U.S. Department of Agriculture

Ensiling Wet Distillers Grains with Solubles: A review

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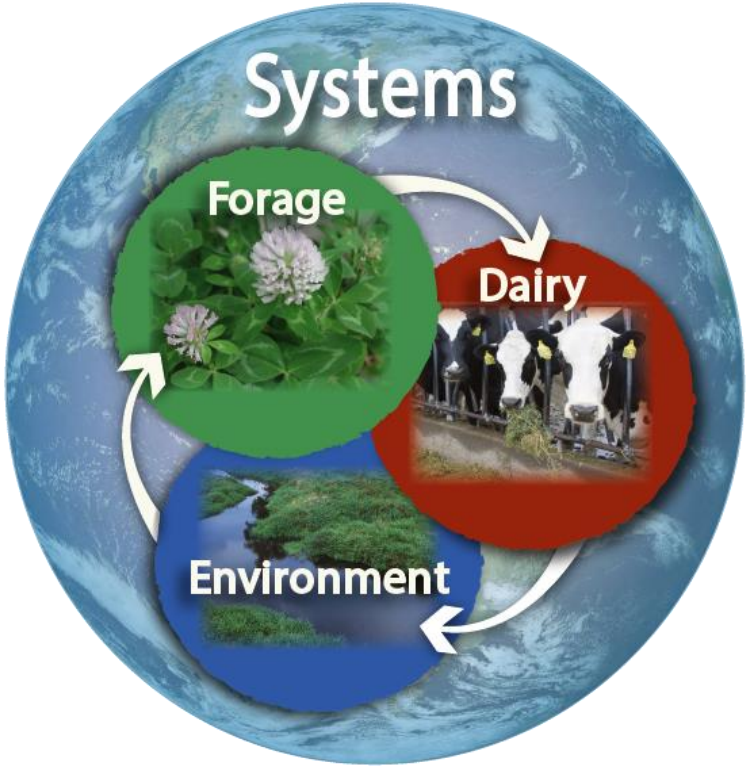


Introduction

- U.S. ethanol production expanded greatly from 2001 to 2011.

- Total distillers grains production increased from 2 million mt in 2001 to 35 million mt in 2011.

Source: RFA, 2011

Wet ethanol co-products

- Wet corn distillers grains with solubles (30 to 35% DM).
- Modified wet corn distillers grains with solubles (45 to 50% DM).

Advantages of WDGS use

- Highly palatable feed.
- Wet versus dried.
  - May have greater energy value
- Improves diet homogeneity.
  - Increases moisture in diet
  - Reduces sorting
- Lower cost of production at the plant.
- Lower cost to the livestock producer.

Challenges of WDGS use

- Freezes in the winter.
  - Chunks make mixing difficult
  - Diet less consistent
- Losses due to spoilage.
  - Molds rapidly – less than 7 days

Methods of ensiling

- Silo bags
- Bunker silos
- Covered piles

Source:
South Dakota
State University

Bunker silos

Week 1

Week 3

Week 2

Week 4

Source: SDSU

Bunker silos

Source: University of Nebraska

Ensiling WDGS alone

	Day					
Item	0	3	7	14	129	SEM
pH	3.1	3.1	3.2	3.2	3.1	0.04
	- - - - - - - - % DM - - - - - - - -					
Lactic acid	0.90	0.95	0.97	1.02	0.98	0.02
Acetic acid	0	0	0.11	0.30	0.23	0.16
Ethanol	0	1.34	1.09	1.24	2.25	0.39

Mjoun et al., 2011

Ensiling WDGS alone

- Ensiling in silo bags.
  - Air exclusion is high
  - Low spoilage
  - Low dry matter losses
- Preservation is very good if bagged immediately.

Ensiling WDGS with other by-product feeds

- Choose feeds low in protein, fat, and phosphorus to balance nutritionally.
  - Soybean hulls
  - Beet pulp
  - Crop residues such as corn stalks
- Blends are easier to mix into TMR’s.
  - Easier to break-up in winter

Nutrient content of selected feeds

	Nutrient content (% DM)						
	CP	ADF	NDF	Fat	TDN	P	S
DGS	29.7	19.7	38.8	10.0	79.5	0.83	0.44
Corn	9.4	3.4	9.5	4.2	88.7	0.30	0.10
Soy hulls	13.9	44.6	60.3	2.7	67.3	0.17	0.12
Beet pulp	10.0	23.1	45.8	1.1	69.1	0.09	0.30
Corn silage	8.8	28.1	45.0	3.2	68.8	0.26	0.14
Corn stalks	5.4	46.5	77.0	1.1	54.1	0.16	0.10
Oat straw	4.4	47.0	70.0	2.2	50.0	0.06	0.23
Wheat straw	4.8	49.4	73.0	1.6	47.5	0.10	0.11
Alfalfa hay	17.2	41.5	53.6	1.7	53.9	0.28	0.26
Mixed hay	13.3	42.1	62.5	2.3	57.0	0.27	0.29

Source: NRC (2001)

Ensiling WDGS

- Ensiling WDGS with soyhulls
  - Anderson et al. 2009. J. Anim. Sci. 87:2113-2123.
- Ensiling WDGS with wet beet pulp
  - Kalscheur et al. 2004. J. Dairy Sci. 87:53. (abstr.)
- Ensiling WDGS with whole plant maize
  - Mjoun et al. 2011. J. Sci. Food Agric. 91:1336-1250.
- Ensiling WDGS with corn stover
  - Anderson et al. 2015. Prof. Anim. Scientist (in press).

Ensiling WDGS with soyhulls

(Anderson et al., 2009)

- Blends of 100:0, 85:15, and 70:30 WDG:SH.
- Mixed in a TMR mixer and ensiled in mini-silos for 0, 3, 7, and 21 days.

Ensiling WDGS with soyhulls

	Blend			
Item	100:0	85:15	70:30	SEM
DM, %	34.8^{c}	42.0^{b}	49.1^{a}	0.50
CP, %	31.1^{a}	25.1^{b}	21.4^{c}	2.26
pH	3.23^{c}	3.93^{b}	4.25^{a}	0.03
Lactic acid, %	4.41^{a}	3.11^{b}	2.18^{c}	0.08
Acetic acid, %	0^{b}	0.26^{a}	0.30^{a}	0.02
Ethanol, %	0.69^{c}	1.26^{a}	1.00^{b}	0.08

$^{abc}P < 0.05$

Ensiling WDGS with beet pulp

(Kalscheur et al., 2004)

- Blends of 100:0, 33:67, 67:33, and 0:100 WDGS to WBP.
- Mixed in a TMR mixer, ensiled in a silo bag, and samples on day 0, 4, 8, 21, and 112.

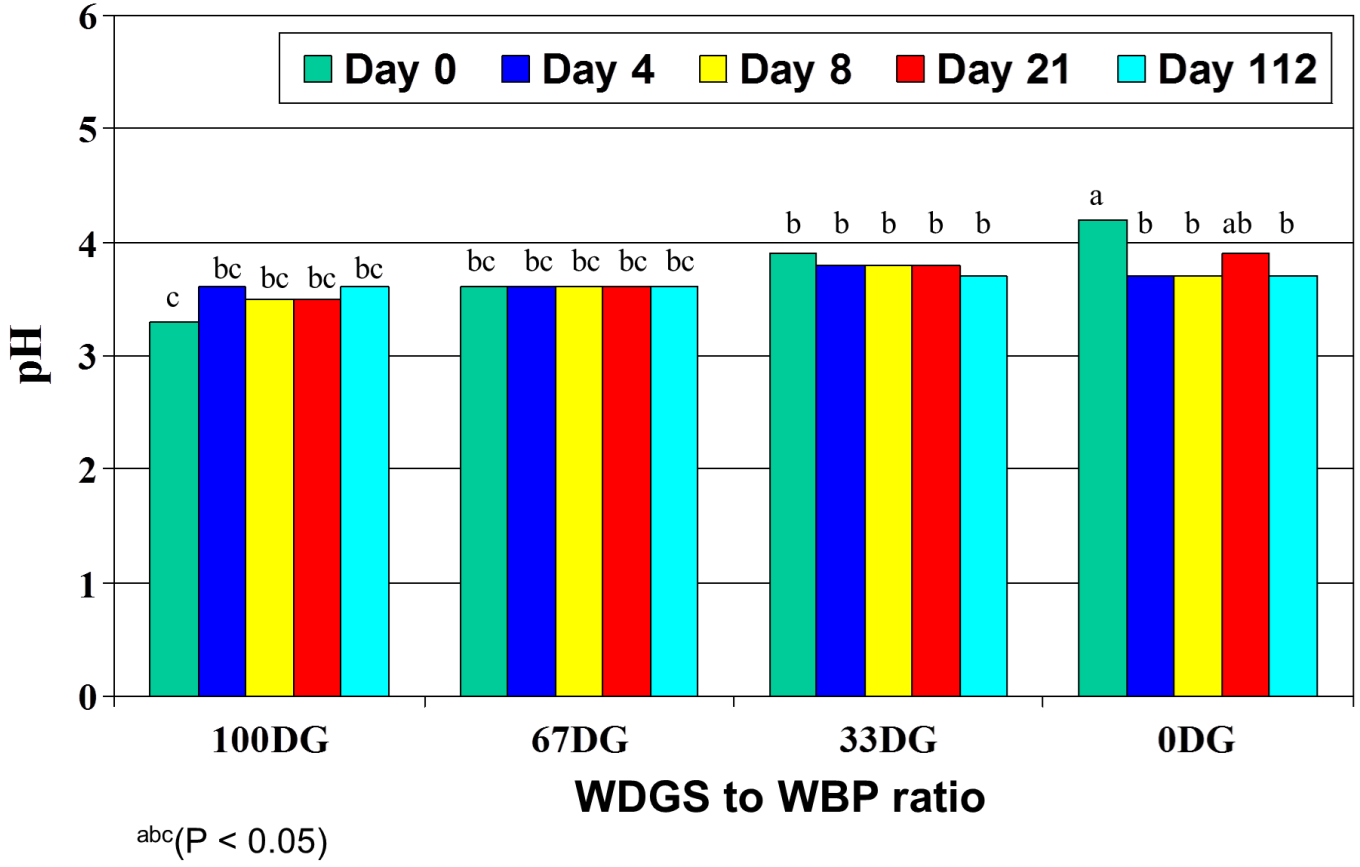
100% BP 67%BP:33%DG 33%BP:67%DG

Ensiling WDGS with beet pulp

	WDGS:WBP				
Item	100:0	67:33	33:67	0:100	SEM
DM, %	32.9^{a}	29.0^{b}	25.9^{c}	22.7^{d}	0.95
CP, %	31.4^{a}	25.2^{b}	19.1^{c}	9.0^{d}	1.57
pH	3.49^{c}	3.59^{b}	3.81^{a}	3.85^{a}	0.03
Lactic acid, %	3.79^{a}	1.15^{c}	0.69^{d}	2.22^{b}	0.08
Acetic acid, %	1.53^{c}	2.11^{b}	2.41^{a}	2.44^{a}	0.07

Ensiling WDGS with beet pulp

pH prior to and after ensiling



[abc](P < 0.05)

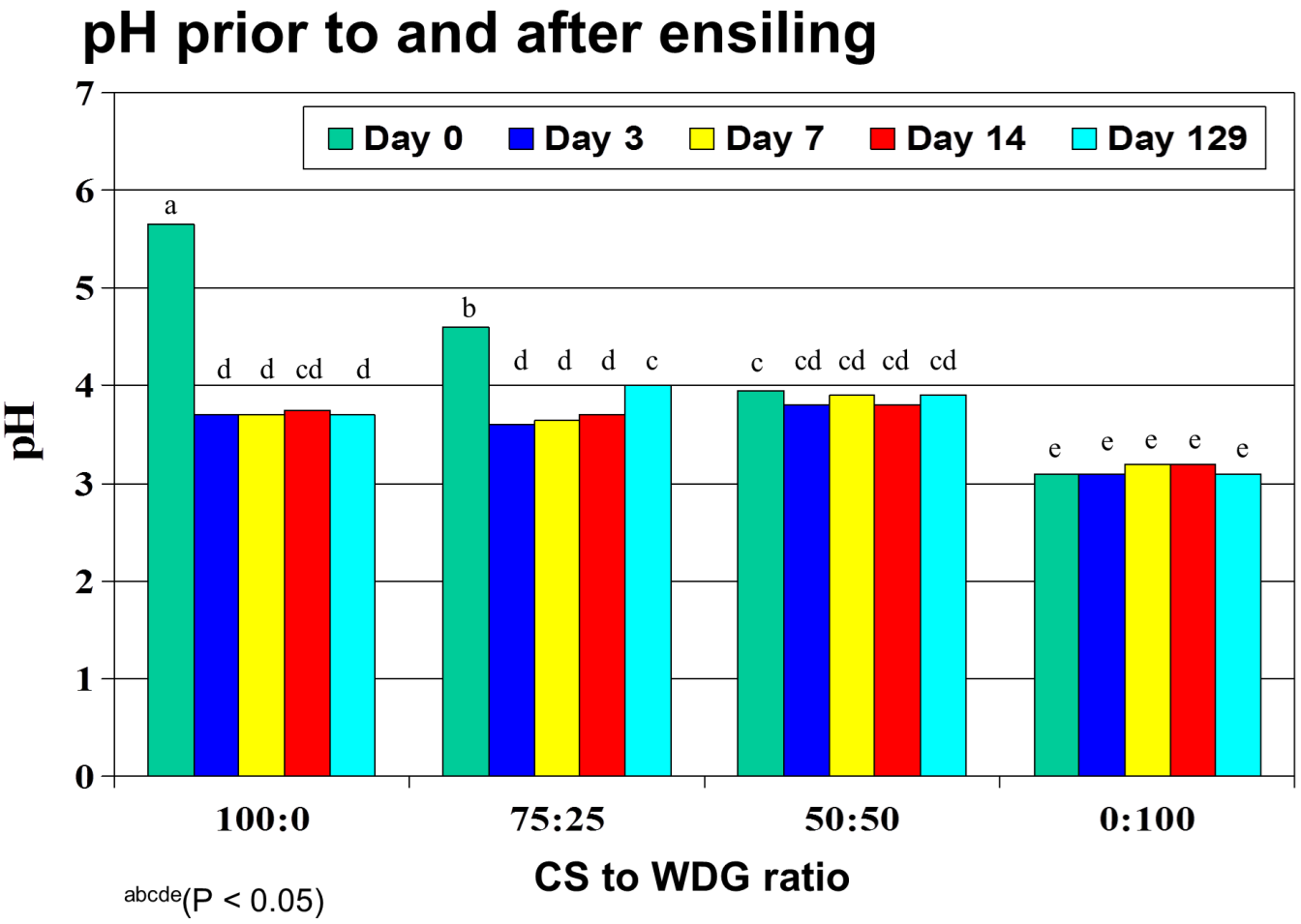
Ensiling WDGS with whole plant maize

(Mjoun et al., 2011)

75:25 whole plant maize to WDGS blend

- Blends of 100:0, 75:25, 50:50, and 0:100 whole plant maize to WDGS.
- Mixed in a TMR mixer and ensiled in a silo bag.
- Sampled at day 0, 3, 7, 14, and 129.

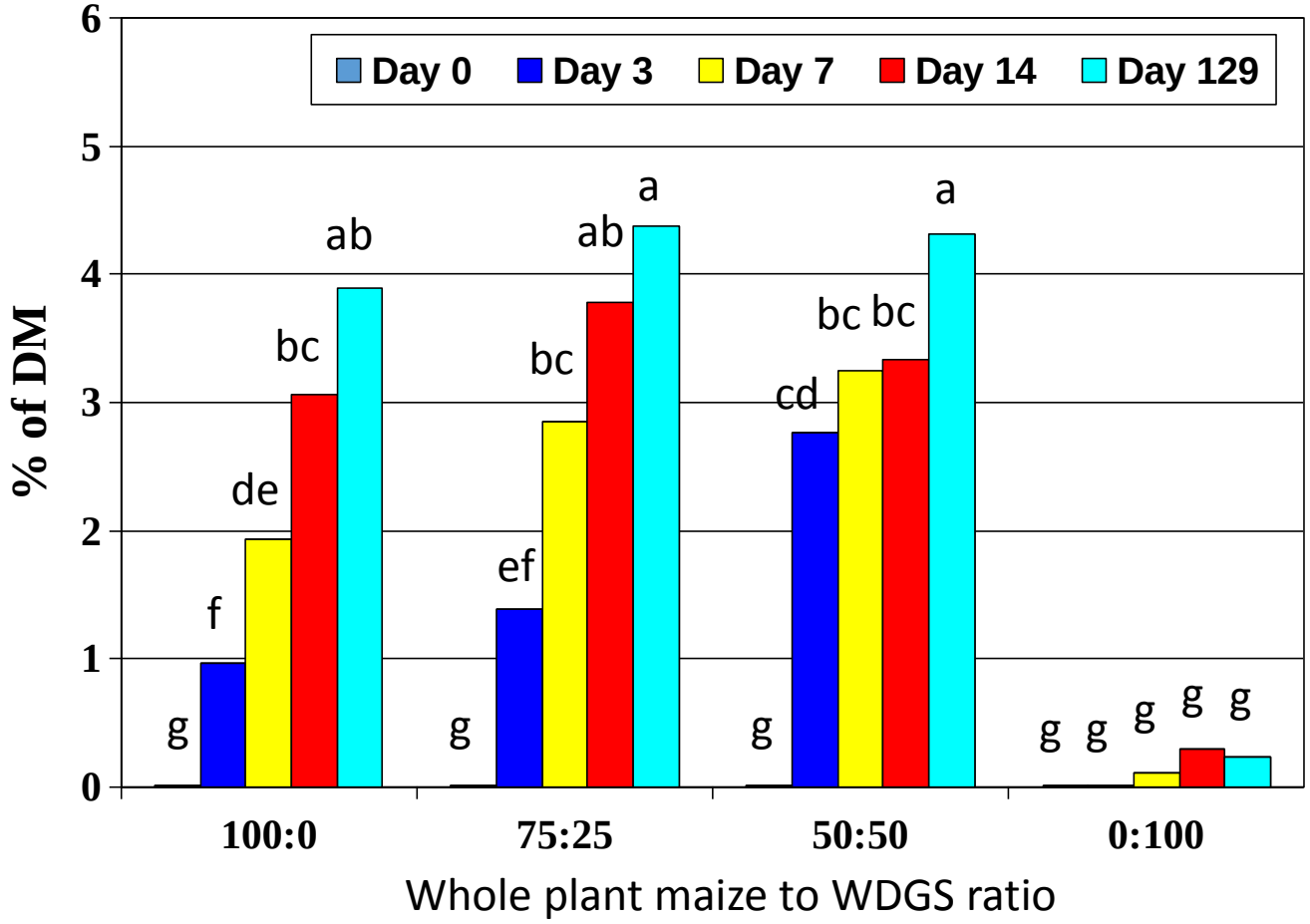
Ensiling WDGS with whole plant maize



Mjoun et al., 2011

Ensiling WDGS with whole plant maize

Acetic acid prior to and after ensiling

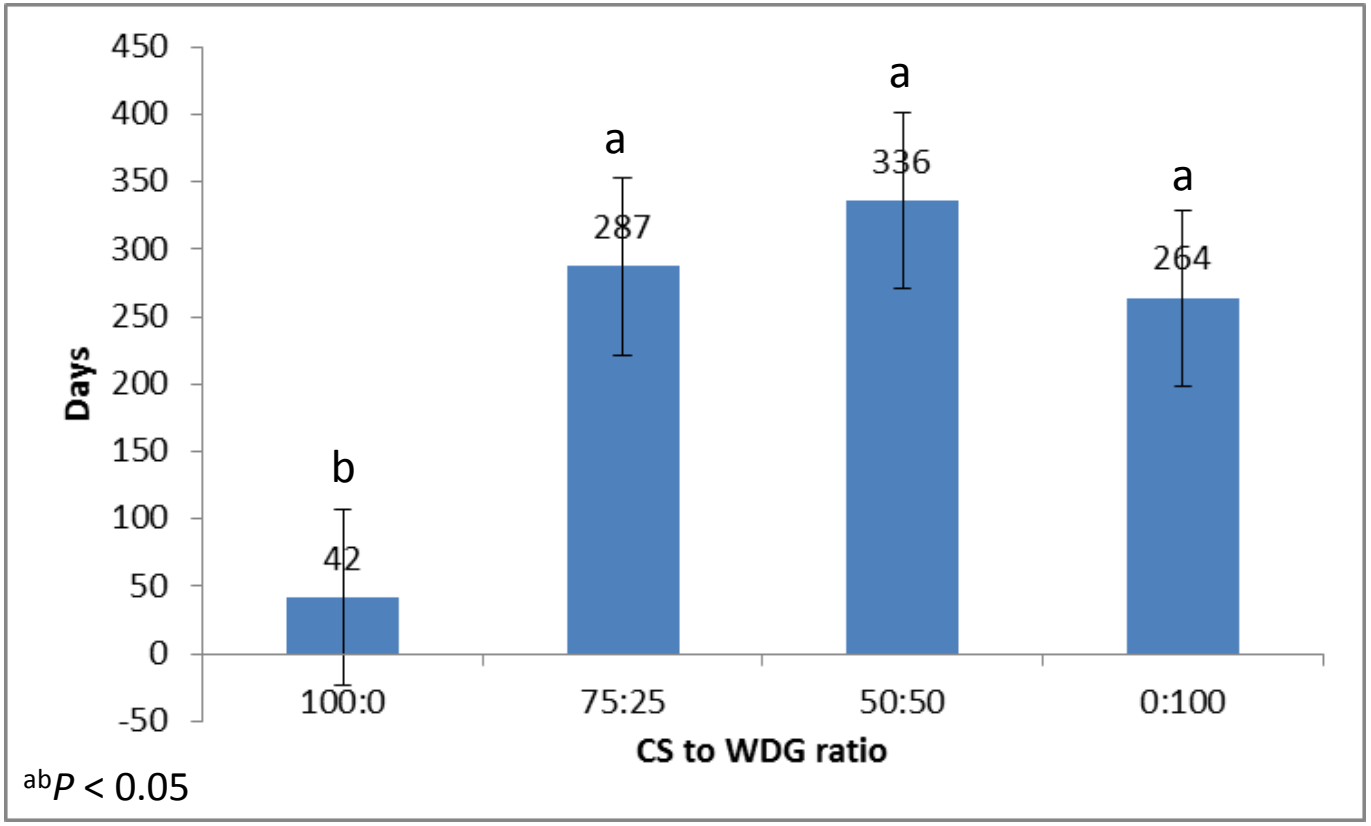


a-g$P < 0.05$

Mjoun et al., 2011

Ensiling WDGS with whole plant maize

Aerobic stability*



***Aerobic stability:** Number of hours it takes for temperature in feed to increase 2° C above ambient temperature.

Ensiling WDGS with corn stover

(Anderson et al., 2015)

- Coarsely ground corn stover was mixed with WDGS at a ratio of 1 part stover to 2 parts WDGS (as-fed basis).
- Three batches were ensiled untreated and 3 batches were treated with an ensiling additive at a rate of 1 kg/t.
- Samples were collected at day 0, 7, 14, and 21 after ensiling.

Ensiling WDGS with corn stover

	Treatment		
Item	UNT	TRT	SEM
DM, %	40.1	41.1	0.90
CP, %	17.9	17.2	0.43
pH	4.13	4.12	0.03
Lactic acid, %	3.31	3.42	0.64
Acetic acid, %	1.69	2.11	0.19

Ensiling WDGS - recommendations

- DM of blends should be no more than 50%.
- Drier blends do not preserve as well.
- Use of WDGS over MWDGS is preferred.

Conclusions

- Feeding WDGS presents challenges to smaller livestock producers.
- Individual farm characteristics and handling capabilities need to be considered when choosing storage methods.
- Combining WDGS with other feedstuffs prior to ensiling is an approach to increase their use in diet formulation and improve their long-term storage capability.
- Blending WDGS with alternative feedstuffs can extend feed supplies and reduce feed costs.

QUESTIONS?

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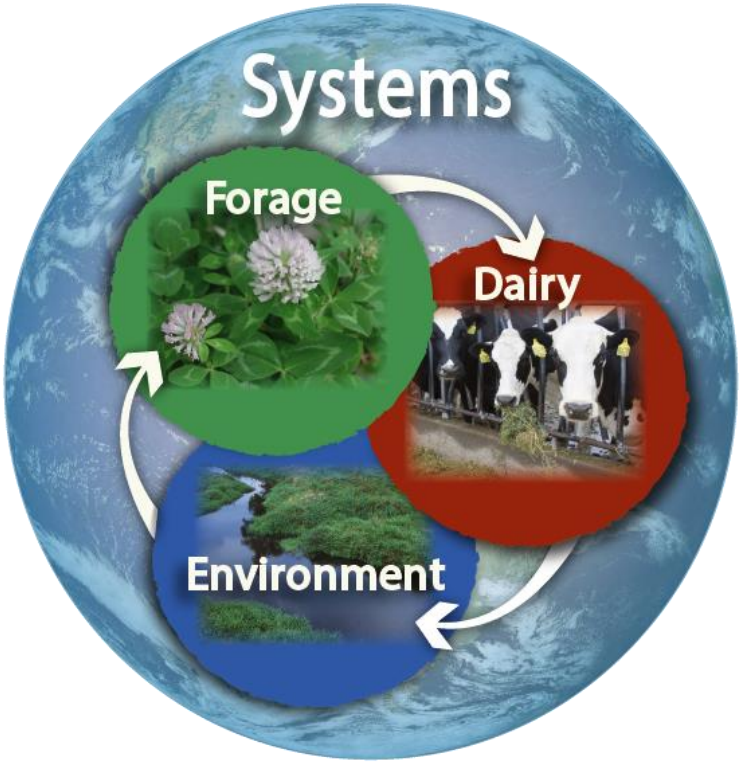

www.ars.usda.gov/mwa/madison/dfrc