THE PROJECT GOAL:

The SAM Initiative is a regional, collaborative effort to advance the deployment of both liquid and solid manure injection technologies in high-density animal production regions of the Chesapeake Bay watershed. Manure injection improves manure nutrient use efficiency and water quality, offering a potential win-win solution for both farmers and Chesapeake Bay restoration efforts. Widespread adoption of manure injection technologies for land application of both liquid and solid manures will benefit farmers financially by avoiding the loss of valuable plant-available manure nitrogen, while making significant strides towards meeting Chesapeake Bay restoration goals.

In 2014, the National Fish and Wildlife Foundation (NFWF) Chesapeake Bay Stewardship Fund received support for the SAM Initiative from the National Resources Conservation Service Conservation Innovation Grant Program. With funding in place, the team began to address the following challenges to expanding the adoption of manure injection in the region:
CHALLENGES:

**Design and Demonstrate Poultry Litter Injection Technologies for Field and Commercial Use**

- Prototype farm-scale poultry litter injectors (dubbed Subsurfers) demonstrated the agronomic and financial benefits of poultry litter injection, but engineering design flaws prevented further use. Aside from some farmers on the Delmarva Peninsula who spread their own poultry litter, most farmers in the Bay watershed and elsewhere in the U.S. contract with commercial applicators to land apply their poultry litter and no commercial-grade poultry litter injection systems had ever been demonstrated. To expand the deployment of poultry litter injection, the team needed to re-design and demonstrate new technologies that would be technically and financially feasible for farm/research-scale and commercial deployment.

**Expand Adoption of Liquid Manure Injection Technologies**

- Liquid manure injection technologies are proven, and available for purchase at local equipment retailers. However, even in states with generous cost share programs and regulatory drivers, very few farmers or custom applicators were using them. As most farmers in the region depend on custom applicators to land apply their manure, getting them on board with offering manure injection services to their clients is critical. To expand the deployment of liquid manure injection technologies, the team needed to overcome barriers to adoption – especially with custom applicators, who apply most of the liquid manure in the region.

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**MANURE INJECTION – A WIN-WIN FOR FARMERS AND WATER QUALITY**

I. **Manure injection saves money on fertilizer.** Injecting manure below the soil surface reduces the amount of plant-available nitrogen lost to the air through volatilization, and washed to surface and groundwater resources when it rains. This means more manure nitrogen is available to support crop production. Farmers who inject manure can save money by reducing or eliminating supplemental commercial nitrogen application later in the season.

II. **Low-disturbance manure injection technologies are compatible with soil health practices.** Low disturbance manure injection technologies support no-till farming, a cornerstone practice for building soil health.

III. **Injecting manure reduces odor.** As farmers grapple with encroaching development in rural areas, reducing odor associated with manure application has become increasingly important for neighbor relations.

IV. **By conserving manure nutrients, manure injection improves water quality.** In the Chesapeake Bay region, nutrient reduction efficiencies are assigned to conservation practices and used by states to track progress towards meeting water quality goals. For manure injection, experts suggest that manure injection should be assigned a 12% reduction for nitrogen, a 22% reduction for phosphorus in coastal plain areas, and 36% reduction for phosphorus in upland regions.
ACCOMPLISHMENTS:

• **Building a better poultry litter Subsurfer:** The project team developed two different designs that improve on the original poultry litter Subsurfer by the USDA ARS team in Arkansas. The first Subsurfer re-design was completed by Dr. Amy Shober and Shawn Tingle (University of Delaware) and Dr. Josh McGrath and Gene Hahn (University of Kentucky). They re-engineered the Subsurfer augers and hydraulic system to address performance problems and added a liquid injection system to evaluate the benefits of injecting poultry litter with a nitrification inhibitor. Although limited to an eight foot wide injection width, field trials indicate this system works as designed. A second design, developed by Dr. Pete Kleinman (USDA-ARS Pasture Systems and Watershed Management Research Unit), Dr. Arthur Allen (University of Maryland Eastern Shore), and Stoltzfus Manufacturing, uses a drag chain system to move litter to the injection ports. They suggest that the next prototype could be constructed independent of the Subsurfer and incorporate folding wings to expand the width of poultry litter injection.

**Next Steps:** Construction of additional prototypes will build on lessons learned. Additional field demonstrations and work with regional farmers will determine commercial market potential.

• **Designing and building a commercial-grade poultry litter injector:** With leadership from Dr. John Long (Oklahoma State University) the team designed and constructed a commercial-grade poultry litter injection prototype that uses a pneumatic air delivery system to inject poultry litter. Similar in concept to commercial air seeders, the injector is designed to apply poultry litter at widths comparable to commercial spreaders. The design allows for spreader rows to “fold up” for transportation along roadways from one farm to another. Although this technology is still in the research and development phase, the prototype demonstrates a promising design approach for a commercial-grade poultry litter injector.

**Next Steps:** Additional research and development is needed to bring this technology to commercial markets.
ACCOMPLISHMENTS (cont.):

- **Expanding adoption of proven liquid manure injection technologies:** Traditional cost share programs that reward farmers on a per-acre basis and outreach and education efforts were not moving the dial on liquid manure injection in the Bay region, so partners tried new approaches:
  
  **Engaging nutrient management planners to help expand adoption.** In Pennsylvania, Red Barn Consulting’s nutrient management planners identified 49 of their clients they thought would be interested in learning about manure injection. During the nutrient management planning process, the planners would explain how manure injection would impact the farm’s nutrient management plan. About a third of the farmers were interested in trying it. Another third said “no,” because their custom applicator did not have manure injection equipment.

  **Making manure injection work for custom applicators.** Building on lessons learned from previous collaborations with custom applicators, SAM partners enlisted the support of Maryland partners to try a different cost share approach. Instead of offering financial incentives to farmers injecting manure, the team tried offering the financial incentive directly to the custom applicator. The custom applicators in turn encouraged their clients to try manure injection. With funding support from the Maryland Chesapeake and Atlantic Coastal Bay Trust Fund, after two years of effort, three new manure injection systems have been purchased, and two custom applicators have worked with over 45 farmers to inject manure on 7,500 acres. Building on this success, NFWF recently funded an effort to expand manure injection into south central Pennsylvania using this approach.

  **Outreach and extension efforts supported expanded adoption:**
  
  o Land grant university and extension partners designed field and laboratory trials to answer farmer questions about manure injection.
  
  o Hundreds of farmers and conservation professionals participated in field day events showcasing manure injection equipment. SAM team members and collaborators shared information about the nutrient management benefits of manure injection as well as results from laboratory and field trials to address farmer questions about adoption.

**Next Steps:** Continue building on lessons learned to engage the private sector in expanding adoption of proven and commercially available manure injection technologies in the region.

The biggest driver for manure injection adoption in the Bay watershed to date has been custom applicators. The project team secured incentives that were delivered directly to custom applicators on a per-acre basis for manure injection. They in turn encouraged their clients to give manure injection a try. Nutrient management planners shared information with farmers about manure injection during the planning process and identified opportunities and barriers to expanded adoption. Land grant university and extension partners supported adoption by addressing farmer questions and hosting field day events to share information and showcase injection equipment.

**Tim McMichael, owner of McMichael Custom Spreading, stands by a VTI drag hose manure injection system. Watch McMichael Custom Spreading inject dairy manure into a corn field on the Eastern Shore of Maryland at:** https://youtube/tJIN9rVneVo
SAM TEAM MEMBERS INCLUDE: Dr. Josh McGrath and Gene Hahn, University of Kentucky; Dr. Amy Shober and Shawn Tingle, University of Delaware; Dr. Arthur Allen, University of Maryland Eastern Shore; Dr. Peter Kleinman, USDA-ARS Pasture Systems and Watershed Management Research Unit; Dr. John Long and Dr. Randy Taylor, Oklahoma State University; Dr. Rory Maguire and Andrew Bierer, Virginia Tech; Dr. Quirine Ketterings, Cornell University; Peter Hughes, Evin Fitzpatrick, and Darren Shenk, Red Barn Consulting; Jenn Cotting and Naomi Young, Environmental Finance Center; and Kristen Hughes Evans, Sustainable Chesapeake.

PROJECT COLLABORATORS: Custom applicator partners and equipment suppliers include: Allegheny AG LLC, McMichael Custom Spreading, Agri-Applicators, Inc., Jason Stuth, Josh Lehman (formerly Lehman Ag LLC), and Atlantic Tractor.

FARMS THAT SUPPORTED THE PROJECT INCLUDE: Riverhill Farm, Valley View Farm, Cros-B-Crest Farm, Windcrest Holsteins Farm, Beery Farms, Matt DeBaugh Farm. The SAM team would also like to thank the 45 farmers who injected manure in partnership with custom applicators and the 43 farmers in Pennsylvania who worked with Red Barn Consulting to identify opportunities and barriers to expanding manure injection in the south central area.

CONSERVATION, LAND GRANT UNIVERSITY, EXTENSION AND STATE AGENCY PARTNERS INCLUDE:
Stan Fultz, Jeffrey Semmler, and Matt Morris (University of Maryland Extension)
Doug Beegle (Penn State Extension)
Dwight Dotterer, Hans Schmidt and Louise Lawrence (Maryland Department of Agriculture)
Tim Sexton and Crawford Patterson, Virginia Department of Conservation and Recreation
Denny Remsburg and the Catoctin and Frederick Soil Conservation District staff and Board of Directors
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Established by Congress in 1984, the National Fish and Wildlife Foundation (NFWF) works with both the public and private sectors to protect and restore the nation's fish, wildlife, plants and habitat's. NFWF’s Chesapeake Bay Stewardship Fund is dedicated to protecting and restoring the Bay by helping local communities clean up and restore their polluted rivers and streams.

This project was funded through NRCS Conservation Innovation Grants (CIG). CIG is a competitive grant program that stimulates the development and adoption of innovative approaches and technologies for conservation on agricultural lands. Through CIG, NRCS partners with public and private entities to accelerate technology transfer and adopt promising technologies.

Stan Fultz (retired, University of Maryland Extension dairy specialist) speaks to farmers and conservation partners at a field day event hosted by DeBaugh Farms in Boonsboro, Maryland in October of 2016. The event showcased manure injection equipment including the Veenhuis injector (in the photo) that was purchased by the Catoctin and Frederick Soil Conservation District. The District contracted with Allegheny Ag to deliver manure injection services to their clients in the Central Maryland region.