Farmers’ Use of Nutrient Management: Lessons From Watershed Case Studies

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Overview

• 2 Case studies examined regarding nutrient management on agricultural lands
  • (1) Synthesis of National Institute of Food and Agriculture (NIFA) and Conservation Effects Assessment Project (CEAP) joint project
  • (2) Field studies from 2 nutrient-impaired river basins, and 2 nutrient-impaired watersheds in North Carolina
    • Neuse, Tar-Pamlico, Jordan Lake, and Lake Falls Basins

• Both approaches looked into:
  • The need for nutrient management plans
  • Which (if any) were already in use
  • To what extent farmers followed these plans

• Previous studies explored physical attributes of farms as to why nutrient management plans succeeded or failed
  • Osmond et. al. explore farmer decision-making
Acronyms

• NIFA - National Institute of Food and Agriculture
• CEAP - Conservation Effects Assessment Project
• NLEW – Nitrogen Loss Estimation Worksheet
• RYE – Realistic Yield Expectations
• STP – Soil Test Phosphorus
• RUSLE - Revised Universal Soil Loss Equation
NIFA/CEAP Joint Project

• USDA implemented CEAP in 2002
  ◦ Aimed at determining effectiveness of conservation practices at the watershed level

• Funded 13 watershed scale research sites

• Minimum of 5 years water quality and land use data to be applicable

• 4 research goals
  • Relationship between conservation practices and water quality change
  • Relationship between conservation practices to each other and water quality change
  • Optimal placement of practices in the watershed to achieve water quality goals
  • ***What socioeconomic factors increased/decreased adoption of conservation practices?***
    • Osmond et. al. focused on this question
NIFA/CEAP Joint Project

• After results of 13 studies, “semi-structured” surveys conducted
  • Participants included farmers, community leaders, agency personnel, citizens, project personnel, others knowledgeable about CEAP projects or water quality in general
  • Questioned on water quality concerns, conservation practices before program, conservation practices added

• Results of interviews used in combination with overall study results to draw links between conservation practices being implemented, and background factors

• Internal validity assessments performed, where disagreements arose reassessments undertaken to eliminate ambiguity
NIFA/CEAP Project Results

• Found that farmers understood the water quality problem as well as the federal agency, university, and water conservation district/watershed association personnel
• Decision to implement or disregard nutrient management plans related to other factors
  • Economic factors important, but could be superseded
  • Level of management (additional work)
    • Often mentioned by farmers interviewed
    • Time savings cited as reason for conservation tillage
  • Yield expectations
  • Threat of regulation
  • Visibility of problem (Sediment vs. Nutrient)
• List of factors shows priority on efficiency of farm, and relationships

Summary of factors found to increase or decrease adoption of conservation practices

<table>
<thead>
<tr>
<th>Category</th>
<th>Increase adoption</th>
<th>Decrease adoption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm business</td>
<td>practice also improves profits</td>
<td>reduces profits</td>
</tr>
<tr>
<td>Profit</td>
<td>practice increases crop yields</td>
<td>practice decreases yields</td>
</tr>
<tr>
<td>Yield</td>
<td>lowers cropping costs</td>
<td>increases cropping costs</td>
</tr>
<tr>
<td>Production cost</td>
<td>government financial incentives, cost share</td>
<td>practice is expensive to install and maintain</td>
</tr>
<tr>
<td>Conservation cost</td>
<td></td>
<td>lost farm land, time, attitude that farming is a business, high commodity prices, lack equipment</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td>don’t see off-farm consequences</td>
</tr>
<tr>
<td></td>
<td></td>
<td>difficult to install and maintain</td>
</tr>
<tr>
<td>Conservation efficacy</td>
<td>can see the result on-farm (e.g. reduced erosion)</td>
<td>water quality problems are someone else’s fault/problem, lack knowledge/awareness of cons. practices or assistance, conservation not acceptable to farming community</td>
</tr>
<tr>
<td>On farm</td>
<td>can see off-site results</td>
<td></td>
</tr>
<tr>
<td>Off farm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>belief that conservation is doing the right thing</td>
<td></td>
</tr>
<tr>
<td>Stewardship</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Government/NGO+</td>
<td>personal attention (time) from experts (e.g., NRCS, Extension); networking and feedback, trust (knowledge, local)</td>
<td>lack of trust</td>
</tr>
<tr>
<td>Relationship</td>
<td></td>
<td>top down, prescribed, inflexible practice recommendations/requirements, lost control of property/decisions, paperwork regulations</td>
</tr>
<tr>
<td>Approach</td>
<td>bottom up, not top down, not being told</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Management Plan Failures

• Individual Results give better insight

• Most disliked plans
  • Riparian buffers – removed potentially productive land from use
  • Nutrient management – Often quickly abandoned, or farmers simply didn’t sign up
    • Lack of trust between farmers and research/universities, “Your location vs. my actual farm”
    • Optimism for upcoming year – desire for N levels to be high enough to support an extraordinary growing season

• Expectation vs. reality – Education and Outreach Programs
  • Agency official reported outreach programs a huge success, with high demand for nutrient management seminars
  • Farmer reported the opposite, saying participants still wary of information even if data is present

• Technological Improvements mistaken for management plan success
  • Nebraska site found lowered ground N levels, later found fertilizer rates steady but new irrigation methods in place
NIFA/CEAP Project Success

• 2 of the 13 sites showed wide nutrient management plan adoption

• Arkansas
  • Focus on cattle pastures
  • Regulatory pressures brought into play
    • Adoption rates still low
  • Dedicated extension agent hired to meet farmers and gain their trust, adoption rates began climbing

• New York
  • Drinking water comes from upstate NY (Catskills)
    • City pays for conservation management throughout the region, focused on nutrient management
  • Management plans reviewed every 3 years
  • Farmers track nutrient/manure application and yearly apply for reimbursement
  • Successful once nutrient plans were simplified, and financial resources offered as compensation

• Unintentional changes occurred as tilling and technological advances implemented – timing, placement, and rate of nutrient placement alters runoff levels
North Carolina Impaired Basin Study

• 18 year study aimed at nutrient-impaired river or lake basins to better determine agricultural activities within these basins
  • Focused on whether farmers were following recommendations of management plans or research, or applying based on outside advice/no additional input

• Models used to select for heavy agricultural regions, and exclude urban areas

• Farmers in selected regions (each contained between 1- >30 fields) interviewed, and farms surveyed for physical aspects, conservation practices, and/or water control
  • Specific attention paid to nutrient levels in soil testing, and fertilizer/nutrient application practices
RUSLE/NLEW

• Revised Universal Soil Loss Equation
  • Allows for calculation of soil erosion as well as appropriate N rates for various crop types

• Nitrogen Loss Estimation Worksheet
  • Used to compare farmer-applied N rates with state agency recommendations
  • Determines farmer use of Nitrogen
    • Accounted poorly to some extent for non-homogeneous locations and crop ratios, but gave an overall understanding of results

• Note: Osmond et. al. recognized the difficulty for predicting N requirements with differing crop and yearly specifics, but submit that it is necessary for reducing N losses
  • North Carolina uses a Realistic Yield Expectation (RYE) to determine levels, based on a best 3 out of 5 years approach, for each crop by soil series. Crop N rates determined by the Interagency Nutrient Management committee.
Cultivated Crops mostly in the Coastal Plain

Hay/Pasture mostly in the Piedmont
North Carolina Results

- N application often found to be lower than recommended
  - Tar-Pimlico and Jordan Lake Basins, when compared RYE rates and NLEW results
  - Where over-application existed, it was generally small

- Even where nutrient management plans existed, N application often did not match needs for recommended levels
  - Most did not have plans

- Phosphorus application shown to be unrelated to previous existing levels in soil
  - Majority of counties found to be above levels that required additional P (60 mg/kg)
    - Neuse River Basin had high testing levels, Jordan Lake ~1/3 prior testing
  - In the Jordan Lake Basin, 2/3 of the fields had unneeded application
    - High starting levels associated with high application, and vice versa
    - Largely associated with crop type, pasture vs. crop land
North Carolina
Use of Nutrient Management Plans

• Fertilizer/Nutrient application rarely found to follow nutrient management plans
  • One county hired an extension agent to work with farmers
  • Enabled farmers to write their own plans, and held a mandatory one day workshop
  • Agent reported that 2 years in, no farmers were still using the plans

• Majority of farmers used the same fertilizer levels throughout a crop, even across multiple fields
  • Lowest found with “Miscellaneous” and wheat crops, with no variation between fields at 81% of farmers
  • No accounting for existing levels, or soil/geographical conditions

• In many cases (especially coastal regions) P application was entirely unnecessary, but still undertaken
Conclusion

• In general, nutrient management plans either did not exist, or were not being followed

• Study suggests 3 likely reasons
  • Farmers hesitant to follow suggested levels due to lack of trust in research and findings
  • Abundant nutrients viewed as insurance for higher yield
  • Used recommendations from other sources – fertilizer dealers

• Successful nutrient management plans had common factors
  • Efforts eased management time
  • Worked directly and consistently with a small group of farmers
  • Substantial monetary (or other) resources were allocated

• A disconnect exists between front-line farmer needs, and need for nutrient management
  • Efforts to reduce nutrient pollution must take into account farmer needs, and must address social and cultural forces behind farmer decision making
Discussion Questions?

• Should farmers have to absorb some, if any, of the costs to reduce nutrient pollution? (Including testing costs)

• Can strategies be marketed as increasing yield, not just reducing pollution?
  • 4 R’s – Right rate, time, source, place