Water Priorities Delphi Survey: Phase 2

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Contents

Introduction

Purdue University and the University of Connecticut are conducting a synthesis evaluation of the U.S. Department of Agriculture National Institute of Food and Agriculture (USDA NIFA) 2001 – 2013 Water Portfolio (called NIFA Water Portfolio from this point forward). The NIFA Water Portfolio has funded a variety of research, education, and extension efforts focusing on water resource issues in the United States and abroad. Through this synthesis, we seek to identify critical findings and lessons learned, and to evaluate the effectiveness of projects in promoting solutions to water problems in agricultural, rural, and urbanizing watersheds.

One component of the NIFA Water Portfolio Synthesis (called Synthesis from this point forward) is an analysis of water priorities that lead to water funding priority recommendations. In a previous document, we reported survey responses of 35 federal agency water experts who rated their level of agreement with 40 water-related issues (water priority areas) that they believe NIFA should prioritize for future funding. Participants were also asked to write about their reasoning behind their top water priorities and to indicate other water funding priorities that were not included in the original list of 40. Taking the results of Phase 1, we administered a second survey (Phase 2) in order to further refine the water priorities list and to further explore elements of water funding that emerged from the open-ended responses in the Phase 1 survey. In the following pages, we report Phase 2 results.

Summary

Overall, 21 people responded to the Phase 2 survey. Through survey respondent ranking of 40 water priorities, we found that study respondents recommended the following five topics that should be considered for future NIFA funding:

1) Climate change and water quality and quantity.
2) Water quality and conservation practices.
3) Water quality and nutrients.
4) Climate change and adaptation and mitigation strategies.
5) Policy analysis: Water quality and quantity.

Survey respondents were asked for feedback on broad themes related to climate change and water reuse that were not included in the original list of 40 water priorities. Almost half of survey respondents "strongly agreed" that NIFA should prioritize funding in the following areas:

- Connect climate change science knowledge, generated across agencies, to NIFA goals and objectives.
- Understand tipping points/thresholds related to climate change impacts (e.g., low water supplies, water salinity and land recovery, groundwater recharge).
- Water reuse and food safety.

Survey respondents reported that the following themes, broadly applicable to all water priorities, are "extremely important" considerations to be included as part of any NIFA funded water project:

- Scientists, professionals, and/or educators from different disciplines/expertise (i.e., interdisciplinary teams).
- Stakeholder involvement/collaboration in the projects.
- Promotion/facilitation of data sharing across federal agencies.

Methods

Data Collection and Analysis

The water priority portion of the Synthesis was designed using the Delphi method[1] in order to formulate a consensus of water priorities among federal agency water experts. The initial stage of the Delphi process entailed two focus group sessions to gather initial opinions on water issues and funding priorities. The focus group sessions were followed by the Phase 1 survey distributed via email to focus group participants (the Phase 1 report includes that survey's methodology and water priority development process). Phase 2 of the process entailed distributing Phase 1 survey results, which ranked the original 40 water priorities by mean response, to Phase 1 survey respondents. The Phase 2 survey was distributed with the Phase 1 results and administered online through Qualtrics software in June 2016 to the 35 Phase 1 survey participants; 21 surveys were completed, for a 60% response rate.

Survey respondents were asked to refine the original list of 40 water priorities to their top three priorities. The priorities were presented in order of overall response mean (highest to lowest) (1 = "Strongly Disagree" through 5 = "Strongly Agree") for the statement: **"NIFA should prioritize future water funding within the following…broad topic areas**". Each priority statement included the actual mean response and the respondent's own response. We then asked respondents to select **"which priorities you believe to be the 3 most important water issues that USDA NIFA should consider funding in the future"**.

Example priority statement:

1) Climate change and water quality and quantity (n=34)
   Mean = 4.41 Your previous response = {respondents' actual response from 1 – 5}

Survey data were analyzed using SPSS software. Open-ended questions were analyzed by one researcher who interpreted the responses into general themes. These open-ended summaries are located in the body of the report. Verbatim lists of open-ended responses are located in the Appendix of this report.

[1] For a good summary of the Delphi method, wee Powell, C. (2003). The Delphi technique: myths and realities. *Journal of advanced nursing*, *41*(4), 376-382.

Results

Federal Agencies Represented

Seven federal agencies were represented through 21 respondents. Agencies were identified through respondents' place of work, utilizing email addresses and information located on agency websites. The U.S. Environmental Protection Agency (EPA) (38.1%) and U.S. Department of Agriculture (USDA) (38.1%), together, represent the majority (76.2%) of survey responses. Table 1 lists each federal agency and their corresponding survey completion numbers.

Table 1 *Survey responses by federal agency*

Federal Agency Name	Federal Agency Abbreviation	Completed Surveys (n)	Percent of Total Reponses
U.S. Environmental Protection Agency	**EPA**	**8**	**38.1**
U.S. Department of Agriculture	**USDA**	**8**	**38.1**
USDA Natural Resources Conservation Service	*USDA-NRCS*	*2*	*9.5*
USDA National Institute of Food and Agriculture	*USDA-NIFA*	*1*	*4.8*
USDA Economic Research Service	*USDA-ERS*	*2*	*9.5*
National Aeronautics and Space Administration	**NASA**	**1**	**4.8**
National Oceanic and Atmospheric Administration	**NOAA**	**1**	**4.8**
Bureau of Reclamation	**BOR**	**1**	**4.8**
U.S. Geologic Society	**USGS**	**1**	**4.8**
National Science Foundation	**NSF**	**1**	**4.8**
Total		**21**	

Water Priorities and Ranking

Survey respondents were asked to refine the original list of 40 water priorities presented in the Phase 1 survey by selecting their top three water priorities: **"The following list of 40 water priority areas are ranked according to overall response mean (1 = "Strongly Disagree" through 5 = "Strongly Agree"). The overall response mean and the response you provided in the Phase 1 survey are included for each priority. Please review the list and then select which priorities you believe to be the 3 most important water issues that USDA NIFA should consider funding in the future.**"

Table 2 shows the results of respondents' selections. Water priorities are ranked in order of priorities selected by respondents, from those that were selected the most to the least, and then by the highest to lowest means of all Phase 1 responses. Overall, 21 priorities of the original 40 were selected by respondents, with 14 of these being selected by one or two respondents only. Almost 62% (n=13) of respondents selected "*Climate change and water quality and quantity*" as one of their top three priorities – this priority was also ranked 1st in Phase 1. The 2nd most selected priority was "*Water quality and conservation practices*" (38.1%, n=8), which was ranked 3rd in Phase 1. The 3rd most selected priority was "*Water quality and nutrients*" (42.8%, n=9), which was the 5th highest ranking in Phase 1. The 4th highest selected priority was "*Climate change and adaptation and mitigation strategies*" (28.6%, n=6) – ranked 2nd in Phase 1. There was a large difference in ranking for "*Policy analysis: Water quality and quantity*" (19.0%, n=4), leaping from 21st in Phase 1 to in the 5th most selected priority in Phase 2. The top 5 ranked priorities in Phase 1 fell within the top 6 in Phase 2.

Table 2 *Water priorities: Ranked by number of respondents who selected each priority*

Category	Phase 2 N	Phase 1 mean	Phase 1 rank	Phase 1 N
1) Climate change and water quality and quantity	13	4.41	1	34
2) Water quality and conservation practices	8	4.22	3	32
3) Water quality and nutrients	8	4.21	5	33
4) Climate change and adaptation and mitigation strategies	6	4.39	2	33
5) Policy analysis: Water quality and quantity	4	3.84	21	32
6) Water data (includes water monitoring water usage tool development, etc.)	3	4.21	4	33
7) Tile drainage systems	3	4.00	12	33
8) Water quality and drought	2	4.18	6	33
9) Water reuse	2	4.15	8	33
10) Benchmarks indicators and models to study/monitor water quality and quantity	2	4.12	9	33
11) Watershed management	1	4.18	7	34
12) Climate change and economics	1	4.06	10	31
13) Water quality and livestock	1	3.91	14	32
14) Water quantity and efficiency (includes technology and structures)	1	3.91	15	32
15) Stakeholder involvement/collaboration in water projects	1	3.88	16	33
16) Groundwater recharge	1	3.88	18	32
17) Water protection and conservation behavior	1	3.88	20	33
18) Water management tools	1	3.78	24	32
19) Water quantity and crop production	1	3.75	25	32
20) Drinking water and health (includes communities impacted by natural disaster)	1	3.72	30	32
21) Water lifecycle analysis, water footprint	1	3.44	38	32
22) Irrigation efficiency and management	0	4.03	11	32
23) Water quantity: Impact on water quality	0	3.94	13	32
24) Soil science and water	0	3.88	17	33
25) Water quality and microbiological/organic material	0	3.88	19	33
26) Water quality and agrochemicals	0	3.84	22	32
27) Water quality and sedimentation	0	3.81	23	32
28) Water quality and salinity	0	3.75	26	32
29) Education strategies/programs for water resource educators	0	3.75	27	32
30) End-user use of water research and tools	0	3.74	28	31
31) Water vulnerability assessments	0	3.73	29	33
32) Water quantity and allocation of water resources between different uses/users	0	3.72	31	32
33) Water and land use	0	3.70	32	33
34) Water quality and pharmaceuticals	0	3.69	33	32
35) Food safety	0	3.65	34	31
36) Water quality and fracking	0	3.58	35	33
37) Waste water management (including stormwater)	0	3.50	36	32
38) International food security	0	3.44	37	32
39) Water and invasives	0	3.41	39	32
40) Private wells and/or septic systems	0	2.97	10	32

Table 3 shows the top ten water priority areas that were selected by Phase 2 survey respondents. The table is organized to show which federal agencies selected which priority areas. Although the majority of respondents and agencies (6 agencies, 13 people) selected "*Climate change and water quality and quantity*" – with the USDA having the largest number of staff who selected it (75%, n=6) – the EPA had a stronger response for the 2nd ("*Water quality and conservation practices*"; EPA response: 62.5%, n=5) and 3rd ("*Water quality and nutrients*"; EPA response: 50%, n=4) ranked priorities. The second largest number of agencies (4 agencies, 6 people) selected priority #4 (*"Climate change and adaptation and mitigation strategies*").

Table 3 *Top ten water priority area selections by federal agency (% of each agency)*

Water Priority Areas	Current N	Phase 1 rank	Percent of Agency Staff that Selected the Priority						
			BOR (n=1)	EPA (n=8)	NASA (n=1)	NOAA (n=1)	USDA (n=8)	USGS (n=1)	NSF (n=1)
1) Climate change and water quality and quantity	13	1	100.0%	37.5%	100.0%	100.0%	75.0%	100.0%	100.0%
2) Water quality and conservation practices	8	3	0.0%	62.5%	0.0%	0.0%	37.5%	0.0%	0.0%
3) Water quality and nutrients	8	5	0.0%	50.0%	0.0%	0.0%	37.5%	0.0%	100.0%
4) Climate change and adaptation and mitigation strategies	6	2	0.0%	12.5%	100.0%	100.0%	37.5%	0.0%	0.0%
5) Policy analysis: Water quality and quantity	4	21	0.0%	12.5%	0.0%	0.0%	25.0%	100.0%	0.0%
6) Water data (includes water monitoring water usage tool development, etc.)	3	4	0.0%	12.5%	0.0%	0.0%	25.0%	0.0%	0.0%
7) Tile drainage systems	3	12	0.0%	12.5%	0.0%	0.0%	12.5%	0.0%	100.0%
8) Water quality and drought	2	6	0.0%	12.5%	0.0%	100.0%	0.0%	0.0%	0.0%
9) Water reuse	2	8	100.0%	12.5%	0.0%	0.0%	0.0%	0.0%	0.0%
10) Benchmarks indicators and models to study/monitor water quality and quantity	2	9	0.0%	12.5%	0.0%	0.0%	0.0%	100.0%	0.0%

Additional Information on Top Rated Water Priority Areas

We asked respondents to provide optional additional information about each of the top three water priorities they selected. We wanted to understand respondents' thoughts regarding the appropriate scale through which to conduct research, education, and/or outreach on this priority, as well as the reasoning behind respondents' selections. The following section includes a synthesis of open-ended responses entered when prompted for this additional information. The responses are displayed in order of Phase 2 priority rankings (from most selected to least selected). All verbatim responses are located in the Appendix. Not all respondents entered information when prompted.

Appropriate Scale for Research/Education/Outreach – synthesis of open-ended responses, top five priorities

We asked respondents to enter responses to the question: *In your opinion, what is the appropriate scale through which to conduct research, education, and/or outreach on this priority?*

The goal of the Phase 2 survey was to determine five water funding priority areas as identified by federal agency water experts. We therefore provide analysis of the predominant scales that emerged from the open-ended responses for the top five priorities below.

#1 Climate change and water quality and quantity

Overall there appears to be no consistent answer to the appropriate scale for this water priority. Four written responses indicated the watershed scale was appropriate, although there was a range of opinions as to how large or small a project's watershed should be. Three responses indicated that a regional or national scale would be appropriate, while two responses mentioned the "local" scale.

#2 Water quality and conservation practices

Three responses indicated scaling from the field to watershed scale was an appropriate scale through which to conduct a NIFA funded project for this water priority. One response suggested the watershed scale (HUC 12 to HUC 14), while another suggested "local".

#3 Water quality and nutrients

Responses were consistent in suggesting the watershed scale as an appropriate project scale for this water priority. There was, however, disagreement as to the appropriate watershed size through which to conduct a NIFA funded project. Two responses suggested multiple scales, including the field to multi-field or watershed.

#4 Climate change and adaptation and mitigation strategies

There were no consistent responses regarding an appropriate scale to conduct a NIFA funded project for this water priority. Responses included the watershed, state, regional, and national scales.

5 Policy analysis: Water quality and quantity

Three responses suggested the watershed scale to conduct a NIFA funded project for this water priority, with no consistent watershed size listed. Two responses suggested the state level, while one also suggested the local and inter-state scales.

Reasoning for Priority Selections – open-ended responses

Survey respondents were asked to explain, in one to two sentences, why they thought NIFA should focus on the priority they selected as part of their top three. Verbatim open-ended responses are included in the Appendix.

New Topics and Themes

Open-ended responses to Phase 1 survey response were coded into several broad themes that were consistently expressed, by respondents, across water priority areas. In Phase 2, we asked specific questions about these broadly expressed themes, including aspects of water and climate change, and water reuse. In addition, we found that some of the ideas expressed in Phase 1 responses could be *broadly* applicable to all water priority areas (e.g., require interdisciplinary project teams). We thus also asked respondents to rate and discuss these broadly applicable areas; these responses are also included in this section.

Climate Change

In Phase 1 respondents reported that water issues related to climate change are important priorities. Each of the climate change specific water priority areas were highly ranked – they were each in the top ten and each had a 4.00+ mean. In addition, climate change was mentioned throughout the open-ended responses (not only in the climate change specific topics). We therefore pulled out some of the themes that emerged in the open-ended responses to include in the Phase 2 survey. We asked respondents to: "…**indicate your level of agreement that NIFA should prioritize future water funding for the following topics."** [Strongly Disagree=1; Disagree=2; Neither Agree nor Disagree=3; Agree=4; Strongly Agree=5]. Table 4 shows the overall responses to the climate change topics included in Phase 2.

Looking at the mean responses, almost all of the climate change issues shown below fell very closely to a mean of 4.00 "Agree". The topic "*a) Connect climate change science knowledge, generated across agencies, to NIFA goals and objectives*" had the highest mean (4.32). Only "*f) Understand potential impacts/ramifications of climate change across temporal scales*" fell below the "Agree" rating (3.79). Less than half of respondents selected "Strongly Agree" for every category; "*a) Connect climate change science knowledge, generated across agencies, to NIFA goals and objectives*" and "*b) Understand tipping points/thresholds related to climate change impacts (e.g., low water supplies, water salinity and land recovery, groundwater recharge)*" had the highest proportion of "Strongly Agree" responses (47.4% for both priorities).

***Table 4** Climate change topics ranked by mean*

	Mean	% "Strongly Agree"	Standard Deviation
a) Connect climate change science knowledge, generated across agencies, to NIFA goals and objectives (n=19)	4.32	47.4	.749
b) Understand tipping points/thresholds related to climate change impacts (e.g., low water supplies, water salinity and land recovery, groundwater recharge) (n=19)	4.21	47.4	.976
c) Understand potential impacts/ramifications of climate change to watershed function (n=20)	4.15	30.0	.671
d) Understand potential impacts/ramifications of climate change across sectors (uses/users of water) (n=19)	4.05	36.8	.970
e) Understand potential impacts/ramifications of climate change across geographic scales (n=20)	4.05	30.0	.826
f) Understand potential impacts/ramifications of climate change across temporal scales (n=19)	3.79	5.3	.631

Climate Change – synthesis of open-ended responses

Survey respondents who selected "Strongly Agree" for the climate change topics shown in Table 4 were asked to include more information about the importance of that particular topic. Verbatim survey responses are included in the Appendix. Through an analysis of the responses, we found that there is some indication that respondents thought about how to communicate water risks related to climate change, and corresponding risk mitigation/adaptation strategies, to the public and to decision makers (and how to motivate these actors into action). There was some sentiment that understanding tipping points would be a good avenue for communication as well as a means to understand timescales of climate change impacts, as well as severity and geographical scope of potential risks, in order to implement effective climate risk mitigation/adaptation policies. Moreover, an integrated approach to climate change that would cross disciplines, agencies, and sectors, appear to be seen by respondents as a necessary approach to addressing water risks associated with climate change.

Water Reuse

"Water reuse" emerged as an important issue in Phase 1. This topic was ranked eighth (mean=4.15; % Strongly Agree=37.1%) in Phase 1, and was discussed in open-ended responses for several different priorities. We therefore pulled out some of the themes that emerged in the Phase 1 open-ended responses to include in Phase 2. We asked respondents: "**Please consider the following question: If NIFA were to fund "Water reuse", how should they prioritize those funds? Please indicate your level of agreement that NIFA should prioritize future water funding for the following topics."** [Strongly Disagree=1; Disagree=2; Neither Agree nor Disagree=3; Agree=4; Strongly Agree=5]. Table 5 shows the overall responses to the water reuse topics included in Phase 2.

The topic "*a) Water reuse and food safety*" had the highest mean (4.37) and by far the largest proportion of respondents who selected "Strongly Agree" (47.4%). The next six topics hovered around the mean 4.00 "Agree". The bottom three topics, which suggested NIFA funded projects on specific sources of water capture for reuse (not *specifically* related to agricultural uses), fell near the mean 3.00 "Neither Agree nor Disagree". That "*a) Water reuse and food safety*" had the highest mean and largest proportion of "Strongly Agree" responses perhaps reflects a concern over the ultimate end-use of reclaimed water (i.e., safe food). This end-use would be effected by all reclaimed water sources whether from agriculture, stormwater, floodwater, or fracking water. This idea is reflected somewhat in the open-ended responses which are discussed in brief below.

Table 5 *Water reuse topics ranked by mean*

	Mean	% "Strongly Agree"	Standard Deviation
a) Water reuse and food safety (n=19)	4.37	47.4	.684
b) Water reuse and adoption (getting people to actually use reused water) (n=19)	4.11	21.1	.567
c) Agricultural water capture for reuse (n=20)	4.10	25.0	.718
d) Water reuse as climate change adaptation strategy (n=19)	4.05	26.3	.780
e) Water reuse as drought risk mitigation strategy (n=19)	4.05	26.3	.780
f) Water reuse as water quantity risk mitigation strategy (n=19)	4.05	21.1	.705
g) Water reuse and economics (n=20)	3.95	20.0	.686
h) Stormwater capture for reuse (n=18)	3.61	11.1	.916
i) Floodwater capture for reuse (n=19)	3.37	5.3	.831
j) Fracking water capture for reuse (n=19)	3.00	0.0	.745

Water Reuse – synthesis of open-ended responses

Survey respondents who selected "Strongly Agree" for the water reuse topics shown in Table 5 were asked to include more information about the importance of that particular topic. Verbatim survey responses are included in the Appendix. We analyzed the open-ended response and found that, as noted above, "*a) Water reuse and food safety*" had the highest mean and largest proportion of "Strongly Agree" responses, which perhaps reflects respondents' overall concern over the end-use of reclaimed/recycled water rather than the source of that water per se. This is reflected in the comments found in the Appendix, showing concern over irrigation water and the effect of different contaminants (from different sources) on food crops in particular. In addition, respondents noted that water reuse could be critical to the sustainability of water resources, as well as a strategy for risk mitigation and climate change adaption in the agricultural sector (if reuse doesn't undermine ecological functions and is an impactful/feasible strategy). However, each of these areas are connected to "*b) Water reuse and adoption*" in that respondents recognized that public acceptance of reclaimed/recycled water is key to its use. That is, whether or not water reuse is an appropriate risk reduction and water sustainability strategy, without safeguards in place (e.g., food safety) and public acceptance, water reuse will remain an anomaly.

Areas with Broad Applicability

Topics that are more broadly applicable to specific water priority areas emerged through the open-ended responses of the Phase 1 survey. For example, aspects of research/education/outreach could be incorporated into how NIFA prioritizes projects for funding. We pulled out some of the themes that emerged in the open-ended responses to include in Phase 2. We asked respondents: "**Please consider the following question: How important is it to incorporate the following elements into NIFA RFAs, assuming they are relevant to the proposed project? Please indicate your level of agreement that NIFA should prioritize funding for water projects that incorporate the following components.**" [Not at all Important=1; Slightly Important=2; Moderately Important=3; Important=4; Extremely Important=5]. Table 6 shows the overall responses to the broadly applicable topics included in Phase 2.

Most of the topics fell near the mean 4.00 "Important", with the highest mean attributed to the importance of interdisciplinary teams ("(*a) Scientists, professionals, and/or educators from different disciplines/expertise (i.e., interdisciplinary teams)*"; mean=4.39). This topic also had the highest proportion of respondents who selected it as "Extremely Important" (44.4%). Although interdisciplinary teams were valued, inter-agency work was not deemed as important; "*h) Inter-agency projects*" was the lowest rated topic in this section of Phase 2 (mean=3.67; % Extremely Important=22.2%). The second and third highest proportion of respondents who rated topics as "Extremely Important" were "*b) Stakeholder involvement/collaboration in the projects"* (36.8%), and "*d) Education/Extension/outreach are a specific part of project outcomes"* (31.6%), showing that interactions with stakeholders outside the project team through collaboration or outreach were considered to be fairly important components that should be considered for inclusion in NIFA funded projects.

Table 6 *Broadly applicable topics ranked by mean*

	Mean	% "Extremely Important"	Standard Deviation
a) Scientists, professionals, and/or educators from different disciplines/expertise (i.e., interdisciplinary teams) (n=18)	4.39	44.4	.608
b) Stakeholder involvement/collaboration in the projects (n=19)	4.16	36.8	.765
c) Promotion/facilitation of data sharing across federal agencies (n=19)	4.11	26.3	.737
d) Education/Extension/outreach are a specific part of project outcomes (n=19)	4.00	31.6	1.000
e) Open-access data for public/agency use (n=19)	4.00	26.3	.943
f) Research/education/outreach about end users (e.g., social indicators, behavior change) (n=19)	4.00	21.1	.667
g) Research/education/outreach to end users (e.g., water education, use of tools) (n=19)	3.95	26.3	.848
h) Inter-agency projects (n=18)	3.67	22.2	.970

Broadly Applicable Topics – synthesis of open-ended responses

Survey respondents who selected "Extremely Important" for the broadly applicable themes shown in Table 6 were asked to include more information about those particular themes. Verbatim survey responses are included in the Appendix. Through an analysis of the responses, we found that respondents recognized that climate and water issues are complex and touch a variety of disciplines, thus interdisciplinarity (a) was deemed important. In terms of inter-agency projects (h), those who contributed open-ended responses discussed issues such as complexity of water/climate problems warranting inter-agency collaborations (much like interdisciplinary project teams) and that inter-agency collaborations would streamline both research/education/outreach strategies as well as project funding. Similarly, open-access data (e) was noted as being a strategy for reduced costs, connecting disciplines, and adding to research credibility through data transparency. Collaborating with stakeholders in NIFA projects (b), projects that focus *on* end-users (f) and *to* end-users (g), and including education/Extension/outreach as part of project outcomes (d) were each seen to contribute in some part to understanding stakeholder issues, goals, and needs, as well as acceptance and use of project outcomes.

Appendix

Open-ended responses

Appropriate Scale for Research/Education/Outreach

The following are open-ended responses attributed to each water priority for the question: *In your opinion, what is the appropriate scale through which to conduct research, education, and/or outreach on this priority?* The responses captured here are all verbatim responses to this question. Not all respondents entered information when prompted.

#1 Climate change and water quality and quantity

- By cropping region or regional water networks.
- This may be best studied at the watershed level. Not for example the Mississippi watershed scale but an appropriate scale to maybe divide the major tributaries to the Mississippi. I don't want to focus only on the Mississippi - but with the dead zone it is a major issue.
- National scale, covering different regions of the country.
- The large watershed scale is the most appropriate level.
- Local to regional scales is the most appropriate area to conduct research, education and outreach. National and global scale work is being fairly well addressed through large Federal and Academic programs currently. These need to be coupled with the scales of actions that can and will take place in the future.
- Larger scale phenom such as climate change can only be conducted at the sub basin (HUC 12) or larger. Most of the detectable impact may come at mid elevation in snow-runoff systems as the rain-on-snow elevation move higher.
- High Priority.
- Climate change impacts multiple of the other topics including drought and water quality, ground water recharge and strategies for watershed management. A coordinated research portfolio to include these and other topics should be developed.
- Large scale through local scale. NIFA needs to encourage learning and change at all levels.
- Watershed scale, including upstream and downstream.
- My interpretation of this priority is "understanding" climate change impacts, so this should be conducted at a broader scale, regional and/or national. Local changes will be extremely variable, and may not be consistent with broader-scale impacts.
- Data collection, public education, raise awareness of climate change impacts to encourage planning and preparation.

#2 Water quality and conservation practices

- Small watershed scale, like HUC 12s, in order to see results. Also some field scale to show direct correlations between the practices and immediate effects on local water quality.
- This issue should be evaluated at the field and watershed scale. Research and education at the field scale for farmers and at the watershed scale for policy officials.
- 14 digit HUC, or smaller that are the critical areas in 12 digit HUC watersheds.

- All scales work for this, but scaling up from edge of field to sub catchments is the most needed. Landscape position that provides the most impact for individual conservation practices, and any possible cumulative effects of installing multiple practices are the operative questions.
- The impact of nonpoint sources is huge and are unmanageable.
- To have an effect, this needs to be done at a more local scale, perhaps with participation from regional or state agencies and institutions.

#3 Water quality and nutrients

- Small watershed scale, like HUC 12s, in order to see results. also some field scale to show direct correlations between the practices and immediate effects on local water quality
- Major watershed basins, Upper MS, Great Lakes, Lower MS.
- Probably at the largest scale one thinks of the Chesapeake Bay and or the dead zone in the Gulf.
- Watershed scale.
- watershed...probably HUC8 to HUC12
- 14 digit HUC, or smaller that are the critical areas in 12 digit HUC watersheds.
- Field scale to multi-field scale. Probably the most pressing is to find ways to moderate the impacts of dissolved phosphorus.
- Nutrients are one of the most pervasive water quality problems, with significant ecological and human health (nitrates/HABs) impacts.

#4 Climate change and adaptation and mitigation strategies

- Once there is a clearer picture of how climate change effects water quality and quantity, adaptation and mitigation strategies need to be addressed on the same regional cropping scale.
- Research should focus on developing technologies that address both mitigation and adaptation and developed needed strategies and policies associated with these strategies.
- National, Regional and State.
- All scales?
- Watershed scale, as with question 1.

5 Policy analysis: Water quality and quantity

- Watershed.
- This is an issue to be addressed at the watershed and state-level. The watershed because that is the basis of the water budget. The states because they have primary responsibility for water allocation and most states have implementation authority for water quality laws.
- State, inter-state, state, and local.
- Hydrologic Units e.g., HUC 8

#6 Water data (includes water monitoring, water usage, tool development, etc.)

- This is a field to watershed scale issue. Field scale for irrigation management improvements and watershed for water allocation and policy decisions.

- Hydrologic Units e.g., HUC 8
- Data should be gathered at as fine a scale as possible (both spatial and temporal). These data can then be aggregated and appropriate data analytic tools can be applied to understand what is happening and why.

#7 Tile drainage systems

- I hope that we can learn from two separate cases. The Lake Erie harmful algal bloom - which is likely due to tile drainage and increased nutrients. The Lake was essentially cleaned up on the 1990's then tile drainage came in and the water quality has suffered.
- Field level and small watersheds are the appropriate level for studying most of the issues surrounding tile drainage.

#8 Water quality and drought

- Field scale, small watershed scale.

#9 Water reuse

- Local scales to understand barriers for greater adoption of water reuse.
- Health impacts including emerging contaminants and appropriate uses of recycled. Treatment and operation to protect public health.

#10 Benchmarks, indicators, and models to study/monitor water quality and quantity

- HUC8 or HUC6.
- Hydrologic Units e.g., HUC 8.

#11 Watershed management

- 14 digit HUC, or smaller that are the critical areas in 12 digit HUC watersheds.

#12 Climate change and economics

- Local, regional and national.

#14 Water quantity and efficiency (includes technology and structures)

- State and local.

#15 Stakeholder involvement/collaboration in water projects

- Implementation of strategies to conserve and protect water resources are mostly implemented at the individual or group level. Therefore, involvement of stakeholders is key success. Each project should have a community participatory component.

#16 Groundwater recharge

- A combination of field level and large aquifer scale studies need to be completed.

#17 Water protection and conservation behavior

- National scale.

#18 Water management tools

- Local and Regional scale.

#19 Water quantity and crop production

- High priority.

#21 Water lifecycle analysis, water footprint

- Despite great advances in the area of water lifecycle analysis, it remains an area where active engagement would increase our knowledge of water interactions particularly in the water energy food nexus.

Reasoning for Priority Selections

The following are open-ended responses to the question related to the priorities survey respondents selected (see Table 2 for the priority list): *In 1 to 2 sentences, please explain why you think NIFA should focus on this priority.* The responses captured here are all verbatim responses to this question. Not all respondents entered information when prompted.

#1 Climate change and water quality and quantity

- This should be #1 priority due to the fact that it is going to affect all sectors of agriculture and society.
- I believe that with the Clean Water Act not addressing non-point sources, climate change may very well exacerbate the impact of nutrients on degradation of water quality.
- Local research institutions have no incentive to look broadly.
- As many commentators have noted, water is the mechanism through which many climate change impacts occur. Water is a critical aspect of both understanding impacts and also mitigating those impacts.
- NIFA provides an additional opportunity to focus on regional to watershed scales. While there are many activities focused on this scale - continued outreach and education would only be an additional benefit.
- While trends will be hard to detect, ANY forecast of conditions will be useful for water users. Most of the current estimates of future condition are large blobs and splotches on a National map, and don't seem actionable for individual water users. Changes in climate alters both water quality and quantity.
- The impact of climate change on the agriculture industry should be quantified and mitigation strategies designed and implemented.
- There is a lot of misunderstanding between climate change and climate variability. Some difference matter to some, some don't. NIFA needs to encourage research into teasing out what things should matter the most in an end-to-end environment.
- Integrating local practices at the watershed scale can help account for water balance in the watershed, and help devise site specific strategies that should be applied to all sites in the watershed. Managing groundwater, surface water, and land use under a changing climate will require larger cognizance of how local actions are impacted by, and how they impact, other watershed-wide variables (both hydrometeorlogical and anthropogenic).

- Climate-change driven shifts in regional productivity (and other, related factors, e.g. pest/disease pressures) will affect many people in both rural and urban settings.
- Climate change has already begun to impact water quality and quantity for public water supplies. Many smaller utilities are unprepared or unable to mitigate the impacts.

#2 Water quality and conservation practices

- In order to get greater adoption of conservations practices by farmers it is important to show the direct connection to clean water, which is something that is important to farmers. This serves as outreach to farmers to show the importance of conservation practices and also as information on the efficiency of these practices to use in modeling efforts.
- The USDA support for practices through the conservation programs of the Farm Bill is where USDA interacts with water quality. There is no greater priority than determining the impact of this interaction for both the Department and the taxpayer.
- If not NIFA, no one at USDA is doing this. NIFA has the ability to access experts that cover the range of topics needed to consider effective research programs in this area.
- Nutrient enrichment of surface water is going up, and many catchments are already loaded with legacy Nitrogen and Phosphorus. In addition, many catchments in the Midwest are 'replumbed' with drainage tile and surface ditches as well as altered stream patterns. These combine to create very hydraulically efficient landscapes that export nutrients quickly and efficiently.
- I believe this is consistent with their goals.
- Conservation decisions, especially in a changing climate, could have a big impact on water quality throughout watersheds and large downstream areas.
- Urgently need better/more tailored recommendations on conservation systems including research on yield and WQ effects.

#3 Water quality and nutrients

- Very related to water quality and conservation practices work. This would be more focused on fertilizers applications, tile drains, and other standard farming practices and which ones result in less nutrient runoff from farm fields. Also research on how yields can be increased with more strategic use of fertilizers. Finally research on best ways to be able to use tile drains but minimize nutrient runoff as a result.
- Nutrients are a driver for agriculture and its effect on the environment. Along with nutrient management, its relationship to hydrology, sediment, bacteria and pathogens should be addressed.
- Both of the two cases below are degrading important water bodies and I believe in large part due to agricultural practices! Nutrients in water quality is the number one water quality issue associated with agriculture, and also a major continuing water source of water impairment. To mitigate nutrient impairment in most regions of the country will require agriculture to do much more than it is currently doing.
- The issue relates directly to food and agriculture, and nutrient enrichment is an ongoing problem.
- This is the number on pollution issue in our nation’s waterways.

- Increases in dissolved P have increased primary productivity in aquatic systems. Algal blooms and their associated die-off has created toxic and polluted condition in many surface waters.

#4 Climate change and adaptation and mitigation strategies

- Only logical, that once there is a better understanding of climate change and its effects, on water quality and quantity adaptation and mitigation strategies will be needed for farmers to address climate change.
- The increase in climate variability and significant increase in the variation rate will demand changes in the strategies and policies that are able to address such variability. That cannot be address with conducting the needed research, extension and education that provide need data for decision making.
- I believe Climate Change is real. If it is adaption and mitigation strategies should be in place and functioning now while there is time for impacts.
- It's important that people become trained on what strategies will serve them best over the long haul - as well as the short (i.e. one year or even sub-year) planning horizon. Climate is a big influence on agriculture through water, solar input, as well as other meteorlogical phenomena (e.g. air quality, severe storms, etc.)
- See answer to question 1 for 'adaptation' strategies. In addition, agriculture has a large role to play in controlling greenhouse gases, from land use, to cropping and land management practices, to water usage. Agriculture is the 2nd largest user of water; and can be either a GHG sink or source.

5 Policy analysis: Water quality and quantity

- Most water issues can be addressed by effective policy.
- The strategic decisions on what share of water to allocate to consumptive uses, instream uses (recreation and environment), and the aggressiveness to address water quality concerns will not be made by individual producers. These decisions are made at the watershed and state-level and are in the policy arena. Informed policy decisions based on sound analysis are preferred.
- Government programs that incentivize higher irrigation efficiency in areas with critical groundwater declines can result in increased water use efficiency but also additional water being taken from an aquifer rather than the water being left in the aquifer. Local economic response in the short term is positive but it may occur at a cost of increasing speed of aquifer depletion.
- We need to be as sure as we can that proposed policies will deliver the intended results. Policies are jurisdiction based but need to work within and perhaps across hydrologic units.
- Effective analyses needs to reconcile that asymmetrical arrangement to assess policy effectiveness. Given the potentially long lead times from policy development thru measuring results, we may not have much time to fix policies that don't work.

#6 Water data (includes water monitoring, water usage, tool development, etc.)

- You cannot manage what you cannot measure. We still do not know the consumptive use of water in agriculture and thus we really do not know where the water applied to the field actually goes. Does the water go out in crops, down to deep percolation or laterally out the end of the field? Until we know where the water goes can we really manage it?

- We can't effectively manage what we don't know. We need data and tools to develop technical analyses and sector allocations as bases for political decisions. We can't get public support for difficult political decisions if we can't explain what's what in plain language.
- Without good data, everything is based on extrapolating cased studies or based on unsubstantiated assumptions.

#7 Tile drainage systems

- Wide spread eutrophication of waters in the Midwest!
- A large expansion of tile drainage has occurred in the past decade, and the will have major water quality implications for the next 20 to 50 years. At the same time, there are a lot of interesting innovation regarding tile drainage, such as tools for holding water in drains, that could mitigated many negative impacts.
- One of the largest impacts of nutrients on water quality is via tile drains. Tools for better management urgently needed.

#8 Water quality and drought

- Drought is becoming more widespread and affects producers in areas that require irrigation. In turn the extensive use by agriculture during drought periods negatively impacts water quality which is needed to protect aquatic life, and for drinking water and recreation. Would be good to look at these interactions and ways to be more efficient in irrigation water use to protect water quality during low water times.

#9 Water reuse

- Education and outreach as well as understanding local policies appears to be the largest barrier to greater adoption of water reuse technologies. NIFA appears well positioned to help in this regard.
- Water reuse is now widely being considered as water supply to address drought, water scarcity, receiving water quality and full use of resources. There a [are] potential public health [issues] from contaminants with known health effects as well as emerging contaminants the [that] are present in wastewater.

#10 Benchmarks, indicators, and models to study/monitor water quality and quantity

- The topic helps quantify the effectiveness of management actions.
- We can't effectively manage what we can't measure. Building on the data and tools, we need metrics and benchmarks for resilience which may be location dependent.

#11 Watershed management

- NIFA research influences those doing implementation work on the ground, including NRCS staff, conservation districts, and some industry.

#12 Climate change and economics

- <u>Local:</u> to help Ag producers make responsible, climate-informed choices while ensuring they are able to successfully manage their business. <u>Regional:</u> to help the Ag sector in a given region develop a healthy economy in the face of climate change. <u>National:</u> to understand the economic implications of climate change at the sectoral level: both the costs of not controlling GHGs and the benefits of investing in improved practices that at first may seem costly.

#14 Water quantity and efficiency (includes technology and structures)

- We need to continue efforts in research to maximize beneficial use of water. This can be done by providing water users with existing and new tools available to achieve maximum practical water use efficiency, and the knowledge of how to use them.

#15 Stakeholder involvement/collaboration in water projects

- The successful implementation of strategies will depend upon implementation by individuals or groups.

#16 Groundwater recharge

- Groundwater recharge has the potential to simultaneously address two issues: the overdraft of major aquifers and the impacts from increasing flooding. Capturing peak flows in wet years is potentially a win-win strategy, but it requires dealing with issues such as water capture and diversion, deep tillage, and possibly negative impacts on crop yields during recharge years.

#17 Water protection and conservation behavior

- With the failure of voluntary programs to promote an adequate adoption of nutrient management practices, a better understanding of what drives farmer decisions-making is needed. This would enable the design of more effective policies.

#18 Water management tools

- People need better tools and they need to know they exist and how to use them.

#19 Water quantity and crop production

- Currently, agriculture uses about 80% of fresh water. Any development in plant breeding that that increase water efficiency uses, reduces about of water consumed by agriculture, or uses recycle water, will have significant impact.

New Topics and Themes

Climate Change

The following open-ended responses were articulated by respondents who selected "Strongly Agree" for the water reuse topics shown in Table 4. The bulleted text in the following open-ended section were taken verbatim from survey responses. Not all respondents entered information when prompted.

a) Connect climate change science knowledge, generated across agencies, to NIFA goals and objectives

- Two of the biggest issue are population growth and climate change!
- This is where NIFA brings power - cross disciplinary interactions on research and recommendations.
- Many agencies seem to speak past one another, and miss major points from one another, as well as synergistic possibilities.
- N/A
- Without the connection to goals, there is less likely to have an articulated strategy to address climate change issues.
- NIFA needs to pick targets that take into account the way the world will be (different) as well as the way it is today.

- Integrated approach with focus on preparing impacted sectors.

b) Understand tipping points/thresholds related to climate change impacts (e.g., low water supplies, water salinity and land recovery, groundwater recharge)

- We need to understand tipping points to better articulate the severity of what we are up against to the public - so they then understand what lies ahead for their children.
- Threshold effects are a major driver of concerns that climate damages could be much larger than early estimates suggested, but these thresholds are poorly understood.
- The understanding of tipping points provides a measureable end point to avoid. I believe it will make things more realistic for the public.
- I understand tipping points to mean an acceleration of some climate change effect toward a threshold e.g., point of no return. Using that, we need to understand how much time we have for the needed changes to take effect. That should drive our schedule to implementing the necessary policies.
- We are already reaching tipping points. Current and likely future tipping points need to be communicated in ways that inform decisions and that motivate action.
- Understanding tipping points is very closely tied to, "Understand potential impacts/ramifications of climate change across geographic scales." Both will involve substantial modeling efforts to understand geographic extent and severity of climate change impacts.
- Integrated comprehensive monitoring of trends/changes in water quality.

c) Understand potential impacts/ramifications of climate change to watershed function

- It is necessary to tackle these questions at the watershed level if progress is to be made.
- Both water quality and water quantity depend upon hydrology that will vary dramatically under climate change. Wetlands and artificial water storage also matter a great deal.
- Something as simple as an earlier peak flow that is no longer synchronized with Cottonwood Tree see[d] dispersal might have a large impact on riparian plant communities.
- The answers / solutions need to keep or make watersheds whole or it will be a wasted effort.
- Watersheds are important and too many people doing what's best for them might not serve the whole watershed and thus ultimately doom the whole area. Also this will allow looking at cross disciplinary issues (e.g. water-food, energy productions, runoff sediments/pollutants; etc.)
- Integrated models, robust monitoring and statistical analyses, climate informed vulnerability assessments, ecological integrity and functioning, etc. all needs to be integrated and communicated to watershed and regional stakeholders across jurisdictions. We all need to be better educated about causes, dependencies, thresholds, and ramifications in order to make responsible choices.

d) Understand potential impacts/ramifications of climate change across sectors (uses/users of water)

- Water quality and quantity impacts for agriculture, environment and drinking water supplies.
- Major water use sectors that compete with agriculture for water.
- N/A

- Policies to address climate change impacts will fail politically if significant sector impacts are not addressed e.g., public water supply, Ag irrigation, industrial/commercial use.
- We have to get our collective knowledge into the hands of decision makers concerning water. This is difficult because it requires deep understanding of the climate related 'forcings' as well as the "why" behind the decision (and supporting structure) of water users.
- In a geographic region, there are many water users that are competing for the same water. It is critical that regional water management strategies be developing that balance critical needs for: ecosystem function, Ag production, energy generation and municipal uses. Should be addressed in the socio-political context that is informed by systems modeling, monitoring, and vulnerability assessments.
- Research and education of climate change impacts that connect all sectors.

e) Understand potential impacts/ramifications of climate change across geographic scales

- Across major crop producing regions.
- Sensitivity to impacts is likely to vary based upon vulnerability factors that vary spatially (e.g.: soil moisture holding capacity) or depend on geography (e.g.: Mississippi River transportation systems).
- Predictive ability at a small enough scale to be actionable by water users.
- Same answer as for a., emphasizing the inter-jurisdictional interactions and decision making.

Water Reuse

The following open-ended responses were articulated by respondents who selected "Strongly Agree" for the water reuse topics shown in Table 5. The bulleted text in the following open-ended section were taken verbatim from survey responses. Not all respondents entered information when prompted.

a) Water reuse and food safety

- If reused water is to be used in irrigation we need better information on food safety. Right now the very general rules for reuse on food crops discourage such use as they are restrictive and sometimes don't even make sense.
- Water reuse is not for all crops - but with good science can be implemented for many crops.
- ditto
- The biggest concerns with reuse of treated waste water have to do with food safety concerns.
- Much of the produce grown for US consumption is in water-short areas, where water reuse may be the most helpful. Producers are already struggling to meet new Food Safety rules, adding a new stream of (potentially) hazardous water has many issues.
- It is important to keep in mind the contaminants in recycle water. Such contaminants will be different based on the sources (nutrient from irrigation, fracking, or brackish water). In fracking, number of chemicals are used and some are not reported by fracking industry. How this chemical affect crop and consequently our diet is important to investigate.
- We don't want to poison our food.

b) Water reuse and adoption

- Water reuse is critical to sustainability in some areas of the country. A well thought out educational program is the best way to engage the public and ultimately get their approval.
- Putting aside potable reuse, there won't be enough water if we don't reuse it for industrial and some agricultural purposes e.g., golf course and lawn watering.
- What good is all the technology behind water reuse if no one will use it? I'm unsure but I think this is still one of our biggest problems. (Not just the phycology but also the physical mechanisms to move such water might need further consideration).
- I am a bit confused about the initial question - are we talking about NIFA research or NIFA promoting practices? Some of these I would strongly support research before supporting promotion. That said, it is important to get society comfortable with the idea of water reuse for different purposes.

c) Agricultural water capture for reuse

- Important area for NIFA -- how to capture and reuse water in Ag settings while maintaining crop quality and safety.
- Ultimately this could lead to less degradation of surface waters.
- NIFA should focus on Ag water use and reuse, as opposed [to] broader issues.
- Ag is one of the largest water diverters. Tracing the process of capture for reuse is key to understanding the water budget and protecting the current water users that rely on the current water return flows for supply.

d) Water reuse as climate change adaptation strategy

- Absolutely critical, especially in the American Southwest.
- The key here is to determine if there is a significant impact of this as a strategy.
- We also need to protect our surrounding environment which will help to protect us from climate change.
- Definitely an issue given the increased variability in precipitation (more intense rain events followed by longer periods of diminished rain and higher temperatures). Need to manage times when there is excess water for times when there is a water deficit; all this can help improve watershed integrity and function while also improving the urban/suburban/exurban footprint. However, need to be sure we are not reusing so much as to harm the basic water needs for ecological functioning.

e) Water reuse as drought risk mitigation strategy

- What better way to mitigate the adverse effects of drought.
- Under drought condition, strategies to determine the suitability of the use of recycle water should development to include the length and severity of the drought.
- This is already the only the answer is some places - we need to know what's safe and what's not.
- See answer to [e]. In addition to increased variability, droughts are becoming longer and more intense and the whole array of water management strategies will need to be adopted -

improved efficiency, improved watershed management, water reuse, and more. [Answer e: Definitely an issue given the increased variability in precipitation (more intense rain events followed by longer periods of diminished rain and higher temperatures). Need to manage times when there is excess water for times when there is a water deficit; all this can help improve watershed integrity and function while also improving the urban/suburban/exurban footprint. However, need to be sure we are not reusing so much as to harm the basic water needs for ecological functioning.]

- This is complicated - but direct potable reuse is about 1/4 the cost of desalination!
- Many options are technically or chemically feasible. But whether they will be economically feasible will determine their ultimate success.
- The cost of making water usable is very important. Such as the cost of water produced by desalination, or remediation of fracking water. With new technologies, the cost will be reduced to be use at the agriculture scale.

f) Water reuse as a water quantity risk mitigation strategy

- Same as above. [“Above” answer: What better way to mitigate the adverse effects of drought.]
- Putting aside potable reuse, there won't be enough water if we don't reuse it for industrial and some agricultural purposes e.g., golf course and lawn watering.
- Same answer as for [e and f]. [e and f answers: especially in light of competing demand and limited water rights. Water rights in the west is another factor that needs socio-political compromise. Definitely an issue given the increased variability in precipitation (more intense rain events followed by longer periods of diminished rain and higher temperatures). Need to manage times when there is excess water for times when there is a water deficit; all this can help improve watershed integrity and function while also improving the urban/suburban/exurban footprint. However, need to be sure we are not reusing so much as to harm the basic water needs for ecological functioning. In addition to increased variability, droughts are becoming longer and more intense and the whole array of water management strategies will need to be adopted - improved efficiency, improved watershed management, water reuse, and more.]

h) Stormwater capture for reuse

- This is huge area for farmers and cities -- lots of water is essentially "wasted" by flowing into the ocean. In times of water scarcity we could be cleansing and using this water -- but we don't have all the research in place to ensure its safety.
- Stormwater is the most viable alternative for increasing the agricultural water supply in water short areas. If quality issues and downstream flow issues can be addressed, stormwater could provide water more frequently and at less cost that either recovered floodwater or fracking water.

i) Floodwater capture for reuse

- Most aquifer recharge depends upon capturing floodwater that is not allocated for other uses.

Broadly Applicable Themes

The following open-ended responses were articulated by respondents who selected "Extremely Important" for each of the broad themes shown in Table 6. The bulleted text in the following open-ended section were taken verbatim from survey responses. Not all respondents entered information when prompted.

a) Scientists, professionals, and/or educators from different disciplines/expertise (i.e., interdisciplinary teams)

- Climate change is high priority, and interdisciplinary team will be critical to address all the issues.
- Without all of the disciplines involved we will be hampered in moving the ball forward. If, for example, the public really understood the implications of climate change on their lives - keeping the tape over the politicians' mouths - they would realize that humans are in trouble around the planet.
- The complex problem can effectively resolved through multidisciplinary team that consist of all needed expertise and different field of science.
- Most of this is inter-disciplinary.
- A must.
- Water-related issues are not just biological, physical, engineering, or behavioral science problems. Effective solutions can only be developed at the interfaces of the various scientific disciplines.

b) Stakeholder Involvement/collaboration in the projects

- Stakeholders will provide invaluable insights to the goals of the projects.
- Essential! But there has to be a two way street where reason weighs heavier than 'feelings.'
- Through stakeholder[s], we can effectively and correctly identify the major issue associated with water use.
- Designing solutions should include those who are key for implementation.
- Highly desirable for acceptance of product.

c) Promotion/facilitation of data sharing across federal agencies

- Federal policy.
- Data standards, meta-data requirements and common knowledge of Privacy laws and procedures will need to be widely understood to gain value and knowledge from the many data streams that exist.

d) Education/Extension/outreach are a specific part of project outcomes

- Research results only make a difference if they are communicated -- i.e. how can and should our behavior change as a result of the study just conducted.
- Extension services could be extremely helpful in educating the public.
- Difficult policies won't work without public acceptance.
- A must.

e) Open-access data for public/agency uses

- Federal policy.
- That will make the process cheaper and will help to connect research activities from different discipline.
- Transparency for credibility.

f) Research/education/outreach about end users

- Essential.
- End users are the ones who will actually implement practices/systems developed through research. Understanding what their needs are and how they make decisions is critical to understanding whether new management systems will be adopted.
- Highly desirable.

g) Research/education/outreach to end users (e.g., water education, use of tools)

- Similarly, end users need help via tools to institutionalize research results and use them to help their situation (like actual drought risk planning based on results of a NIFA study).
- This is how the Orange County Water District got buy in from the population in general in Orange County, CA.
- A must.

h) Inter-agency projects

- Interagency projects make sense because of the complexity of the problems we will face with uncontrolled population growth and the uncertainty associated with climate change.
- That will streamline strategies and funding activities.
- I probably don't know enough to really answer all these priorities. But to me, inter-agency (especially more than 2) seems like one of the hardest things to pull-off - so I would give it extra emphasis!
- Highly desirable - especially with DOE (energy-water-ag), EPA (water quality and water quantity), DOI (USGS data, BuRec western water rights), USDA Forest Service (watershed function), NOAA (Climate Resilience Toolkit outreach), etc.