SCC: Smart Water Crowdsensing: Examining how innovative data analytics and citizen science can ensure safe drinking water in rural versus suburban communities CNS- 1831669 Lead PI: Dong Wang, Institution: University of Notre Dame IRG, FY-2018	
Principal Research Investigators (Name, Institution) Drs. Dong Wang, Na Wei, Jennifer Tank, Danielle Wood, Diogo Bolster University of Notre Dame	 Community Partners (Name, Institution) Mark Espich, St. Joseph County Environmental Health Department Mike Sutton, Indiana Private Water Workgroup Adam Beck, Penn-Harris-Madison School Corporation Ben Brubaker, South Bend School Corporation Heather Goss, Fairfield Community Schools

This slide serves as a brief Introduction to investigators and community partners

Project Overview



- 1. Smarter Water Crowdsensing (SWC) platform
- 2. Implement SWC in different types of communities
- 3. Water monitoring data in different temporal and spatial scales
- 4. Engage community stakeholders in SWC.

Project Vision

- Develop a citizen science based Smart Water Crowdsensing (SWC) framework using interdisciplinary approaches for reliable and timely detection of drinking water contamination.
- Promote public awareness of drinking water quality, and empower private well dependent communities with management tools to protect health and well-being in the long run.

Project Website: https://swcproject.weebly.com/

Suggested length: 30(s)

Project Overview

Use-Inspired Research

 Groundwater is the drinking water source for more than half of the population in the US. However, there is no central utility to monitor the well water quality. Northern Indiana has been identified as a hotspot for groundwater nitrate contamination. This project is motivated by the real-world problem in the local well water dependent communities in the St. Joseph County, IN.



Community Partners:

- Mark Espich, St.
 Joseph County
 Environmental
 Health Department,
- Adam Beck, Penn-Harris-Madison
 School Corporation

Fundamental Research Contributions

- Technological:
 - The project developed and tested novel crowdsensing data analytical models in SWC. The results demonstrated that it is feasible to obtain reliable crowdsensing data on drinking water contamination using unreliable crowd sensors for community level well water monitoring.

• Social:

 By comparing different community types (suburban, urban, and rural), it is found that the socio-demographic qualities may influence crowdsensing participation and data quality.

Suggested length: 30(s)

Project Update

• Successfully implemented SWC in the well water dependent communities in South Bend, Granger, and Goshen (IN).

The key components of SWC: point-of-use nitrate test kits, website and smartphone app, data analytic engine, social science surveys



Suggested length: 2(m)

Project Website



Project Update, cont'd

• Validation of SWC using standard lab analysis

Results showed that water measurement errors from the crowdsensing participants were in the range of 0-2 mg/L nitrate-N, suggesting the feasibility of using the developed crowdsensing framework to monitor groundwater nitrate contamination.



Crowdsensing measurement errors

SWC modeling reduces the crowdsensing errors



Home testing of water sample using nitrate kit



Students at local high school discussing data collection



PHD student, analyzing water samples.

Suggested length: 2(m)

Project Update, cont'd

• GIS Mapping of Nitrate levels

GIS maps were created based on nitrate monitoring data in collaboration with the St. Joseph County Health Department.



Project Evolution

1. We learned that the residents are more likely to regularly participate in crowdsensing data collection when they become aware of the importance of water quality monitoring and health risks of water contamination. Thus, we modified our recruitment and incentive strategy to include more educational aspects (workshops on water monitoring, Flyer, gift books on water)



Outreach event at ND-LEEF teaching how to test for nitrate



Collaborating with InPWR for public education on water quality

2. Through feedback from the participating residents and St. Joseph County Health Department, we learned that the community are eager to know what causes the nitrate contamination. Thus, we re-designed data collection part to include more questions related to source identification. The information collected were used to identify that septic tanks and nearby farming could be two major sources for nitrate contamination.

Evaluating Project Impact on Communities

 The SWC project increased public awareness of importance of well water safety and empowered the residents with knowledge to protect their own water and health.

> Pre- and post-surveys and focus group meetings with crowdsensing participants showed that participation in the SWC crowdsensing experiment could improve their knowledge on groundwater quality and protection.

• The local government implemented important changes in Granger community: sewer and city water



https://www.southbendtribune.com/news/local/ground-zero-in-groundwater-debate-granger-subdivision-to-have-sewers-treated-water/article_e60e4fa0-67c1-11eb-b674-e7d799a1d715.html

Anticipated outcomes & success measures for next year

- The team plans to improve the data analytic models in SWC by analyzing the sensing measurements collected from the crowdsensing data and lab validation data.
- The team will expand the crowdsensing experiments in different communities to further validate the generality of the SWC framework.
- The team will collaborate with the school teachers to incorporate the project into educational goals so as to optimize the approach to recruit and engage participants through school systems. We will also design alternative approach for teachers in need during the pandemic.

SCC: Smart Water Crowdsensing: Examining how innovative data analytics and citizen science can ensure safe drinking water in rural versus suburban communities CNS-1831669 Lead PI: Dong Wang, Institution: University of Notre Dame **IRG. FY-2018 Project Vision Visual Schematic** Develop a citizen science based Smart Water Crowdsensing (SWC) framework using interdisciplinary Water monitoring data approaches Promote public health and increase the resident awareness of drinking water quality in private well Feedback

Use-Inspired Research

- Northern Indiana has been identified as a hotspot for groundwater nitrate contamination.
- This project is motivated by the real-world problem in the local well water dependent communities in the St. Joseph County, IN.
- Community Partners:
 - Mark Espich, St. Joseph County Environmental Health Department,
 - Adam Beck, Penn-Harris-Madison School Corporation

Fundamental Research Contributions

• Social:

dependent communities

- The socio-demographic qualities may fluence crowdsensing participation and data quality in different communities.
- Technical:
 - It is feasible to obtain reliable crowdsensing data on drinking water contamination using unreliable crowd sensors from local communities.

Please organize the contents of slides (2) and (3) as a quad-chart using the template below. The quad chart should not be included in your lightning talks but should be submitted to NSF S&CC through an upload link that will provided in the coming weeks.