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Vulnerability and Risk Assessment

- Modeling of both the activities that potentially release nitrates into the subsurface environment and the fate/transport of nitrates in the environment is essential for risk assessment.
- Measures of risk and vulnerability should take into account not only current conditions but also anticipated future conditions.
- Large farms aren't necessarily a bigger threat than small farms.

Application of Management Practices

- Voluntary BMP subsidy programs have not achieved widespread significant reductions in agricultural nonpoint source pollution.
- Some researchers are recommending moving away from voluntary subsidy programs and towards the “polluter-pays-principle” with an emphasis on performance outcomes rather than BMPs.
- Recent research is inconclusive on the magnitude of the economic impact of such a change. A recent regional analysis estimates a relatively large impact while recent farm-level analyses estimate smaller impacts.

Application of Management Practices

- Subsidized but compulsory BMP implementation has effectively reduced pollution in multiple cases in the US and EU.
- Competitive bidding for subsidies that are also targeted to the highest risk areas could improve effectiveness.

Question 5:

Management practice implementation

Results from a simulation model of dairy production:

Policy	Waste collection	Waste disposal	Irrigation system	Irrigation mgmt.	Crop rotation	Net income loss
Baseline	Flush-lagoon	On-site	Furrow	Salt flushing	Corn-wheat	NA
Application control	Scrape-tank	Half off-site	Furrow	No flushing	Corn-wheat	-27%
Leaching control	Flush-lagoon	On-site	Linear move	No flushing	Corn-wheat	-1%
Aquifer control	Flush-lagoon	On-site	Furrow	No flushing; return flow capture	Corn-wheat	-1%

Question 5:

Management practice implementation

Results from a simulation model of field crop production focusing on applied water and nitrogen under non-uniform irrigation:

Policy	Emission reduction	Net income loss
N emission charge	-58%	-13%
Water input charge	-38%	-14%
N input charge	-16%	-35%

Question 6:

Recommended management practices

- More precise management of water and N inputs
 - Improved irrigation system uniformity
 - Full accounting of N sources
 - Reductions in applied water and N
 - Proper timing of water and N applications
- Precision farming technologies
- Changes in crop choice, including fallowing
- Return flow capture, at least for dairies
- *Flexibility should be built into regulations*

Question 8:

Knowledge and education

- Education-based policies tend to be flexible, non-controversial, and inexpensive.
- Education-based policies tend to be ineffective.
- Keys for success:
 - “Win-win” technology
 - Strong sense of altruism
 - High private costs of pollution
- Education is best used in a complementary role: facilitating compliance with compulsory pollution control policies.

Verification Measures

- Input controls (BMPs) are relatively inexpensive to verify.
- But rigid BMP requirements tend to increase implementation costs.
- Emission-based controls are more flexible and thus more cost-effective, but verification is a significant problem for NPS pollution.
- Ambient-based controls would be easier to verify, but require a robust model of the regional pollutant transport process.
- Controls based on estimated (modeled) emissions may provide a good compromise.
- Producers could be incentivized to monitor, verify and report their own emissions.

Question 9:

Verifying BMP effectiveness

- A recent country-wide analysis found a general lack of information about the environmental effectiveness of nutrient pollution control programs.
- Proper verification should involve:
 - Short-term, local monitoring near sources to determine individual BMP effectiveness.
 - Long-term, regional monitoring near receptor points to assess overall policy effectiveness.