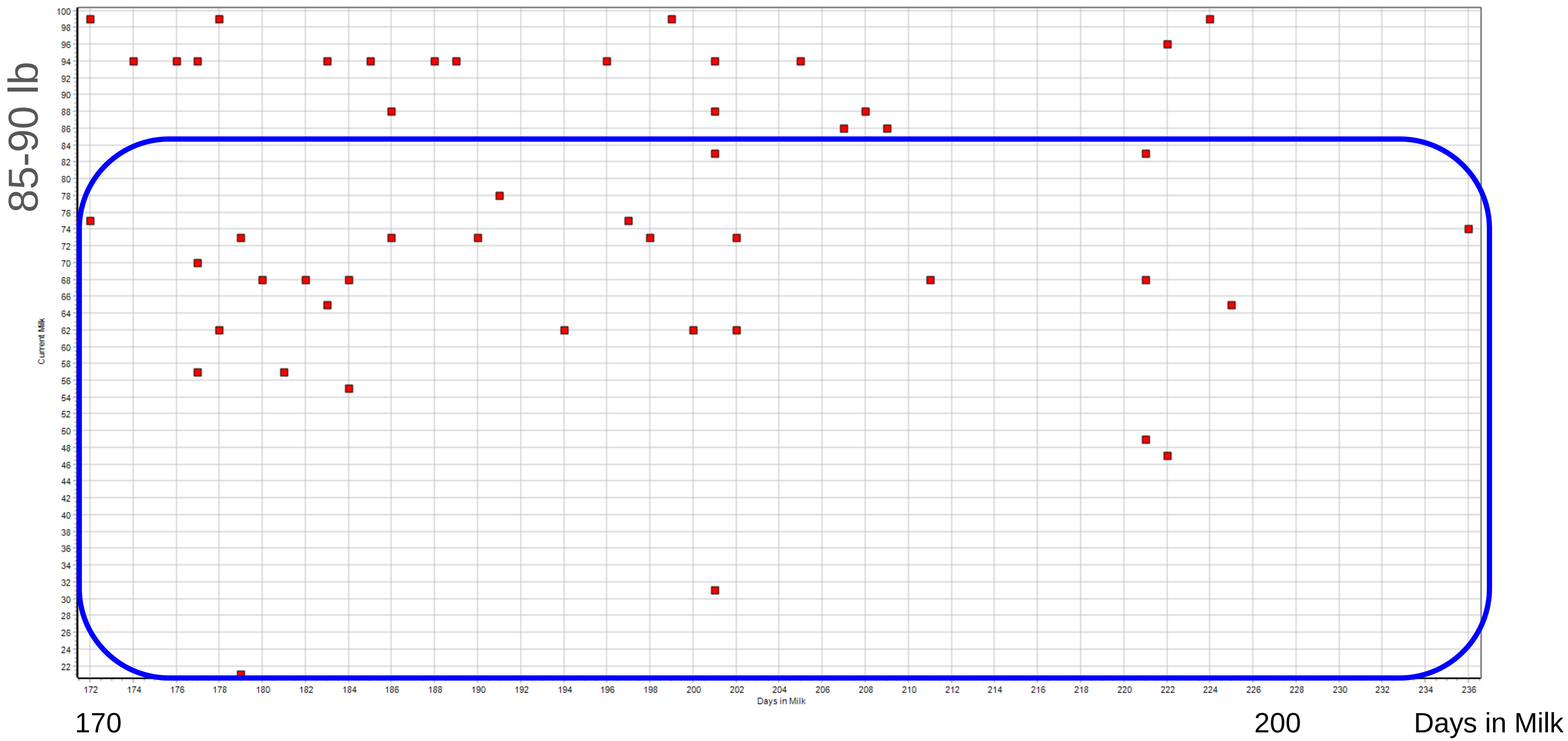
	January	February	March	April
Milking	4040	3954	3847	3911
To Calve	423+	364+	535+	491+
To Dry	373-	335-	336-	457-
To Market	136-	136-	135-	136-

Reproduction

- Exception monitoring:
  - Which cows are overdue for first service, preg check, or simply overdue?
  - Are there cows that should be flagged as Do Not Breed (DNB)?
- Historical performance
  - What has been the trend in 21-d Preg Rate and Insemination Risk?
  - What has been the trend for conception risk?
- “Peering into the future”
  - Are there trends in dry cow or transition performance that might negatively impact future reproductive performance?
- Monitoring Tasks
  - Are synchronization injections correct, no missing cows
  - Are breeders managing the semen tank/handling straws correctly?

Are There Mid to Late Lactation Cows That Need to be Made “DNB”?

Non-pregnant, older cows (lactation > 2) currently past 170 DIM
Projected decline in milk of ~ 0.16 lb/d → in 220 days, drop 35+ lb of milk
Estimated culling threshold for DNB cows = 55 lb for this herd

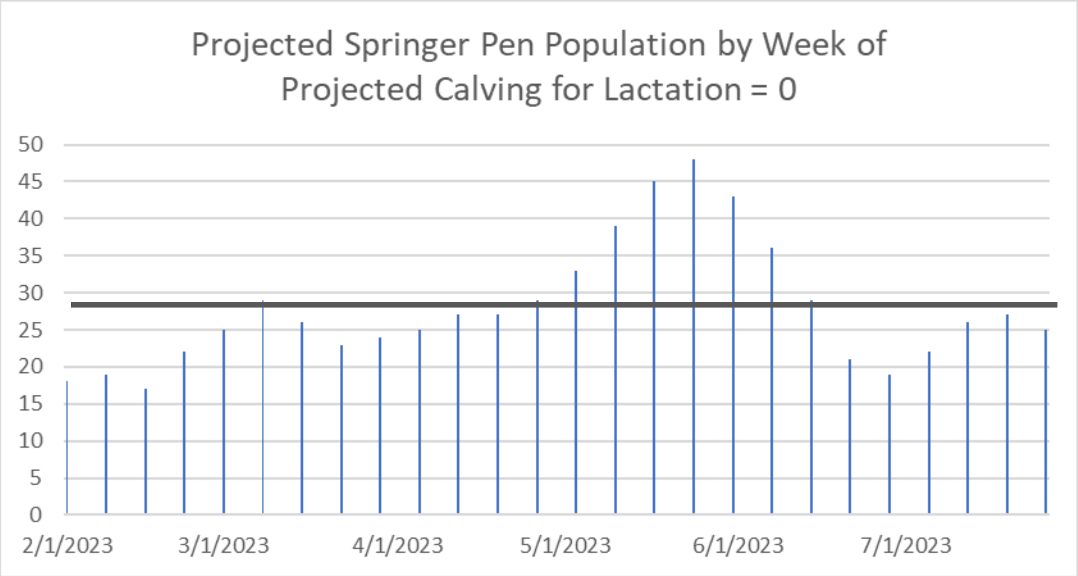


~30 cows that need further scrutiny regarding future breeding efforts

Transition Monitoring

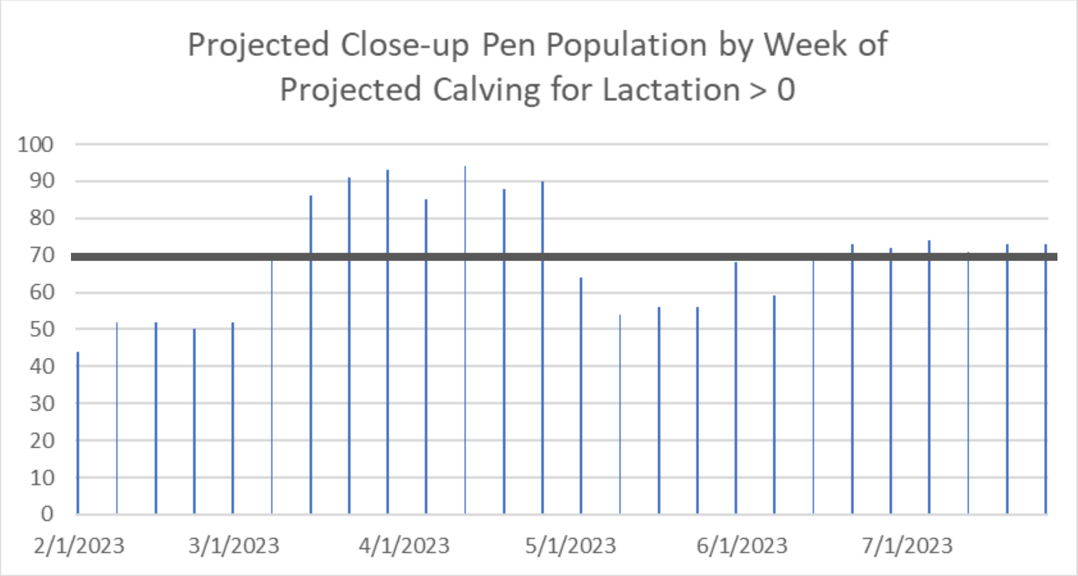
- Exception monitoring:
  - Which cows are in early lactation and underperforming?
  - Are there overdue cows in the dry pens that need to be examined?
- Historical performance
  - What has been the trend in transition disease risk?
    - Milk Fever, RP, Metritis, Ketosis, DA, Mastitis
- “Peering into the future”
  - What are the projected calvings? (are my cows likely to become overcrowded? Do I need to add more close-up capacity or plan to move fresh cows out earlier?)
- Monitoring Tasks
  - Are dry pens over-crowded today?
  - Are cows moved to dry pens and close-up at the right times?

Projected Calvings



Lact=0 (Springers)

- Average projected calvings/week = 7
- Capacity for ~28 in pen
- Projected to peak out at 172% of capacity



Lact>0 (Close-up Cows)

- Average projected calvings/week = 23
- Capacity for ~ 70 in pen
- Projected to have 7 weeks with >125%

Genetics Monitoring

- Exception monitoring:
  - Is there a sire used that is well below herd “standards”?
  - Are there animals receiving sexed semen that are below your genetic cut point goal?

- Historical performance
  - What has been the trend in genetic performance (DWP$, NM$, PTAM, etc.)?

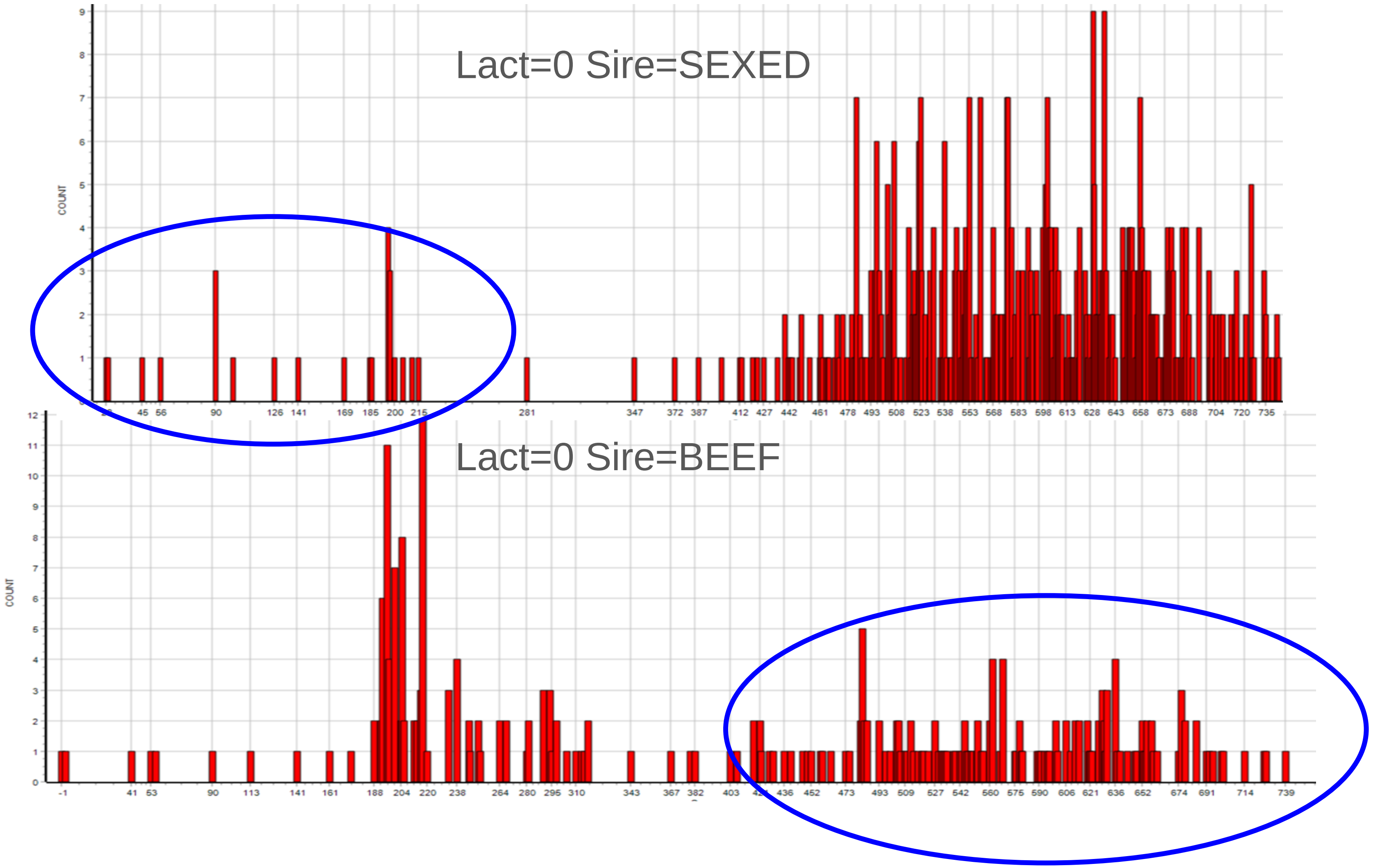
Genetics Monitoring

- “Peering into the future”
  - What is the trend for pedigree index PTAM for calves in-utero?
  - What are the genetic values of bulls used this month vs. previous months?
  - Based on my current use of different type of semen, how many heifers will I have in the future?

- Monitoring Tasks
  - Are the right cows inseminated with the right bulls?

Have the Heifers Been Inseminated with the Correct Semen Type?

Graph of DPW$ of Heifers by Sire of Conception for Their Future Calf



Lactation Health Issues (Mastitis & Lameness)

- Exception monitoring:
  - Which cows have chronically high SCC but no clinical cases recorded?
  - Which cows have 3 or more clinical cases recorded?
  - Which cows are chronically lame (treated more than twice in a lactation)?
- Historical performance
  - What has been the trend for early lactation disease risk?
  - What has been the trend for overall disease risk in the herd?

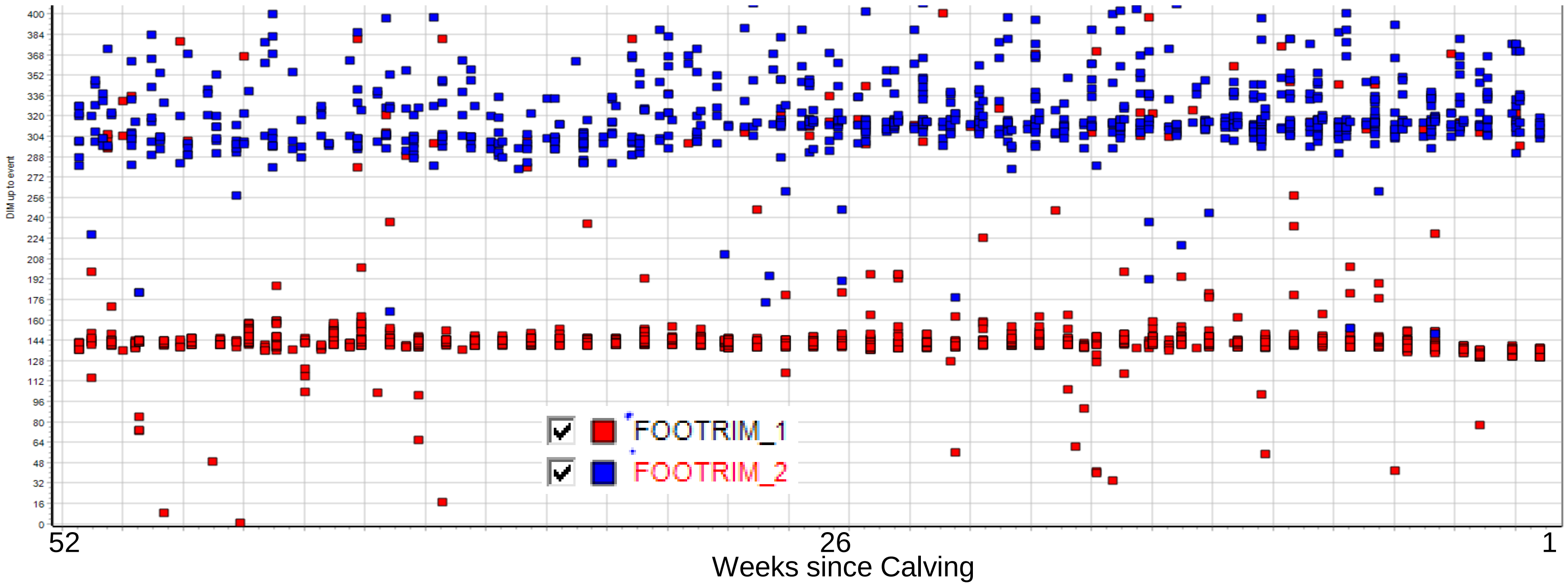
Lactation Health Issues (Mastitis & Lameness)

- “Peering into the future”
  - Is first test SCC changing over time? Has the incidence of fresh mastitis changed recently?
  - Are the proportion of LS*=2-3 cows increasing over time?
  - Are hoof trimming reports showing unfavorable trends in lesions?

- Monitoring Tasks
  - Cows prep, stall raking/bedding – stall hygiene evaluation/scoring?
  - Are cows moved just in time? Are cows standing too long?
  - Are routine trimmings occurring as planned?

LS = Locomotion score (1-5, where 1=non gait abnormality, 2=arch when walking, 3=arch walking and standing, etc.)

Are Routine Trimmings Occurring As Planned?



Routine trimming of most cows at ~140-146 DIM followed by a pre-dry trim

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Nov	Dec	Total
1st Trim @ 140-146 DIM	87	77	86	67	64	72	89	95	81	718
Total 1st Trims	110	113	116	104	99	121	137	132	123	1055
	79%	68%	74%	64%	65%	60%	65%	72%	66%	68%

Youngstock Monitoring

- Exception monitoring:
  - Are there heifers with more than X cases of pneumonia?
  - Are there heifers that are overdue for movement into or out of the breeding pen?

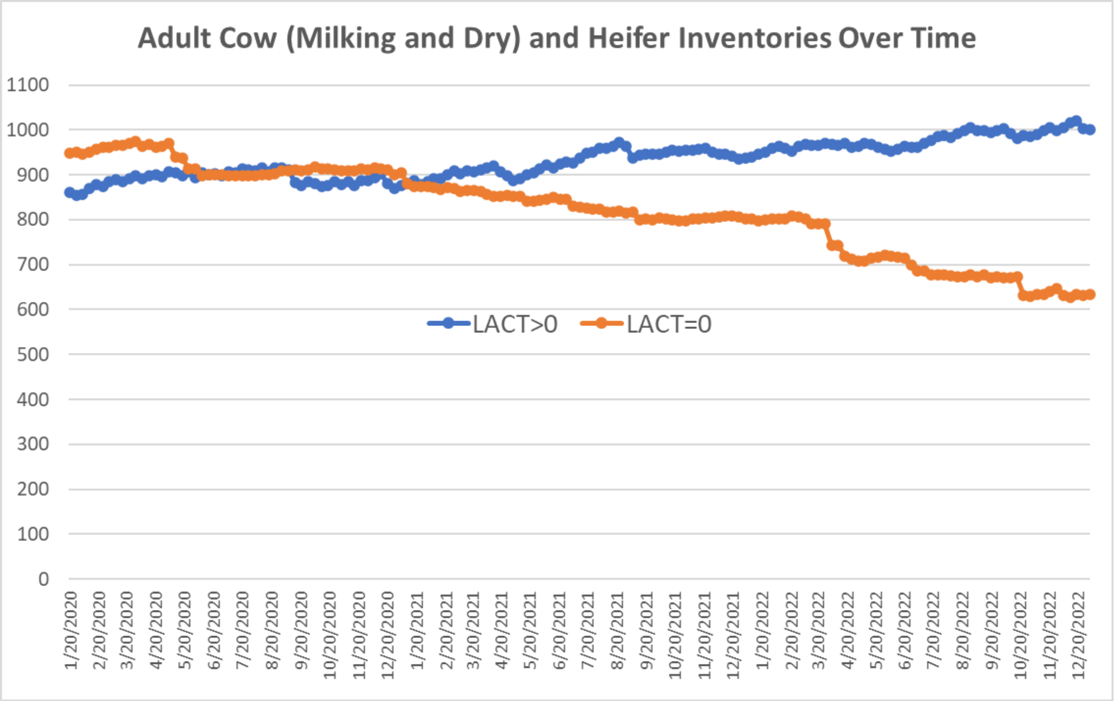
- Historical performance
  - What has been the trend in preweaning disease risk?
    - Scours, Pneumonia
  - What has been the trend in preweaning and postweaning growth rate?
  - What is the trend for Age at 1st Service and Age at 1st Calving?

Youngstock Monitoring

- “Peering into the future”
  - Am I on track to produce enough future replacements?
  - Am I breeding the appropriate animals to sexed vs. conventional vs. beef semen to enhance the future genetic value?

- Monitoring Tasks
  - Colostrum collection, handling and deliver
  - Are calves receiving the correct amounts of milk/grain
  - Are birth weights, weaning weights, postweaning weights performed and recorded?
  - Are heifers moved into breeding pens correctly?

Are You Producing Enough Heifers to Meet Ongoing Replacement Needs?



Current Heifer:Cow inventory

626 heifers: 1000 cows (63%)

At a high level, how is this herd doing in terms of producing enough heifers???

Average annual Replacement Rate = 36%

Heifer completion rate = 84% (born alive to calving)

Heifer completion rate = 80% (born to calving)

Heifer Needs for the Previous Herd…

- Assuming the same replacement rate moving forward…
- Just to maintain herd size → need ~80% of avg milking & dry herd in heifer inventory
- Currently, sitting at 63% → will support < 30% replacement rate in the future
- Need 28 fresh heifers each month to maintain herd size

By MYDUE	Sexed Ho	Convent Ho	Beef Sire	Heifers to Calve	Proj Heifer Calves
Jan23	15	4	1	20	15
Feb23	13	2	3	18	12
Mar23	16	2	4	22	15
Apr23	25	4	3	32	24
May23	20	5	2	27	20
Jun23	27	5	6	38	26
Jul23	22	3	3	28	21
Total	138	25	22	185	133
Average/month				**26**	**19**

Not Raising Enough Replacements Can be a HUGE Mistake

- Raising fewer heifers → may save cash flow now but hurts future profits
- A herd with a 36% replacement rate that “decides” to raise only enough heifers to support a 30% replacement rate is “deciding” to retain cull cows longer (if no management changes occurred that truly changed replacement risk)
- 36% → 30% replacement rate due to insufficient heifers…
  - Now, the average market cow is retained ~ 200 days longer
  - Under current conditions, miking these less productive cows longer than optimal results in lost opportunity of approximately $300-$400 or more *per delayed replacement*
- Important: Plan to produce a modest excess of replacement beyond anticipated future needs

Summary

- Data – used properly, should help drive performance improvement
- Beware of data quality and application issues
- Remember, correlation is NOT causality
- Instead of benchmarking against other dairies, monitor internal performance and processes
  - Don't confuse Goals with Metrics – goals are important but appropriate metrics help us get there faster
  - Ask the important questions and then find the data to help answer

Evolution of Mastitis Treatments

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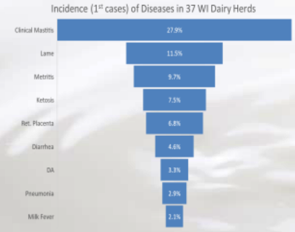
College of Veterinary Medicine
Michigan State University
Follow me on Twitter: @topmilk

1

Mastitis is the Most Frequent Disease of Adult Dairy Cows



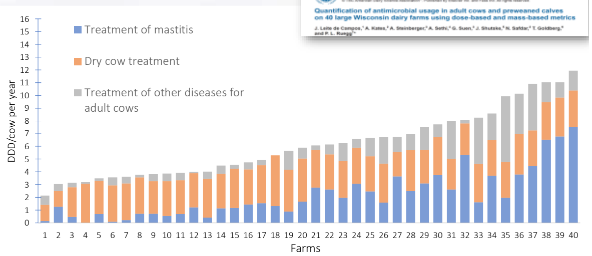
About 15 - 35% of cows have subclinical mastitis everyday

About 20 – 40% of cows develop a clinical case each lactation

Goncalves, Leite de Campos, Ruegg, et al., 2022 Pathogens

2

Mastitis Treatment Accounts for the Most Doses per Cow per year of Antibiotic

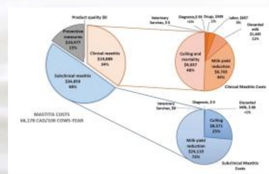


3

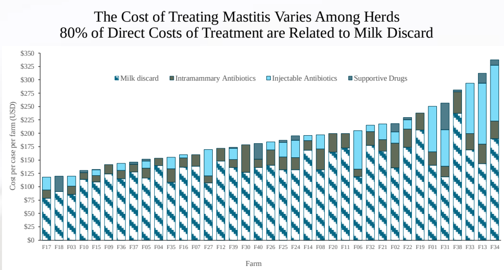
Mastitis is the Costliest Disease of Dairy Cattle

- Mastitis has direct and indirect economic consequences
  - Direct
    - Reduced Milk Yield
    - Reduced Value of Milk
    - Discarded milk
    - Cost of Treatment & Prevention
  - Indirect
    - Reduced Reproductive performance
    - Final product quality
    - Ability to sell milk
- Opportunity costs
  - Value of inputs used to reduce risk of mastitis
    - Udder preparation
    - Teat dips
    - Bedding

- Mastitis was estimated to cost $662 CDN per cow per year (from Aghamodhammadi et al., 2018)
  - 48% Subclinical losses
  - 34% Clinical mastitis losses
  - 15% Use of preventive measures



4



Average cost per case (USD) for clinical mastitis cases treated or not treated using antimicrobials. Clinical mastitis cases were obtained from 37 Wisconsin dairy farms from September 2017 to December 2017. *Leite de Campos, et al., 2022 (PhD dissertation)*

5

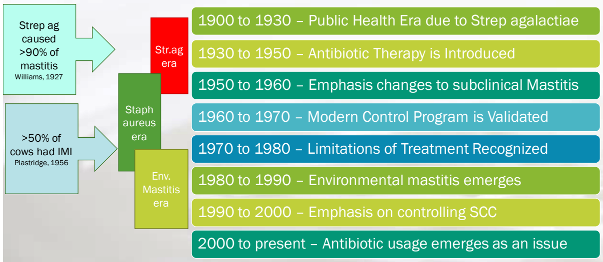
Objective

Review:

- Historical basis of mastitis therapy
- Options for improving current therapies

6

Treatment of Mastitis – THE PAST



7

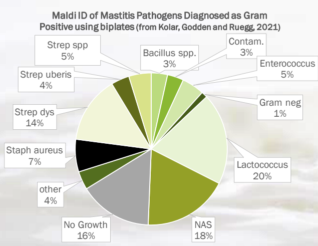
6 of 7 IMM products in U.S. Were developed to Treat Strep ag & Staph aureus

		Amoxi-Mast	Polymast	DariClox	Masti-Clear	Pirsue	Spectra-mastLC	Today
Active Ingredient		Amoxicillin	Ampicillin	Cloxacillin	PenicillinG	Pirlimycin	Ceftiofur	Cephapirin
Label Claim	Str ag.	YES	YES	YES	YES			YES
	S aureus	YES	YES	YES		YES		YES
	Str dys.		YES		YES	YES	YES	
	Strp ub.				YES	YES		
	Other		E. coli				CNS & E coli	
Label Dosing & Duration		3 tubes @ 12 h	3 tubes @ 24 h	3 tubes @ 12 h	3 tubes @ 12 h	2-8 tubes @ 24 h	2-8 tubes @ 24 h	2 tubes @ 12 h
Company		Merck	BI	Merck	Hanford	Zoetis	Zoetis	BI

8

Our "normal" treatment strategies were developed to treat non-severe mastitis caused by Strep ag

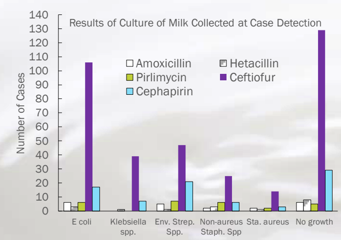
- Strep ag & Staph aureus
  - Very low spontaneous bacteriological cure rates
  - Long duration subclinical infection
  - Sporadic mild clinical cases
  - Milk abnormal about 3-5 days
  - Differ in expectations for bacteriological clearance after IMM therapy
- When most cases were Strep ag it was logical for farmers to treat mastitis based on detection of inflammation
  - **It is NOT logical now**



9

Treatments given to 558 cases of CM on 51 WI dairy farms in 2010

From Oliveira and Ruegg, 2014.



>85% of clinical mastitis cases are non-severe

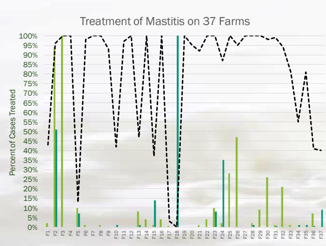
Many are Gram neg or Culture neg

WHY do we treat most cases with antibiotics?

10

Treatment of Mastitis – Current Practices

- Treatment records from 20,625 cases of CM on 37 WI dairy herds
  - All farms treated at least 1 case with antibiotics
  - 31% (6,473) of cases <u>**did not**</u> receive antibiotics
  - Injectable antibiotics were used to treat at least 1 case in 65% of herds
    - No Antibiotics are approved for this Extralabel usage
  - 41% of farms used supportive treatments

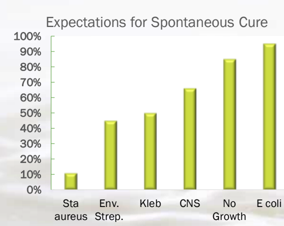


Leite de Campos, Goncalves, and Ruegg et al, submitted

11

When are Antibiotics Helpful?

- Value of antibiotics is enhancing bacteriological clearance
  - Must be a "treatable case"
  - Drug must be able to destroy bacteria
  - Must understand spectrum of activity & know most likely bacterial cause
  - Antibiotics are of benefit only in excess of spontaneous cure
  - <u>**Culling**</u> should be first choice for cows diagnosed with Mycoplasma bovis and most Staph aureus cases
  - In 37 WI herds
    - 20 % (L1) to 40% (L 4+) of cows with CM cows left the herd before completing the affected lactation



Deluyker et al 1999, Gillespie et al., 2002, Oliver et al., 2004, Hoe & Ruegg, 2005, Morin et al, 1998, Apparao, et al., 2009, Fuenzalida & Ruegg, 2017, Suojala et al, 2010, Lago et al., 2010; Kolar

12

Appropriate Treatment of Non-Severe Primary Cases of Clinical Mastitis

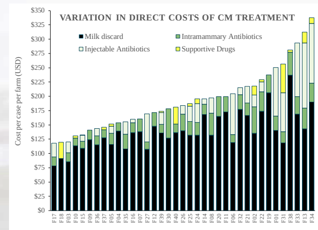
- Most non-severe cases on most farms should not receive antibiotics
- Must have knowledge of types of pathogens present on the farm
- When possible, should be selective therapy based on culture results
  - IMM antibiotics for Gram +
  - Systemic therapy reserved for sick cows
  - Don't treat chronic cows
    - Review SCC and health history of cow before using AB
  - Standard protocols should follow label guidelines
  - When no AB are given.. The cow must be able to mount effective immune response
- When the pathogen is not known,
  - The duration of IMM therapy should be short

Large Dairy Herd Management
http://ldhm.adsa.org/

13

Present Trends in Mastitis Treatment

1. Reduced duration of IMM treatments
2. Greater adoption of selective treatment protocols
3. Selection of the right cows to treat



14

Key Concept
Inflammation Does NOT =INFECTION

- Infection
  - actively dividing bacteria in udder
- Inflammation
  - the bodies response to infection
  - purpose is to kill bacteria
- We identify mastitis infections AFTER the cow's immune system is already killing bacteria
- Sometimes the bacteria are already gone before we notice the symptoms

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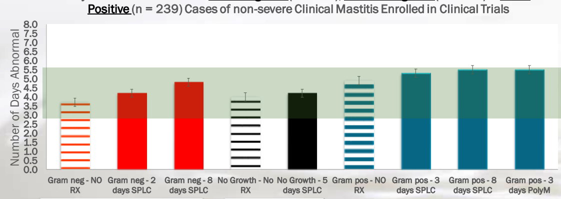
Milk is Abnormal for 3 – 5.5 Days With or Without Treatment

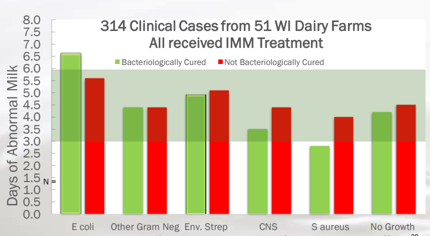
Days of Abnormal Milk for Gram-negative (n = 168), Culture-Negative (N = 121) & Gram Positive (n = 239) Cases of non-severe Clinical Mastitis Enrolled in Clinical Trials



Kolar, Godden & Ruegg, 2022 preliminary

16

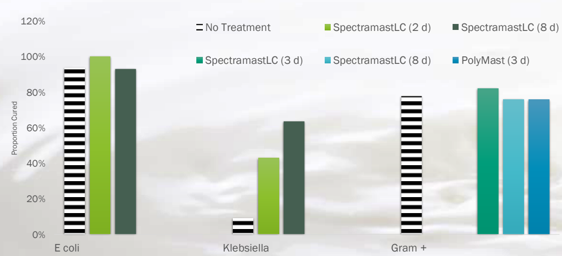
Inflammation Lasts 3-6 days Regardless of Bacteriological Cure



Oliveira & Ruegg, JDS 2014

17

Bacteriological Cure at 21 to 28 Days is Not Always Improved by Longer Treatment



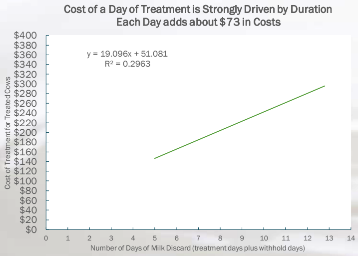
Fuenzalida & Ruegg, JDS 2019

Kolar, Godden & Ruegg, 2022 preliminary

18

Treating Longer Adds Costs

Leite de Campos et al., preliminary data from 20,625 cases of Clinical Mastitis on 37 WI dairy farms



EXAMPLE

- 1,000 cow dairy with 250 CM cases per year
  - $18,250 excess USD spent for 1 extra day of treatment
- Average milk yield per day before the case was 95 lbs
- Monthly milk price ranged from 0.37 – 0.43 USD/kg

19

On a herd basis, there is NO Economic Advantage to routine longer duration antibiotic treatment for mastitis

J Dairy Sci, Pinzon, Cabrera & Ruegg, 2011

- Decision Tree Analysis
  - Calculated Expected Monetary Values (losses)
- Expected monetary value (loss) calculated using this formula:
  - EMV = sum of probability of EVERY outcome X cost of every outcome
- Baseline Assumptions in our model
  - $0.22 USD per liter milk price
    - $10/cwt
  - Typical cost and milk withhold for IMM treatment
  - Baseline Pathogens in herd
    - 30% Gram positive
    - 30% Gram negative
    - 40% no growth
  - Cost included all possible outcomes
    - Recurrence, culling, death, loss of quarters, reduced milk yield, increased SCC etc..

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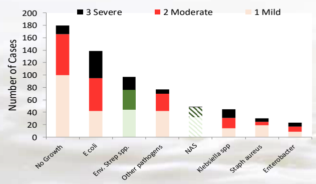
Present Trends Influencing Reduced Use of Antibiotics

1. Reduced duration of IMM treatments
2. Greater adoption of selective treatment protocols
3. Selection of the right cows to treat

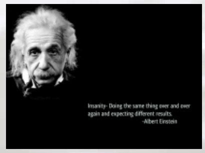
Most Clinical Cases are No Growth or Gram Negative, Non-Severe, not Staph aureus & Don't Require Antibiotics



21

Do not use Antibiotics to Treat Non-Severe Clinical Mastitis in Chronic Cows

- There is no evidence that use of intramammary antibiotics will change outcomes of cows with **chronic mastitis**
- Must have a diagnosis
- Discard that milk until it becomes normal
  - 4-6 days



- **Do not administer antibiotics to cows who will not benefit**
  - Chronic Staph aureus
  - Mycoplasma bovis
  - Multiple infected quarters
  - Damaged teats
  - Repeated previous treatment failures
  - Long history of chronically high SCC

22

Clinical Case Management Non-antibiotic Treatment Options

1. Watchful waiting
   - Hospitalize cow and discard milk until normal
   - Use NSAID for pain if severity 2
2. Dry off affected gland
   - Use if 1 quarter is chronically affected
3. Divert cow to beef market
   - Use if animal is not economically viable for dairy
4. Segregate cow & use ¼ milker
5. Early dry off of cow

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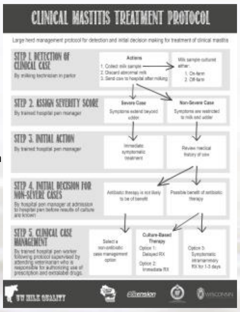
- Selective Treatment means applying criteria to select:
  - The right cow
    - Not chronically infected
    - Able to mount effective immune response if no antibiotics are considered
  - The right Pathogen
    - Low spontaneous cure rate and acceptable therapeutic cure rate
    - Large margin of value for therapy
  - The right Drug
    - Appropriate spectrum of activity for presumed pathogen
  - The right Duration
    - Label treatment unless evidence-based criteria indicates extended duration will improve outcomes

1 - Detection
2 -Triage
3 – initial action
4 – justifying need for antibiotics
5 – clinical case management



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How should you treat non-severe mastitis if you don't know the bacteria?

Etiology	% of all cases	Evidence that IMM AB help
E coli	28%	No
Klebsiella sp	5%	Variable
Enterobacter sp	3%	No
Strep spp.	13%	Often Yes
Enterococci spp	2%	No
CNS	6%	Variable
No Growth	29%	No
Yeast	3%	No
Staph aureus	3%	In a very few cases Yes
Other Pathogens	7%	No

- If the bacteria is not known
  - Use a narrow spectrum IMM antibiotic for short duration
- Most cases will be
  - No growth
  - Gram negative
  - Intrinsically resistant
- Base longer duration treatment on cow history

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Conclusion

- Current mastitis treatment protocols are based on lessons learned during a past era and are gradually evolving
- Antibiotic treatment of non-severe mastitis based on detection of abnormal milk in an otherwise healthy cow is **wrong more frequently than it is right**
- There are many **cow-level indicators** that can be used to reduce reliance on antibiotics
- What we can do today to improve mastitis treatments
  - Use shorter duration IMM treatment
    - Follow label of short duration IMM products
    - Reduce the duration by 1 day of flexible duration products
  - Culture more clinical mastitis cases
    - use data to make antibiotic usage decisions
  - Cull (don't treat) cows infected with Staph aureus
  - Use narrower spectrum drugs unless you are treating a case that is outside the spectrum of activity of the product

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For more details visit: TOPMILK on YOUTUBE

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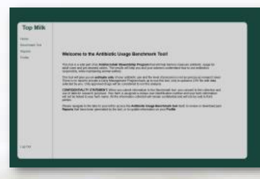
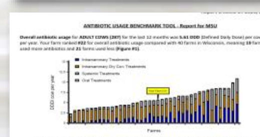
Visit Topmilk





28

Many Thanks to My MSU Team

- Juliana Leite de Campos & Quinn Kolar
  - PhD MSU Animal Science May 2022
- Leticia De Souza Ferreira
  - MS student in MSU CVM
- Juliano Goncalves, MV, PhD & Zelmar Rodiguez, MV, PhD
  - Postdoctoral Researchers
- Carolina Pinzon-Sanchez
  - Outreach specialist
- Cara Robison
  - Lab Manager

29

Building a Foundational Repro Program

Paul M. Fricke, Ph.D.

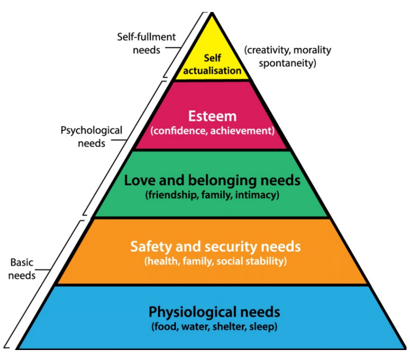
Professor of Dairy Science

Department of Animal & Dairy Sciences
UNIVERSITY OF WISCONSIN-MADISON

Extension
UNIVERSITY OF WISCONSIN-MADISON

1

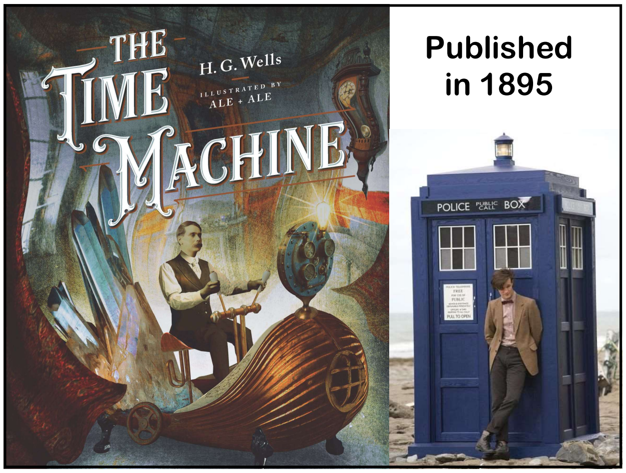
Maslow's Hierarchy of Needs



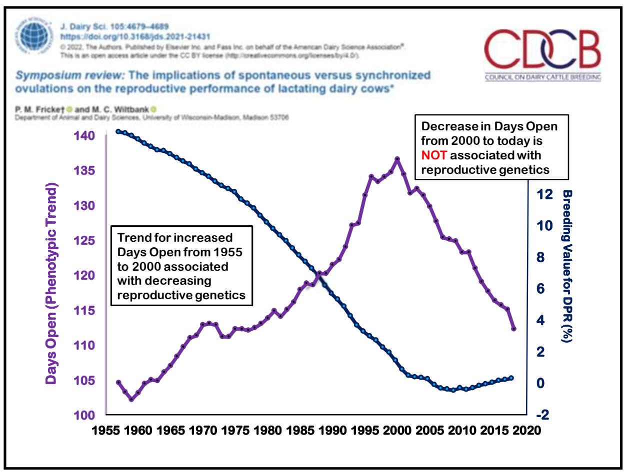
2

Dr. Fricke's Hierarchy of Repro Needs

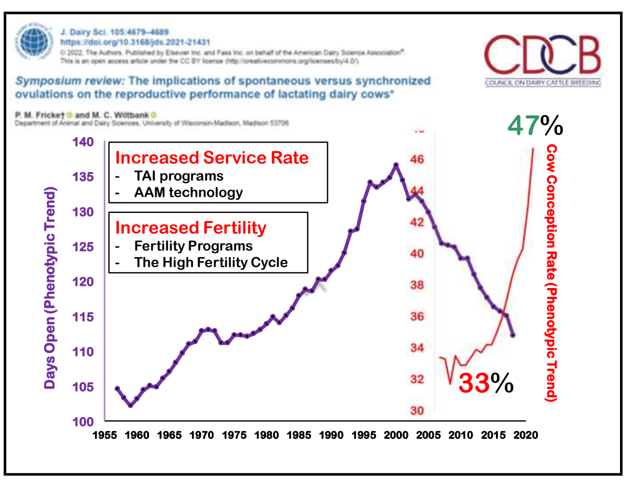
3


THE TIME MACHINE
H. G. Wells
ILLUSTRATED BY ALE + ALE
Published in 1895
POLICE PUBLIC CALL BOX

4


J. Dairy Sci. 105:4679–4689
https://doi.org/10.3168/jds.2021-21431
Symposium review: The implications of spontaneous versus synchronized ovulations on the reproductive performance of lactating dairy cows*
P. M. Fricke and M. C. Wiltbank
CDCB
COUNCIL ON DAIRY CATTLE BREEDING
Decrease in Days Open from 2000 to today is NOT associated with reproductive genetics
Trend for increased Days Open from 1955 to 2000 associated with decreasing reproductive genetics
Days Open (Phenotypic Trend)
Breeding Value for DPR (%)
140
135
130
125
120
115
110
105
100
12
10
8
6
4
2
0
-2
1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020

5


J. Dairy Sci. 105:4679–4689
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Symposium review: The implications of spontaneous versus synchronized ovulations on the reproductive performance of lactating dairy cows*
P. M. Fricke and M. C. Wiltbank
CDCB
COUNCIL ON DAIRY CATTLE BREEDING
Increased Service Rate
- TAI programs
- AAM technology
Increased Fertility
- Fertility Programs
- The High Fertility Cycle
47%
33%
Days Open (Phenotypic Trend)
Cow Conception Rate (Phenotypic Trend)
140
135
130
125
120
115
110
105
100
46
44
42
40
38
36
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30
1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020

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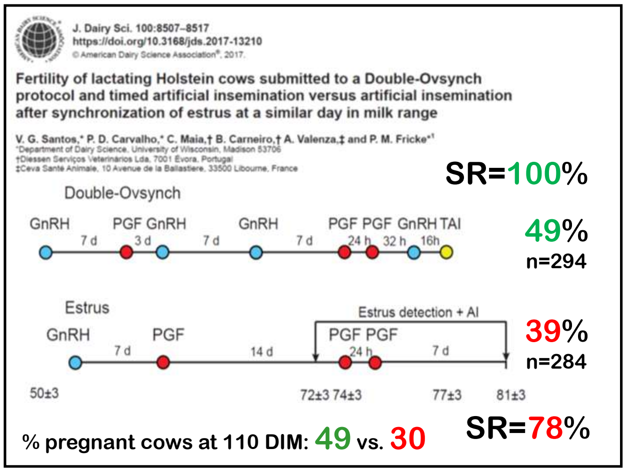
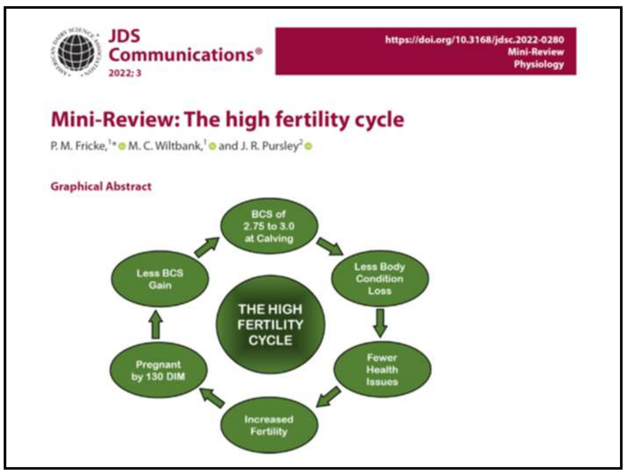
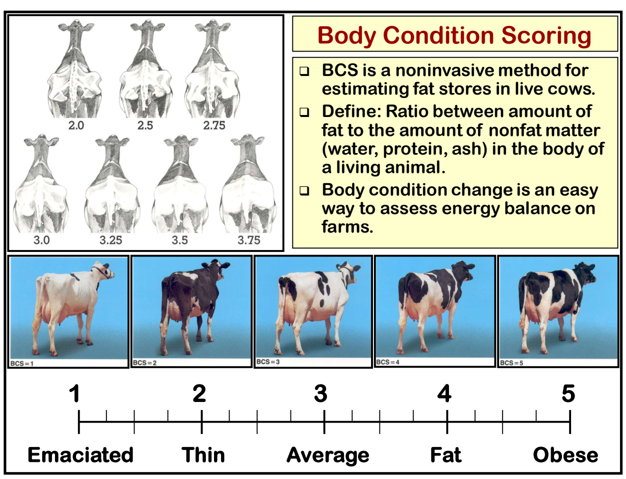

J. Dairy Sci. 100:8507–8517
https://doi.org/10.3168/jds.2017-13210
© American Dairy Science Association®, 2017.
Fertility of lactating Holstein cows submitted to a Double-Ovsynch protocol and timed artificial insemination versus artificial insemination after synchronization of estrus at a similar day in milk range
V. G. Santos,* P. D. Carvalho,* C. Maia,† B. Carneiro,† A. Valenza,‡ and P. M. Fricke*1
*Department of Dairy Science, University of Wisconsin, Madison 53706
†Diessen Serviços Veterinários Lda, 7001 Évora, Portugal
‡Ceva Santé Animale, 10 Avenue de la Ballastiere, 33500 Libourne, France
SR=100%
Double-Ovsynch
GnRH
PGF GnRH
GnRH
PGF PGF GnRH TAI
7 d
3 d
7 d
7 d
24 h
32 h
16h
49%
n=294
Estrus
GnRH
PGF
Estrus detection + AI
PGF PGF
7 d
14 d
24 h
7 d
39%
n=284
50±3
72±3 74±3
77±3
81±3
% pregnant cows at 110 DIM: 49 vs. 30
SR=78%

7


JDS Communications®
2022; 3
https://doi.org/10.3168/jdsc.2022-0280
Mini-Review
Physiology
Mini-Review: The high fertility cycle
P. M. Fricke,1* M. C. Wiltbank,1 and J. R. Pursley2
Graphical Abstract
BCS of 2.75 to 3.0 at Calving
Less Body Condition Loss
Fewer Health Issues
Increased Fertility
Pregnant by 130 DIM
Less BCS Gain
THE HIGH FERTILITY CYCLE

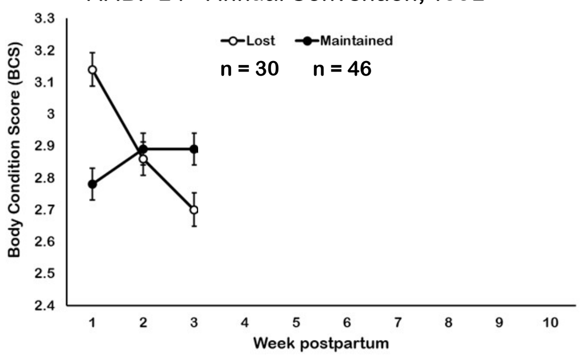
8


Body Condition Scoring
BCS is a noninvasive method for estimating fat stores in live cows.
Define: Ratio between amount of fat to the amount of nonfat matter (water, protein, ash) in the body of a living animal.
Body condition change is an easy way to assess energy balance on farms.
2.0
2.5
2.75
3.0
3.25
3.5
3.75
1
2
3
4
5
Emaciated
Thin
Average
Fat
Obese

9

Jack H. Britt

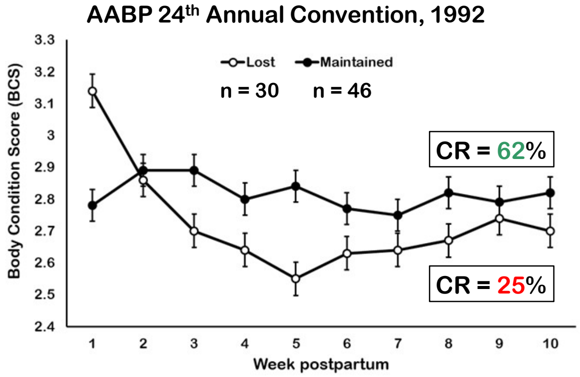
AABP 24th Annual Convention, 1992



10

Jack H. Britt

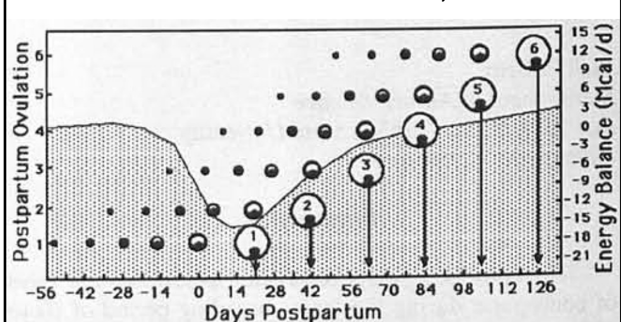
AABP 24th Annual Convention, 1992



11

Jack H. Britt

AABP 24th Annual Convention, 1992



"The Britt Hypothesis"

12

Three Studies:

Relationships among changes in body condition score (BCS) and reproduction in lactating dairy cows

- Carvalho et al., 2014
  J. Dairy Sci. 97:3666-3683
- Barletta et al., 2017
  Theriogenology 104:30-36
- Middleton et al., 2019
  J. Dairy Sci. 102:5577-5587

13

J. Dairy Sci. 97:3666–3683
http://dx.doi.org/10.3168/jds.2013-7809

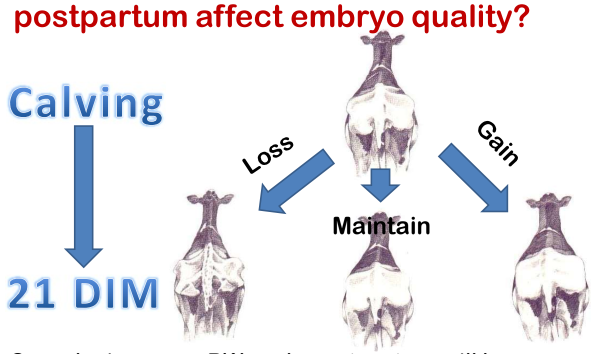
Relationships between fertility and postpartum changes in body condition and body weight in lactating dairy cows

P. D. Carvalho,* A. H. Souza,*[1] M. C. Amundson,* K. S. Hackbart,* M. J. Fuenzalida,* M. M. Herlihy,* H. Ayres,* A. R. Dresch,* L. M. Vieira,* J. N. Guenther,* R. R. Grummer,† P. M. Fricke,* R. D. Shaver,* and M. C. Wiltbank*[2]
*Department of Dairy Science, University of Wisconsin-Madison, Madison 53706
†Balchem Corporation, New Hampton, NY 10958

DEPARTMENT OF
DAIRY SCIENCE
University of Wisconsin-Madison

14

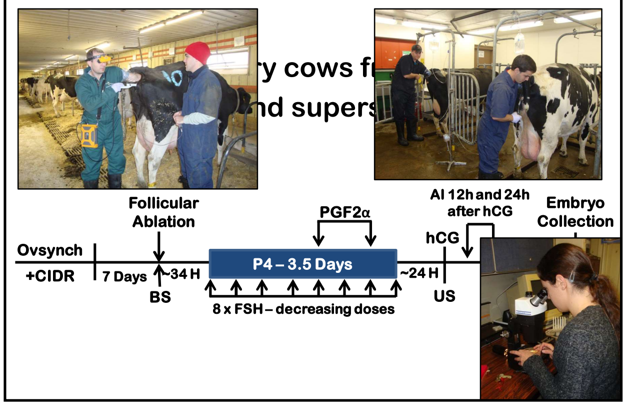
Does Body Weight change early postpartum affect embryo quality?



Cows losing more BW early postpartum will have poor embryo quality

15

Materials & Methods



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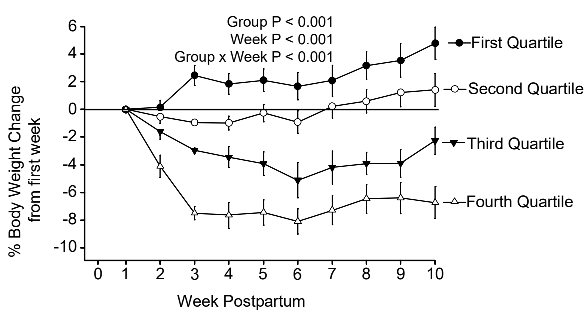
% Body weight change



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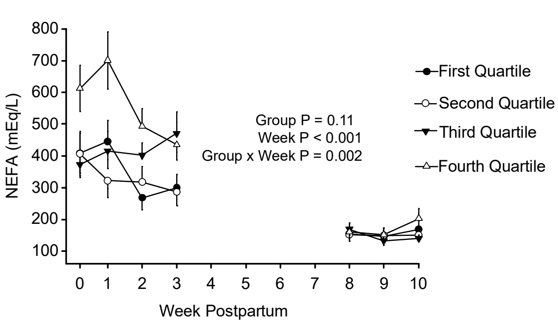
NEFA concentrations



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Embryo Characteristics

	Quartile				
	Fourth Q Lost +	Third Q Lost	Second Q Maintain	First Q Gain	P-value
CL (no.)	18.4 ± 2.6	18.4 ± 1.7	19.0 ± 1.7	16.0 ± 2.0	0.67
Fertilized embryos (%)	76.9 ± 7.1	77.0 ± 6.6	77.6 ± 7.6	78.4 ± 7.1	0.99
Quality 1 & 2 embryos (%)	38.0 ± 8.7	61.3 ± 8.2	60.6 ± 9.4	63.4 ± 8.6	0.14
Degenerate embryos (%)	35.2 ± 8.5^{a}	12.6 ± 4.6^{b}	14.5 ± 6.3^{b}	9.6 ± 3.7^{b}	0.02
Qual 1 & 2 of Fertilized (%)	48.4 ± 9.5^{a}	78.3 ± 6.6^{b}	72.6 ± 9.5^{b}	77.7 ± 7.4^{b}	0.05
Degenerate of Fertilized (%)	$46.9 \pm 9.6^{a,A}$	$17.4 \pm 6.4^{b,B}$	$24.8 \pm 9.3^{ab,A}$	$16.2 \pm 7.0^{b,B}$	0.04

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J. Dairy Sci. 93:1596–1603
doi:10.3168/jds.2009-2852

Associations of elevated nonesterified fatty acids and β-hydroxybutyrate concentrations with early lactation reproductive performance and milk production in transition dairy cattle in the northeastern United States

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*Department of Animal Science, College of Agriculture and Life Sciences, and
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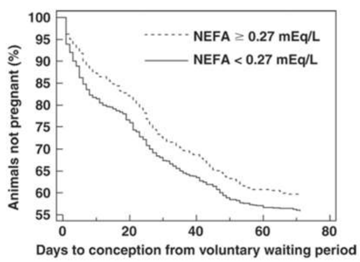
- Cows from 91 dairy herds were sampled for NEFA and BHBA prepartum (n = 1,164) or postpartum (n = 1,095).
- Cows with NEFA concentrations > 0.27 mEq/L resulted in 16% decreased risk of conception within 70 d after the VWP ($P = 0.05$).



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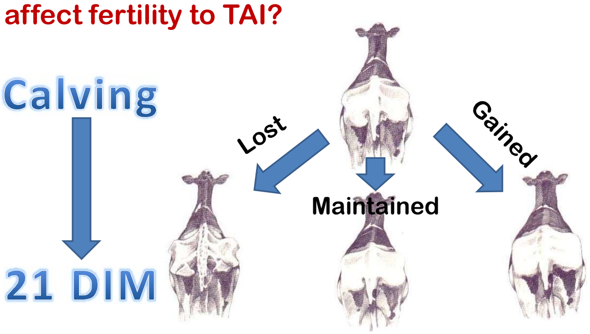
Does a change in BCS early postpartum affect fertility to TAI?



Cows losing more BCS early postpartum will have decreased fertility at first TAI

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% of cows, BCS at calving and 21 DIM

	BCS Change			P-Value
	Lost	Maintained	Gained	BCS
% cows	42 (789/1887)	36 (675/1887)	22 (423/1887)	-
% Primi.	47 (373/789)	53 (356/675)	55 (233/423)	0.02
BCS at calving	2.93±0.01[a]	2.89±0.02[ab]	2.85±0.02[b]	0.005
BCS at 21 DIM	2.64±0.01[c]	2.89±0.02[b]	3.10±0.02[a]	<0.001
BCS Δ	-0.29	0.0	+0.25	
ECM (kg/d)[1]	30.9±0.4	31.5±0.4	28.7±0.4	0.3

[1]From calving to 21DIM

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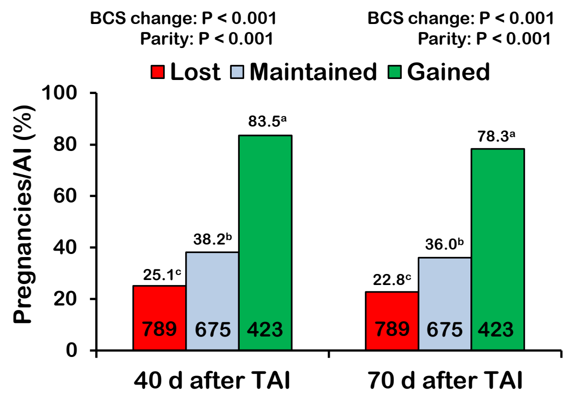
P/AI to Double-Ovsynch



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Case Study Extreme Example

A nutritionist called me about a 450-cow dairy with severe repro problems

- 21-d Pregnancy Rate: 8%
  - <20% = poor
  - 21% to 25% = OK with room for improvement
  - 26% to 30% = excellent
  - >30% = outstanding
- 21-d Service Rate: 33%
  - Goal: >60%
- Conception Rate: 39% overall
  - No sexed semen used in lactating cows
  - CR is difficult to benchmark; many factors are involved
  - Goal: 45% to 55%

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Far-Off Dry Cows

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Early Lactation Cows

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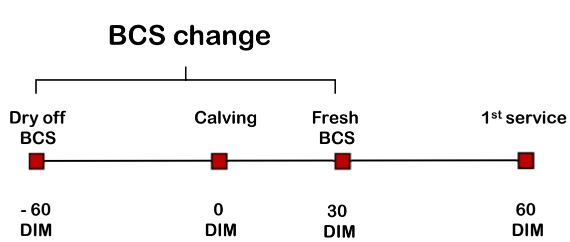
Unpublished Analysis

Megan Lauber, MS student



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Demographics by BCS change

	BCS Change from Dry off to 30 DIM			
	Q1 n = 608	Q2 n = 672	Q3 n = 650	Q4 n = 449
BCS Change	-1.5 to -0.75	- 0.50	-0.25	0 to 0.75
BCS Change (Mean ± SEM)	-0.84 ± 0.01	-0.50 ± 0	-0.25 ± 0	0.04 ±0.01
Parity (Mean ± SEM)	3.47 ± 0.06	3.07 ± 0.05	2.86 ± 0.5	2.73 ± 0.06
Week 8 Milk (lbs)	117	117	113	108
1st F:P Ratio (Mean ± SEM)	1.30 ± 0.02	1.25 ± 0.01	1.21 ± 0.01	1.19 ± 0.01

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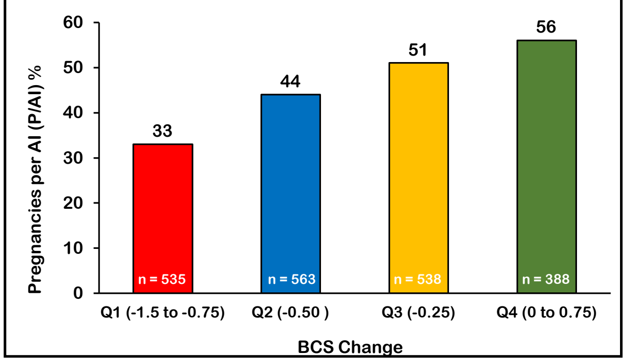
Pregnancy outcomes, d 32



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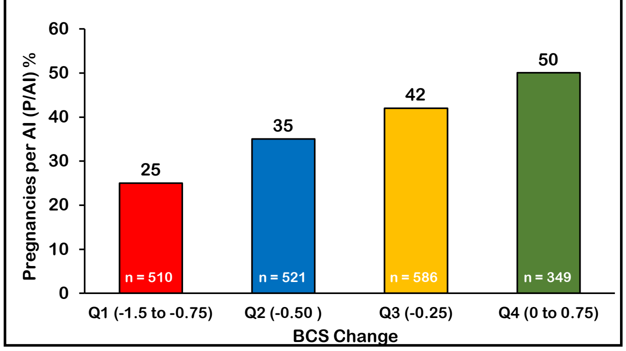
Pregnancy outcomes, d 60



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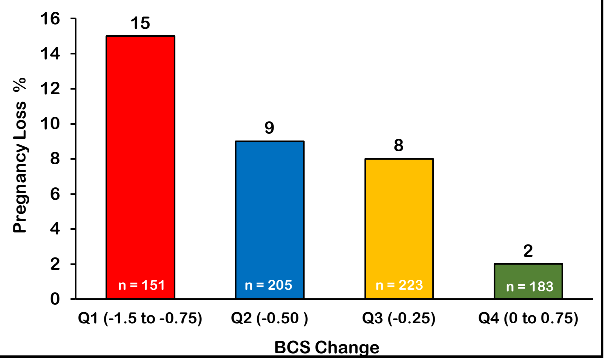
Pregnancy Loss, d 32-60



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Question:

How can we get cows to gain or maintain BCS after calving?

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Theriogenology 104 (2017) 30–36

Contents lists available at ScienceDirect

Theriogenology

journal homepage: www.theriojournal.com

Association of changes among body condition score during the transition period with NEFA and BHBA concentrations, milk production, fertility, and health of Holstein cows

R.V. Barletta [a, *], M. Maturana Filho [b], P.D. Carvalho [a], T.A. Del Valle [b], A.S. Netto [b], F.P. Rennó [b], R.D. Mingoti [b], J.R. Gandra [d], G.B. Mourão [c], P.M. Fricke [a], R. Sartori [c], E.H. Madureira [b], M.C. Wiltbank [a]

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BCS change from 21 days before calving to 21 days after calving

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Effect of BCS Change on Health Events

Barletta et al., 2017; Theriogenology 104:30-36.

Event	Lost	Maintained	Gained
	50% (116/234)	22% (52/234)	28% (66/234)
Metritis	23%	21%	20%
Mastitis	29%[b]	17%[a,b]	17%[a]
Ketosis	27%	19%	15%
Pneumonia	15%	12%	9%
>1 Event	63%[b]	46%[a]	39%[a]

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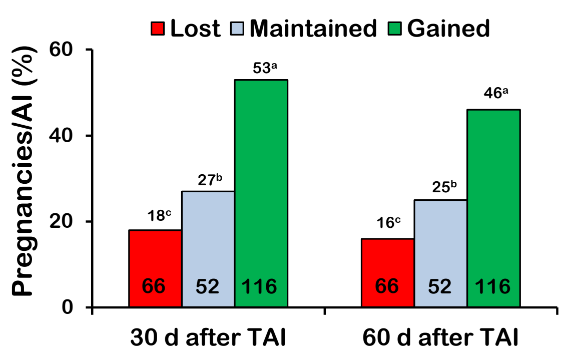
P/AI to TAI after a fertility program

Barletta et al., 2017; Theriogenology 104:30-36



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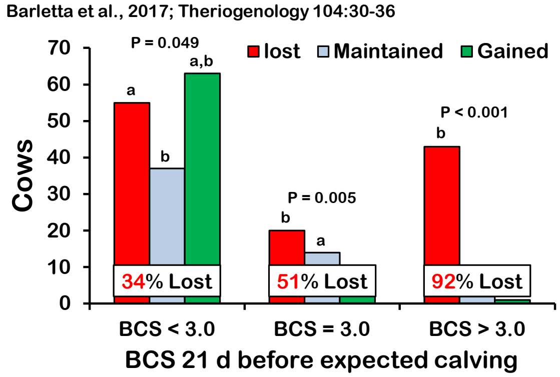
Overall, 50% of cows lost BCS from 21 d before to 21 days after calving

Barletta et al., 2017; Theriogenology 104:30-36



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Question:

How can we get cows to gainor maintain BCS after calving?

Answer:

Avoid calving over-conditioned cows!

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Question:

How can we avoid calving over-conditioned cows?

Calving Interval (13 months = 390 d)		
VWP (60 d)	21-d PR (0 to ? d)	Gestation (282 d)
Fixed	Variable	Fixed

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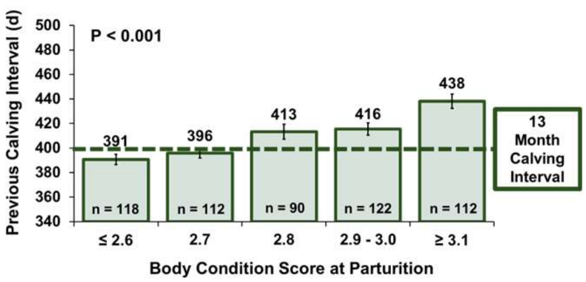
Effect of previous calving interval on BCS at calving

Middleton et al., 2019; J. Dairy Sci. 102:5577-5587



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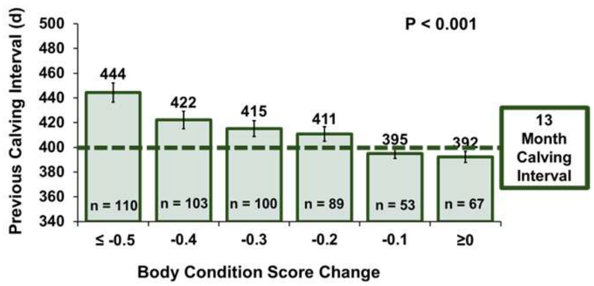
Effect of previous calving interval on BCS change calving to 30 DIM

Middleton et al., 2019; J. Dairy Sci. 102:5577-5587



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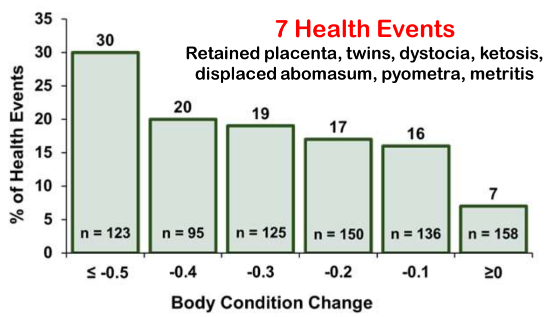
Effect of BCS change on health events

Middleton et al., 2019; J. Dairy Sci. 102:5577-5587



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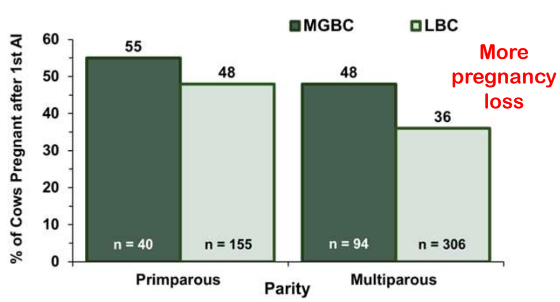
Effect of BCS change after calving on fertility to first TAI

Middleton et al., 2019; J. Dairy Sci. 102:5577-5587



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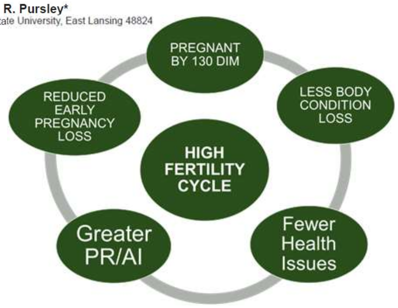
J. Dairy Sci. 102:5577–5587
https://doi.org/10.3168/jds.2018-15828

The high-fertility cycle: How timely pregnancies in one lactation may lead to less body condition loss, fewer health issues, greater fertility, and reduced early pregnancy losses in the next lactation

E. L. Middleton, T. Minela, and J. R. Pursley*
Department of Animal Science, Michigan State University, East Lansing 48824



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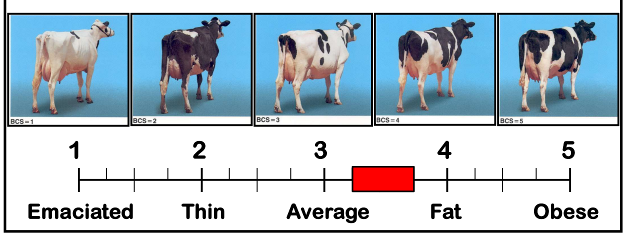
Re-think BCS targets

2001 BCS Recommendations:

Calving: 3.25 to 3.75
Early: 2.50 to 3.25
Mid: 2.75 to 3.25
Late: 3.00 to 3.50
Dry Off: 3.25 to 3.75

Too High!



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Double-Ovsynch for first TAI

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					GnRH	
					PGF	
	GnRH					
	GnRH					
	PGF	PGF	GnRH	TAI		

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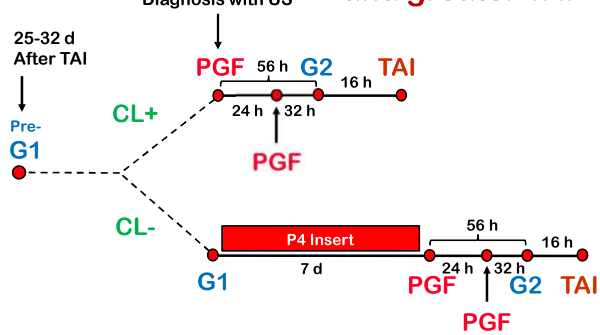
Resynch for 2nd and greater TAI



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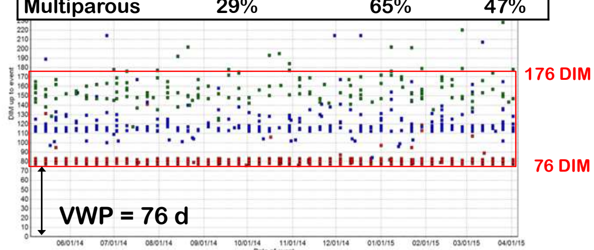
TAI for First Three Inseminations

Parity	21-d Preg Rate	Service Rate	P/AI
All cows	31%	66%	50%
Primiparous	41%	70%	61%
Multiparous	29%	65%	47%



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BREDSUM By Times Bred

January, 2019 to January, 2020

	95% CI	%Conc	#Preg	#Open	Other	Abort	Total	%Tot	SPC
1	46-55	50	269	266	5	35	540	49	2.0
2	47-58	53	153	137	4	13	294	27	1.9
3	42-58	50	75	75	1	6	151	14	2.0
4	34-57	46	31	37	1	2	69	6	2.2
5	21-54	36	10	18	0	1	28	3	2.8
6	-	62	10	6	0	0	16	1	1.6
7	-	50	1	1	0	0	2	0	2.0
8	-	100	1	0	0	0	1	0	1.0
TOTALS	47-53	50	550	540	11	57	1101	100	2.0

90% pregnant after 3 AI

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