

Appendix C. Delphi Process – second round results for research objectives identified in conference discussions and working groups and as a result of conference participation.

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Table 4. Research objectives presented in the first round Delphi, by major theme areas

Pathogen vectors or pathways

1. Develop rigorous sampling standards for soils, water, and plants to measure human pathogens.
2. Define the fate and transport of pathogens in the context of flooding and reservoirs.
3. Identify effects of levels of soil biodiversity on pathogen survival.
4. Identify pathways during the crop production cycle for contamination of crops by pathogens.
5. Characterize the persistence of pathogens in the growing and harvested crop.
6. Identify animals that are significant pathogen vectors.
7. Describe pathogen risks associated with different population densities of animal vectors.
8. Identify spatial and temporal characteristics of riparian habitats as related to *E. coli* O157:H7 transmission.
9. Describe occurrence of *E. coli* O157:H7 in mammals associated with conservation practices.
10. Describe occurrence of *E. coli* O157:H7 in cattle as effected by production practices.
11. Investigate the potential effects of cattle production on pathogen ecology in the system.
12. Conduct population studies of feral pigs, including habitat characterization.

Mitigation & Management Practices

13. Develop standards for testing of water, soils, sediments, fauna, and plant tissues
14. Determine how harvesting methods affects the risk of pathogen contamination.
15. Identify conditions that promote survival and proliferation of pathogens in conservation practices that collect sediment.
16. Determine the effects of treating of irrigation water to reduce pathogens
17. Determine the effects of crop production practices on elimination, persistence or transport of pathogens.
18. Identify the fate of pathogens captured by conservation practices.
19. Identify practices to help growers determine when, and if, sediment from catch basins can be safely reincorporated onto the field.
20. Identify practices to help growers determine when, and if, tailwater can be reintroduced to the field.
21. Compare conventional and organic production methods for effects on occurrence and persistence of pathogens
22. Identify how crop production and/or conservation practices affect migration of non-farm animals.

Risk Management

23. Identify practices that preserve food safety while improving water quality.
24. Study and describe the seasonality of outbreaks.
25. Develop a risk assessment mechanism that includes both the consequences of pathogen transmission and the consequences of water pollution.
26. Identify a way to categorize and rank specific sources of risk.
27. Quantify the effectiveness of specific farm audit requirements in protecting food safety. .
28. Quantify the effectiveness of specific good agricultural practices in protecting food safety.

Table 5. Research objectives retained in the second round DELPHI, by major theme areas.

Pathogen Vectors or Pathways

1. Compare the fate of pathogens introduced into barren and vegetated systems.
2. Describe how storm flows, floods, and water control structures affect pathogen movement and survival.
3. Characterize pathogen pathways during crop production, harvesting, and packing.
4. Characterize the persistence of pathogens in the growing and harvested crop.
5. Identify animals, including smaller mammals and/or birds, which are significant pathogen vectors.
6. Describe how different husbandry techniques impact the occurrence of E. coli O157:H7 in cattle.
7. Determine how different range management strategies affect pathogen development and export.

Management Practices and Mitigation

8. Identify environmental conditions that promote survival and proliferation of pathogens in collected sediments.
9. Determine the effects and feasibility of treating irrigation water and irrigation reservoirs to reduce pathogens.
10. Identify the fate of pathogens captured through various conservation practices (e.g., grassed waterways, sediment basins, tailwater ponds).
11. Identify practices to help growers determine when, and if, sediment from catch basins can be safely reincorporated onto the field.
12. Identify practices to help growers determine when, and if, tailwater can be reintroduced to the field.
13. Identify strategies to safeguard against importing pathogens in manure or compost.

Risk Management

14. Specify proven practices that preserve food safety while improving water quality.
15. Identify a way to categorize and rank specific sources of risk.
16. Develop a risk assessment mechanism that includes the consequences of pathogen transmission AND water pollution.
17. Quantify the effectiveness of specific farm audit requirements in protecting food safety.
18. Quantify the effectiveness of specific good agricultural practices in protecting food safety.

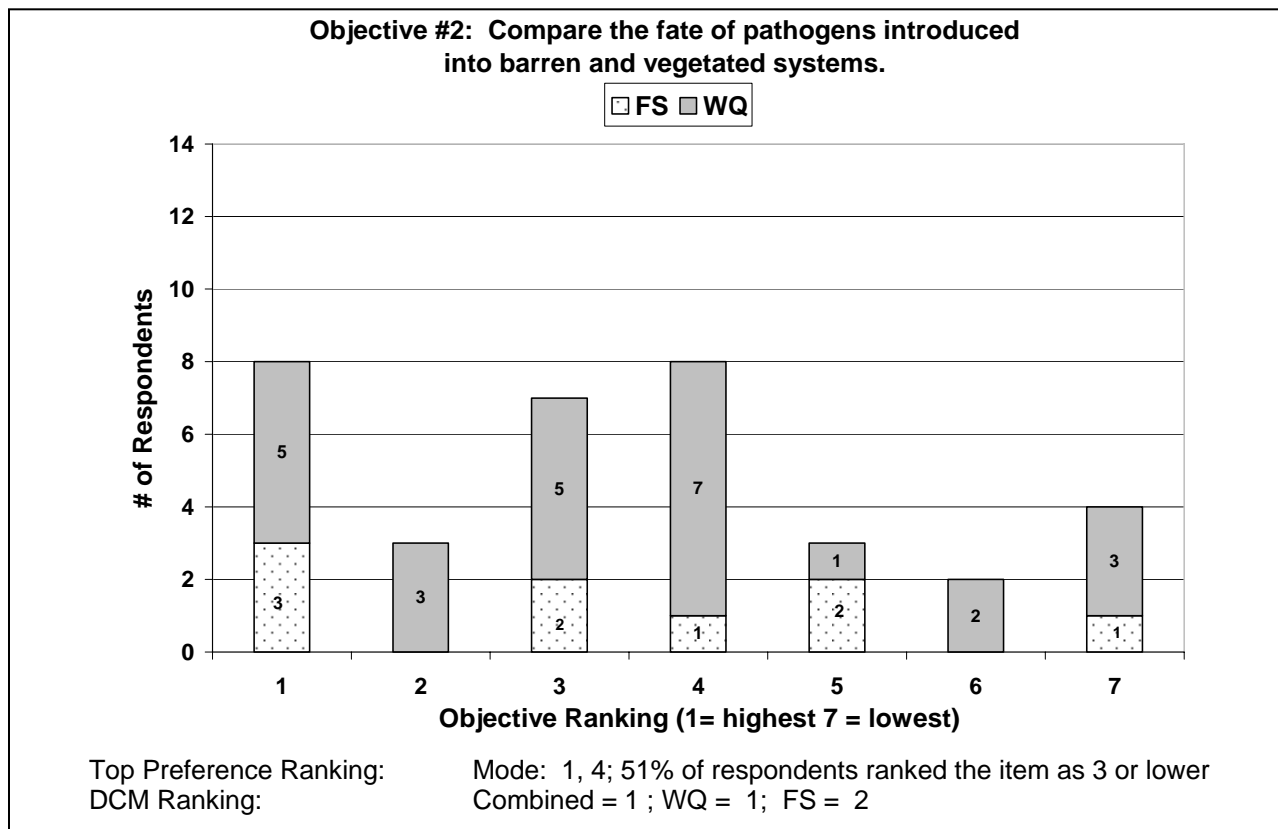
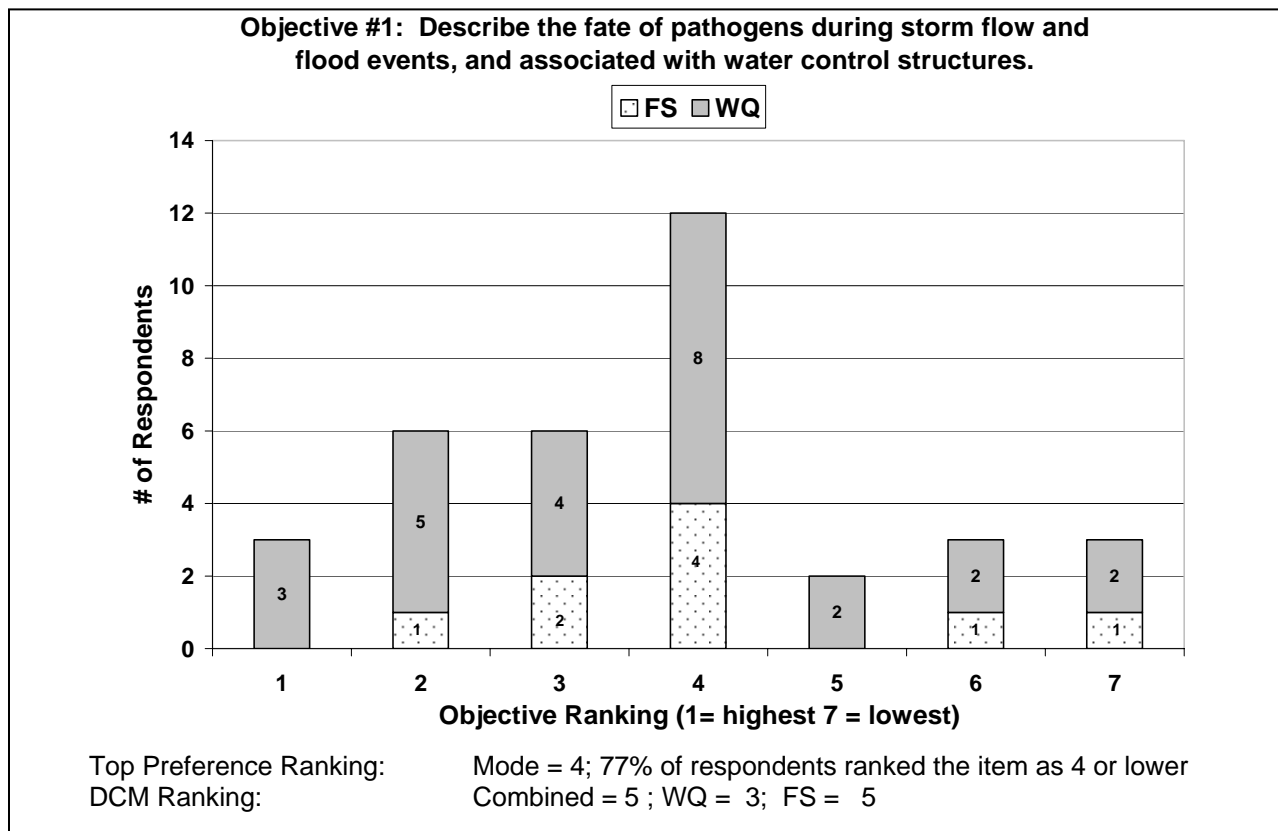
Table 6. Priority ranking within major theme areas for research objectives identified in San Luis Obispo conference discussions and working groups. Ranking results are included for top preference and Distance-based ideal-seeking Consensus ranking Model (DCM).

	Top Preference Ranking	DCM Rankings		
	Combined	Combined	Water quality	Food safety
Pathogen Vector or Pathway				
Objective #1: Describe the fate of pathogens during storm flow and flood events, and associated with water control structures.	3	5	3	5
Objective #2: Compare the fate of pathogens introduced into barren and vegetated systems.	4	1	1	2
Objective #3: Characterize pathogen pathways during crop production, harvesting, and packing.	1	2	1*	1
Objective #4: Characterize the persistence of pathogens in the growing and harvested crop.	5	3	4	3
Objective #5: Identify animals, including smaller mammals and/or birds, which are significant pathogen vectors.	2	4	5	4
Objective #6: Describe how different husbandry techniques impact the occurrence of E. coli O157:H7 in cattle.	6	6	6	6
Objective #7: Determine how different range management strategies affect pathogen development and export.	7	7	7	7
Mitigation and Management Practices				
Objective #8: Identify environmental conditions that promote survival and proliferation of pathogens in collected sediments.	2	2	2	1
Objective #9: Determine the effects and feasibility of treating irrigation water and irrigation reservoirs to reduce pathogens.	5	5	5	2
Objective #10: Identify the fate of pathogens captured through various conservation practices (e.g., grassed waterways, sediment basins, etc).	1	1	1	2
Objective #11: Identify practices to help growers determine when and if sediment from catch basins can be safely reincorporated onto the field.	3	3	3	2
Objective #12: Identify practices to help growers determine when, and if, tailwater can be reintroduced to the field.	4	4	4	2
Objective #13: Strategies to safeguard against importing pathogens in manure or compost.	6	6	6	2

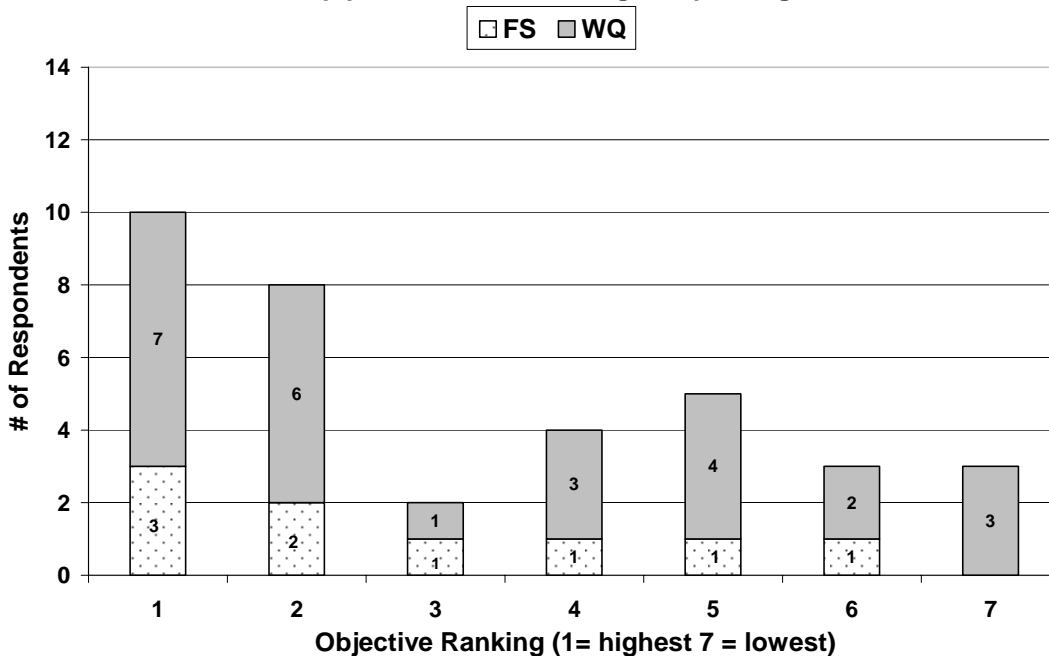
* Identical rankings indicate that DCM analysis did not identify a preference.

	Top Preference Ranking	DCM Rankings		
	Combined	Combined	Water quality	Food safety
Risk Management Research				
Objective #14: Specify proven practices that preserve food safety while improving water quality.	1	1	1	3
Objective #15: Develop risk assessment protocols that consider both food safety and water quality concerns.	3	2	2	2
Objective #16: Identify a way to categorize and rank specific sources of risk.	4	4	4	1
Objective #17: Quantify the effectiveness of specific farm audit requirements in protecting food safety.	5	5	5	4
Objective #18: Quantify the effectiveness of specific good agricultural practices in protecting food safety.	2	3	3	5

Figure 3. Delphi results for participant rankings of pathogen vector or pathway research objectives.
Items were ranked from 1 (highest priority) to 7 (lowest priority).

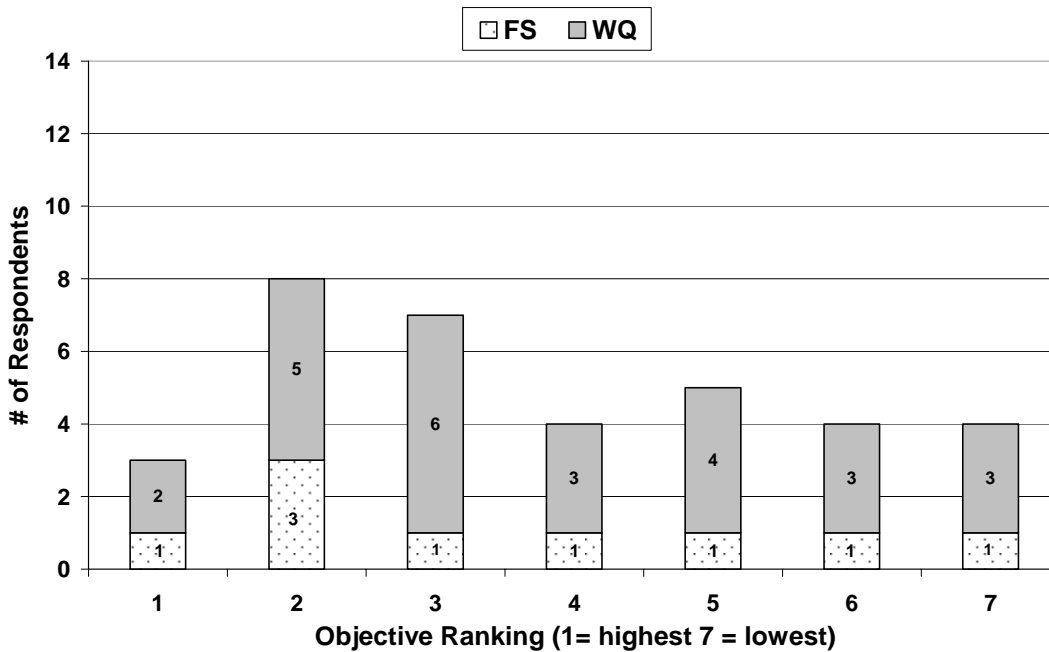


Objective #3: Characterize pathogen pathways during crop production, harvesting and packing.



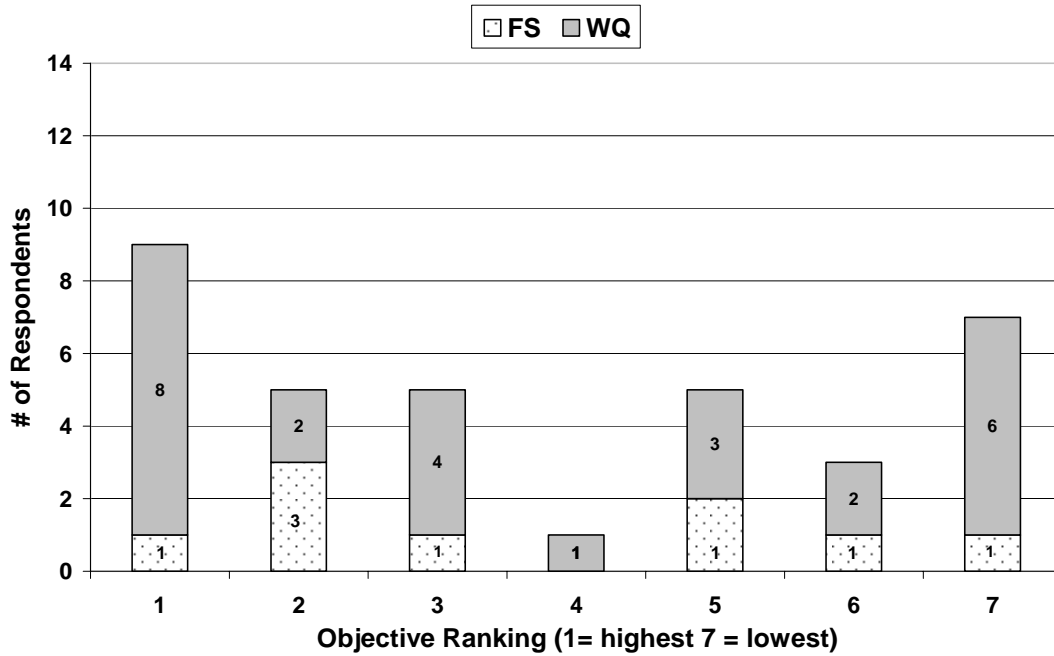
Top Preference Ranking: Mode = 1; 51% of respondents ranked the item as 2 or 1 (the highest priority).
DCM Ranking: Combined = 2; WQ = 2; FS = 1

Objective #4: Characterize the persistence of pathogens in the growing and harvested crop.



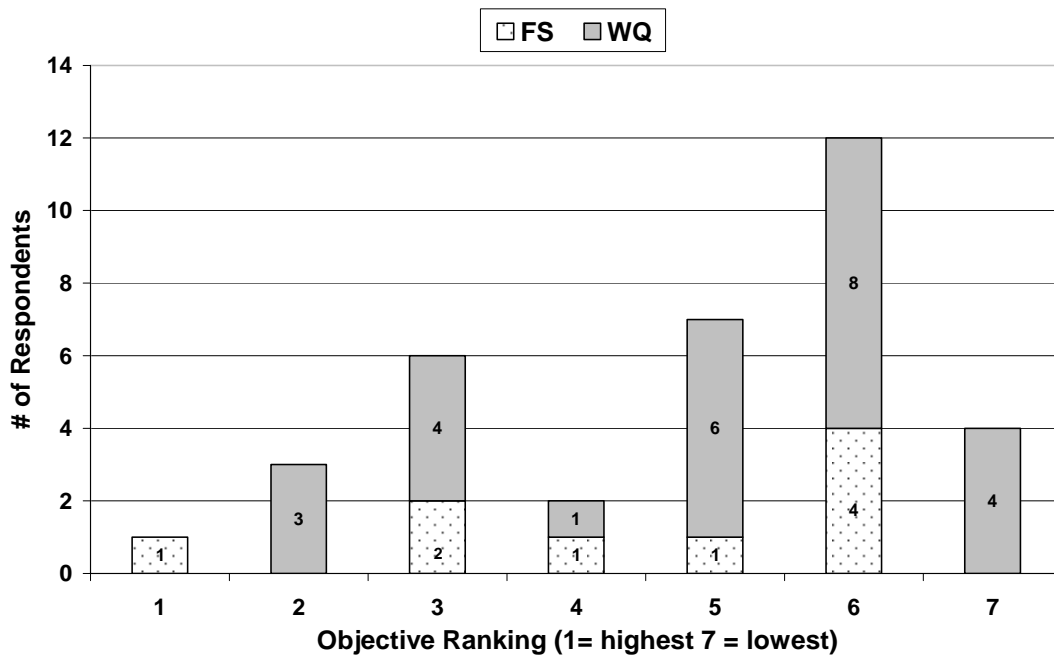
Top Preference Ranking: Mode = 2, 4; 51% of respondents ranked the item as 3 or lower.
DCM Ranking: Combined = 3; WQ = 4; FS = 3

Objective #5: Identify animals, including smaller mammals and/or birds, which are significant pathogen vectors.



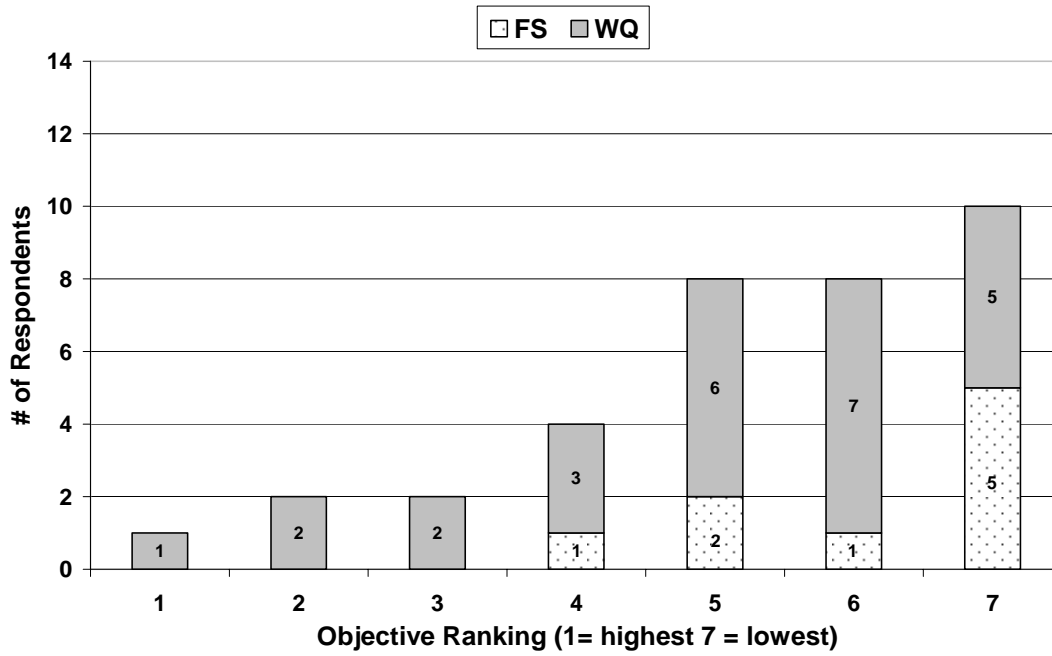
Top Preference Ranking: Mode = 1; 54% of respondents ranked the item as 3 or lower
DCM Ranking: Combined = 4; WQ = 5; FS = 4

Objective #6: Describe how different husbandry techniques impact the occurrence of E. coli O157:H7 in cattle.



Top Preference Ranking: Mode = 6; 66% ranked the item as 5 or higher
DCM Ranking: Combined = 6; WQ = 6; FS = 6

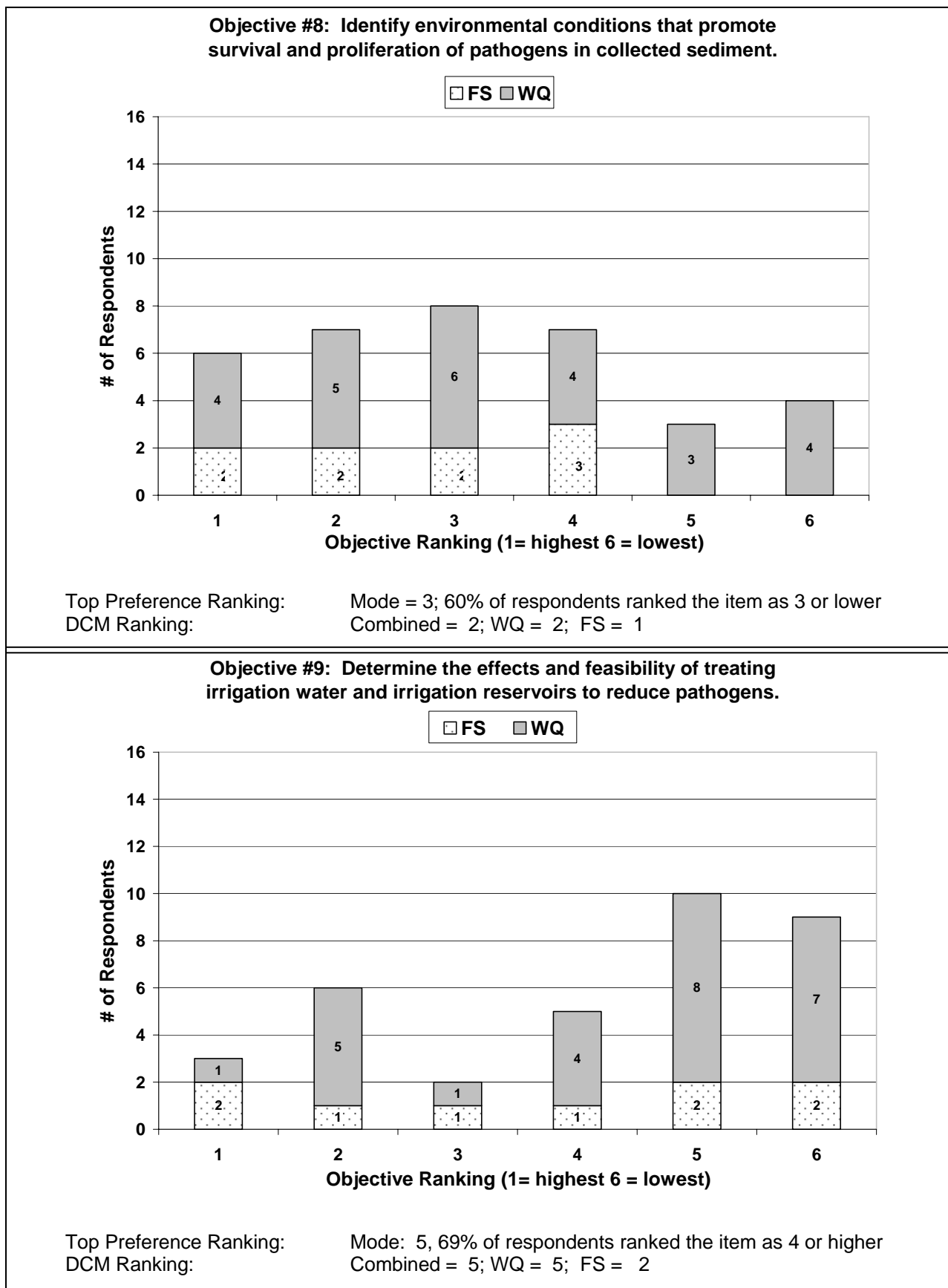
Objective #7: Determine how different range management strategies affect pathogen development and export.



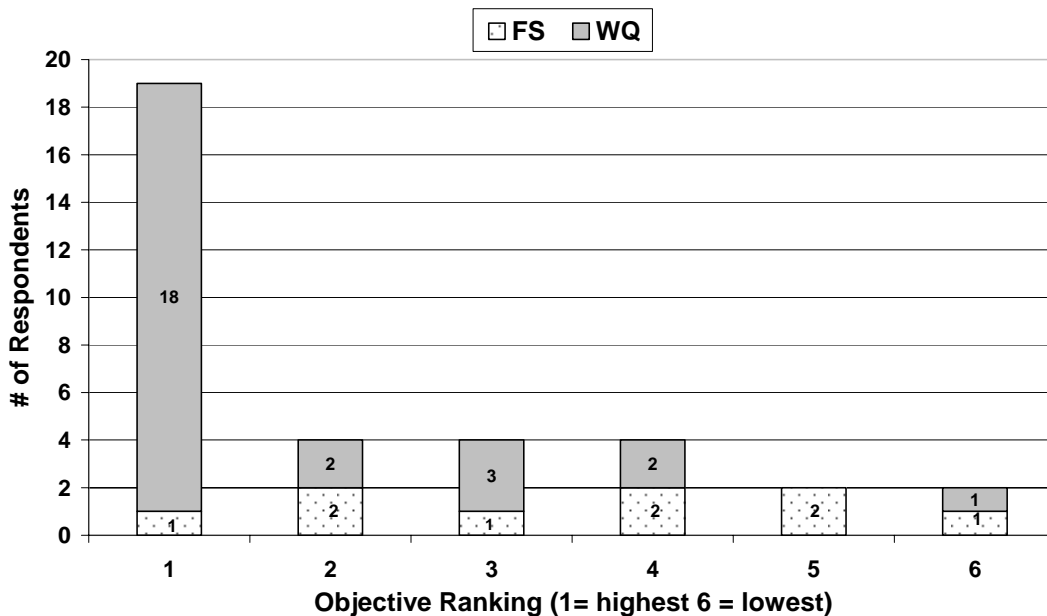
Top Preference Ranking:
DCM Ranking:

Mode = 7; 74% ranked the item as 5 or higher
Combined = 7; WQ = 7; FS = 7

Figure 4. Delphi results for participant rankings of mitigation and management practices research objectives. Items were ranked from 1 (highest priority) to 6 (lowest priority).

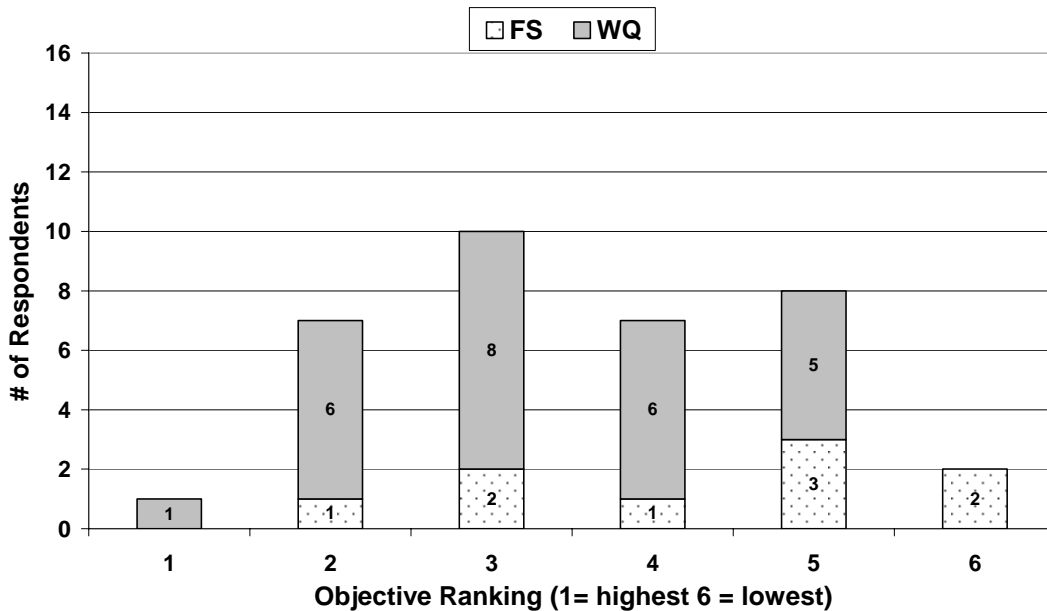


Objective #10: Identify the fate of pathogens captured through various conservation practices (e.g., grassed waterways, sediment basins, etc).



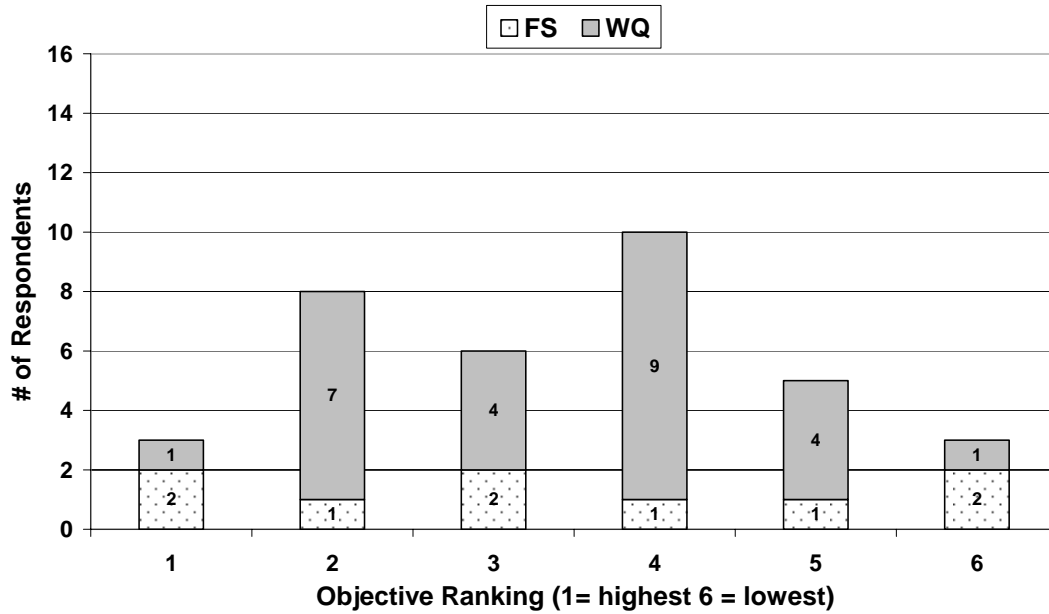
Top Preference Ranking: Mode = 1; 66% of respondents ranked the item as 1 or 2
DCM Ranking: Combined = 1; WQ = 1; FS = 2

Objective #11: Identify practices to help growers determine when and if sediment from catch basins can be safely reincorporated onto the field.



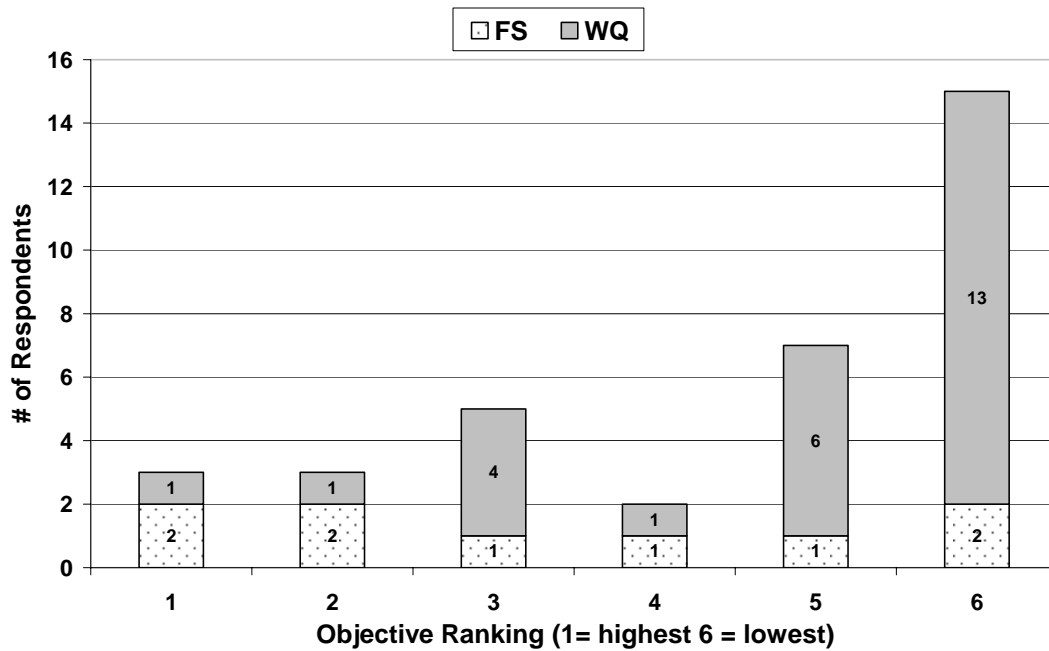
Top Preference Ranking: Mode: 3; 51% of respondents ranked the item as 3 or lower
DCM Ranking: Combined = 3; WQ = 3; FS = 2

Objective #12: Identify practices to help growers determine when, and if tailwater can be reintroduced into the field.



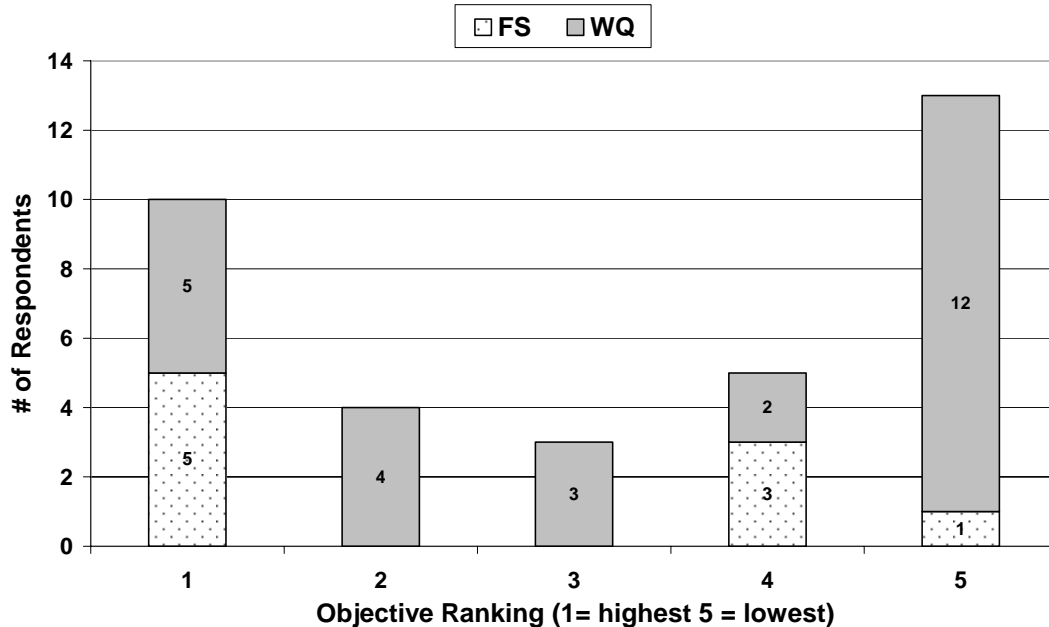
Top Preference Ranking: Mode: 4; 51% of respondents ranked the item as 4 or higher
DCM Ranking: Combined = 4; WQ = 4; FS = 2

Objective #13: Strategies to safeguard against importing pathogens in manure or compost.



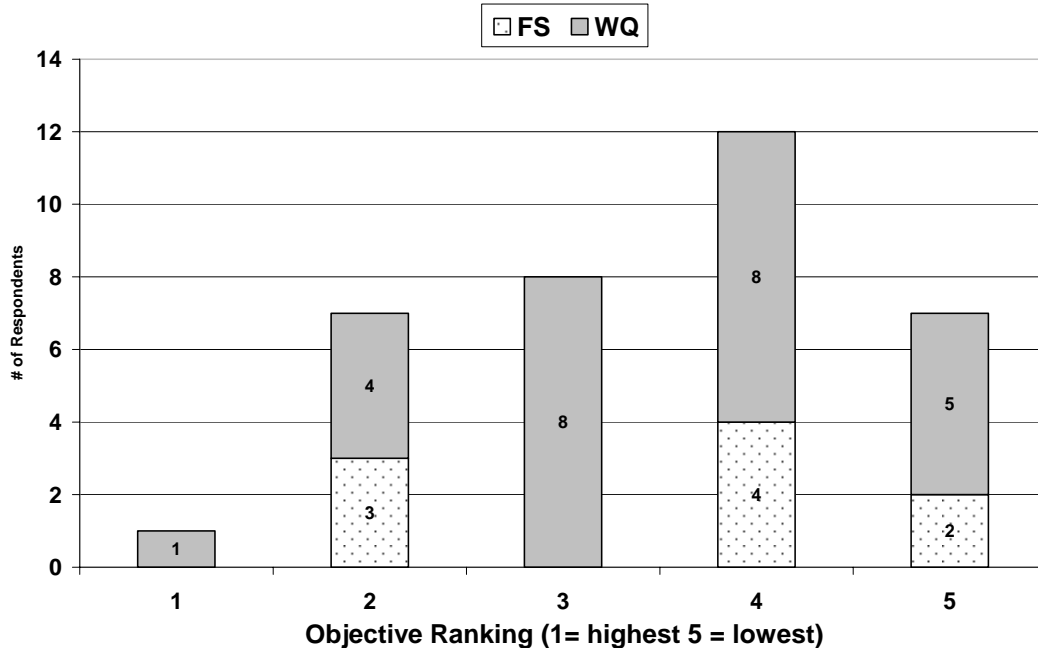
Top Preference Ranking: Mode: 6; 63% of respondents ranked the item as a 5 or 6
DCM Ranking: Combined = 6; WQ = 6; FS = 6

Objective #16: Identify a way to categorize and rank specific sources of risk.



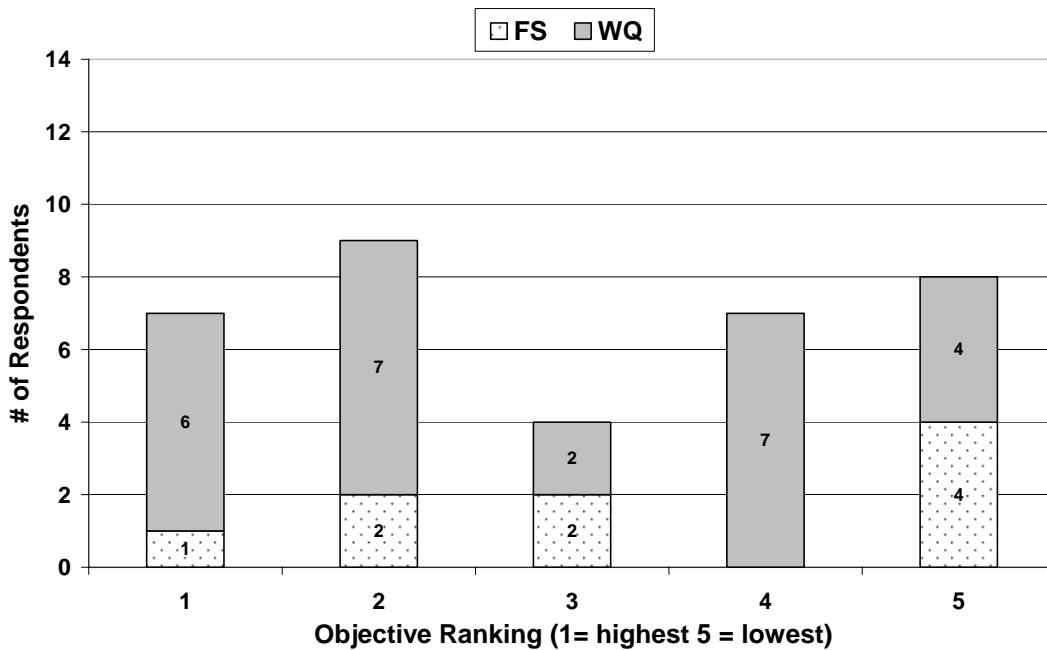
Top Preference Ranking: Mode: 5; 51% of respondents ranked the item as a 4 or 5. However, 40% ranked the item as a 1 or 2
DCM Ranking: Combined = 4; WQ = 4; FS = 1

Objective #17: Quantify the effectiveness of specific farm audit requirements in protecting food safety.



Top Preference Ranking: Mode: 4; 54% of respondents ranked the item as a 4 or 5
DCM Ranking: Combined = 5; WQ = 5; FS = 4

Objective #18: Quantify the effectiveness of specific good agricultural practices in protecting food safety.



Top Preference Ranking: Mode: 2; 46% of respondents ranked the item as a 1 or 2. However, 43% ranked this item as a 4 or 5

DCM Ranking: Combined = 3; WQ = 3; FS = 5

Figure 6. Delphi results for research objectives identified during the San Luis Obispo conference identified by respondents as their top 5 research priorities.

Delphi participants were asked to select their “top 5” research priorities from the following list of 18 items originally conceived during the food safety and water quality conference, and prioritized during the first round Delphi survey.

1. Compare the fate of pathogens introduced into barren and vegetated systems.
2. Describe how storm flows, floods, and water control structures affect pathogen movement and survival.
3. Characterize pathogen pathways during crop production, harvesting, and packing.
4. Characterize the persistence of pathogens in the growing and harvested crop.
5. Identify animals, including smaller mammals and/or birds, which are significant pathogen vectors.
6. Describe how different husbandry techniques impact the occurrence of E. coli O157:H7 in cattle.
7. Determine how different range management strategies affect pathogen development and export.
8. Identify environmental conditions that promote survival and proliferation of pathogens in collected sediments.
9. Determine the effects and feasibility of treating irrigation water and irrigation reservoirs to reduce pathogens.
10. Identify the fate of pathogens captured through various conservation practices (e.g., grassed waterways, sediment basins, tailwater ponds).
11. Identify practices to help growers determine when, and if, sediment from catch basins can be safely reincorporated onto the field.
12. Identify practices to help growers determine when, and if, tailwater can be reintroduced to the field.
13. Identify strategies to safeguard against importing pathogens in manure or compost.
14. Specify proven practices that preserve food safety while improving water quality.
15. Identify a way to categorize and rank specific sources of risk.
16. Develop a risk assessment mechanism that includes the consequences of pathogen transmission AND water pollution.
17. Quantify the effectiveness of specific farm audit requirements in protecting food safety.
18. Quantify the effectiveness of specific good agricultural practices in protecting food safety.

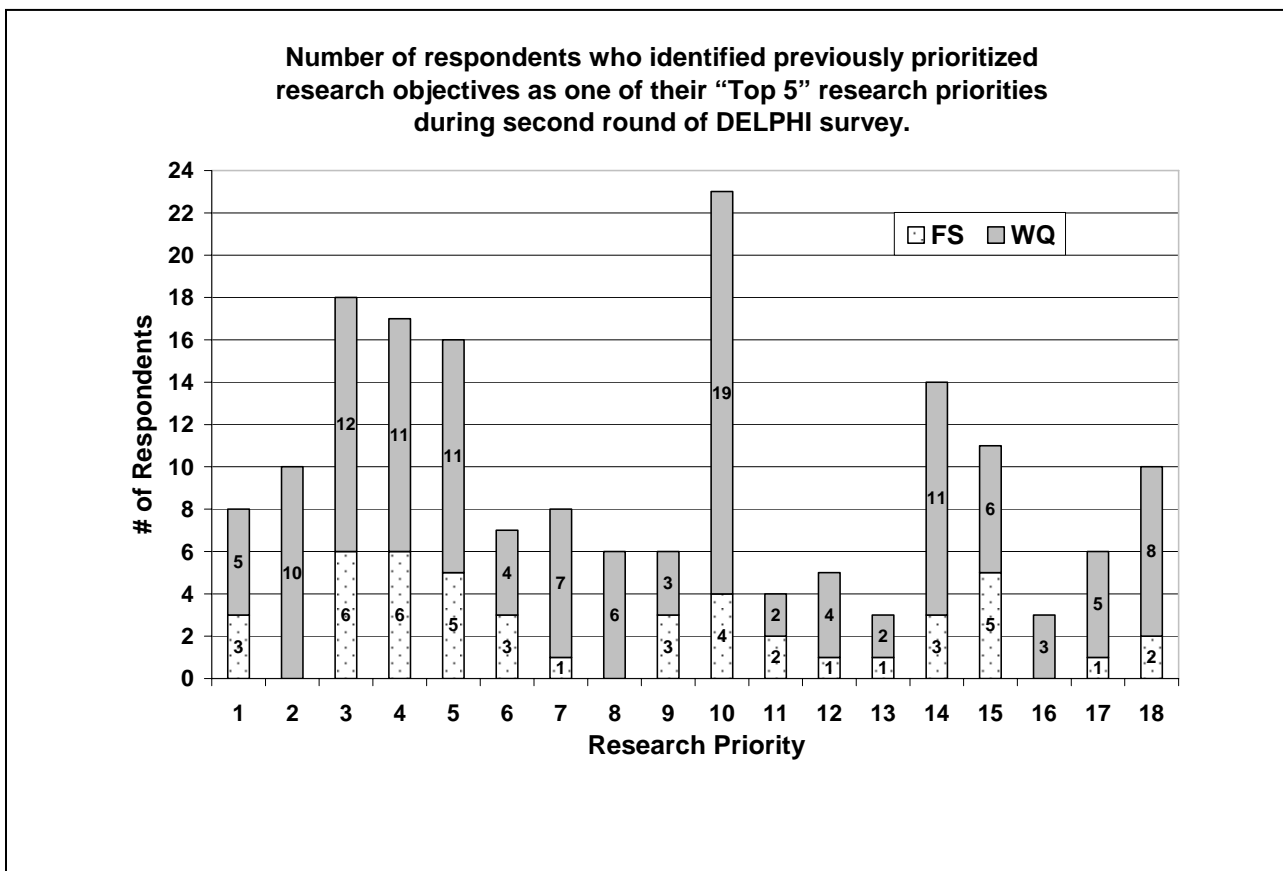
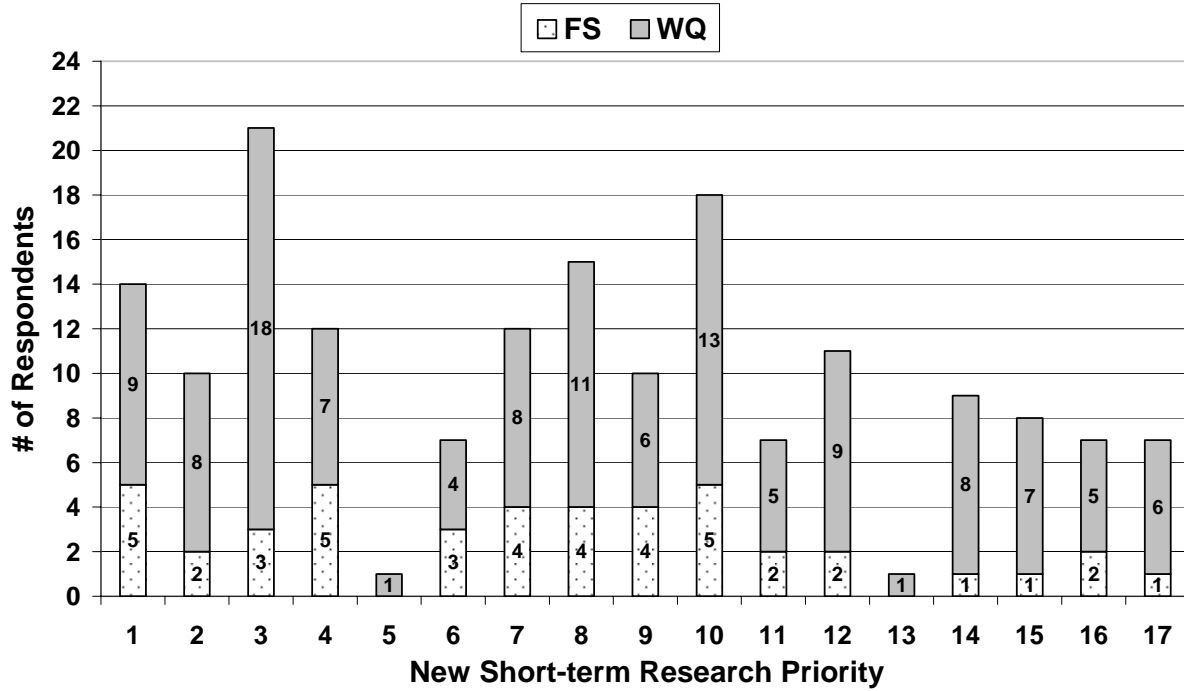


Figure 7. Delphi results for new research priorities identified by respondents as a result of involvement in the San Luis Obispo conference.

Participants were asked to identify “new research priorities” during the first round Delphi survey. Since these new ideas were the product of individual survey responses, and therefore not formally vetted by all participants, they were summarized and considered separately from the previous list of items. Participants were asked to identify their “top 5 newly identified” short- and long-term research priorities from the following list of 17 objectives.

1. Examine how pathogens respond to climate (solar radiation, temperature, humidity, wind, etc.).
2. Determine whether farm practices significantly affect other pathogens, beyond E. coli O157:H7 (Salmonella, Campylobacter, Listeria, Cryptosporidium, etc.).
3. Develop course materials on food safety-water quality co-management.
4. Find ways to reduce pathogen loading into irrigation water.
5. Develop methods to kill pathogens sequestered in soils.
6. Examine the potential for pathogens to be splashed onto baby vegetable plants.
7. Determine whether the probability that E. coli will move into food has been increased by regional developments (Changes in riparian ecosystems, cultural practices, and processing).
8. Investigate the extent that beneficial microbial populations control pathogens in water, soils, on plants, and in manures.
9. Develop a water quality monitoring and reporting program.
10. Develop a systems approach to water quality-food safety co-management.
11. Derive a procedure to match food crops to specific fields upon which they can be grown securely.
12. Determine safe buffer distances from animal’s tracks and their feces.
13. Develop measures to contain pathogens sequestered in abandoned carcasses or offal.
14. Evaluate factors contributing to wildlife movement.
15. Conduct a cost/benefit analysis to ascertain the value of additional research.
16. Research bird populations and their ability to vector human pathogens of concern.
17. Describe how the water management options are affected by different degrees of acceptable food safety risk (small, very small, extremely small, zero).

Number of respondents who identified new research objectives as one of their "Top 5" critical short-term research needs during the second round of DELPHI process.



Number of respondents who identified new research objectives as one of their "Top 5" critical long-term research needs during the second round of DELPHI process.

