Reducing Agriculture's impact on climate change

Georgia Environmental Conference
Jekyll Island
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Dr. Mark Risse, PE

Georgia Power Professor of Water Resources

Director, Marine Extension and Georgia Sea Grant

The University of Georgia

Southeast Climate

EXTENSION | Advancing Climate Extension in Agriculture

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http://www.agroclimate.org/seclimate/

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Southeast Climate Extension is a project to advance climate extension in agriculture for the Southeastern U.S.

There are three parts to climate extension: engagement, education, and the successful application of gained knowledge for reducing risk.

This project is working to improve all three aspects, advancing the use and relevance of climate information for agricultural risk management in the Southeastern U.S.

See our expanded Extension Resources here.

UPCOMING EVENTS:

More information at http://www.agroclimate.org/seclimate/events
- Feb. 11, 2014: Edisto, SC "Advanced Farming Technologies for Reducing Climate Risks"
- Feb. 20, 2014: Headland, AL – Tri-State Row Crop Climate Learning Network meeting

ADAPTATION EXCHANGE 2013

FARMER DOCUMOMENTS GALLERY

ENSION
and Consumer Sciences

National Extension Project to Address Animal Ag's Carbon Footprint and Adaption to Climate Change

The overall goal is that Extension, working with partner organizations, effectively informs and influences livestock and poultry producers and consumers of animal products in all regions of the U.S. to foster production practices that are environmentally sound, climatically compatible, and economically viable.

USDA | NIFA

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This free, self-paced course requires 10 to 12 hours to complete—and the online platform eliminates travel time and expenses.

"Is the climate changing and what can we expect in the future?"

"How should we be planning and managing for the future?"

"How should farmers respond?"

"Where can we get objective information that serves the animal ag community?"

Animal Agriculture & Climate Change

A FREE ONLINE COURSE

- *Extension educators/agents*
- *Agricultural consultants/ educators*
- *Technical service providers*

Professional continuing education credits available upon completion

Register and find out more at ***www.animalagclimatechange.org.***

Livestock and Poultry Environmental Learning Center

USDA

LPE Outputs

- Online Course
  - 7 modules, 15 hours
  - Certificate available
- LPELC Newsletter
  - Events and news
  - New publications
- Website
  - Videos, webcasts, pubs

www.eXtension.org
Click on Animal Manure Management

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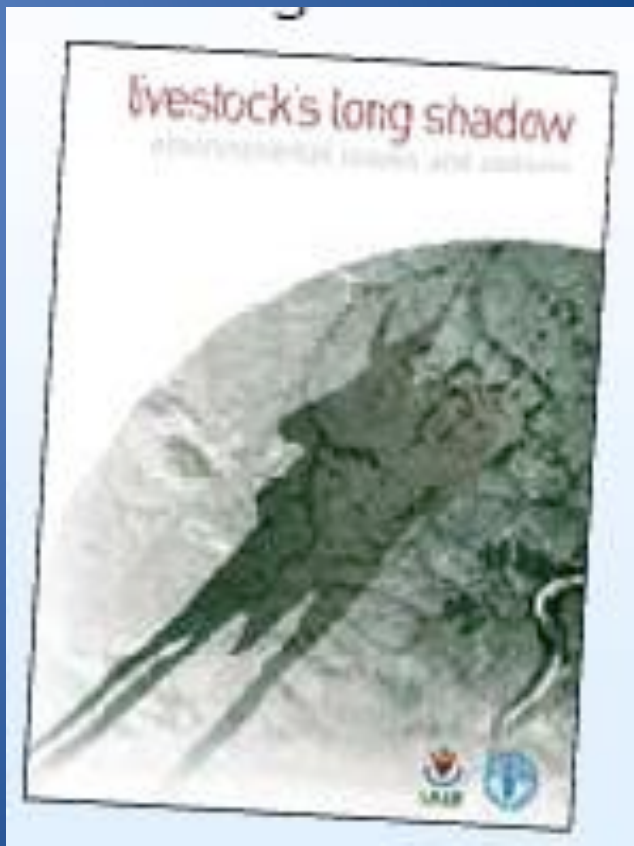
GHG's are here to stay!

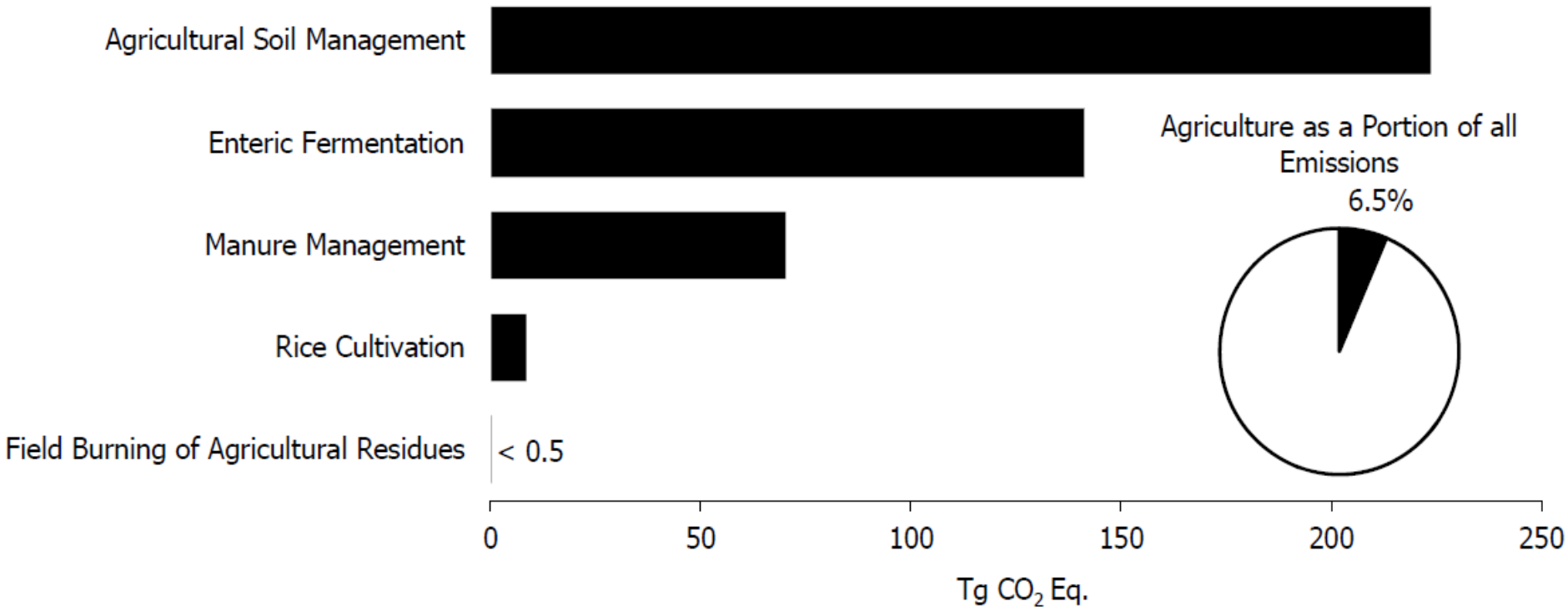
- UN report states meat production contributes more GHG than transportation.
- Recent US study concludes that transportation accounts for 26% of US emissions while livestock production is less than 3%.



Markets may drive GHG issue

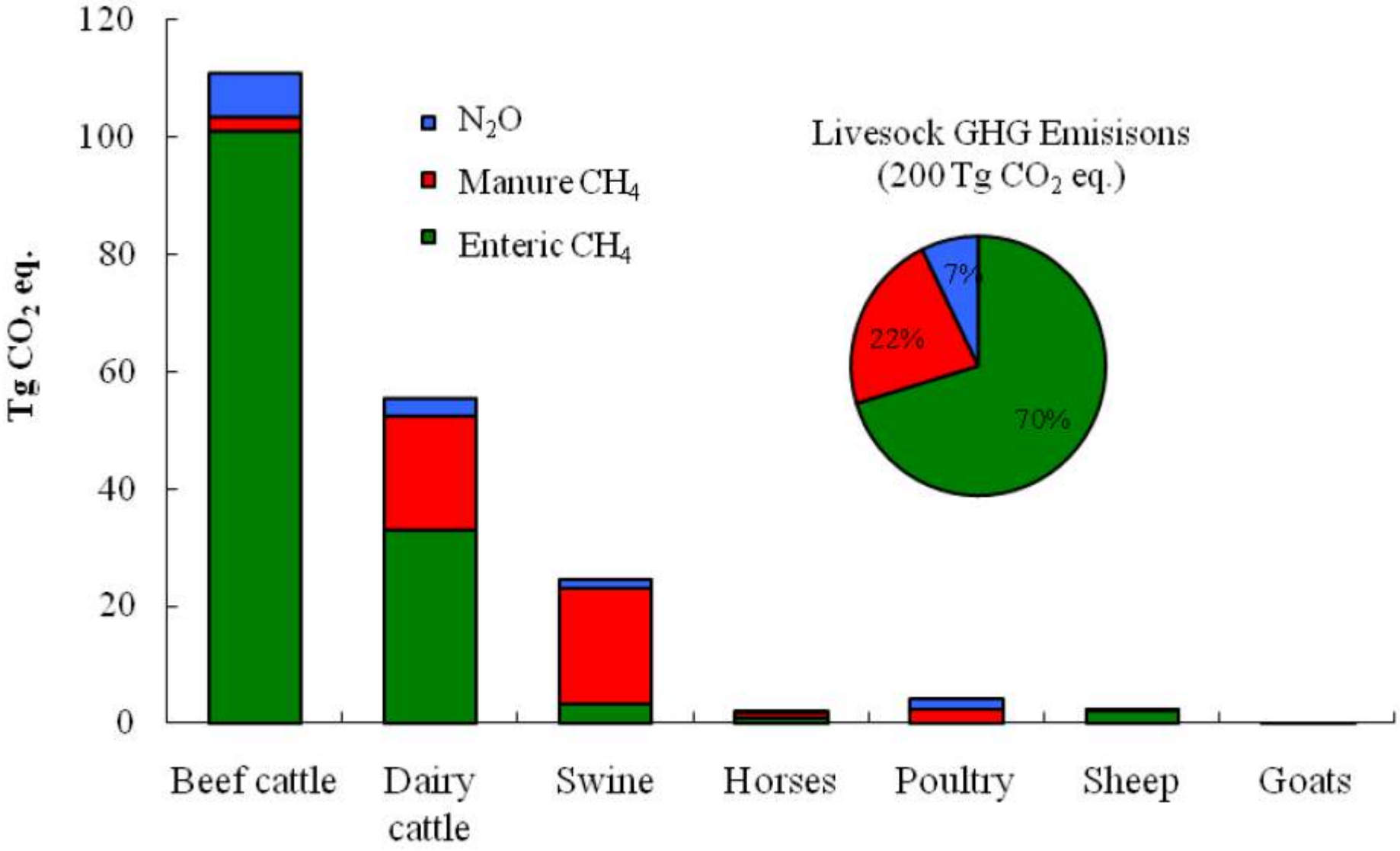
- Major retailers demand
- Carbon credits
- Life Cycle Analysis
- Sustainability
- International markets

U.S. Ag Greenhouse Gas Sources



EPA 2012

Livestock Greenhouse Gas Emissions

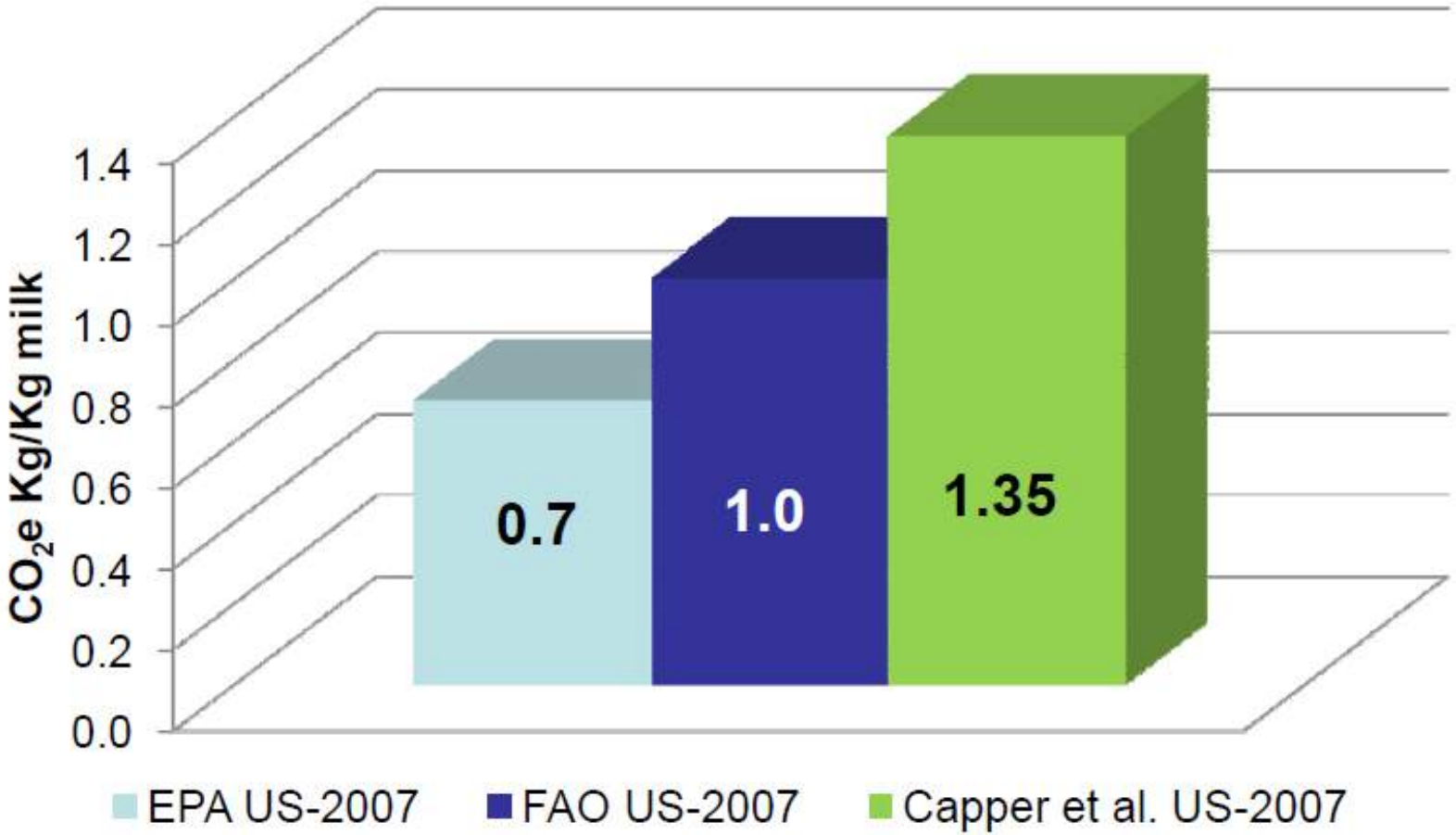


USDA 2011

What is a carbon footprint?

- Total GHG emissions for a given person, place, event, or product
- Created using a Life Cycle Analysis (LCA)
  - Measure inputs, outputs and impacts of the product
  - Resource accounting
- Helps avoid shifting environmental impacts from one area to another

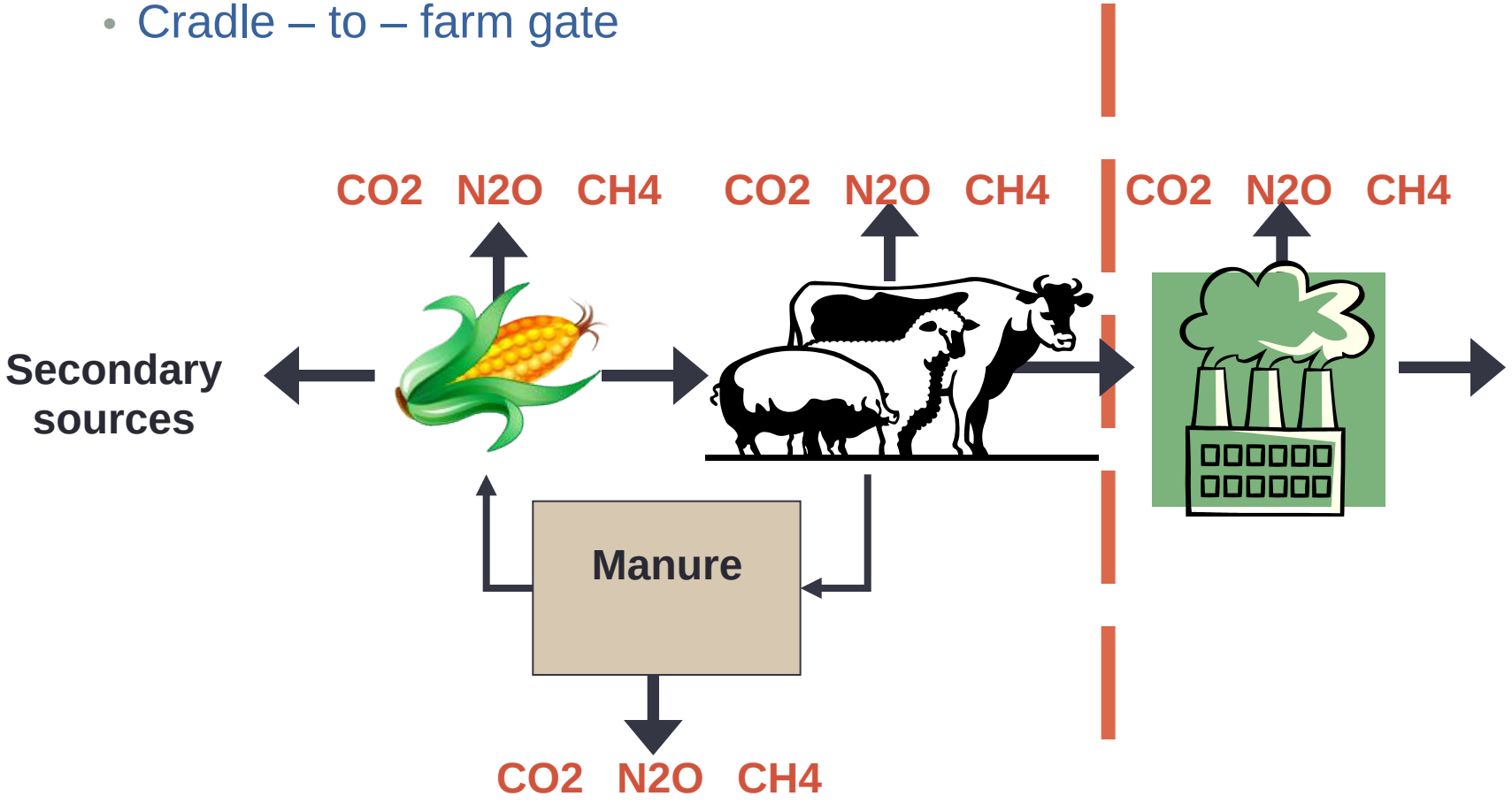
Not all analysis come up with the same “answer”…



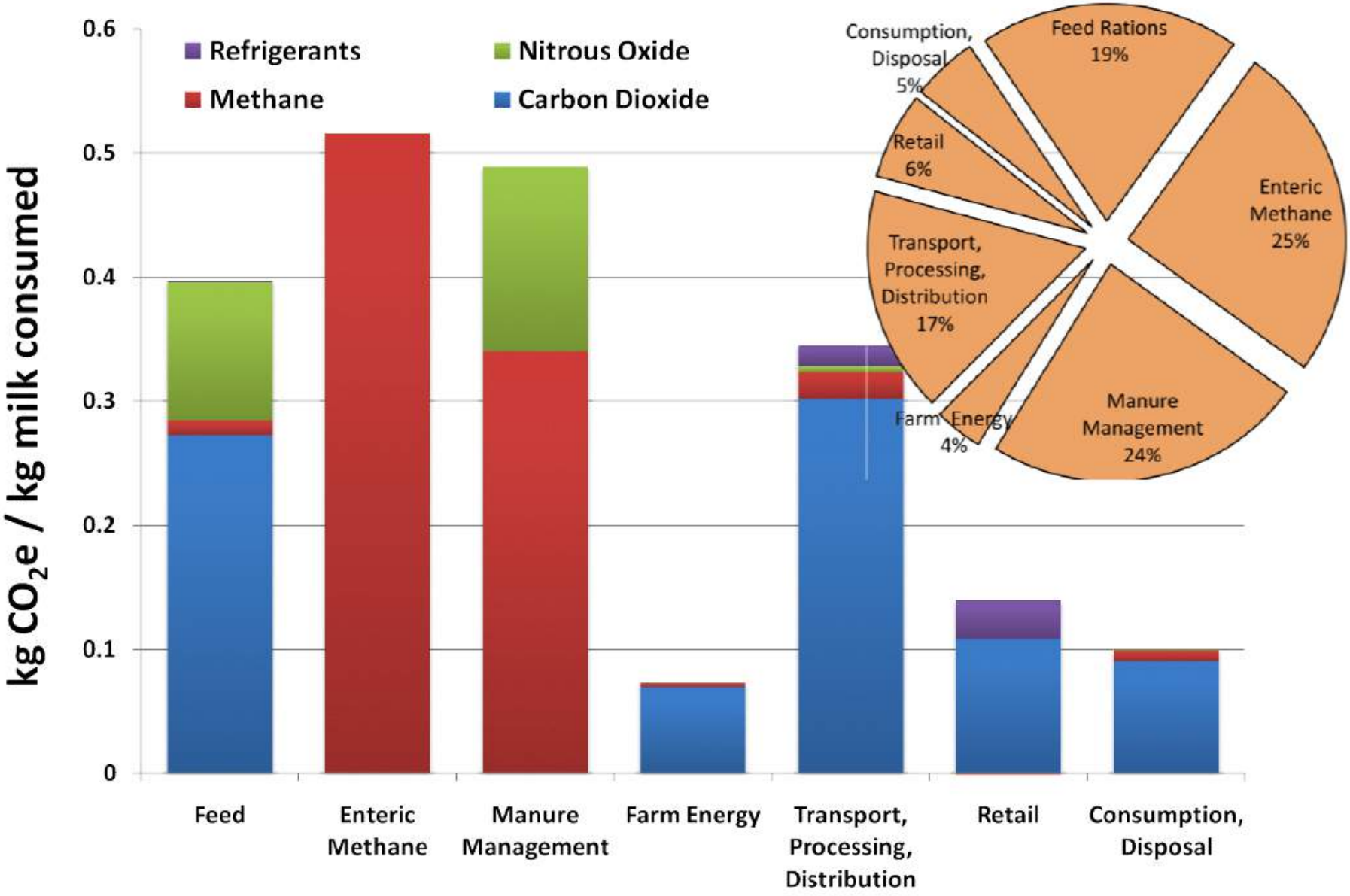
Sources : U.S. EPA (2010) “*Inventory of U.S. Greenhouse Gas Emissions and Sinks:1990-2008*”
UN-FAO (2010) “*Greenhouse Gas Emissions from the Dairy Sector: A Life Cycle Assessment*”
Capper, et al. (2009) “*The Environmental Impact of Dairy Production, 1944 vs. 2007*”, J. An Sci.

Boundaries

- Boundary definition
  - EPA: only manure management
  - Cradle – to – grave
  - Cradle – to – farm gate



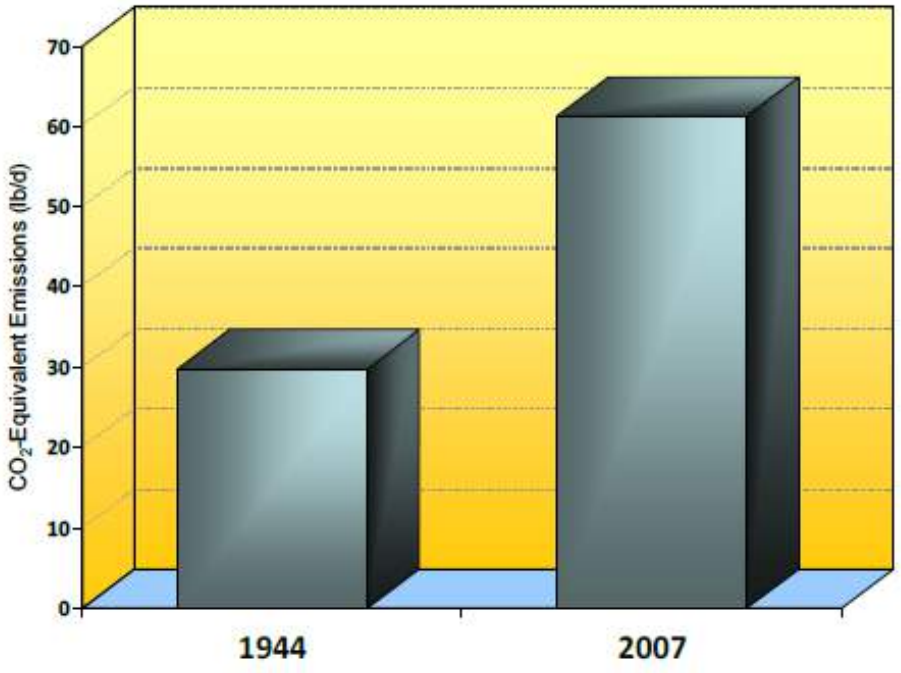
Assumptions



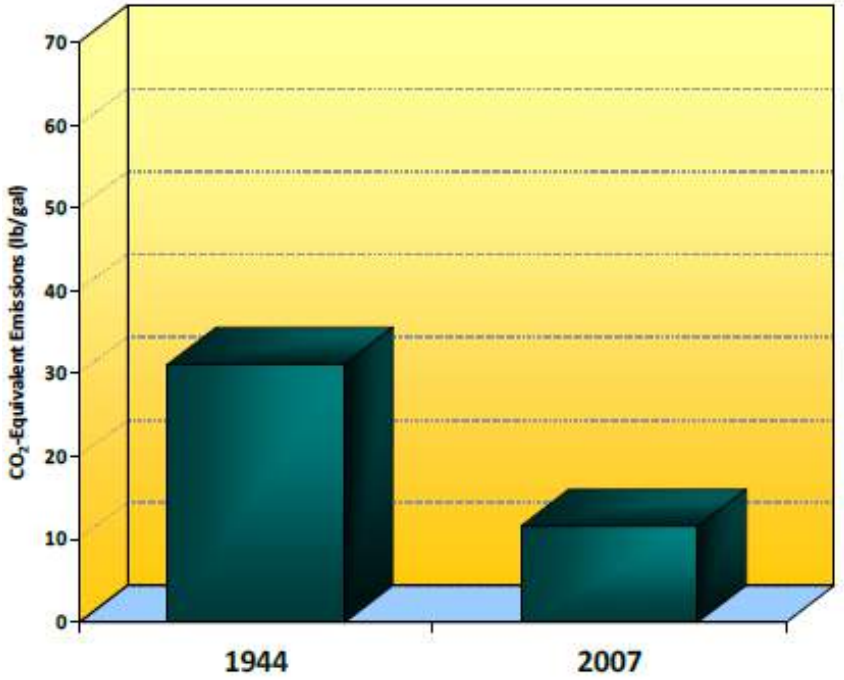
"Generic" Dairy Carbon Footprint, Thoma et al. 2010

Units

- Per cow
- Per gallon (kg) of milk
- Per gallon (kg) of energy corrected milk (ECM)
  - Fat and protein



Per cow



Per gallon of milk

Capper 2009

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Calculating the Carbon Footprint for the University of Georgia Swine and Dairy Farms Using Selected Models

By
Lin Ma

Major Professor: Mark Risse
Committee: Miguel Cabrera
Daniel Markewitz

04/24/2015

Objectives

- Choose appropriate existing models to calculate GHG emissions on selected UGA farms.
- Make recommendations for future work when recalculating GHG emissions as necessary.
- Make recommendation for management options to reduce GHG emissions on each farm.

Study Area

- Two UGA farms are selected as our study area: Double Bridges Swine Center (the UGA swine farm) and UGA Teaching Dairy Farm (the UGA dairy farm).

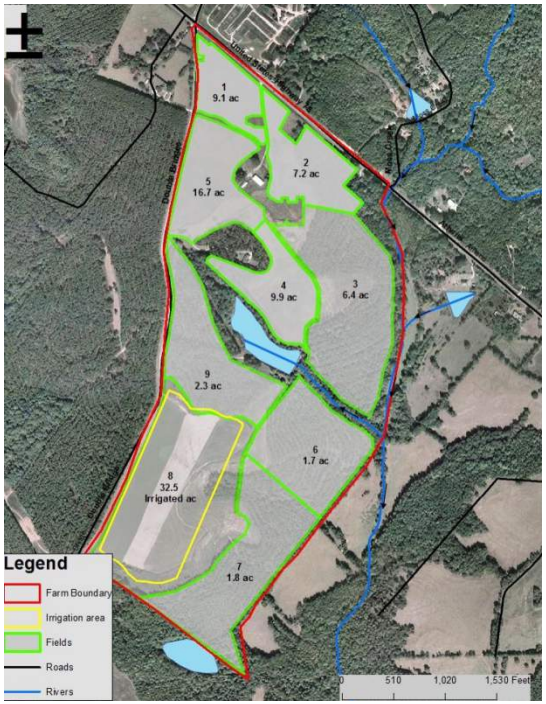

Figure 5: The UGA swine farm center field map

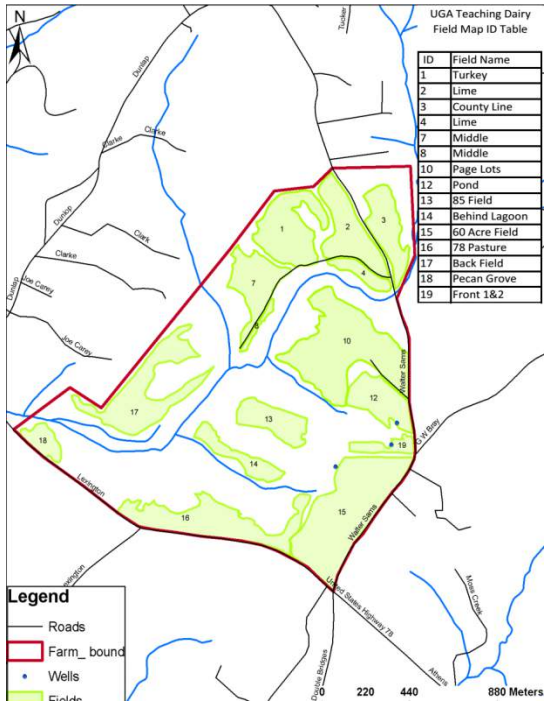

Figure 6: The UGA dairy farm field map

Tools and Procedures

- *All Tier II Cradle to Farm Gate LCAs*
- *Clean Air-Cool Planet Campus Carbon Calculator (Version 6.9)*
  - Tool the UGA uses currently.
  - Inputs only included electricity use, fertilizer application and animal inventory from 1990 to current year.
- *Farm Smart (Version 1.5)*
  - Process-based tool designed specifically for dairy farms supported by USDA.
- *Cool Farm Tool (Version 2.0)*
  - Process based tool designed for general agricultural operations by UK.
- *COMET-Farm Tool*
  - Process-based model that was originally developed to simulate soil carbon levels. The USDA-NRCS promotes this tool to US farmers.
  - This tool did not include all energy use for whole farm.
- *Pig Production Environmental Footprint Calculator (Version 3.X)*
  - Developed for the National pork producers association and is designed specifically for pork production.
  - Very detailed for the buildings and pig production but limited in terms of field operations

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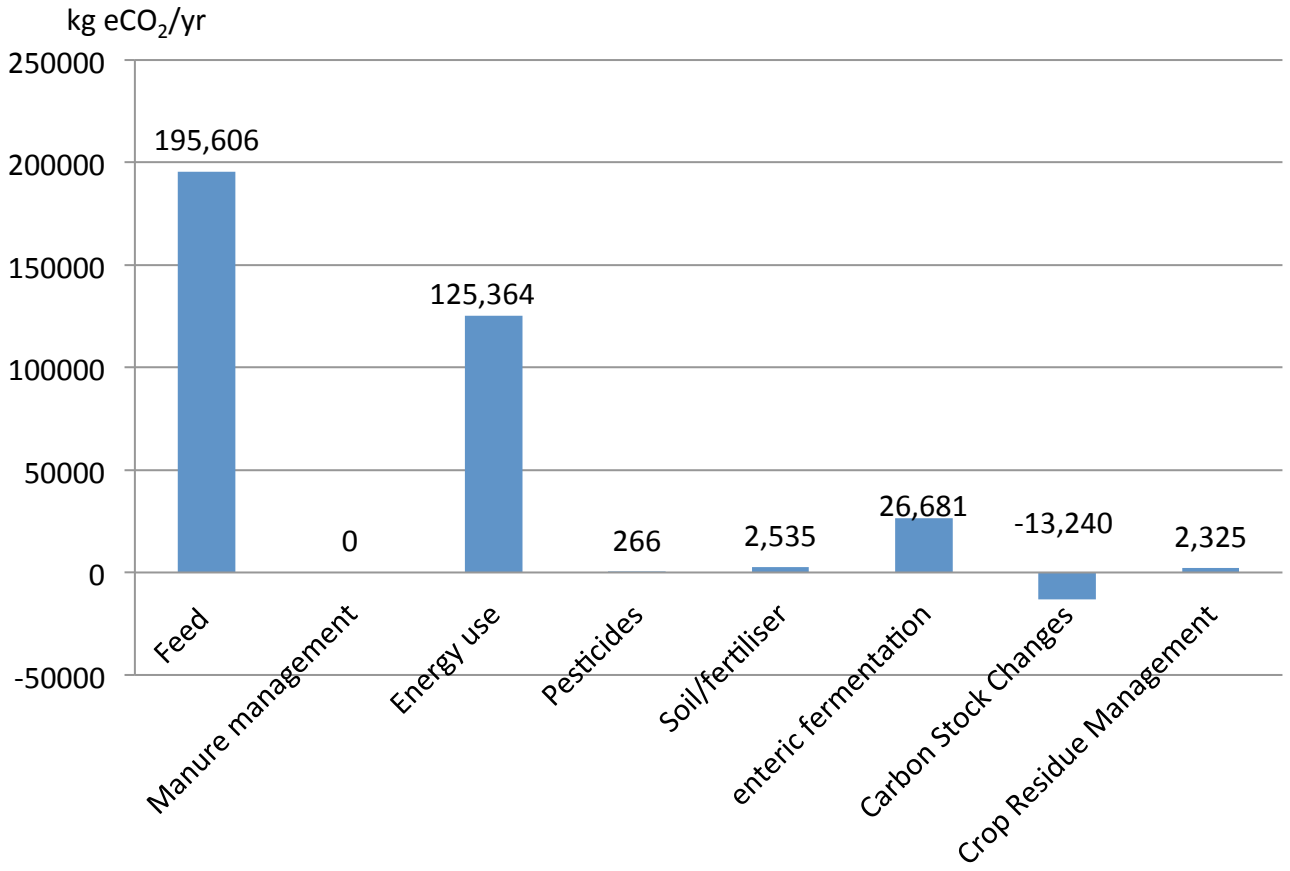
Results and Discussion

- *Carbon Footprint in the UGA Swine Farm*

Model	Greenhouse Gas Emission (kg/yr)			
	CO_2	N_2O	CH_4	Total (eCO_2)
Clean Air-Cool Planet	102,426	132	21,470	678,400
Cool Farm Tool (Version 2.0)	307,996	16	1,067	339,538
COMET-Farm Tool	26,500	111	20,084	561,700
Pig Production Env Calc	294,092	68	490	326,804

Results and Discussion

- *Carbon Footprint in the UGA Swine Farm*



Carbon footprint components for the UGA swine farm using Cool Farm Tool (Version 2.0)

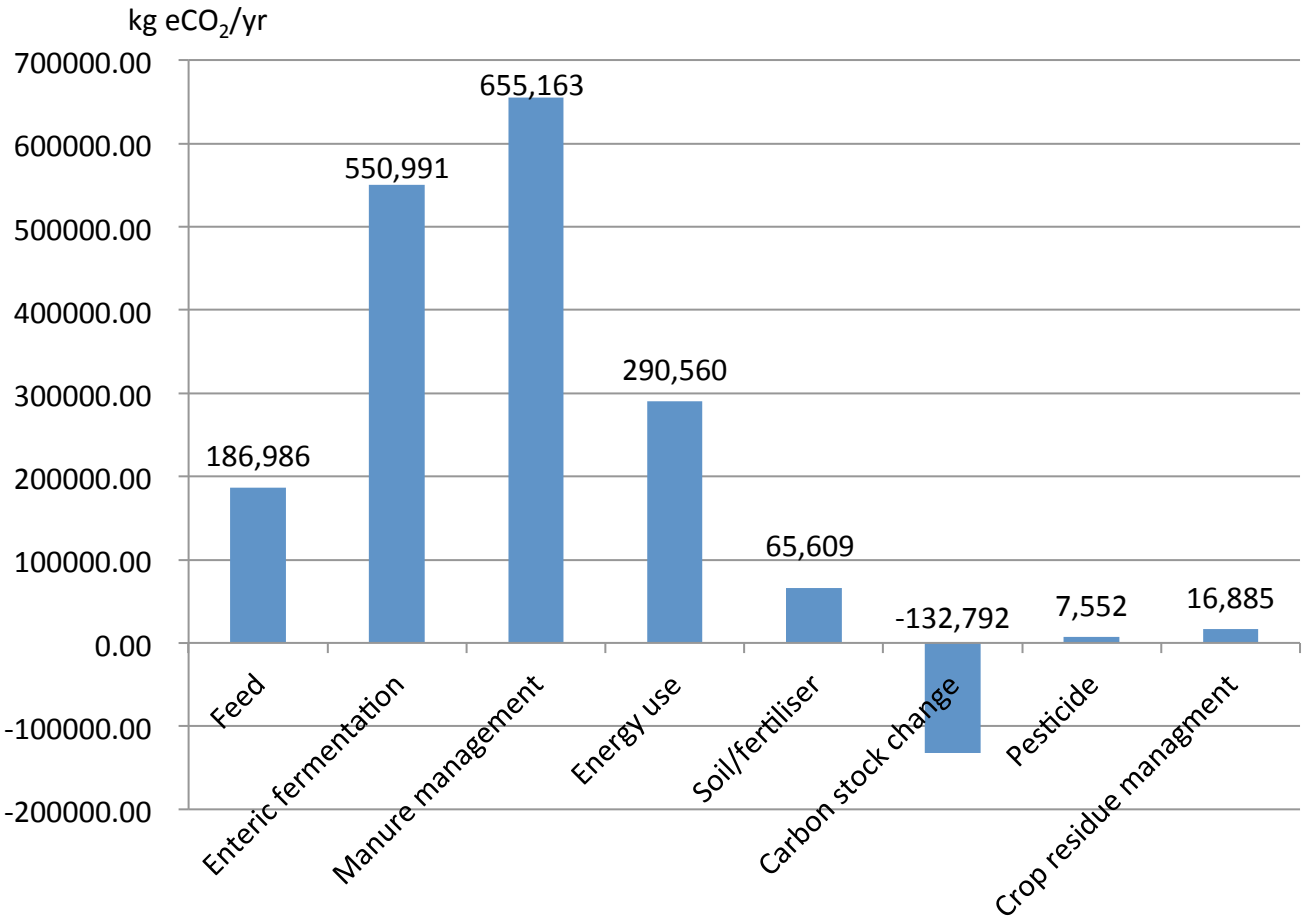
Results and Discussion

- *Carbon Footprint in the UGA Dairy Farm*

Model	Greenhouse Gas Emission (kg/yr)			
	CO_2	N_2O	CH_4	Total (eCO_2)
Clean Air-Cool Planet Campus	245,163	747	42,103	1,520,300
Cool Farm Tool	1,006,782	277	22,040	1,640,954
COMET-Farm Tool	-94,500	1,705	95,720	2,806,600
Farm Smart	1,383,466	1	1,199	1,413,738

Results and Discussion

- *Carbon Footprint in the UGA Dairy Farm*



Carbon footprint components for the UGA swine farm using Cool Farm Tool (Version 2.0)

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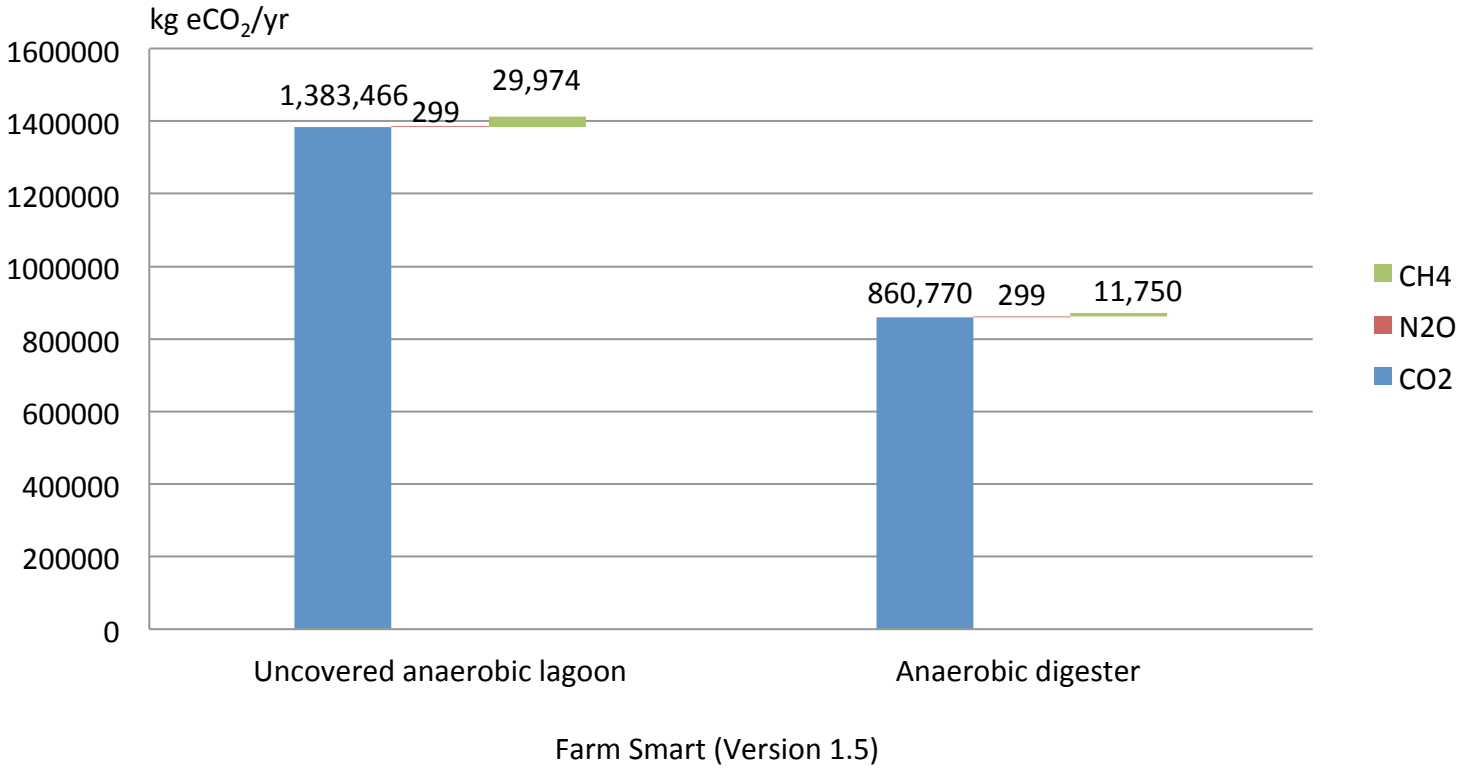
Results and Discussion

- *Carbon Footprint in the UGA Dairy Farm (Farm Smart)*

	UGA Dairy Farm (kg eCO_2/lb milk)	National (kg eCO_2/lb milk)	Difference (kg eCO_2/lb milk)
Feed production	0.0839	0.1451	-0.0612
Enteric fermentation	0.1279	0.1950	-0.0671
Fuel use	0.1668	0.0318	0.1351
Indirect Nitrous	0.0115	0.0163	-0.0048
Direct Nitrous	0.0071	0.0460	-0.0390
Total pasture manure	0.0000	0.0079	-0.0079
Total manure GHGs	0.2467	0.1633	0.0834
Total	0.6440	0.6055	0.0384

Results and Discussion

- *Management Options for Reducing the Carbon Footprint —Manure management*

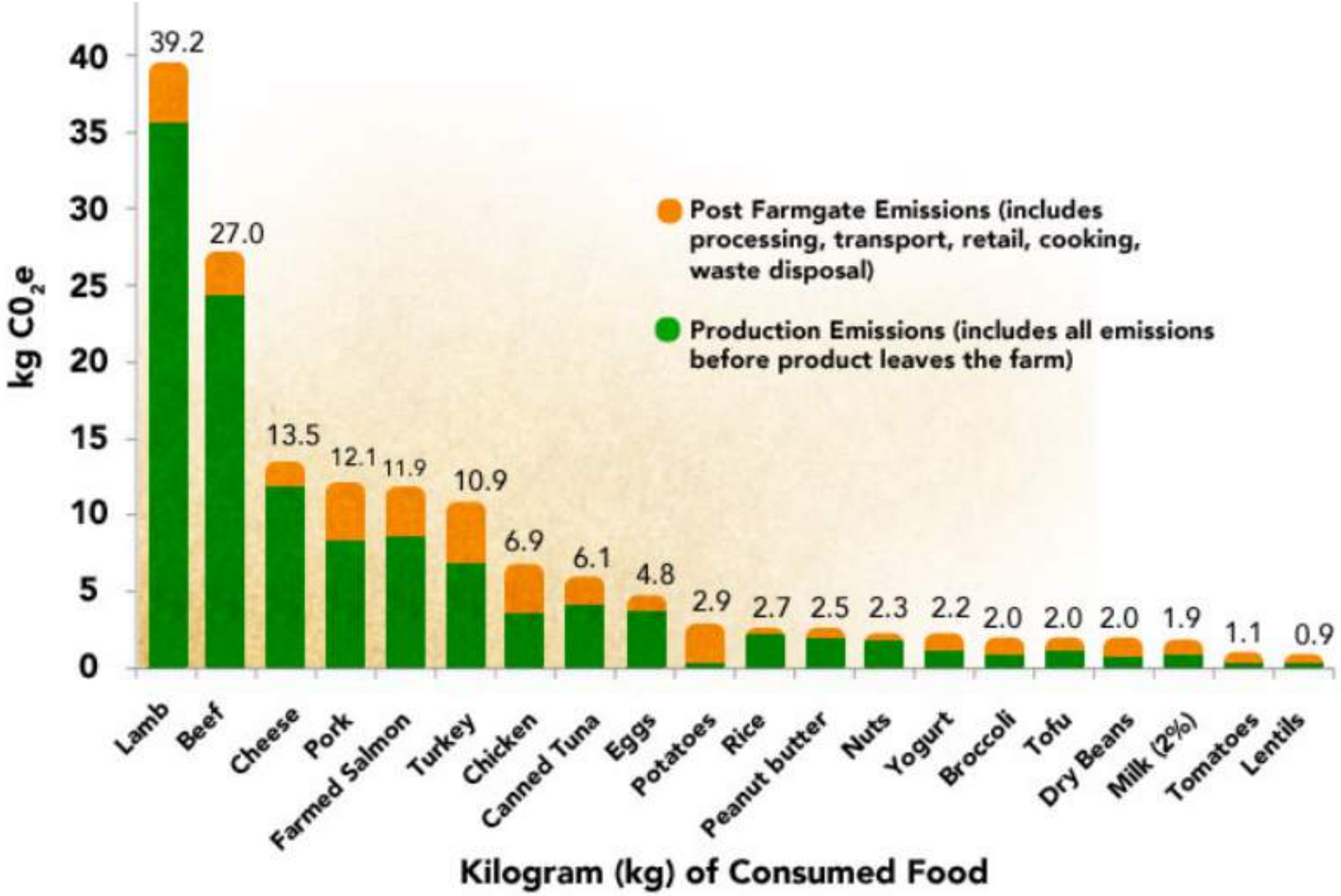


Conclusions

- The tools produced widely varying results. The CCC was the easiest to use and required the fewest inputs but also did not account for many management options. The more complex models accounted for a wider variety of options and generally provided more useful output of estimates.

- Several management changes such as changing from intensive tillage to reduced tillage or no tillage, changing manure management from uncovered anaerobic lagoon to anaerobic digester, or changing the type of corn used in the swine ration were investigated and shown to have potential to reduce carbon footprint on the UGA farms. This shows the real strength of using more complex tools, as these management changes could not be considered using CCC.

Product comparisons



EWG 2011

Is Grass Fed Beef Better?

- Austrailian Meat Institute Study show 30% higher Carbon footprint.
- Other studies show reduced
- More emissions on grass from animal
- All depends on C sequestration in pastures.

Georgia Case Study using ISFM

Confined

Pasture-based

Farm Characteristic	Pasture-based Dairy	Confined Dairy
Number of Cattle	500	700
Breed	Holstein and Jersey Crosses	Holsteins and Holstein, Jersey, and Swedish Red Crosses
Average Mature Cow Body Weight (lb)	1100	1300
Grazing Strategy	All Cows Year Round	Dry Cows and Older Heifers
Milk production		
Total (lb/cow/year)	11,000	23,640
Milk fat concentration (%)	3.6	3.8
ECM (lb/year)	5,590,000	17,350,000
Feed production and utilization		
Harvested silage (ton DM)	0	3367
Grazed forage (ton DM)	1103	655
Purchased grain (ton DM)	805	3335

State Route 13

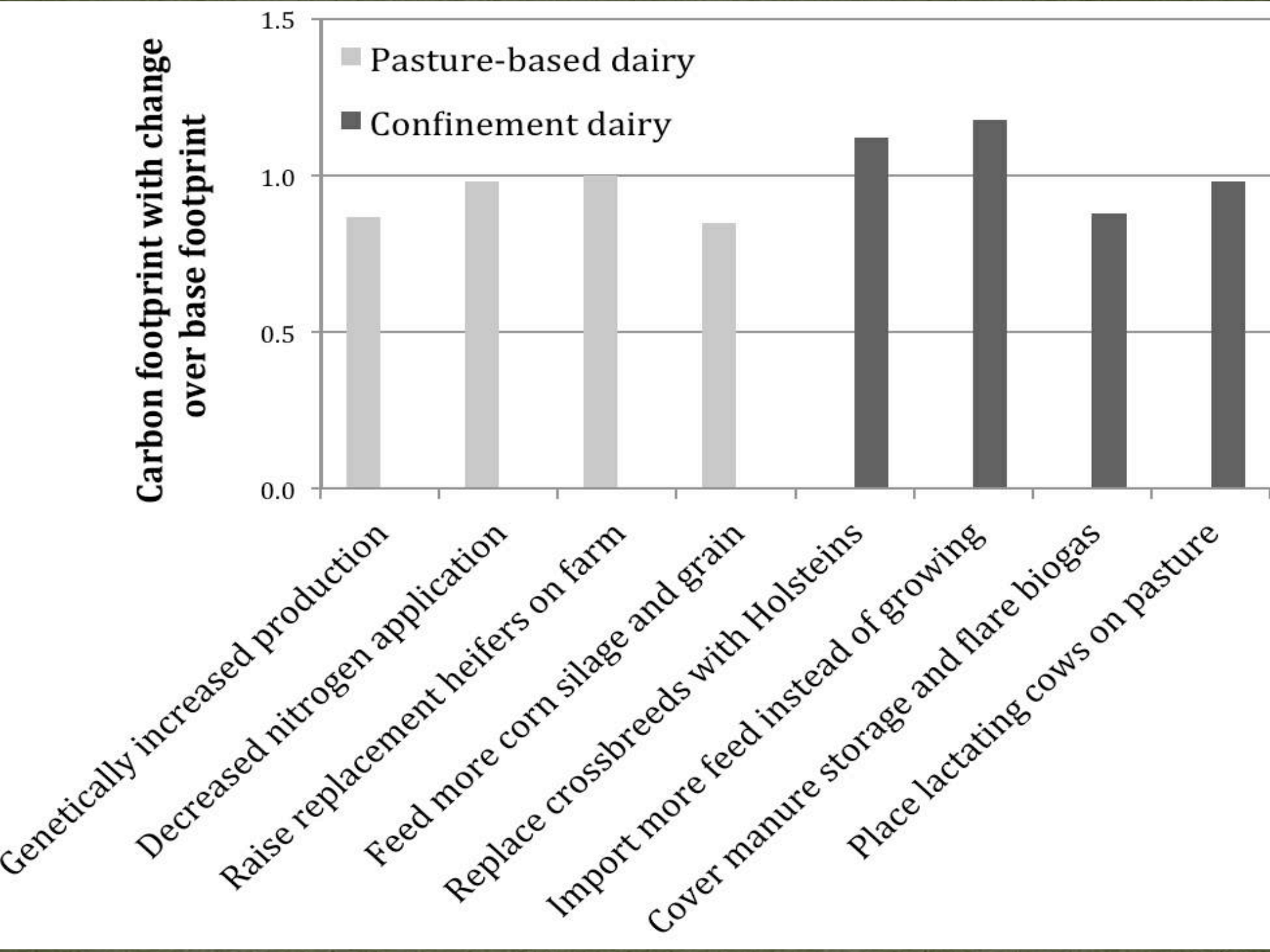
Greenhouse Gas Emissions:

Greenhouse Gas Emission or Assimilation	Pasture-based Dairy ton CO_2 equiv.	Confined Dairy ton CO_2 equiv.
Methane	1,705	3,878
Nitrous oxide	220	1,543
Carbon dioxide (fuel)	126	526
Secondary sources	608	1,642
Assimilation during feed production	-826	-2,562
Not allocated to milk	-174	-446
Sum	1,586	4,581

Carbon Footprints:

Farm Characteristic	Pasture-based Dairy	Confined Dairy
Carbon Footprint (lb. CO_2 equiv. / lb ECM)	0.58	0.56
Carbon Sequestration* (lb CO_2 / lb ECM)	0.09	0.00
Carbon Footprint With Sequestration (lb. CO_2 equiv. / lb ECM)	0.49	0.56

* Estimated using the Comet-VR model (USDA-NRCS, 2009).


Carbon footprint with change over base footprint
1.5
1.0
0.5
0.0
Pasture-based dairy
Confinement dairy
Genetically increased production
Decreased nitrogen application
Raise replacement heifers on farm
Feed more corn silage and grain
Replace crossbreeds with Holsteins
Import more feed instead of growing
Cover manure storage and flare biogas
Place lactating cows on pasture

Reducing Impacts

- Increase production per animal
  - Improve reproduction, genetics
  - Disease Control and Herd Health
- Feeding
  - Higher digestibility feeds, improve nutrient use
    - Processing feeds, Grinding and pelleting (Reduces CH_4 20%), Steam-flaking (40% Reduction)
    - Feed ionophores (Reduces CH_4 by 28%)
    - Addition of fats (up to 5%) to ruminant diets (Reduces CH_4 by 33%)
  - Decrease N Execretion
    - **Forages should be grazed or harvested when immature**
      - **Immature forages are more digestible and have less fiber than mature forages,**
      - **Rotation grazing, legume additions**

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manure handling and storage

- Cover manure storage and flare gas
- Digest manure to create biogas / electricity.
  - **Effects of manure storage method**

	Anerobic lagoon	Slurry earthen pond	Stockpiled Deep litter	Compost
	Relative emissions			
CH_4	10	8	6	1
Total GHG	Very high	4	2-3	1
Dominant gas	CH_4	CH_4	CH_4 & N_2O	N_2O

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UGA's new Swine Center

Reduce Energy/Fuel Consumption

- Conservation/reduced tillage
- Harvest forage by grazing rather than mechanical
- Crop drying in fields or improved efficiency
- Reduce Irrigation requirements
- Improve nutrient use efficiency
- Reduce fossil fuel use

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Increase Carbon Sequestration

- Cropland:
  - Reduced-till or no-till
  - Increased crop rotation intensity
  - Buffer strips
  - Conservation measures that reduce soil erosion
  - Higher residue crops (corn, sorghum, wheat)
- Grazing land
  - Improve forage quality & quantity-Rotational
  - Reduce overgrazing
  - Nutrient Management
    - Match nitrogen to pasture needs
    - Legumes

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Improvement in soil OM in 3 paddocks located in a pasture-based dairy in Wrens, GA. (2007-2009)

Paddock	Initial	1 year	2 years	3 years
	------ *Soil Organic Matter, %* ------			
P4	1.08	1.15	1.25	2.20
P8	1.01	1.17	1.59	2.18
P14	1.14	1.63	1.86	2.00
Avg.	**1.07**	**1.32**	**1.57**	**2.13**

3 years after grazing system started, averaging an inc. in soil OM of 0.35 percentage points per year!!!

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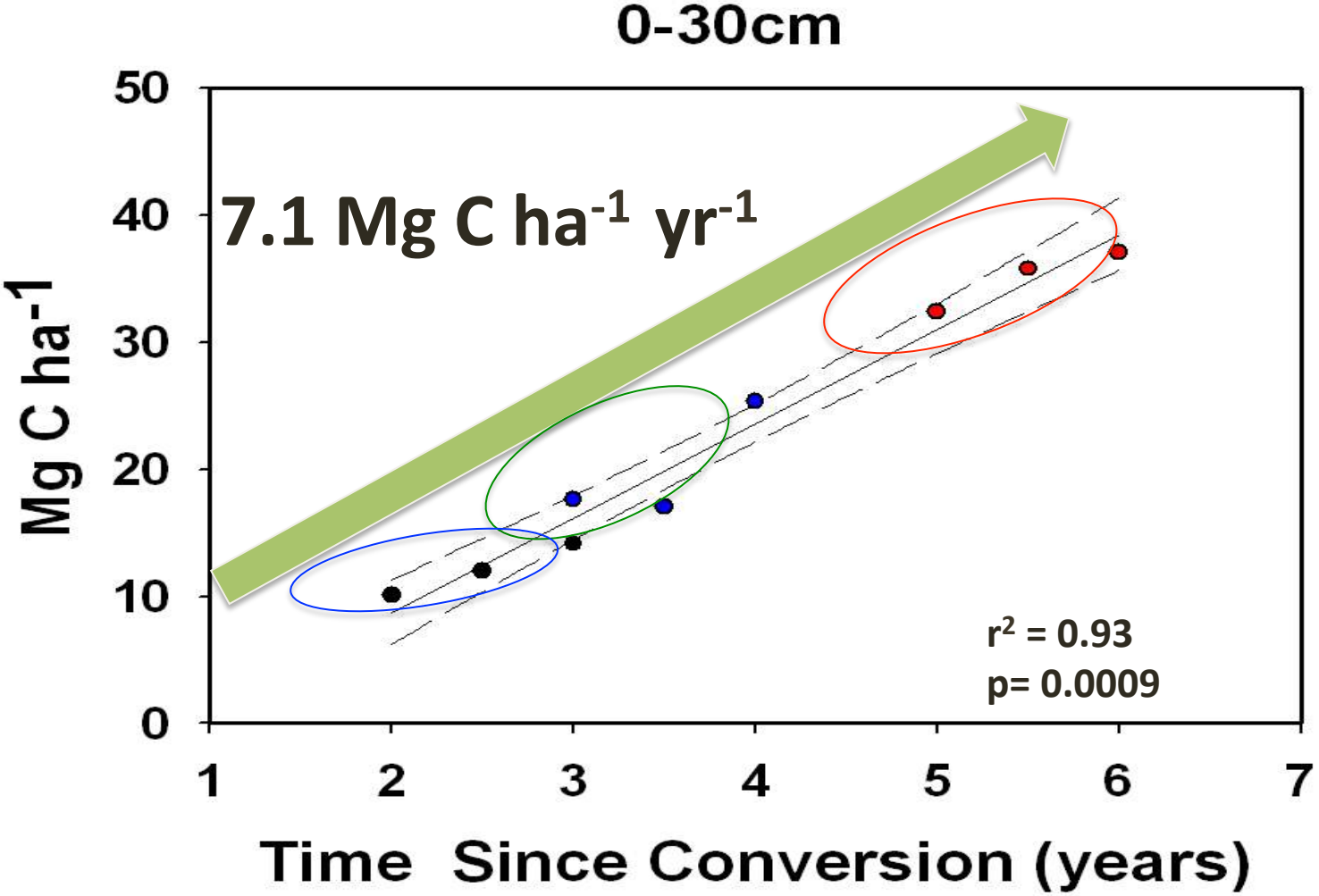
Impact of Pasture-Based Livestock on Soil Carbon



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Thank you for listening!

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