Minutes of NE 1044 Mtg – Lexington, KY – October 30 – 31, 2013

Meeting began at 9:15 AM and hosted by Yoko and chaired by Rhonda Miller

Present in KY – Yoko Kusunose, Rhonda Miller, Mike Westendorf, Vinicius Moreira, Rich Muck, Joe Harrison, Santiago Utsumi, Stephen Herbert

Connecting by adobe – Al Rotz, Steve Smith , John Westra, Brian Rude

October 30, 2013 - Reports

AM

Vinnie – Anaerobic lagoon island coverage project – parlor wastewater treatment

Previously looked at floating islands at research station under "greenhouse" conditions

Floating foam islands were 1000 sq ft vs 2000 sq ft, 7 % vs 14 % coverage of lagoon surface on 1^{st} of 3 lagoons that were in series

Ryegrass vs corn

Ryegrass was harvested 2 x per year and corn 1 X

Wastewater was tested for multiple parameters

Ryegrass did well, corn did not do well – basically no growth

Nitrogen removal seemed to be improved, but P concentrations increased based on concentrations in waste-water

The amount of nutrients that are removed via plant mass is minimal, not worth the effort to harvest

Steve Smith – NIFA advisor

NIFA update – see handout

Competitive programs – take the time to read the releases for AFRI rfps, a new rfp is Water due out in Dec 2013

Due to government shutdown, the release dates are likely delayed by a month

Should we visit with S 1032 group for potential future collaboration, they recently went through some "sustainability" process (with outside facilitator) to look to the future, group of engineers, Animal productions systems – systems of methods …. – Wendy Powers, Applegate, Deanne Meyer, Jactone Arogo, Brent Auverman

Request their document that was an outcome from their 2013 meeting

Rich Muck

Mark Powell report - Feed-milk-manure nitrogen relationships in global dairy systems (collaboration with FAO)

6 month stint with FAO in Rome (Mark Powell)

Looked at grouping based on continuum from confinement to grazing

37% of lactating cows have NUE-mill of < 10%, these cows account for 10% of milk production and 33% of the total Nex globally

80% of these low production cows are found in Africa

Powell – interrelationships between methane emissions and ammonia emissions and animal performance

CH4 emission peaked at ~ 26 KG DMI/d and ~ 700 g/cow/day

As milk n/intake N increased, NH3 emitted decreased

Powell – emission from bedded manure that has a base soil, sand, or bark

Differences were observed for emission of GHG and NH3, differences may be able to be explained by leachate

Muck – how do silage additives increase milk production

You don't necessarily see an increase in IVDMD

Rumen biomass is increased with use of some inoculants and looking at true digestibility (IVDMD)

IVDMD results were verified with N15 enrichment technique studies

Milk production and milk protein was enhanced when inoculated alf silage was fed at 50% of diet

PM

Mike Westendorf

Nutrient variability in brewers grains – amino acid content of bypass fraction of BG did not vary much between high and low CP samples

% CP averaged ~ 10% higher than NRC values, most other constituents were similar

Outreach project – online composting school for small farms

Joe Harrison – Reported on NH3 loss due to manure types during storage and land application, manure solids content are a big factor related to NH3 loss when land applied

ARS Forage lab tour – Dr Glen Aiken – focus on tall fescue toxicosis, recent strides in low endophyte species and knowledge of which alkaloids cause vascular issues (ergovaline)

Brian Rude

Ryegrass grazing – looked at supplementation strategies of grain and hay to grazing of ryegrass

Second study looking at pasture renovation – native pasture, vs Indiangrass or bluestem mix pasture

Cattle gained faster on Indiangrass

Nutrigenomic methods for improving nutrient efficiency – 3 yr project – evaluate the nutrient efficiency of heifers born from nutritionally deprived dams for 140 days of last part of gestation (80 % for energy and protein)

Santiago

Environmental impacts of pasture based systems with automatic milking systems – 2 stocking rates (1.5 and 1 cow/acre), 2 feeding systems – pasture and concentrate, and pasture-tmr & concentrate, 2 genotypes – USA Holstein and New Zealand Friesan

Thursday AM

Rhonda Miller – BMPs for reducing gas emissions from manure in semi-arid region and high pH soils

Have been in non-compliance for air quality in Cache Valley

Multiple manure sources based on beef and dairy and management practices

50% of NH3 loss in 24 hours, use of straw as bedding reduces NH3 by 75%

Grass-legume grazing study – use of legumes to reduce need for N fertilizers

Tannin impact on nitrogen dynamics - did add some tannin to water source, animals did not like tannins and reduce h2o intake

Yoko – Benefits vs costs of proper waste disposal – with focus on P

Al Rotz – VOC emissions for whole farms, precursors for ozone and smog formation, VOC from silages are 3 -4 times that of manure

Environmental footprints of beef production systems

New versions of IFSM and DairyGEM are ready for release

Stephen Herbert

Fall applied manure – NH3 loss very dependent on ambient air temperature

Manure applied to corn planting – disced, no discing, and aerway

Raised solar panels in pasture fields – cattle can graze underneath

Can get 90 – 95 % of crop growth if panels are raised above animal height

Mark Coyne & Leslie Hammond (grad student)

Compost bedded pack manure as a source of N and P

System helps small to medium sized dairies – 40 – 400 cows to lessen manure mgt costs

KY tends to be a P rich area

Next Meeting

In Brazil at 2015 International Silage conference if approved for international travel

Plan B – Michigan State, Santiago as host

Chair – Joe Harrison

Secretary – Mike Westendorf

Tour of bedded pack dairy in PM of Thursday

Outcomes/Outputs/Impacts from Annual Reports

Rotz

Modeling VOC Emissions: Refinement and evaluation of our VOC emission model for manure and silage sources continued throughout the year. Working VOC emission components were incorporated in both the Integrated Farm System Model and the Dairy Gas Emission Model. The model predicts reasonable emission levels, and management changes cause reasonable changes in emissions. A formal evaluation of these components is planned, but we are waiting for data that is now being collected on California dairy farms by our collaborators at UC Davis.

Environmental Footprints of Beef Production Systems: A methodology was developed and used to determine environmental footprints of beef cattle produced at the U.S. Meat Animal Research Center (MARC) in Clay Center, Nebraska with the goal of quantifying improvements achieved over the past 40 years. Information for MARC operations was gathered and used to establish parameters representing their production system with the Integrated Farm System Model. The MARC farm, cow calf, and feedlot operations were each simulated over recent historical weather to evaluate performance, environmental impact, and economics. The current farm operation included 841 ha of alfalfa and 1,160 ha of corn to produce feed predominately for the beef herd of 5,500 cows, 1,180 replacement cattle, and 3,724 cattle finished per year. Spring and fall cow calf herds were fed on 9,713 ha of pastureland supplemented through the winter with hay and silage produced by the farm operation. Feedlot cattle were backgrounded for 3 mo on hay and silage with some grain and finished over 7 mo on a diet high in corn and wet distillers grain. For weather year 2011, simulated feed production and use, energy use, and production costs were within 1% of actual records. A 25-year simulation of their current production system gave an average annual carbon footprint of 10.9±0.6 kg of CO_2 equivalent units per kg BW sold, and the energy required to produce that beef (energy footprint) was 26.5±4.5 MJ/kg BW. The annual water required (water footprint) was 21,300±5,600 liter/kg BW sold, and the water footprint excluding precipitation was 2,790±910 liter/kg BW. The simulated annual cost of producing their beef was $2.11±0.05/kg BW. Simulation of the production practices of 2005 indicated that the inclusion of distiller's grain in animal diets has had a relatively small effect on environmental footprints except that reactive nitrogen loss has increased 10%. Compared to 1970, the carbon footprint of the beef produced has decreased 6% with no change in the energy footprint, a 3% reduction in the reactive nitrogen footprint, and a 6% reduction in the real cost of production. The water footprint, excluding precipitation, has increased 42% due to greater use of irrigated corn production. This proven methodology provides a means for developing the production data needed to support regional and national full life cycle assessments of the sustainability of beef.

IFSM and DairyGEM: The Integrated Farm System Model (IFSM) and the Dairy Gas Emissions Model (DairyGEM) provide software tools that illustrate the complexity and many interactions among the physical and biological components of farms. Refinement and expansion of both tools continued throughout the year. New versions of each have been completed that estimate reactive VOC emissions from manure and silage sources on farms. This software is available through Internet download for use in individual, workshop and classroom education.

Kusunose

Examples of current efforts to convert manure and manure derivatives into marketable resources were presented at the annual meeting (Oct 30-31, 2013 in Lexington, KY). These included two case studies: The production and marketing of struvite by MultiForm Harvest, based in Seattle Washington, and the sale of pelletized chicken manure by Perdue AgriCycle. These examples were then framed in the context of a decision-making model on the part of producers: Unless marketing costs (transport, verification of product and process, developing and reaching markets) are low, or the value of the final product high (e.g. high-end NOP-certified gardening products), producers will be unable to market their manure (and manure derivatives) and choose to over-apply to their fields (and face fines) or incur expenses to dispose of manure in acceptable ways.

Usefulness of Findings

Three major challenges in converting animal waste to into marketable resources are transporting the product, verifying and conveying its properties to potential buyers, and finding consumers. Animal waste, or even composted animal waste, is bulky, heavy, oftentimes liquid, and has relatively low market value relative to its transportation cost. Moreover, finding consumers and conveying the physical product and its properties to them require expertise and economies of scale that many producers of animal waste do not have.

These two case studies show how these challenges may be addressed. In the case of MultiForm Harvest, the company equipment leases to producers of animal (and human) waste the technology that converts it into struvite, a uniform, easily transported product with known properties. These producers then ship the struvite to MultiForm Harvest, which packages and markets struvite to end-users. Because MultiForm Harvest deals with multiple producers, it has economies of scale. In the case of Perdue AgriCycle, Perdue provides cleaning-out services of poultry houses, collects the chicken litter and processes it in a way that the end product (pelletized chicken manure) is uniform, easy to use, and has verified properties. They currently market their product to gardeners.

In both cases, the manure was converted into a new product with known or verifiable properties, thereby addressing the ‘information problem,’ and the new product was marketed by an entity that aggregated the product (or raw material) from multiple sources, thereby addressing the ‘marketing cost problem.’ By examining such commercial ventures in the private sector, we can glean lessons that will apply to waste-marketing efforts on the part of public or semi-public (e.g. cooperatives) entities.

WA – Harrison

A three-year study was conducted to study the interactive effect of anaerobic digestion (AD), large particle solids, and a manure additive MTMTM on ammonia (NH3) and greenhouse gas (GHG; carbon dioxide, nitrous oxide, and methane) emissions when manure/manure effluent was surface applied. The presence of large particle solids resulted in greater NH3 emissions due to the reduced infiltration of liquid manure into soil ($P < 0.05$). Anaerobic digestion did not have a consistent effect on NH3 emission. Manure effluent with greater ammoniacal nitrogen (AN) concentrations achieved significantly greater NH3 loss after manure application ($P < 0.05$). Anaerobic digestion of manure effluent did not have a significant effect on GHG flux ($P > 0.05$). Treatment with large particle solids in raw manure had significant greater CO2 flux than the other raw manure treatments on the day of manure application ($P < 0.05$). There was no significant manure treatment effects ($P > 0.2$) on methane flux over the three-day period after manure application. The manure additive MTMTM did not have a significant effect ($P > 0.05$) on NH3 and GHG fluxes. The results of this study suggest that solids and AN concentrations in manure/manure effluent are the most important factors affecting NH3 emissions after surface application.

The effect of anaerobic digestion (AD), large particle solids, and a manure additive MTMTM on ammonia (NH3) emission from dairy manure/manure effluent were studied during 110 d of storage. The study consisted of eight treatments in duplicate: AD manure effluent and Non AD manure, with and without large particle solids, and with and without MTMTM. This study was conducted in a naturally ventilated barn. The nitrogen content of manure, especially the ammonical nitrogen played an important role in NH_3 emission. During the first 11 weeks of the storage, AD manure effluent emitted significantly greater average (26 to 22 ppm) and peak (38 to 33 ppm) concentrations of NH_3 and NH_3 fluxes (130 to 94 $\mu g \cdot min^{-1} \cdot m^{-2}$) when compared to raw manure treatments (11 to 9 ppm, 25 to 14 ppm, 81 to 55 $\mu g \cdot min^{-1} \cdot m^{-2}$, respectively). From the 11th week until the end of storage, there was no significant difference in NH_3 emissions across the manure treatments. The presence of large particle solids on manure surface resulted in significantly lower NH_3 emissions when data was evaluated for the whole storage period. The manure additive MTMTM, crust formation and temperature did not have a significant effect on NH_3 emissions during storage. Total ammoniacal nitrogen and solids concentration in manure were the most important factors affecting NH_3 emissions during storage.

The Feed Nutrient Management Planning Economics Tool (FNMP$) will be refined to include the following: a) addition of dairy manure handling systems that include liquid-solids separation, sand bedding and sand separation; b) more accurate estimates of nutrient and solids flows and transformations in beef feedlot systems; c) feed management factors into tool function that can affect nutrient losses; d) adding additional crops, nutrients, and revised nutrient estimates; e) adding micronutrients such as magnesium, sulfur, and others that create added value for off farm transport; f) effect of rainfall and on-farm water management on manure volume; g) multiple cropping systems on a given field within a year ; h) varied Field by field management with respect to P or N nutrient management planning; i) an irrigation option; j) updated equipment prices; k) providing a version of the tool on-line for remote use, l) adding file sharing and storage options, and m) modifying options for off farm transport, haul only cost versus haul and spread.

WA – Harrison – The FNMP$ tool is being prepared as an on-line based tool that can be accessed by users at a central website. This will allow for easier access to the tool and provide a more stable environment for making updates and upgrades.

B. Usefulness of findings

During 110 d of storage of AD and non-AD manure,

The major factors affecting the volatile loss of NH_3 on the day of manure application was the NH_4 content and solids content of the manure. AD manure did not necessarily have a greater loss of NH_3.

PUBLICATIONS:

1. Li, C., W. Salas, R. Zhang, C. Krauter, A. Rotz, and F. Mitloehner. 2012. Manure-DNDC: a biogeochemical process model for quantifying greenhouse gas and ammonia emissions from livestock manure systems. Nutr. Cycl. Agroecosys. 93:163-200.
2. Hafner, S.D., F. Montes, and C.A. Rotz. 2012. A mass transfer model for VOC emission from silage. Atmos. Environ. 54:134-140.
3. Robertson, G.P., T.W. Bruulsema, R.J. Gehl, D. Kanter, D.L. Mauzerall, C.A. Rotz, and C.O. Williams. 2012. Nitrogen–climate interactions in US agriculture. Biogeochemistry. DOI 10.1007/s10533-012-9802-4.
4. Stackhouse-Lawson, K.R., C. A. Rotz, J. W. Oltjen, and F. M. Mitloehner. 2012. Carbon footprint and ammonia emissions of California beef production systems. J. Anim. Sci. 90:4641-4655.
5. Stackhouse-Lawson, K.R., C.A. Rotz, J.W. Oltjen, and F.M. Mitloehner. 2012. Growth-promoting technologies decrease the carbon footprint, ammonia emissions, and costs of California beef production systems. J. Anim. Sci. 90:4656-4665.
6. Hafner, S.D., F. Montes, and C.A. Rotz. 2013. The role of carbon dioxide in emission of ammonia from manure. Atmos. Environ. 66:63-71.
7. Gerber, P.J., A.N. Hristov, B. Henderson, H. Makkar, J. Oh, C. Lee, R. Meinen, F. Montes, T. Ott, J. Firkins, A. Rotz, C. Dell, A.T. Adesogan, W.Z. Yang, J.M. Tricarico, E. Kebreab, G. Waghorn, J. Dijkstra and S. Oosting. 2013. Technical options for the mitigation of direct methane and nitrous oxide emissions from livestock: a review. Animal 7:s2, pp 220–234.
8. Del Prado, A., P. Crosson, J.E. Olesen and C.A. Rotz. 2013. Whole-farm models to quantify greenhouse gas emissions and their potential use for linking climate change mitigation and adaptation in temperate grassland ruminant-based farming systems. Animal 7:s2, pp 373–385.
9. Hafner, S.D., C. Howard, R.E. Muck, R.B. Franco, F. Montes, P.G. Green, F. Mitloehner, S.L. Trabue, C.A. Rotz. 2013. Emission of volatile organic compounds from silage: compounds, sources, and implications. Atmos. Environ. 77:827-839.
10. Rotz, C.A., B.J. Isenberg, K.R. Stackhouse-Lawson, and J. Pollak. 2013. A simulation-based approach for evaluating and comparing the environmental footprints of beef production systems. J. Animal Sci. (in press).
11. Rotz, C.A., F. Montes, S.D. Hafner, A.J. Heber, R.H. Grant. 2013. Ammonia emission model for whole farm evaluation of dairy production systems. J. Environ. Quality. (in press).
12. Hristov, A.N., J. Oh, C. Lee, R. Meinen, F. Montes, T. Ott, J. Firkins, A. Rotz, C. Dell, A. Adesogan, W. Yang, J. Tricarico, E. Kebreab, G. Waghorn, J. Dijkstra & S. Oosting. 2013. Mitigation of greenhouse gas emissions in livestock production – A review of technical options for non-CO2 emissions. Edited by Pierre J. Gerber, Benjamin Henderson and Harinder P.S. Makkar. FAO Animal Production and Health Paper No. 177. FAO, Rome, Italy.
13. Rotz, C.A. and T. L. Veith. 2013. Integration of air and water quality issues, Chapter 10. In Kebreab, E. (ed). Sustainable Animal Agriculture. CAB International. Oxfordshire, UK. (in press)
14. Sørensen, C.G., S.G. Sommer, D. Bochtis, and A. Rotz. 2013. Technologies and Logistics for Handling, Transport and Distribution of Animal Manures. In Sommer, S.G., M.L.

15. Parker, D., Waskom, R.M., Dobrowolski, J., O'Neill, M., Groffman, P.M., Addy, K., Barber, M., Batie, S., Benham, B., Bianchi, M., Blewett, T., Evenson, C., Farrell-Poe, K., Gardner, C., Graham, W., & Harrison, J.H. (2013). Advancing water resource management in agricultural, rural, and urbanizing watersheds: Why land-grant universities matter. *Journal of Soil and Water Conservation.* 68, 337-348.

16. Harrison, J.H. (2013). Nutrient Management, Environmental Issues and Societal Issues Affecting Confinement Dairy Sustainability. , 96(E-Suppl. 1), pp 708. American Dairy Science Association Annual Meeting, Indianapolis, IN.

17. Sun, F., Harrison, J.H., Ndegwa, P.M., Joo, H., Whitefield, E.M., & Johnson, K.A. (2013). Ammonia Emissions from Eight Types of Dairy Manure During Storage. Poster presentation at Waste to Worth Conference, Denver, CO.

18. Neerackal, G.M., Joo, H., Wang, X., Ndegwa, P.M., Harrison, J.H., Heber, A.J., & Ni, J. (2013). Impacts of Anaerobic Digestion and Solids Separation on Ammonia Emissions from Stored Dairy Manure. *ASABE Annual Conference Proceedings.* ASABE 2013 Annual International Meeting, Kansas City, Missouri.

19. Wang, X., Joo, H., Neerackal, G.M., Ndegwa, P.M., Harrison, J.H., Heber, A.J., & Ni, J. (2013). Effects of Anaerobic Digestion and Application Methods on Ammonia Emission from Land Applied Dairy Manure. *ASABE Annual Conference Proceedings.* ASABE National International Meeting, Kansas City, Missouri.

20. Koirala, K., Joo, H.S., Frear, C.S., Harrison, J.H., Stockle, C.O., & Ndegwa, P.M. (2013). Influence of Suspended Solids Characteristics on Ammonia Volatilization Mechanism from Liquid Dairy Manure. *ASABE Annual Conference Proceedings.* 2013 ASABE Annual International Conference, Kansas City, Missouri.

21. Koirala, K., Joo, H.S., Ndegwa, P.M., Frear, C.S., Stockle, C.O., & Harrison, J.H. (2013). Influence of Anaerobic Digestion of Dairy Manure on Ammonia Volatilization Mechanism. *ASABE Annual Conference Proceedings.*

22. Joo, H.S., Ndegwa, P.M., Neerackal, G.M., Wang, X., Harrison, J.H., & Neibergs, J.S. (2013). Mitigation of Ammonia, Hydrogen sulfide, and Greenhouse Gases Emissions

from Naturally Ventilated Dairy Barns. *ASABE Annual Conference Proceedings.* 2013 ASABE Annual International Conference, Kansas City, Missouri.

23. Joo, H.S., Ndegwa, P.M., Harrison, J.H., Whitefield, E.M., Heber, A., & Ni, J.-. (2013). Potential air quality impacts of anaerobic digestion of dairy manure. *From Waste to Worth: "Spreading" Science and Solutions* -, Denver, Colorado.

24. Watson, A.K., Erickson, G., Klopfenstein, T., Koelsch, R., Massey, R., Harrison, J.H., & Luebbe, M.K. (2013). BFNMP$: A tool for estimating feedlot manure economics. *Proceedings of Waste to Worth Conference.* Denver, Colorado.