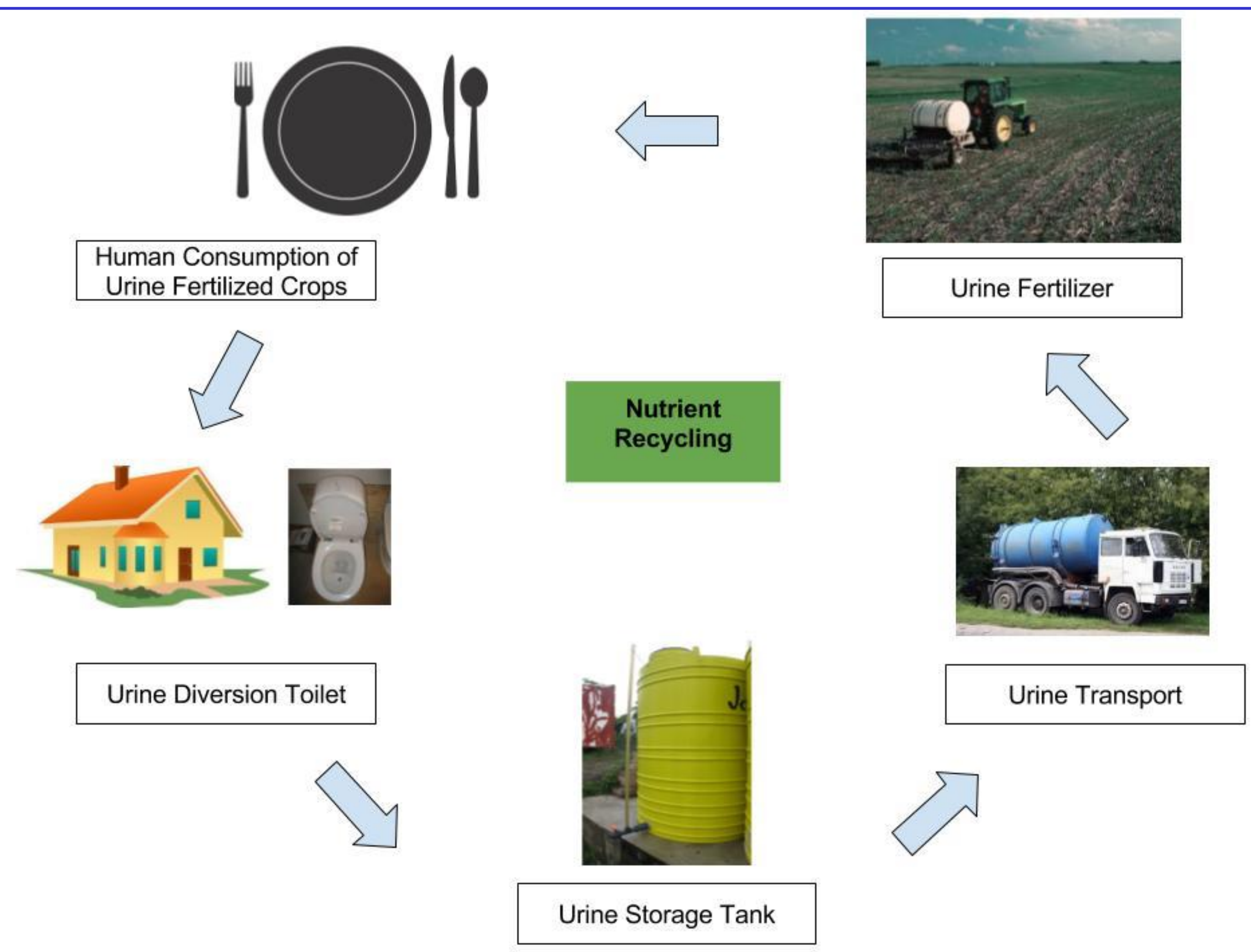
Designing a Survey to Gauge Consumer Support of Urine Source Separation

Kaela Plante[1], Mina Aghababaei Shahrestani[2], Dr. Weiwei Mo[2]

Department of Science, Noble Middle School[1] Department of Environmental Engineering, University of New Hampshire[2]

Project Background

- Large amounts of nitrogen and phosphorus from urine escape into bodies of water everyday, causing eutrophication.
- This can be prevented by recycling urine and using it as a fertilizer on farmlands.
- This process also saves water and money, but many consumers have concerns regarding requirements for using urine diverting toilets.
- The majority of the general public is also turned off to the idea of eating food that has been fertilized by urine.
- The goal of this project was to create a web-based survey tailored with specific questions to gauge individuals interest and acceptability of urine diversion toilets and urine fertilizer.



Literature Review (Boyer et al. 2016)

- General public is not well informed about this technology.
- People who are eco-friendly show the most support for this initiative.
- Most people are willing to try using these toilets, but they do have some concerns.

Risks According to Level of Concern Obtained from Ishii and Boyer (2016)

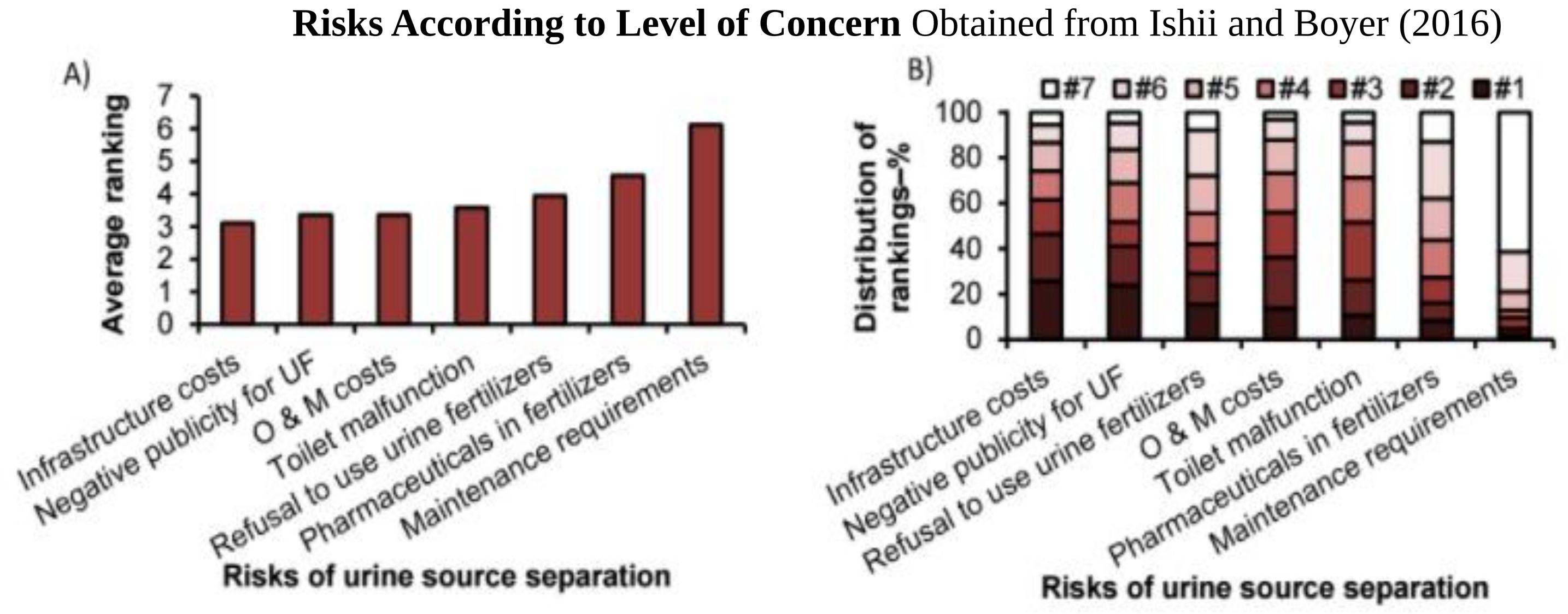


Fig. 1. Average ranking of risks, according to a survey at the University of Florida. A rank of #1 indicates the most important risk, and #7 the least important risk.

Benefits According to Level of Importance Obtained from Ishii and Boyer (2016)

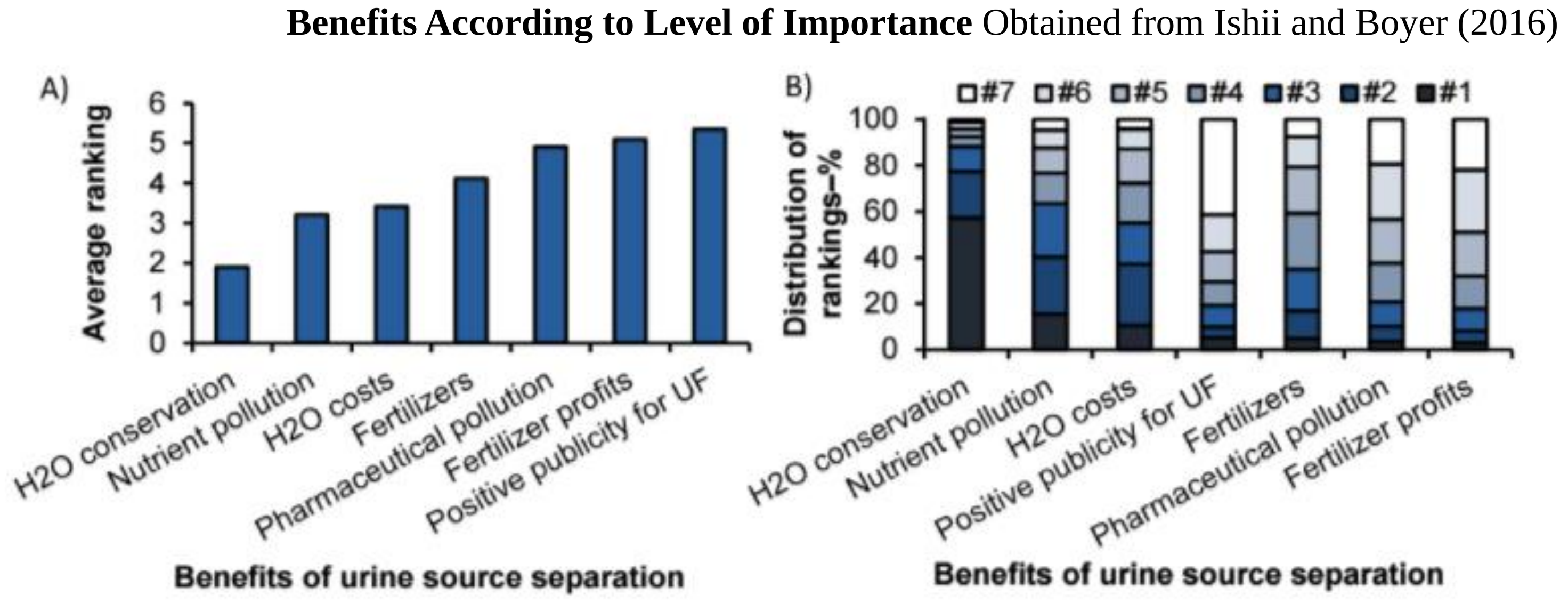


Fig. 2. Average ranking of benefits, according to a survey at the University of Florida. A rank of #1 indicates the most important benefit, and #7 the least important benefit.

Designing Questions Targeted for Three Specific Stakeholders
(With examples of survey questions designed in Qualtrics)

UNH Community

- Would students, faculty, & staff be willing to use urine diversion toilets in residence halls and academic buildings?
- How much extra per semester are students willing to spend to support this initiative?
- Would installing urine diversion toilets throughout all of campus, give the college good publicity?

If you entered a bathroom that had a urine diversion toilet and a conventional toilet, which toilet would you be most likely to use?

- Urine diversion toilet
- Conventional toilet
- Either toilet

Would you be willing to live in UNH housing that had only urine diversion toilets and urinals?

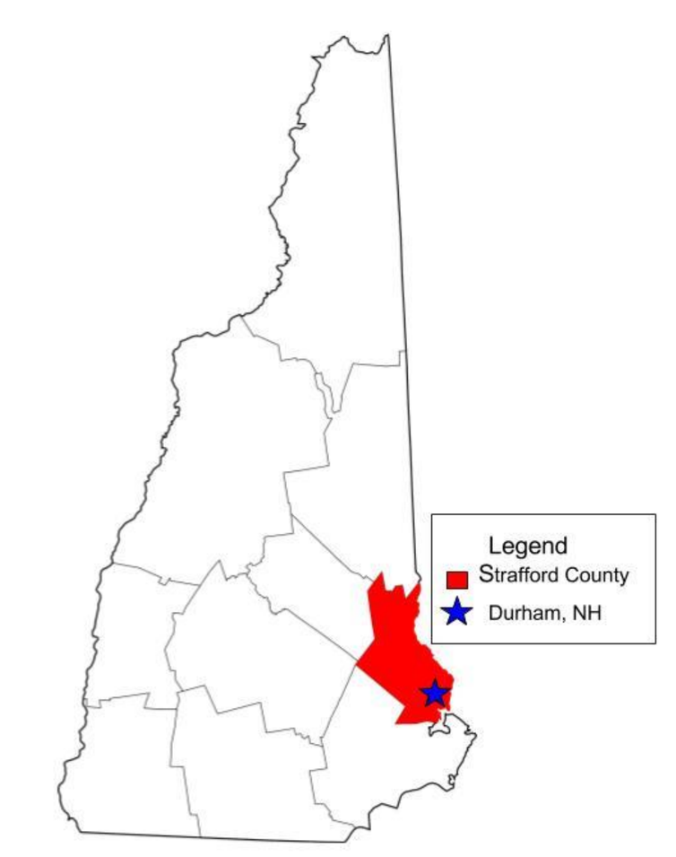
- Yes
- No

Would you vote in favor of implementing urine diversion toilets throughout all of campus, in order to conserve water and decrease operation costs in the long run?

- Yes
- No

Durham Community

- Would residents be willing to install urine diversion toilets in their households?
- What concerns do residents have with installing these toilets?
- How much are homeowners willing to pay for new toilets and piping systems?



Would you consider using urine fertilizer on your own lawn or garden?

- Yes
- No
- I do not have a lawn or garden

What would be the most important reason you would use a urine diversion toilet?

- To save water
- To save money
- To save nutrients from being discharged into the environment
- To collect urine for fertilizer

Urine diversion toilets require regular cleaning in order to make sure that pipes don't get clogged with mineral deposits. This cleaning typically includes using a mild acid such as vinegar and/or hot water. Would you be willing to do the cleaning required for a urine diversion toilet?

- Yes
- No

Farming Community

- Are farmers willing to try urine fertilizer?
- Are farmers willing to let their customers know they use urine fertilizer?
- What concerns do they have with using urine based fertilizers?

How many acres is your farm?

- 0.1-2.5
- 2.6-5
- 5.1-7.5
- 7.6-10
- Over 10

What kind of fertilizer do you use on your farm? Please choose all that apply.

- Chemical Fertilizer
- Organic Fertilizer
- Other

What kinds of crops do you harvest on your farm? Please choose all that apply.

- Fodder
- Vegetables
- Fruits
- Flowers
- Other

Comparing Initial Cost to Overall Economic & Environmental Savings to Determine Consumer Toilet Choice Preferences

Kohler Conventional Toilet
This toilet is a traditional toilet featuring one bowl. There is one 1.28 gallon flush option.

Initial Cost: $199
Economic Savings: $534
Environmental Savings:
-65,408 gallons of water
-0 kg nitrogen
-0 kg phosphorus

Gustavsberg Nordic 396U
This is a urine diversion toilet with a small bowl in the front for urine, and bigger bowl in the back for feces. A urine flush requires .53 gallons of water, and a feces flush requires 1.06 gallons.

Initial Cost: $774
Economic Savings: $1,239.90
Environmental Savings:
-250,908 gallons of water
-134.48 kg nitrogen
-7.33 kg phosphorus

Roediger NoMix Toilet
This is a urine diversion toilet with a screen over the top to catch urine, and bowl in the back for feces. A urine flush requires .26-.79 gallons of water depending on settings, and a feces flush requires 1.59 gallons.

Initial Cost: $908
Economic Savings: $1,427.55
Environmental Savings:
-292,983.43 gallons of water
-134.48 kg nitrogen
-7.33 kg phosphorus

Calculations Based on the Following Assumptions

- Average family consists of two males and two females.
- Lifespan of each toilet is an average of twenty years.
- Water rate in Durham, NH is .0075 cents per gallon.
- Women urinate eight times a day, and defecate once a day, and men urinate seven times a day, and defecate once a day.
- *Women produce .31m^3 of urine per year, and men produce .31m^3 of urine per year.
- *There is 5.3 kg of nitrogen per m^3 of urine.
- *There is .289 kg of phosphate per m^3 of urine.

* Information obtained from Ishii and Boyer (2016)

This survey question is included as part of a choice experiment survey method to determine an individual's willingness to pay for a toilet when presented with overall savings.

Next Steps

- Continue to educate the public.
- Administer the survey to the UNH and Durham communities to analyze interest and user acceptability of urinary diversion toilets.
- Administer the survey to farmers to determine support of urine fertilizer.
- Develop ways to improve the technology and make upfront costs more affordable to consumers.

Acknowledgements

- This research was supported with funding from the National Science Foundation's Research Experience for Teachers in Engineering Grant (ENG-1132648)
- Additional support for this project comes from the NH Sea Grant titled, "Sustainability through Enhanced Nutrient Recovery and Community Engagement in Durham, NH."
- Thank you to Dr. Steven Hale of the Leitzel Center for your work in coordinating the RETE program here at UNH.
- Additional thanks to Kiley Remiszewski for all of her help with check-ins and updates throughout the course of the program.

References

Ishii, Stephanie K.L., and Treavor H. Boyer. "Student Support and Perceptions of Urine Source Separation in a University Community." *Water Research*, vol. 100, 2016, pp. 146–156., doi:10.1016/j.watres.2016.05.004.
Lienert, Judit, and Tove A. Larsen. "High Acceptance of Urine Source Separation in Seven European Countries: A Review." *Environmental Science & Technology*, vol. 44, no. 2, 2010, pp. 556–566., doi:10.1021/es9028765.
*Other references available upon request