

NUTRIENT CYCLING ON WISCONSIN DAIRY FARMS: THE ON FARMERS' GROUND PROJECT



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Overview



- On farmers ground- the 'big picture'
 - What's the study all about?
 - What data are we collecting?
 - How did we collect it ?
- Focus on 'Manure gap'
 - Continuation of Heathers work (Saam, 2004)
 - Reasons for 'Manure gap' - *preliminary results*
- On going research



Big Picture- Nutrient Management



- The unintentional loss of nutrients such as nitrogen (N) and phosphorous (P) from the farm to the environment are pressing problems facing the WI dairy industry
- In the future, the sustainability of all dairy farms will increasingly depend not only on profitable milk production, but also on farmers' ability to meet nutrient management regulations.
- To successfully accomplish the goals of these new nutrient management regulations it is essential that farmers are prepared to implement them.
- Increased input from farmers on this issue is therefore desirable, not only to identify barriers but also opportunities for improving nutrient use on Wisconsin dairy farms.



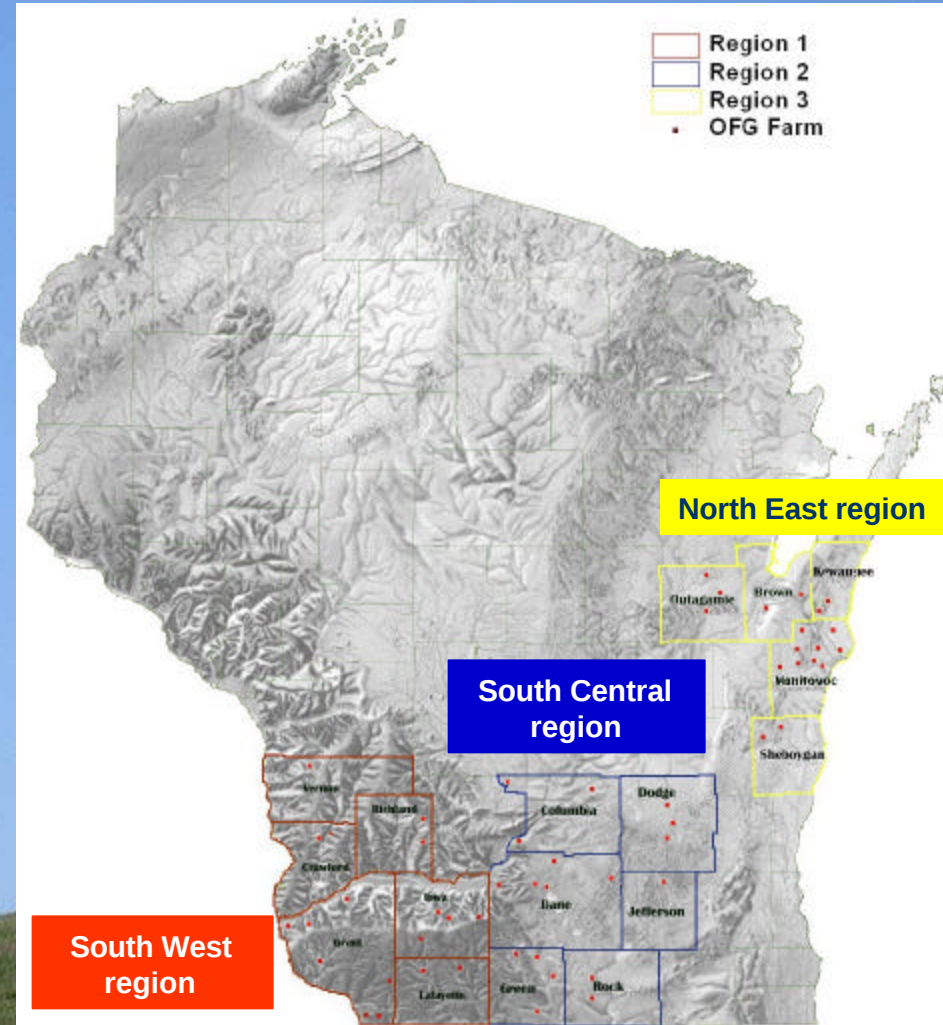
On Farmers' Ground



On Farmers' Ground" (OFG) project was initiated in 2002 to expand our understanding of the ways farmers in Wisconsin currently manage farm nutrients

By working closely with farmers we hope to identify how their nutrient management challenges are influenced by factors such as:

- Farm geographic location,
- Soil type
- Animal stocking density
- Farmer behavioral factors



Data Collection (survey)



Nutrient management data was collected from all 54 farms through a structured, face-to-face on-farm survey. Information collected included:

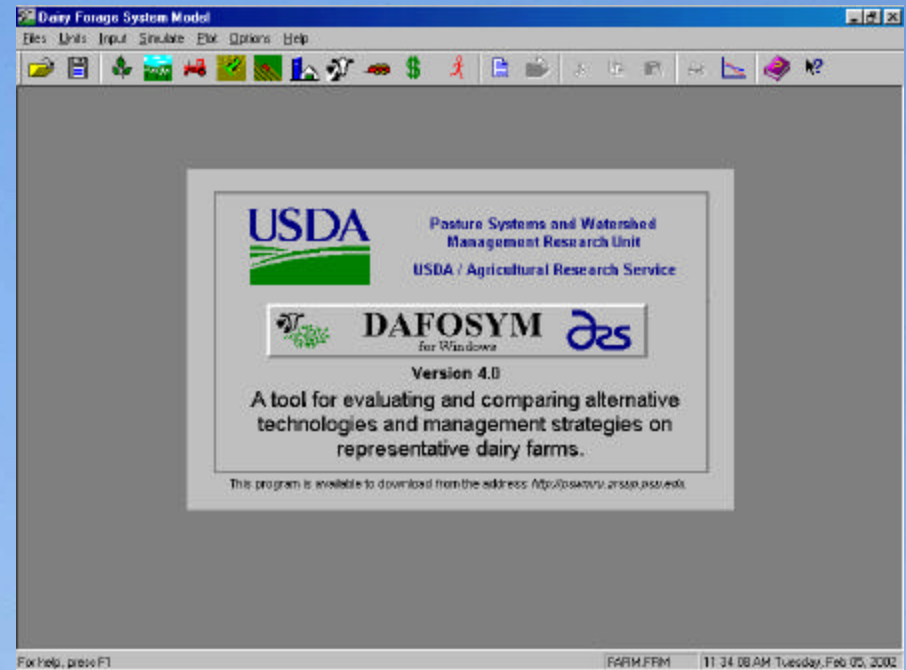
- General farm characteristics
 - e.g. herd size, housing facilities.
- Cropping practices
 - e.g. acres operated, crops planted, fertilizer inputs
- Dairy herd feeding practices
 - e.g. current feeding rations, sources of feed information
- Manure management practices
 - e.g. manure collection, storage, and spreading practices



Data Collection (survey)



- This data is being used in conjunction with various nutrient cycling models such as, the Dairy Forage System Model (DAFOSYM, Rotz, 1989) to compare how each farms current nutrient management practices effect issues such as:
- Whole farm nutrient balance of
 - Phosphorous (P),
 - Nitrogen (N)
 - Potassium (K)
- Specific management issues such as the risk of:
 - P loss
 - Ammonia volatilization
 - Nitrate leaching



Preliminary results- Manure Gap between regions



- Saam (2003) conclusions:
 - Need to recognize that animal density is likely to be an issue in implementing nutrient management standards
 - Total and Tilled Animal land ratios estimates are conservative
 - Actual “Manured” animal land ratios estimates indicate a large, and regionally variant manure gap
 - i.e. the North east farms only use 27% of total cropland to spread manure whereas South west farms use 44%



Manure Gap between regions



- Do OFG farms also show this regional 'Manure Gap' discrepancy?





Manure Gap between regions

Animal density indicator		Southwest	Southcentral	Northeast
<i>Animal Units / Total Cropland (ACLR)</i>	Low8	60	61	72.2
	Medium8	26.7	39	27.8
	High8	13.3	0	0
<i>Animal Units / Manured Cropland (AMLR)</i>	Low8	0	0	0
	Medium8	27	22	17
	High8	73	78	83

- Theoretically, the Northeast region has the lowest number of animals per acre of total cropland
- However actual acres of cropland used spread indicates it is using the lowest % of available cropland to spread manure

Where:

Low = $8 < 0.75$ AU/Acre

Medium = $8 \text{ } 0.75\text{-}1.5$ AU/Acre

High = $8 > 1.5$ AU/Acre



Manure Gap between regions



- What are the reasons for the 'manure gap' ?
 1. Between regions
 2. All farms
- What factors affect where and when farmers spread manure?



Table 1. Manure storage and hauling frequencies of dairy farms from the southwest, southcentral and northeastern regions of Wisconsin.



	Southwest [†]	Southcentral [†]	Northeast [†]	Average [‡]
Manure Storage				
Farms with manure storage (%)	38.9	50.0	61.1	50.0
Mean days of storage	94	243	373	284
Hauling frequencies				
Haul daily year round (%)	88.2	88.2	77.7	84.6
Haul daily year round except summer (%)	0.0	5.9	11.1	5.8
Haul daily year round except winter (%)	5.9	0.0	0.0	1.9
Haul in spring and fall only (%)	5.9	5.9	5.6	5.8
Haul in fall only (%)	0.0	0.0	5.6	1.9

- Storage – NE region has greatest frequency of farms with storage. It might be expected that greater storage allows more ‘timely’ applications of manure
- However the majority of farms from all regions still haul manure year round

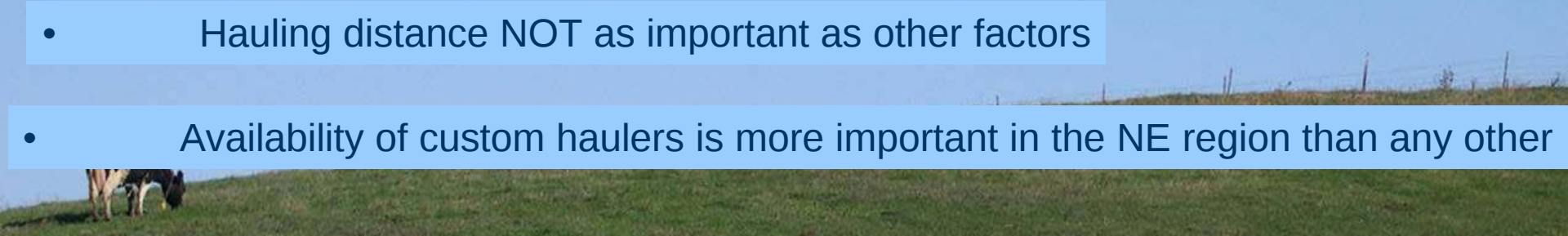


Table 2 . Factors influencing when and where manure is hauled (% important)
On dairy farms from the southwest, southcentral and northeastern regions of Wisconsin.

Factor	Southwest [†]	Southcentral [†]	Northeast [†]	Average [‡]
Crop requirements	71.4	88.9	100.0	90.7
Soil conditions	85.7	77.8	83.3	81.4
Soil residual nutrient levels	57.2	83.3	66.6	72.1
Weather conditions	57.2	61.1	66.6	62.8
Hauling distance	28.6	27.8	22.3	25.6
How full manure storage is (for farms having storage)	66.6	44.4	63.7	56.5
Availability of custom hauler (for farms using custom haulers)	33.3	12.5	50.0	29.4



- Little differences in most other factors that regions regard as important when deciding when and where they spread manure
- Hauling distance NOT as important as other factors
- Availability of custom haulers is more important in the NE region than any other

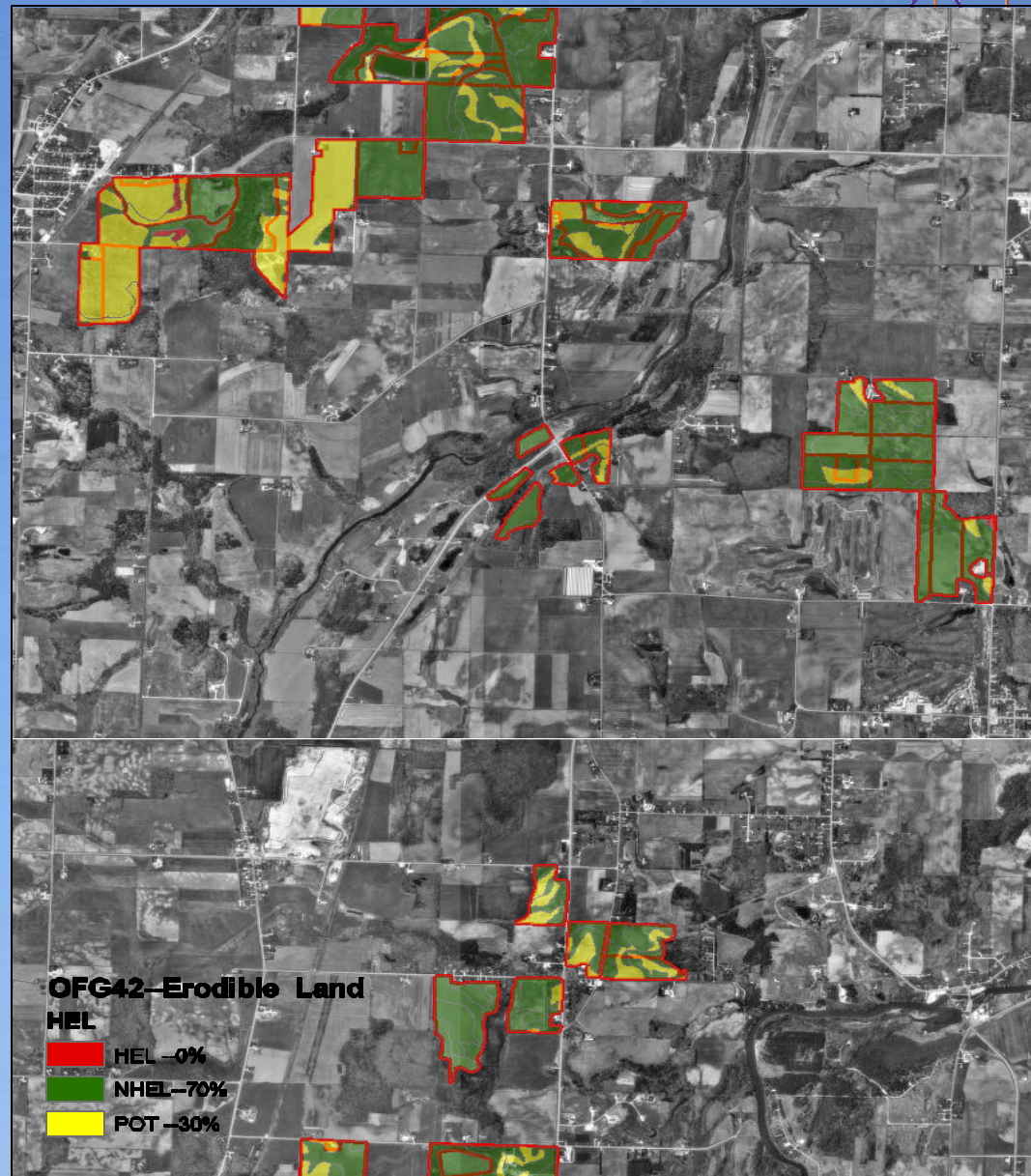


- Low importance of hauling distance for the Northeast region was surprising as generally farms are more spread out than other regions due to developmental pressures.



Housing Development Pressure. *Farm in the North East*

- Difficult to get land near home farm
 - Farm more disaggregated
- So why distance not more important?



Dairy farm in NW region



- Problems with questions?
 - Focus on fields they know they spread on
- To clarify these issues and further understand manure spreading behavior, each of the OFG farmers are currently participating in a manure tracking study



Dairy farm in NW region



Manure tracking



- Manure books constructed for each farm using digitized farm maps
- Each farmer is tracking manure hauling practices for 1 year noting:
 - *Location*
 - *Quantity*
 - *Type*
 - *Factors affecting spreading*



Example of manure tracking records

JUNE 2003

#5
* neighbors grazing
beef cows on out of
their pastures

	Field ID	Loads	Type	Comments	
Sun	1				
Mon	2	15	1	2	field is starting to show past - probably will show in fields soon.
Tues	3				
Wed	4				
Thurs	5				
Fri	6	15	1	3	rained today - also got attacked by bees going into this field!
Sat	7				
Sun	8				
Mon	9				
Tues	10				
Wed	11	14	1	3	a flock was disturbed went to tear up the neighbors can pick getting into the other field. also didn't want to get attacked by bees again.
Thurs	12				
Fri	13				
Sat	14				
Sun	15				
Mon	16	14	1	3	going to spread in this field now until get rid of the other fields #13 & 15.
Tues	17				
Wed	18				
Thurs	19				
Fri	20				
Sat	21	14	1/2	3	
Sun	22				
Mon	23				
Tues	24	14	1	3	
Wed	25				
Thurs	26				
Fri	27	14	1	g/ep	had cow back yesterday back to cleaning calf pen.
Sat	28				
Sun	29				
Mon	30	14	1	g/ep	

* note - all cleanings also include back corner
full load - dump we change smallest
1/2 loads - dump we don't change smallest

MARCH 2003

22

		Field ID	Loads	Type	Comments
Saturday	1	21	8.1	G	Added Super meter to see off, Frazzled
Sunday	2	21	8.1	G	Super meter added
Monday	3	18	8.1	G	Frozen Ground
Tuesday	4	21	8.1	G	" "
Wednesday	5	21	8.2	MG	" " w/ lanes (1 load better 1 YH)
Thursday	6	21	8.1	G	" " " "
Friday	7	18	1	G SW	" " " "
Saturday	8	21	1	G	" " w/ 7-8" snow
Sunday	9	21	1	G	" " " "
Monday	10	21	1	G	" " " "
Tuesday	11	18 15	8.1 0.2	G SW	" " w/ snow
Wednesday	12	21	1	G	" " w/ 1-3" snow
Thursday	13	21 17	8.1 0.2	G SW	" " w/ melting snow, spread w/ 17.6
Friday	14	21	1	G	" " w/ little snow
Saturday	15	21 21	1 1	G SW	poor bare ground
Sunday	16	21	1	G	muddy bare ground - temp above freezing
Monday	17	31 31 31	1 2 4	G YH BP	poor conditions - field 31 used for bed water
Tuesday	18	31 17	1 1	G SW	sprinkling rain + muddy
Wednesday	19	31	1	G	improving conditions dry surface
Thursday	20	17	1	G	Very poor conditions between 17-18
Friday	21	17 17 17	1 1 1	G SW	" "
Saturday	22	17	1	G	" "
Sunday	23	17	1	G	" "
Monday	24	21 17	1 2	G SW	Improving conditions dry field
Tuesday	25	31	1	G	dry on top
Wednesday	26	31	1	G	dry on top
Thursday	27	17	1	G	Wet + messy
Friday	28	17 17	1 1	G SW	very muddy
Saturday	29	31	1	G	Frozen ground
Sunday	30	31	1	G	" "
Monday	31	31 17	1 1	G SW	" "

Manure Gap between regions



- What are the reasons for these differences ?
 1. ~~Between regions~~
 2. All farms
- Why do the majority (73%) of farms 'appear' to be applying manure above N & P 'guidelines'?
- Slight error in the calculation?
 - Assumes all manure is collected and spread!

UNLIKELY TO BE TRUE – *outside areas*



Outside Manure Deposition Adjacent to barn



Outside Manure Deposition

Feed bunk areas



Outside Manure Deposition Pasture





Apparent Manure Collection

- Apparent manure collected was calculated according to the following summarized equation:

$$\% \text{ Apparent Manure Collected} = \text{Total manure excretion} \times (1 - \text{manure not collected})$$

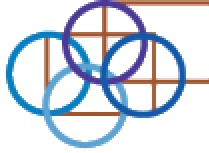
$$\text{Manure not collected} = \frac{\text{hours spent by herd in outside areas not scraped}^*}{24}$$

*calculated on a seasonal basis

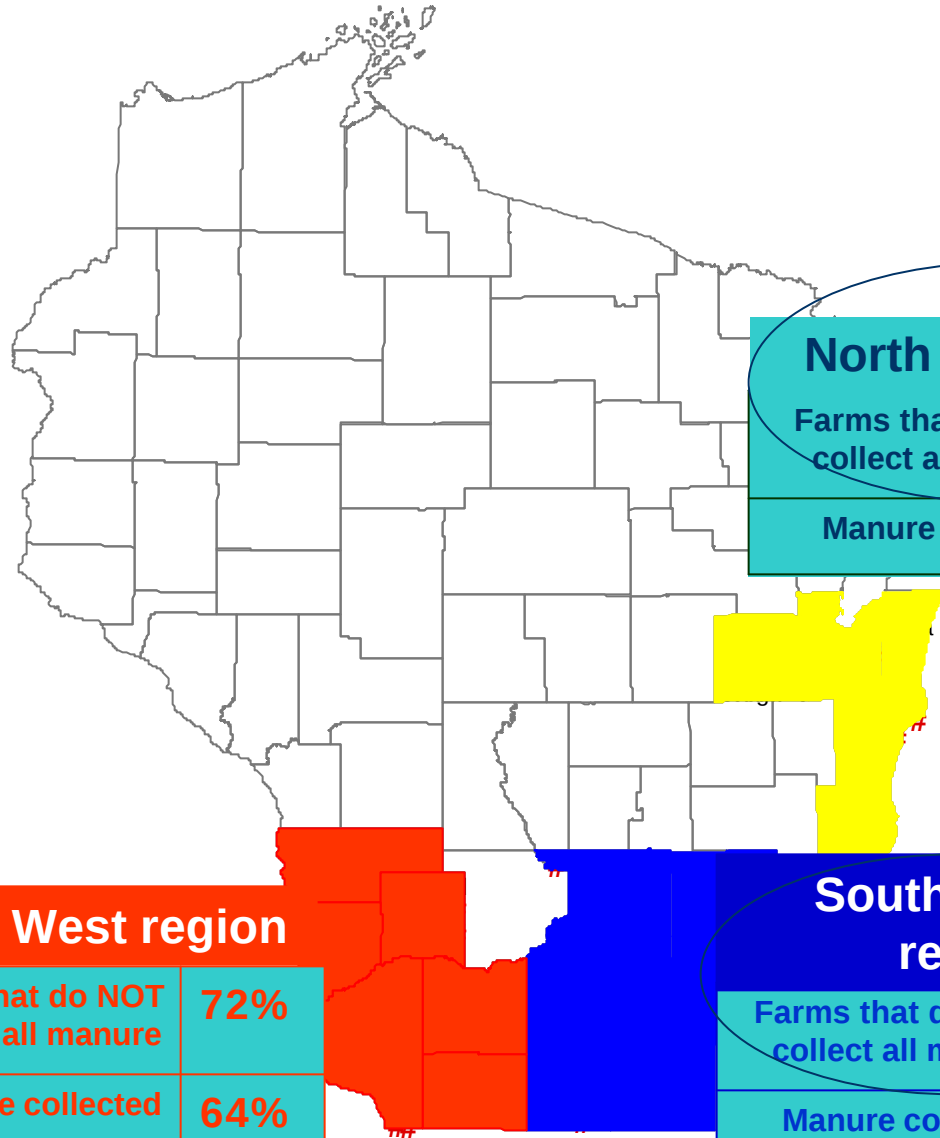
NB season length was not consistent and corrected according to farmers perception



Apparent Manure Collection



Lactating cows only
($n = 18$)



North East region

Farms that do NOT collect all manure	61%
Manure collected	66%

South West region

Farms that do NOT collect all manure	72%
Manure collected	64%

South Central region

Farms that do NOT collect all manure	89%
Manure collected	64%



Summary of 'Manure Gap' results

- The majority of dairy farms do not collect all manure
- Calculated manure loading rates may be much higher than actual manure loading rates
- Potential nutrient buildup in outside areas where manure not collected
- Regional differences between manure gap not yet realized





Future work 'Manure Gap'

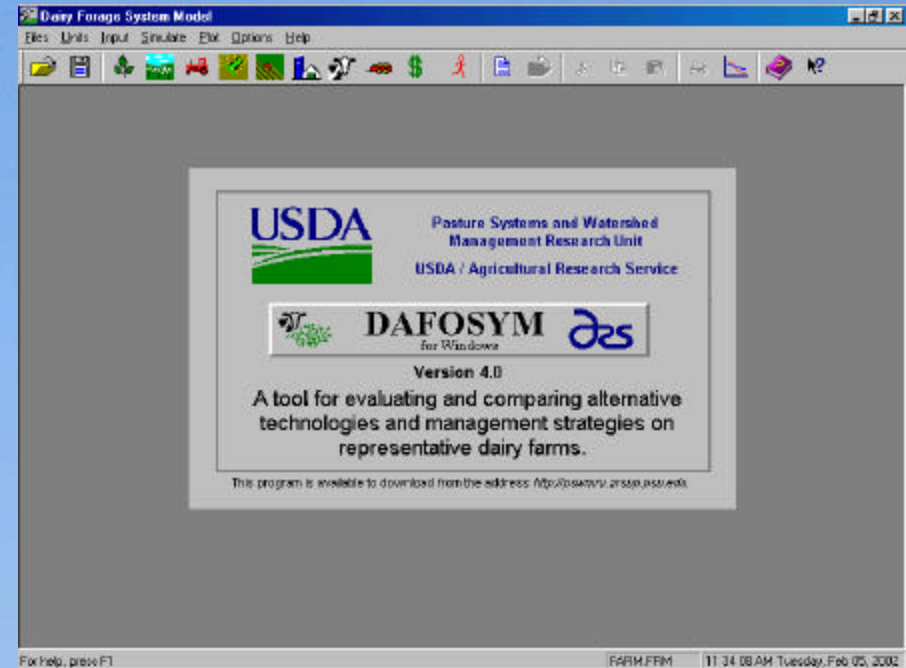
- Process Manure tracking book data
- Calculate annual manure (N, P and K) loading rates in outside areas and application to cropland
 - Measure surface area of each (GPS)
- Evaluate manure management strategies for outside areas



OFG - On going and future work



- Tip of the iceberg!!!!
- Nutrient management data analysis
 - Modeling and comparing nutrient flows for different farms/regions



OFG - On going and future work



- Final Phase-feedback
 - Share compiled and individual study results with farmers and possibly make nutrient balancing recommendations
 - Determine how and why certain nutrient management decisions were made
 - Identify barriers they perceive to nutrient management/ recommendations
 - *Difficulty in tracking manure spreading*
 - *Mass balance approach*



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Further information:

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<http://ipcm.wisc.edu/pubs/pdf/onfarmerground.pdf>.

