BMP Expert Panel for Manure Treatment Technologies

Water Quality Goal Implementation Team

Monday, September 12, 2016

Doug Hamilton, Oklahoma State, Panel Chair

Jeremy Hanson, Virginia Tech, Panel Coordinator

Panel membership

Table B.1 – Membership of the Manure Treatment Technologies BMP Expert Panel	
Panelist	**Affiliation**
Keri Cantrell	KBC Consulting (formerly with USDA-ARS)
John Chastain	Clemson University
Doug Hamilton (Chair)	Oklahoma State University
Andrea Ludwig	University of Tennessee
Robert Meinen	Penn State University
Jactone Ogejo	Virginia Tech
Jeff Porter	USDA-NRCS, Eastern National Technology Support Center
Panel support:	
Jeremy Hanson (Coord.)	Virginia Tech/CBPO
Brian Benham	Virginia Tech (Cooperative Agreement Project Director)
Chris Brosch	Delaware Dept. of Agriculture (WTWG rep)
Mark Dubin	University of Maryland/CBP (AgWG Coord.)
Ashley Toy	EPA Region 3 (Regulatory Support)
David Wood	CRC/CBP (CBP modeling team rep)

The panel's charge

AgWG convened a subgroup in 2014

- Ad hoc subgroup for manure treatment technologies suggested six categories (see Appendix C) for review:
  - Thermochemical (combustion, gasification, pyrolysis, torrefaction)
  - Composting
  - Anaerobic digestion
  - Solid-Liquid Separation
  - Chemical-Wet
  - Chemical-Dry

Expert panel convened later that year

- The expert panel further refined the categories based on available data and applicability in the region:
  - Thermochemical (combustion, gasification, pyrolysis)
  - Composting
  - Anaerobic digestion
  - Mechanical solid-liquid separation
  - Settling
  - Wet chemical treatment
- **Recommendations for Phase 6 Watershed Model only**

Summarized timeline

- **December 15, 2014:** Panel convened for first meeting and hosted open stakeholder session
- **March 31, 2016:** Panel report released for partnership review/comment
- **April 14, 2016:** Webinar detailing panel's full recommendations
- **May 3, 2016:** Close of initial 30-day comment period
- **July 21, 2016:** AgWG approved panel's report
- **September 1, 2016:** WTWG approved panel's report:
- **September 12, 2016:** WQGIT

Manure in the modeling tools…

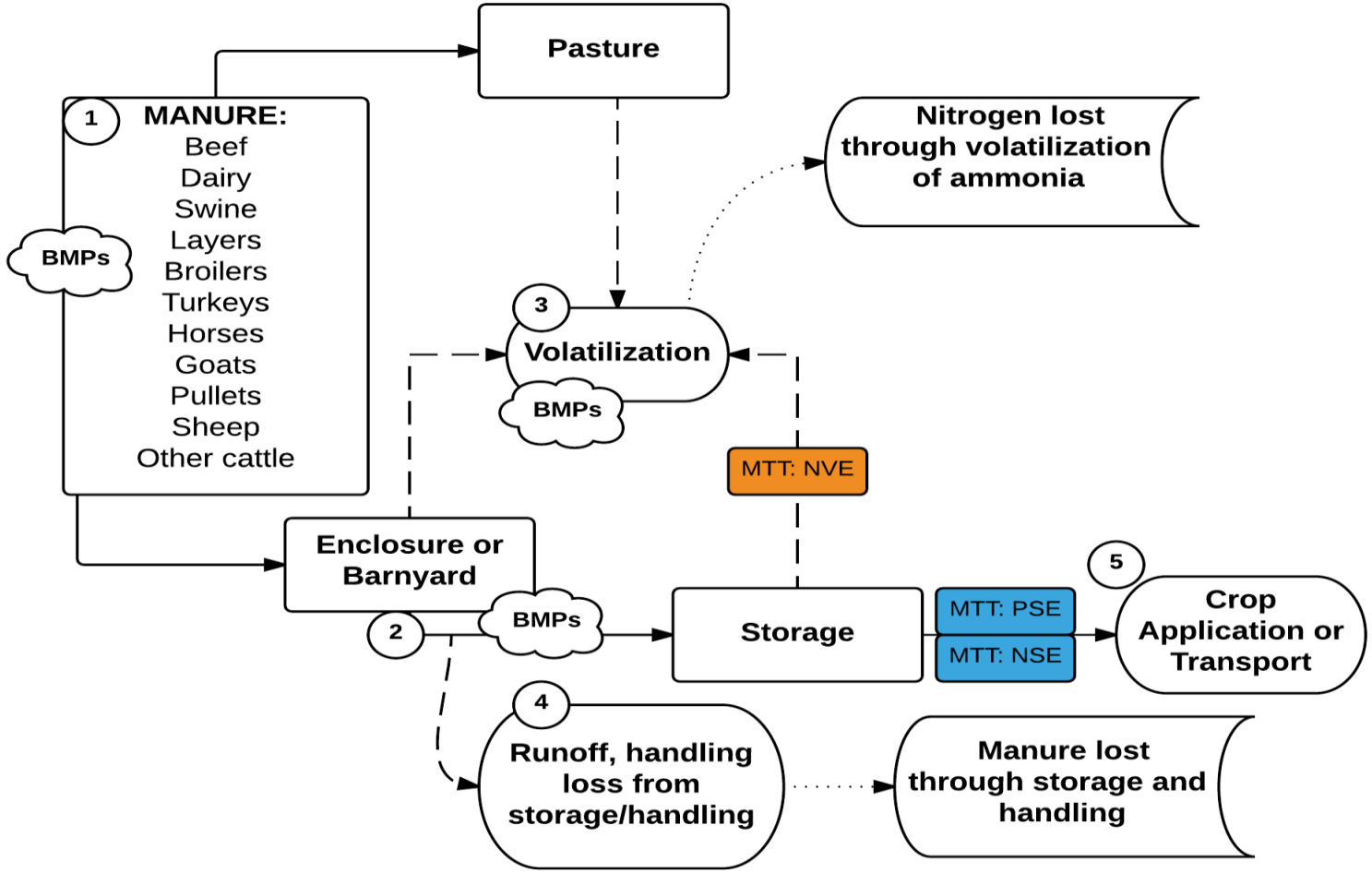


Figure B.2 – Conceptual diagram of manure nutrients in the Phase 5.3.2 Watershed Model

The Effect of Treatment Technologies

- Only “Removal” of nutrients from manure stream is by Nitrogen Volatilization.
- Nitrogen and Phosphorus Separation facilitate the Transport BMP.

Manure treatment is part of a larger system

Peterpaulrubens.org

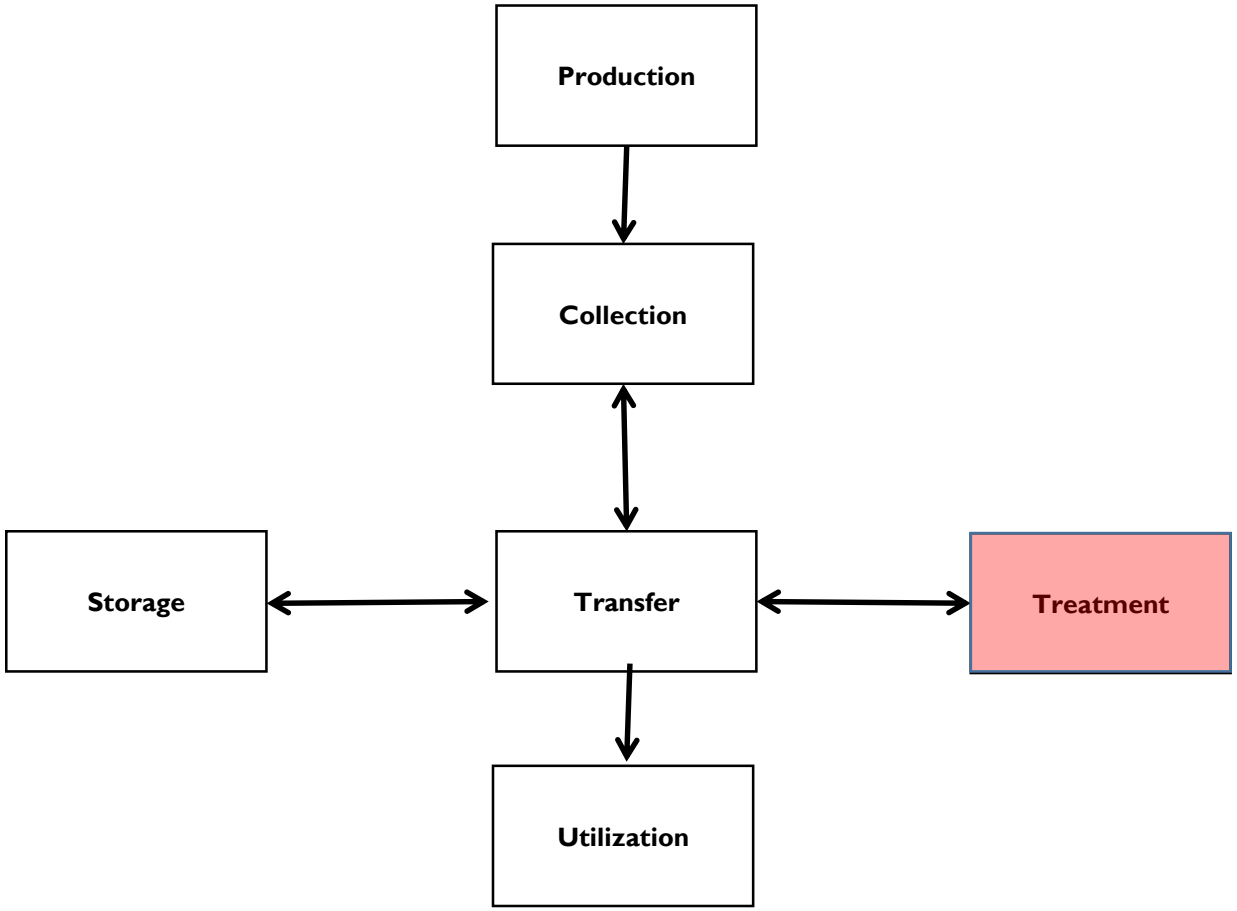
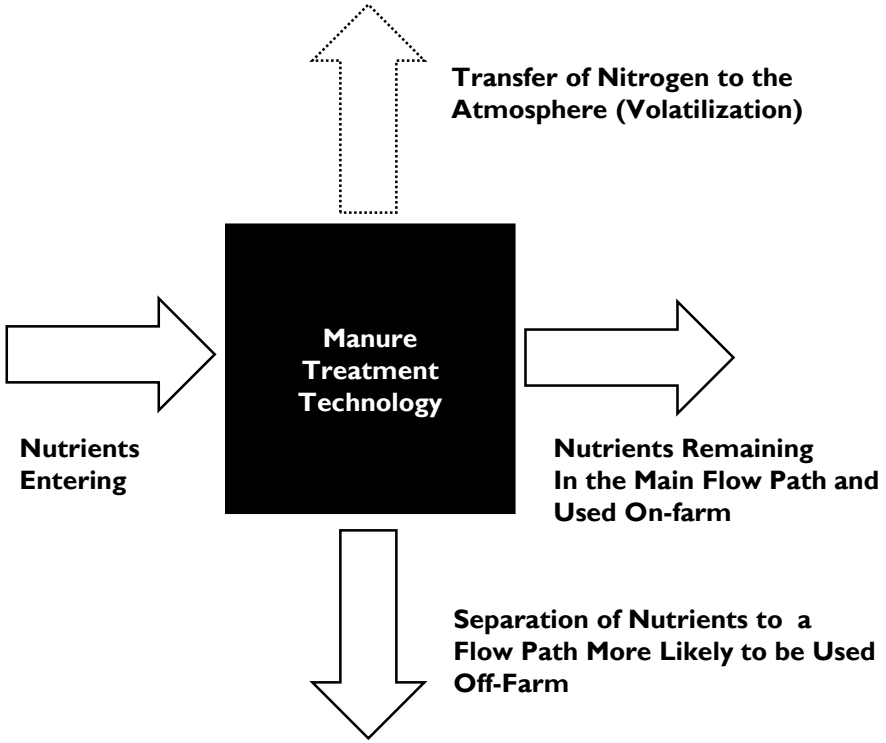
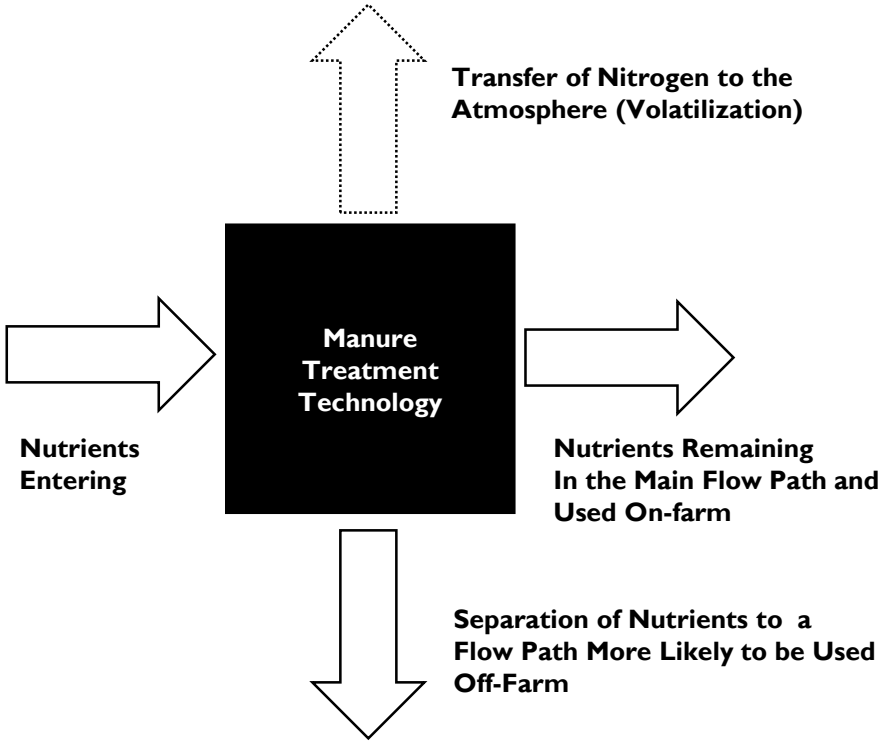


Figure TT.1. Schematic Representation of Manure Handling Systems (from Figure 9-2 in USDA NRCS, 1992).

Manure treatment schematic

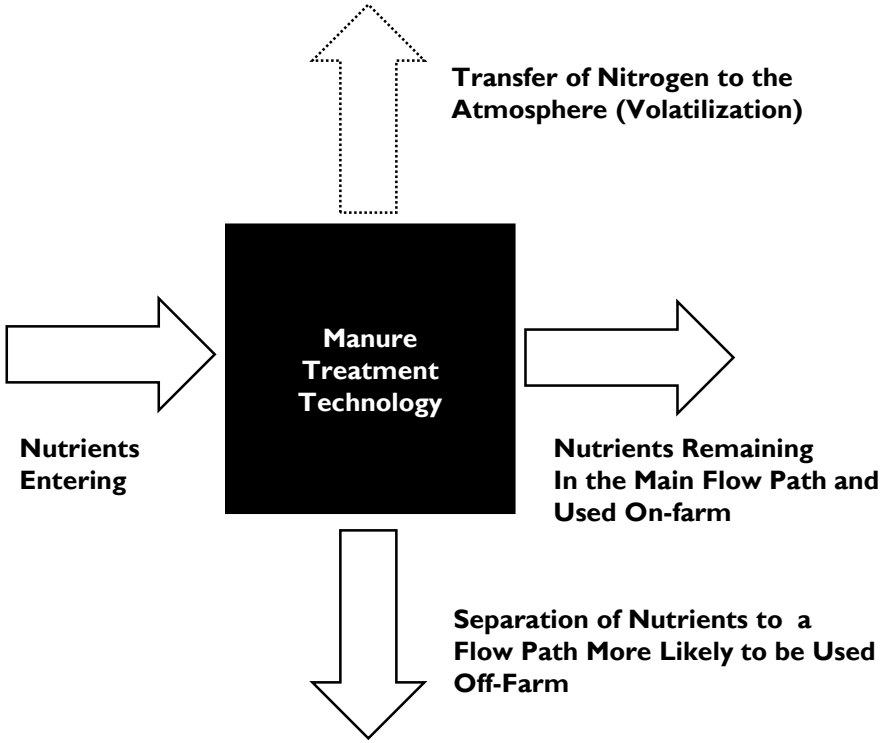


Transfer Efficiency



$$\frac{\text{Mass of Nutrient Leaving in Any Flow Path}}{\text{Mass of Nutrient Entering}} \times 100$$

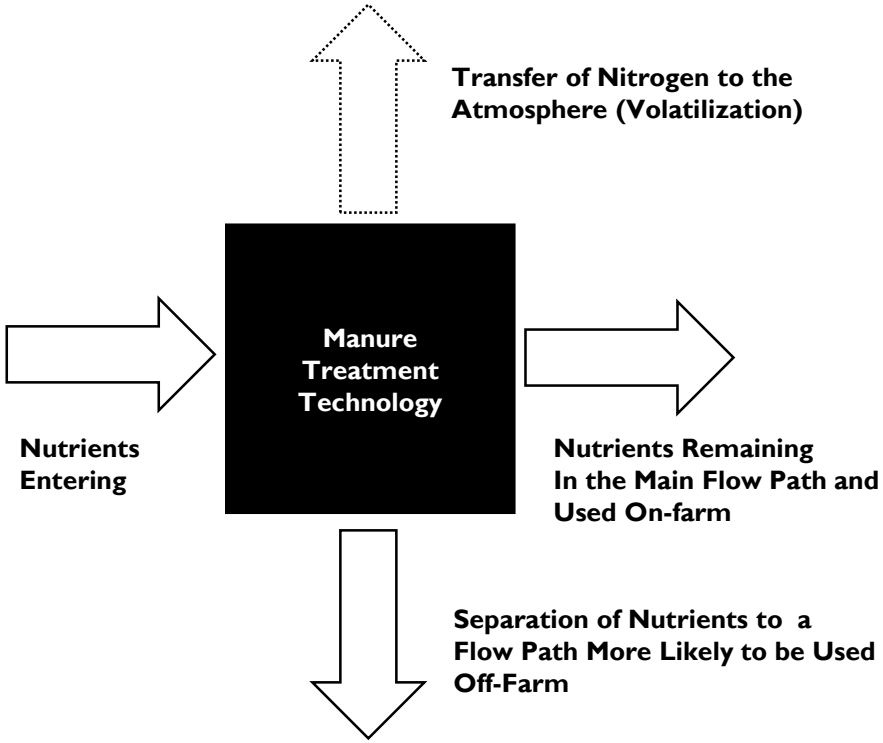
Nitrogen Volatilization Efficiency (NVE)*



$$\frac{\text{Mass of TN Transferred to Atmosphere}}{\text{Mass of TN Entering}} \times 100$$

*Technologies that have an NVE equal to 0 are not proposed for annual BMP reporting, but their benefits can be realized as part of the Manure Transport BMP. Technologies with an NVE > 0 reduce the amount of nitrogen in manure that is subsequently available for field application; these technologies (thermochemical and composting) are recommended as annual BMPs.

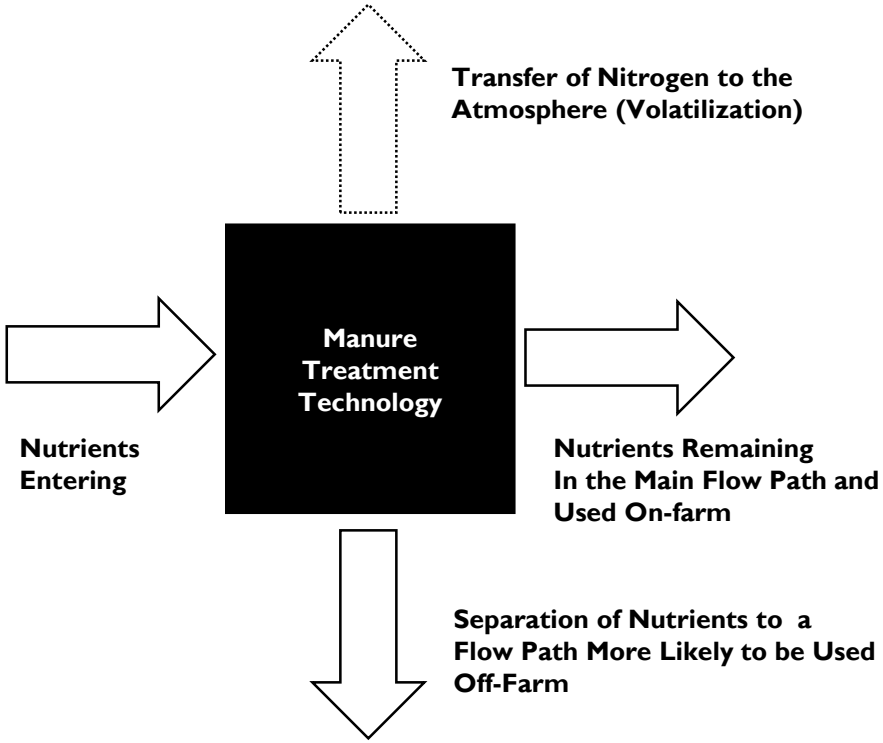
Nitrogen Separation Efficiency (NSE)



$$\frac{\text{Mass of TN Separated from Main Flow}}{\text{Mass of TN Entering}} \times 100$$

The report provides an assessment of the NSE for each category of technology. The panel's conclusions for NSE are not summarized in this presentation due to time.

Phosphorus Separation Efficiency (PSE)



$$\frac{\text{Mass of TP Separated from Main Flow}}{\text{Mass of TP Entering}} \times 100$$

The report provides an assessment of the PSE for each category of technology. The panel's conclusions for PSE are not summarized in this presentation due to time.

Manure in the modeling tools…

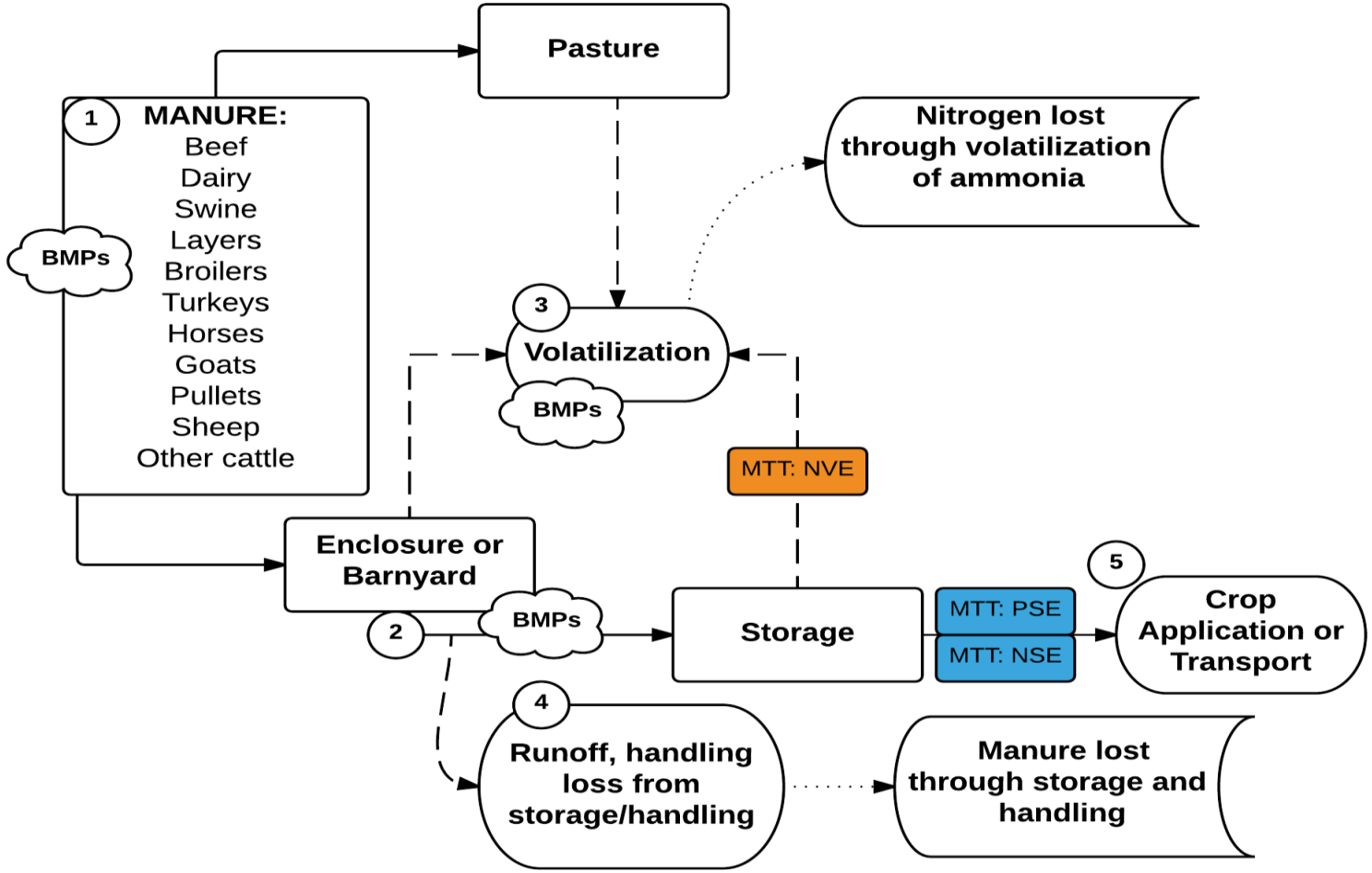


Figure B.2 – Conceptual diagram of manure nutrients in the Phase 5.3.2 Watershed Model

The panel considered three levels of recommendations for the BMPs

1. **Default (Level 1)** is used when only technology and manure type is known.
2. **Defined (Level 2)** is used when the manure type and pertinent operating conditions of the technology are known.
3. **Data-driven (Level 3)** is used when monitoring data for a given farm is available.

Six Categories of Technologies

These are the only categories recommended for annual BMPs at this time (NVE > 0)

1. Thermochemical Processing
2. Composting

Due to time constraints, these are not covered today but detailed information is available in the report and on the April 14th webinar:

3. Anaerobic Digestion
4. Settling
5. Mechanical Solid-Liquid Separation
6. Wet Chemical Treatment

USDA-NRCS

Gasification

1,400 – 2,700 ºF
Limited O_2
Syngas
Ash or Char

USDA-NRCS

Combustion

1,500 – 3,000 ºF
Excess O_2
Direct Heat
Ash

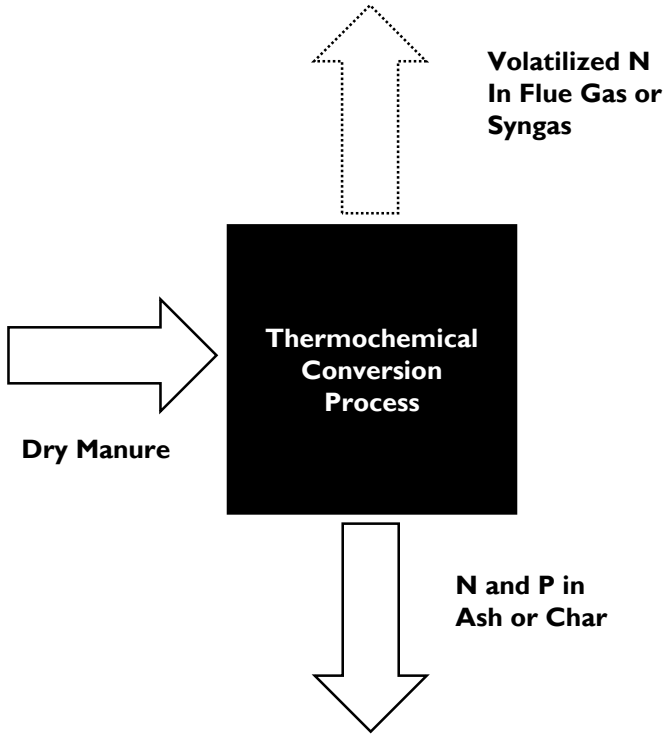
USDA-NRCS

Pyrolysis

575 – 1,475 ºF
No O_2

Thermochemical Conversion

Thermochemical Conversion



Composting

Clatsop County Water Conservation Dist.

Static Pile

Gatheringtogetherfarm.com

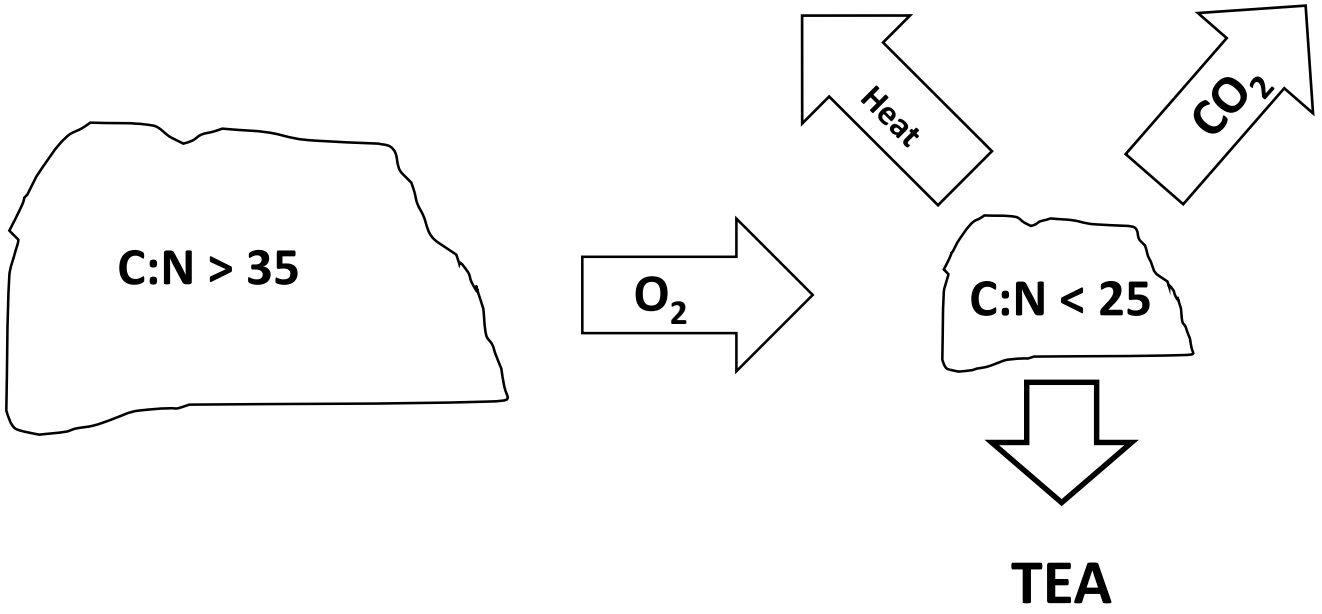
Turned Pile

O2Compost.com

Forced Aeration

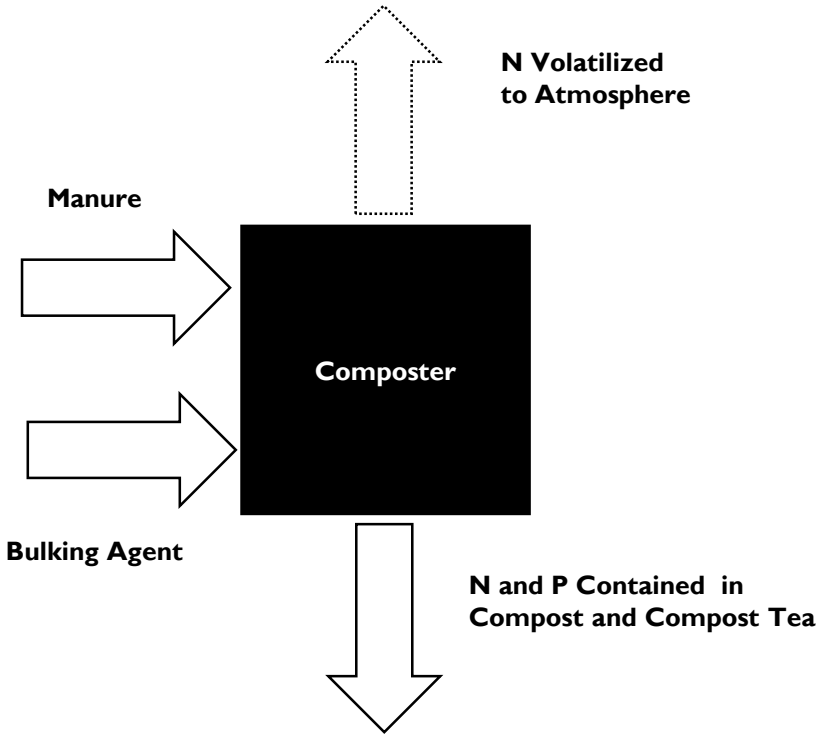
OCES.

In-Vessel (Rotating Bin)



Composting

Composting


N Volatilized
to Atmosphere
Manure
Composter
Bulking Agent
N and P Contained in
Compost and Compost Tea

Summary of MTT BMPs for Phase 6

- 18 Default and Defined NVE values
  - 6 Thermochemical
  - 12 Composting
- Plus Data Driven category

19 total MTT BMPs available

Table A.1. Manure Treatment BMPs eligible for crediting in the Phase 6.0 Watershed Model

Practice Number	Practice Category	Technology Specifications*
MTT1	Thermochemical	Slow Pyrolysis
MTT2	Thermochemical	Fast Pyrolysis**
MTT3	Thermochemical	Gasification-Low Heat
MTT4	Thermochemical	Gasification-High Heat**
MTT5	Thermochemical	Combustion
MTT6	Thermochemical	Combustion-High Heat**
MTT7	Composting	In-Vessel and Rotating Bin- Standard
MTT8	Composting	In-Vessel and Rotating Bin- C:N>100**
MTT9	Composting	In-Vessel and Rotating Bin- C:N<100**
MTT10	Composting	Forced Aeration- Standard
MTT11	Composting	Forced Aeration- C:N>100**
MTT12	Composting	Forced Aeration- C:N<100**
MTT13	Composting	Turned Pile and Windrow- Standard
MTT14	Composting	Turned Pile and Windrow- C:N>100**
MTT15	Composting	Turned Pile and Windrow- C:N<100**
MTT16	Composting	Static Pile and Windrow- Standard
MTT17	Composting	Static Pile and Windrow- C:N>100**
MTT18	Composting	Static Pile and Windrow- C:N<100**
MTT19	Directly Monitored	

* Definitions for specific thermochemical and composting technologies can be found in the report in Sections 4 and 5, respectively.

**Information about process factors, as described in Section 4, pages 29 - 32, and Section 5, pages 43-47, is needed to report these BMPs

Table A.2. Pollutant Reductions Associated with Manure Treatment Practices			
Practice #	TN Removal (%)	TP Removal (%)	TSS Removal (%)
MTT1*	25	0	0
MTT2	75	0	0
MTT3	25	0	0
MTT4	85	0	0
MTT5	85	0	0
MTT6	95	0	0
MTT7*	10	0	0
MTT8	11	0	0
MTT9	13	0	0
MTT10	25	0	0
MTT11	28	0	0
MTT12	32	0	0
MTT13	25	0	0
MTT14	28	0	0
MTT15	32	0	0
MTT16	26	0	0
MTT17	29	0	0
MTT18	33	0	0
MTT19	Monitored	0	0
*MTT1 represents the default practice Thermochemical treatment systems, and MTT7 represents the default for composting treatment systems.			

Table ES.1. Manure Treatment BMPs eligible for crediting in the Phase 6.0 Watershed Model and associated TN reduction

Practice Number	Practice Category	Technology Specifications*	TN Removal (%)
MTT1†	Thermochemical	Slow Pyrolysis	25
MTT2	Thermochemical	Fast Pyrolysis**	75
MTT3	Thermochemical	Gasification-Low Heat	25
MTT4	Thermochemical	Gasification-High Heat**	85
MTT5	Thermochemical	Combustion	85
MTT6	Thermochemical	Combustion-High Heat**	95
MTT7†	Composting	In-Vessel and Rotating Bin- Standard	10
MTT8	Composting	In-Vessel and Rotating Bin- C:N>100**	11
MTT9	Composting	In-Vessel and Rotating Bin- C:N<100**	13
MTT10	Composting	Forced Aeration- Standard	25
MTT11	Composting	Forced Aeration- C:N>100**	28
MTT12	Composting	Forced Aeration- C:N<100**	32
MTT13	Composting	Turned Pile and Windrow- Standard	25
MTT14	Composting	Turned Pile and Windrow- C:N>100**	28
MTT15	Composting	Turned Pile and Windrow- C:N<100**	32
MTT16	Composting	Static Pile and Windrow- Standard	26
MTT17	Composting	Static Pile and Windrow- C:N>100**	29
MTT18	Composting	Static Pile and Windrow- C:N<100**	33
MTT19	Directly Monitored		Monitored

* Definitions for specific thermochemical and composting technologies can be found in the report in Sections 4 and 5, respectively.

**Information about process factors, as described in Section 4, pages 29 - 32, and Section 5, pages 43-48, is needed to report these BMPs

†MTT1 represents the default practice Thermochemical treatment systems, and MTT7 represents the default for composting treatment systems.

Data Driven (Level 3) transfer efficiencies

- Applicable to a treatment system that utilizes one or more manure treatment technologies described in the report. Technologies may be proprietary or non-proprietary and may be used in any sequence to produce one or more end products for subsequent transport or land application.
- Unique transfer efficiencies determined using monitoring data; the calculated transfer efficiency will vary annually from system to system.
- Transport or land applications of any end products from these systems should be reported under separate BMPs (e.g. Manure Transport).
- Manure treatment systems that lack adequate annual performance data to support a Data Driven Transfer Efficiency (i.e., Level 3) should be reported using the appropriate Level 1 or Level 2 Transfer Efficiency for that system's primary manure treatment technology.

Future Research Needs

1. Farm-Scale Data Collection
2. Nutrient Transformations
3. Additional Categories of Technologies
4. Additional Defined Technologies

BMP verification

- MTT BMPs subject to the same expectations set forth in the partnership's BMP Verification Framework.
- Follow the AgWG's existing BMP verification guidance.
- Manure treatment technologies have elements of both "Visual Assessment, Multi-Year" and "Non-Visual Assessment" BMP categories, as defined by the AgWG. Jurisdictions can follow the guidance for either of these categories for Level 1, 2 and 3 MTT BMPs.

BMP verification (continued)

- MTT BMPs are reported/credited annually, and closely related to Manure Transport. Transport is a Non-Visual Assessment BMP, so jurisdictions can utilize protocols/procedures outlined by the AgWG to spot check and verify their records of how much manure is treated, where it is transported, etc.
- The treatment systems themselves have physical components (e.g., a compost facility, a gasifier, etc.) which can be verified using the AgWG's guidance for Visual Assessment-Multi-Year BMPs.
- Systems reported using Level 3 transfer efficiencies will likely be associated with programs that provide more rigorous verification (regulatory, permit, trading). These programs will have detailed and specific requirements for data collection and reporting to provide the mass of volatilized nitrogen.

Brief summary of comments received

- The majority of comments covered general or specific aspects of the following non-mutually-exclusive topics:
  - Air emissions and air deposition (NOx and Ammonia)
  - Non-treatment fate of nutrients (storage/handling, field application, etc.)
  - Tracking and Reporting
  - Modeling
  - Trading
- Comments were also provided on other miscellaneous topics
  - Edits to text/graphics
  - Questions about NVE, NSE, PSE calculations

Air emissions for TCC and Composting

- Thermochemical: For Combustion, available data suggests 90% of the nitrogen released to the air is N_2; the remaining 10% is reactive, primarily as NOx and some ammonia. For gasification it is 96% as N_2, 4% reactive. No data for pyrolysis but the operating conditions make it reasonable to apply the same assumptions as gasification. See text added to pages 32-33 of track-changes version of report.
- Composting systems: Essentially all N emissions are in ammonia form (less than 6% as N_2O). See pages 47-50 of track-changes version of report.
- Forthcoming decision from Modeling Workgroup will be applied to these reactive portions of N emissions and the values in Table ES.1 in the Executive Summary and Table A.2 in the Technical Appendix will be updated to reflect the adjusted values for P6 modeling purposes. The values and tables in the TCC and Composting chapters will remain unchanged to reflect the panel's assessment of TN that remains in the treated manure in the real world.

Other notable changes to report

- Modified Figure B.2 (page 10) and added clarifying language
- Chapter 10 revised based on comments
- Various other clarifying edits or corrections throughout the report, as described in Summary Memo or the Table of comments and responses, and shown in the track-changes version of the report.

Status and request for decision

- Requesting WQGIT approval today.

MTT panel report

- Approved by AgWG
- Approved by WTWG
- Today: Seeking WQGIT approval

Modeling WG

- Discussing how to account for N volatilization and redeposition in P6
- TBD updates to Tables ES.1 and A.2 based on Modeling WG decision

Policy Group

- Rich Batiuk is in touch with MB members

Consensus Continuum

Stop	Hold	Stand Aside	Agreement with Reservations	Endorsement
"I do not agree and feel the need to stand in the way of this decision"	"I believe more work is needed before we make a decision"	"I trust the group and will not block this decision but need to register my disagreement"	"I can live with it"	"I like it"

Adapted from UMD, CLOC

Thank you!