Implementing Waste Solutions for Dairy Farms

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Take Home Messages

- The implementation of solutions to the generation of excess manure in confined animal feeding operations is necessary to allow agricultural operations to thrive in environmentally sensitive areas.
- A collaborative approach to the development of a manure and litter solutions strategy by a diverse array of potential problem-solvers can lead to implementation of real solutions.
- The keys to success are a diverse planning committee, early support from key funders, clear and specific goals, use of professional facilitation, and participation of stakeholders with the authority to make decisions and commitments.
- These factors produce a continuing grass-roots momentum that will realize significant on-the-ground progress in manure management.

Introduction

Practical solutions to the generation of excess manure is necessary for dairy and other livestock farms to thrive in environmentally sensitive areas such as the Chesapeake Bay Watershed. Solutions such as bioenergy generation, bio-based material processing, and nutrient management solutions have all been suggested and attempted; many of these efforts have not been economically sustainable and those that are successful remain limited in their scope. Success may require strange bedfellows. Solutions to the problems of highly concentrated nutrients, pathogens, ammonia emissions, and odor are as likely to be identified by scientists, engineers, operators, economists, conservationists and policy makers working in non-agricultural industries as within the agricultural sector itself. Promoting dialogue to identify common ground among a wide range of potential problem-solvers will help identify the

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most promising strategies to overcome these challenges. This paper reviews a collaborative approach to the development of a manure and litter solutions strategy by a diverse array of potential problem-solvers.

Water Quality Issues

Increased specialization and concentration of livestock and crop production has led to the net export of nutrients from major crop producing areas of the US to areas with a high concentration of animal agriculture. Livestock utilize nitrogen (N) and phosphorus (P) inefficiently, excreting 60 to 80% of that consumed. Therefore, the majority of nutrients brought onto the farm in feed stay on the farm rather than being exported in meat, eggs, or milk. Animal manure is typically land-applied to supply nutrients for crop growth, but application in excess of crop needs results in nutrient losses and contamination of groundwater, surface water or air.

Concentrated animal agriculture has been identified as a significant source of N and P contamination of surface water (median contribution = 6.8 to 48% of P export, and 5.2 to 23% of N export depending on watershed; Smith and Alexander, 2000). The main environmental concerns with N and P are pollution of surface (streams, lakes, rivers) and ground water. These environmental impacts have been thoroughly reviewed (e.g. Apsimon et al., 1987; Daniel *et al*., 1992; Likens et al., 1996; EPA, 1998; Hamilton et al., 2004).

The relative importance of different nutrient sources varies greatly in different regions of the U.S. The Shenandoah Valley of Virginia is an example of an area of intensive animal agriculture associated with increased contamination of surface water. The Shenandoah Valley has the highest population of both dairy cattle and poultry in the state, and as much as 20% of the dairy farms have at least one poultry house. Estimated manure P production in the Shenandoah Valley exceeds crop requirements on a yearly basis. Recoverable manure P produced in the four primary Valley counties exceeds crop P uptake by a factor of 5.5. An analysis of soil samples submitted from Rockingham County between 2003 and 2005 indicated that nearly 84% of 1552 commercial samples submitted were ranked “high” or “very high” in P (Virginia Soils Testing Laboratory, 2005).

Increasing Regulatory Pressure

Increasing public concern about water quality and increased awareness of the potential impact of concentrated livestock production have led to increasingly stringent environmental regulations. One key change in water quality regulations in the past five years is the shift from a primary focus on N to an increasing focus on P contamination of surface water. Regulations limiting manure application to the P needs of the crop are in place for all farms in

Maryland (Water Quality Improvement Act, 1998), and for poultry farms in Virginia (Virginia Poultry Waste Management Program, 1999). The federal Concentrated Animal Feeding Operation regulations to address water pollution call for site-specific decisions on whether N- or P-based manure application limits are needed to protect water quality (EPA, 2003). The same trend toward stricter limits on manure application is occurring in Canada (MLMMI, 2009; Manitoba Conservation, 2009). Also, some federal cost-share funding is now being linked to the implementation of P-based nutrient management plans. Phosphorus-based nutrient management regulations dramatically increase the amount of land required to utilize manure and are having a severe, detrimental effect on the agricultural economy in areas of intensive animal agriculture.

Areas facing the dilemma of an economically important livestock industry concentrated in an environmentally sensitive area currently have few options. If agricultural practices continue as they have in the past despite changing conditions and intensification of operations, continued damage to air and water resources are almost inevitable. If agricultural productivity is reduced, however, the maintenance of a stable farm economy, a viable rural economy, and a reliable domestic food supply are seriously threatened. Practices that reduce nutrient losses from farms without impairing profitability must be developed and implemented.

■ Approach

A group of stakeholders from agricultural, research and conservation organizations in Virginia came together in 2004 and concluded that promoting dialogue among a diverse array of potential problem-solvers would help identify the most promising strategies to address the complications caused by geographically concentrated manure nutrients. To achieve this goal, the initial organizers formed a larger planning committee consisting of stakeholders representing important interests committed to the need for dialogue. The planning committee included academics, producers, state and federal agencies, local, regional and national conservation groups, and local government leaders. Most unusual about this effort was the ability of these organizations to see an opportunity for mutual gain, to set aside their ongoing differences in other arenas, and to agree to work for a common purpose.

Getting Started

This planning committee organized a Forum to develop a *Waste Solutions Strategy*, a detailed plan of action for identifying, researching, and implementing alternative solutions, including manure to energy, for manure management in the Shenandoah Valley of Virginia**.** The planning committee

met over nine months to develop a process that would quickly bring all Forum participants to the same knowledge level about the issues, enable dialogue in a safe atmosphere discouraging blame and finger-pointing, and foster the development of realistic solutions that could be tested or put in the field immediately. From the start, the planning committee was adamant that this Forum would lead to meaningful on-the-ground progress. Working with a professional facilitator, an outcome-based forum was planned to produce a strategy listing specific steps or projects to be undertaken by specific people, covering the issues of policy, research, education, and pilot projects.

Obtaining Support

The diversity of the groups engaged in the planning committee was an asset obtaining early endorsements and support. Members of the planning committee made personal contacts with key entities to sell the concept. Leaders of conservation organizations and leaders of agricultural organizations visited potential supporters together, demonstrating a very unusual and powerful coalition. The power of demonstrating collaboration among groups in the early planning phases of a stakeholder process to attract support cannot be underestimated. When usually adversarial groups come together for common cause, the potential for meaningful progress towards solutions is a powerful motivator for others to become involved.

Developing the Invitation List

A commitment was made to ensure that the invitees to the Forum would reflect the broadest possible diversity of key stakeholders. Invited participants included scientists, engineers, farmers, waste management facility operators, economists, conservationists, policy makers, regulators, and citizens concerned about air, water, and soil quality.

One key to success of the Forum was a deliberate restriction on the number of participants. This Forum was not intended as a comprehensive educational conference geared towards attendees learning from speakers. Instead, it was an active strategic planning process, demanding participation of all attendees and focused on economically and environmentally viable solutions. Of necessity, this limited the invitation list. With four breakout sessions, and a maximum of 20 people in each session to enable meaningful conversation, we targeted 80 attendees. Developing an invitation list of appropriate depth without exceeding the cap was a challenge. In the end, 100 people were invited, and 90 participated.

A second challenge associated with the invitation list was ensuring a relative balance in representation among the various stakeholders. Were there too many producers or too many researchers? Were local government and local

conservation interests adequately represented? The debate ensured that all perspectives would be heard at the Forum, that the range of expertise would be present to generate viable and creative ideas, and that Forum outcomes and strategies would garner the broadest possible support for implementation.

Collaborative problem solving efforts often suffer from suspicion and cynicism that they are "just for show" and will not lead to anything concrete or meaningful. This cynicism makes it critical to begin a collaborative process with the end in mind: implementation. The broader the support and buy-in during the planning phase, the broader the participation by high level decision-makers, the broader the credibility of the process, the more likely that outcomes will be supported and implemented.

Professional Facilitation

In collaboration with the planning committee, the Forum was professionally designed and facilitated to coalesce the best ideas of Forum participants into a functional plan for moving forward. The facilitator and planning committee worked closely together throughout the planning process. The facilitator's contribution was most critical in helping the planning committee sharpen its focus and clarify desired outcomes for the Forum, and then design a workable process to achieve its goals.

The Forum Process

The two-day Forum consisted of two key components: 1) leveling the playing field through a series of presentations by pertinent technical subject matter experts and stakeholders to enable all participants to operate from a similar base of knowledge, and 2) engaging participants in a series of focused discussions on specific topics to build informed consensus on potential solutions. This process culminated in detailed strategies for managing excess manure with the greatest potential for success and implementation by stakeholders. The relatively narrow geographic focus allowed the development of detailed implementation plans, but the approach discussed in this paper would be applicable in any region of the country facing similar challenges.

Leveling the Playing Field

The planning committee considered the educational component of the Forum critical, and spent significant time thinking through strategies to accomplish participant education to level the playing field in Forum deliberations. Ultimately, the planning committee agreed to develop a comprehensive pre-

Forum briefing packet, invite a line-up of subject matter experts to provide short presentations, and present a technical poster session.

There were 24 papers in the briefing packet, all peer-reviewed by members of the planning committee (Table 1). A standard template (2 to 4 pages) was developed and enforced to ensure consistent, concise organization of all papers. Invited participants were urged to review these materials before the Forum and come prepared to discuss additional ideas and critiques. The briefing packet required significant effort and provided a condensed overview of key issues in policy, research, education, and technologies relating to manure management. The briefing packet is posted on the web (available at http://vawsf.com/)

Table 1. Contents of briefing packet

1) General background material
   a) Overview of Virginia animal agriculture industries
   b) Waste streams in the Shenandoah Valley: Biomass inventory
   c) Summary of the Chesapeake Bay Watershed Agricultural Summit
2) Waste management and reduction technologies
   a) Waste and watershed management
   b) Precision feeding to reduce nutrient excretion
      i) Dietary nutrient management to reduce nutrient losses from dairy farms
      ii) Precision feeding to reduce nutrient excretion by poultry and hogs
3) Waste conversion and treatment technologies
   a) Animal waste to energy systems – Economic feasibility in the Chesapeake Bay Watershed
   b) Thermal conversion processes
   c) Biological conversion processes
      i) Summary of processes
      ii) Solids removal
      iii) Anaerobic digestion; high solids anaerobic digestion
      iv) Biological and chemical P removal
      v) Nitrogen removal
   d) Composting principles and use
4) Marketing, policy, and regulatory issues
   a) Overcoming barriers through tax incentives for alternative solutions
   b) Overcoming barriers through innovative policies
   c) Overcoming barriers through regulatory changes in Virginia
   d) Overcoming barriers through federal and state cost share programs
5) Breakout session briefing packets
   a) Research needs
   b) Educational programming needs
   c) Policy changes needed
   d) Pilot projects priorities
6) Speaker notes (distributed at the Forum)

Also, posters were developed and displayed during two open sessions on the first day of the Forum. The posters covered state-of-the-art alternative manure and litter utilization technologies, business and marketing approaches, and relevant regulations and policies. These were developed and manned by participants. Their use allowed participants to come “up to speed” on less familiar topics in a time-efficient manner.

Focused Discussions

In the invitation letters for the Forum, participants were explicitly told that this would be a working event in which they would develop a strategic plan for implementation in the Shenandoah Valley. Because this expectation was made clear, most participants were ready and eager to talk specifics.

Building on the knowledge base ensured by the briefing packet, speakers, and poster session, Forum participants developed specific actions for the four focus areas of pilot project development; educational programming; research; and regulatory and policy changes. Sessions were concurrent and repeated, with all participants rotating through all topics in sequential breakout sessions, building on the work of previous groups. This allowed all Forum participants to have an opportunity to contribute to and review all four topic areas.

During online registration for the Forum, participants were asked to identify their top two preferences for topics; during the Forum participants were placed initially in one of their top preferences to ensure that they would be energized and interested in the discussion. The first discussion session was the longest, to allow greatest engagement by stakeholders in the area of focus of greatest interest.

Each discussion group began by proposing a draft vision and goals for the topic area (these were not difficult to develop) and then jumped quickly into brainstorming specific concrete actions to achieve these goals. Facilitators asked participants to make their proposed actions SMART – Specific, Measurable, Achievable, Realistic, and Timely. This activity was followed in each group by a review of all the proposed actions. Actions were sorted into categories, and combined and clarified.

Participants then rotated through each of the other three topics in a series of shorter sessions to enable all to contribute at an early stage to the vision, goals and actions in each topic area. After all participants contributed to all four topic areas, participants were given a second opportunity to rotate through all four topics to identify those actions that deserved priority attention. “Sticky dots” were used to allow participants to quickly and clearly rank actions according to the following criteria:

- Which actions are the most do-able, achievable, and realistic in the next three years?
- Which actions will make the greatest difference, provide the “biggest bang for the buck,” or have the greatest impact on facilitating improved manure management?
- Which ideas need to happen first, before other things can be accomplished?

During this second rotation, participants were also asked to identify actions on which they personally or their organization might be willing to work, or possibly even fund.

After these two rotations, participants networked at an evening reception and poster session. During this time, the facilitation team organized the results of the prioritization for continuing group discussion on the second day.

The next morning, participants returned to their first discussion group to review the action priorities selected by the Forum as a whole. In most discussion groups, participants split into smaller teams to develop specific plans for the highest priority actions. For each high priority action, participants identified resources needed to implement the action, including financial needs and the people and organizations that would be important to involve. For each high priority action, a possible timeline was indicated for initiation and achievement of the action. As the final step in the strategic planning effort, participants rotated through the other three topic areas to review and contribute to the priorities and plans for all four topics.

■ Forum Outcomes

As hoped, Forum participants found common ground and created a detailed strategy for addressing excess manure in ways that will help enhance farm viability and protect natural resources, including specific priority actions for policy, research, education, and pilot projects. The Forum represented a turning point for several reasons. First, it was a grassroots effort to bring together key players from the agricultural community, environmental groups, and academia, as well as local, state and federal government. Second, Forum participants set aside differences and moved beyond talking about the problem to developing a concrete strategy and action plan. Lastly, because of its success, the Forum served as the beginning of long-term collaboration and partnerships to change the nature of manure management in Virginia, beginning in the Shenandoah Valley.

Priority Goals and Actions

The Forum produced clear priorities including 1) improving nutrient feed management efficiency to reduce P and N in manure without compromising animal health or productivity; 2) improving demand and markets for manure-based products; 3) creating alternative methods for processing manure and alternative end uses for manure, and 4) changing/ influencing policies to ensure funding and achieve other goals. Further details for each priority action were outlined in the Final Report and Solutions Strategy. An example of a strategy for a specific priority action is in Table 2.

Table 2. One example of the strategies developed at the Waste Solutions Forum to support priority goals.

Goal	Implement incentive program to reduce overfeeding of P on 300 VA dairy farms
Impact	Reduce P_2O_5 losses by 2.2 million kg over 3 years
Actions	Identify farms with greatest need for improvement Monitor feeding practices Educate producers and advisors Implement incentive payment program for reduced overfeeding
Resources needed	Sample collection and analysis (~$100,000 for 3 yrs, 300 farms) Incentive payments ($450,000 for 2 yrs)
Commitments made	Virginia Tech research and extension personnel committed to designing the project, submitting proposals for funding, and implementing a funded project. Leadership of a state cost-share agency pledged ~1/3 of the total project cost to leverage other funding sources, or to be used to fully fund a smaller scale incentive payment project State Dairyman's Association and other farm leaders agreed to support and promote the project among dairy producers Commercial laboratory committed to providing a 10-20% discount on feed analysis for the project
Timeline	
3 months post-Forum	Obtain funds; Determine scope of project based on funding availability
Next 6 months	Identify farms; Begin monitoring, educational programming
18 to 30 months post-Forum	Make incentive payments to dairy farmers meeting targets for reduced overfeeding
Outcome	After the Forum, USDA NRCS agreed to fund the remaining 2/3 of the project cost for the program. The project is complete; results are summarized in another presentation at this conference.

Carrying It Forward

At the Forum, participants were asked to identify actions for which they or their organization might be willing to help implement. In addition, participants were asked to join a steering committee that would carry the plan forward. The first meeting of the steering committee was held three weeks after the Forum. In addition to making decisions about its structure and operations, the steering committee decided that its overriding goal would be to seek funding for implementation projects, and thereby create success stories so that the effort to achieve solutions can be sustainable over the long term. To this end, the steering committee developed criteria for deciding which of the priority projects it would try to move forward first, and then it developed implementation project committees. Projects chosen for early support were those solutions arising from the Valley itself, involving Valley farmers, those that use existing infrastructure, efforts, or partnerships; and those that could yield quick results.

What Worked Well? What Problems Should Be Avoided?

The ultimate success of the Waste Solutions Forum is reflected in the implementation of ideas that emerged. Five keys to achieving this success were

- Establishing a broadly representative planning committee,
- Obtaining early support from a variety of funders,
- Developing very clear and specific outcomes for the Forum that drove the process design,
- Working with a professional facilitator who could guide the process design and facilitate a complex Forum with multiple "moving parts," and
- Bringing together a broad array of key high-level stakeholders who were empowered to make decisions and commitments during the Forum.

As important as all the things you do right are all the mistakes you avoid. A few of these potential mistakes are

- Excessive exclusivity. While the invitation-only approach was critical to the success of the forum, it's crucial not to let political differences or absent-mindedness prevent the invitation of key stakeholders.
- Post-forum letdown. Identify the leadership structure for the post-forum efforts in advance of the Forum itself, to continue the momentum.
- Un-professionalism. Don't let "grass roots" be an excuse for poorly prepared materials, poor follow through, or haphazard communication.

- Failure to adapt organizational structures and process as the effort moves forward. The committee structure that works well planning a forum may not be the right approach to implementing the priorities identified. Continue the involvement of professional facilitators following the forum through a transitional phase.

Grassroots Representation and Decision-Making

An unusual feature of the Forum strategy is that it began and remains primarily a grassroots effort. Its success has been due largely on the energy and interest of participants who helped in its conception. A distinguishing feature of the Waste Solutions Forum is that it represented recognition at the grassroots level that solutions must be found by bringing all interested parties together, and that solutions to one part of the puzzle cannot be tackled separately in isolation from solutions to other parts of the puzzle. Policy, research, education and on-the-ground pilot projects are closely inter-related and must be tackled together.

Each of the groups represented had important vested interests in successfully addressing the problems associated with manure in the region. Farmers sought economically viable solutions that will allow them to stay in business and resist pressures to sell farmland for development. Conservation groups sought ways to ensure clean waterways and drinking water maintained by the stewardship of a viable agricultural community. State agencies sought compliance with standards and regulations. Local governments sought to protect their rural agricultural heritage. Academics sought more efficient technologies to reduce pollution. The energy industry sought economically viable and non-polluting alternatives to foreign oil. In his keynote talk the Virginia Secretary of Natural Resources expressed a key theme: *unanimity is not required for success, but solidarity is*. The concept of solidarity underscores the interest of Forum participants in working together and standing together to create pressure for moving solutions forward. While Forum participants did not agree on all of the specific things that need to be done, or the order in which they should be done, all Forum participants demonstrated solidarity in expressing urgent need for exploring and implementing solutions.

Interestingly, the Forum shifted the role of public agencies away from their traditional authoritative decision-making role. Instead they partnered with stakeholders acknowledging their right to participate in decision making. Dukes (1996) suggests that a transformative model for decision-making is participatory consensus-building effort from the bottom-up rather than a top-down decision-making by an elite. The Waste Solutions Forum embodies this transformative approach.

Conclusions

The ultimate success of the Waste Solutions Forum will depend on the energy and commitment of Forum participants in carrying forward the ideas that emerged from diverse interests listening and working with each other. The strength of the Forum lay in its diversity and in the commitment of all participants to finding and implementing long-term sustainable solutions. The keys to success were our diverse planning committee, early support from key funders, clear and specific goals for the Forum, use of professional facilitation, and participation of stakeholders with the authority to make decisions and commitments during the Forum. These factors produced a continuing grass-roots momentum for carrying forward the Forum's plan to realize significant on-the-ground progress in excess manure management.

References

ApSimon, H. M., M. Kruse, and J. N. B. Bell. 1987. Ammonia emissions and their role in acid deposition. Atoms. Environ. 21: 1939-1946.

Daniel, T.C., Sharpley, A.N. and Logan, T.J. (1992) Effect of soil test phosphorus on the quality of the runoff water: Research needs. *In*: National Livestock, Poultry and Aquaculture Waste Management. Proceedings of the National Workshop, Kansas City, Mo. ASAE, St. Joseph, MI, pp. 155-160

Dukes, E.F. 1996. Pages 161-163 *in* Resolving Public Conflict. Manchester University Press, Manchester, United Kingdom.

EPA. 1998. National air pollutant emission trends, 1990-1998. Environmental Protection Agency, Washington D.C.

EPA. 2003. National Pollutant Discharge Elimination System Permit Regulation and Effluent Limitation Guidelines and Standards for Concentrated Animal Feeding Operations: Final Rule. 40 CFR Parts 122 and 412. Environmental Protection Agency, Washington D.C.

EPA 2002. National Primary Drinking Water Regulations. 40 CFR Part 141. EPA 816-F-02-013. Environmental Protection Agency, Washington D.C.

Hamilton, P. A., T. L. Miller, and D. N. Myers. 2004. Water quality in the nation's streams and aquifers - Overview of selected findings, 1991-2001. Circular 1265. U. S. Geological Survey, Reston, VA.

Likens, G.E., C.T. Driscoll, and D.C. Busco. 1996. Long term effects of acid rain: response and recovery of a forest ecosystem. Science. 272:244-246.

Manitoba Conservation (2009) Environmental assessment. Available at http://www.gov.mb.ca/ conservation/eal/index.html.

Manitoba Livestock Manure Management Initiative (MLMMI) (2009) Government Legislation and Programs. Available at http://www.manure.mb.ca/legislation.php.

Smith, R. A. and R. B. Alexander. 2000. Sources of nutrients in the nation's watersheds. Pages 13-21 in Proc. Managing nutrients and pathogens from animal agriculture. Camp Hill, PA.

Virginia Poultry Waste Management Program. 1999. *In* Virginia Code. Vol. 62.1-44.17:1.1.

Virginia Soil Testing Laboratory. 2005. Subject: soil test data summaries. http://www.ext.vt.edu/vce/anr/cropsoil/testsum/ Accessed November 29, 2005.

Water Quality Improvement Act of 1998. 1998. *In* Maryland Agriculture Code. Vol. 8-801.1.