May 2023 | Adriana Castillo Castillo | Safe Drinking Water at the Kitchen Tap

Regional Sustainable Development Partnerships
University of Minnesota Extension

Center for Urban and Regional Affairs | cura
University of Minnesota

minnesota well owners organization

CAP Report # 250

This document is a co-publication of the University of Minnesota's Center for Urban and Regional Affairs (CURA), Regional Sustainable Development Partnerships (RSDP), and Minnesota Well Owners Organization (MNWOO) . Project funding was provided by RSDP, the Mary J. Page Community-University Partnerships Fund, Jane C. Freeman Fellowship for Rural Policy and MNWOO with support from the Minnesota Clean Water Legacy, Toxic Taters, Olmsted County Environmental Services and Soil and Water Conservation District, Stearns County SWCD and by multiple water clinic host locations in community centers, Township Halls, food coops, libraries across central and southeastern Minnesota..

The Community Assistantship Program (CAP) is a cross-college, cross-campus University of Minnesota initiative coordinated by the Center for Urban and Regional Affairs (CURA) and the Regional Sustainable Development Partnerships (RSDP). The content of this report is the responsibility of the author and is not necessarily endorsed by CAP, CURA, RSDP or the University of Minnesota.

The RSDP brings together local talent and resources with University of Minnesota knowledge to drive sustainability in agriculture and food systems, tourism and resilient communities, natural resources and clean energy. The Partnerships are part of University of Minnesota Extension.

This publication may be available in alternate formats upon request: Center for Urban and Regional Affairs (CURA); Phone: (612) 625-1551; E-mail: cura@umn.edu; www.cura.umn.edu

Final Report Outline

Acknowledgments

This work was done only thanks to the help of the people who contributed to make it possible. This team is conformed by the **Minnesota Well Owners Organization (MNWOO)**, Molly Zins and Andi Sutton (from the UMN Extension Central and Southeast Regional Sustainable Development Partnerships).

Jeffrey Broberg, MNWOO Director, and Jeff Stoner, retired Professional Hydrogeologist and member of the MGWA Education Committee, provided consulting advice to the Graduate Student during this project. Special thanks also to Katie Loth (PhD, MPH, RD, LD) and Casey Johnshoy (Medical Student).

In addition, thanks to the Jane C. Freeman Fellowship for Rural Policy at the Humphrey School of Public Affairs and to the Mary J. Page Community-University Partnerships Fund, which supports student work on RSDP projects.

Core Partners

Supporting Partners

INSTITUTE ON THE
ENVIRONMENT
UNIVERSITY OF MINNESOTA
Driven to Discover

Letter from MNWOO's Director Jeff Broberg

minnesota
well owners organization

PO Box 6275
Rochester, MN 55903
507-273-4961

May 15, 2023

Project partners:

As a prelude to this final report from Adriana Castillo-Castillo for the completion of her 2022-23 Regional Sustainable Development Partnerships (RSDP), we thought it worthwhile to review the earlier RSDP work of the Minnesota Well Owners Organization (MNWOO) to meet our mission of helping private well owners to assure safe drinking water at their kitchen sink. Three earlier RSDP projects and an initial 2019 project from the UofM Institute on the Environment (IonE) and three earlier RSDP projects laid the foundation for the work completed by Ms. Castillo-Castillo.

MNWOO was established in 2018 and recognized innumerable challenges to addressing Minnesota private well users (PWUS). We started small water screening clinics in SE Minnesota in 2018 and 2019. We recognized the need to assess the social factors, barriers, and motivators for private well owners who were not testing their water quality.

In 2019 MNWOO and the UofM Center for Changing Landscapes were awarded a grant from IonE to organize and host water quality screening clinics and to use these contacts to conduct surveys of private well owners. The goal was to develop a toolbox for hosting well screening clinics and private well communications and to shift the norm from never testing water quality to routinely testing and taking actions to sustain safe drinking water supplies from all private wells. When Covid ceased our routine in-person testing clinics, MNWOO partnered with the Minnesota Groundwater Association, Olmsted County Public Health, Olmsted Soil, Water Conservation District, and We Are Water to host Covid-safe drive-through clinics in Olmsted County. Regular Covid-safe clinics resumed in 2021.

The IonE private well survey was designed in 2020 and sent to well owners in Stearns and Dakota Counties in 2022[1]. The new clinics developed 50 new partnerships who became clinic hosts, supporters, and volunteers.

[1] Davenport, M., Pradhananga, A., Kreitier, A., 2022. IonE Survey of private well owners

The well-owner survey revealed important insights and showed that many barriers to routine water testing are based on a lack of reliable information. The survey showed that misinformation and specific barriers based on fear of the unknown and fear of high costs to test or treat drinking water create anxiety among well owners. We learned that well owners' fears could be relieved with knowledge about water quality, wells, treatment systems, aquifers, and the resources available to test and manage their wells and water systems.

The IonE Well Owners Toolkit for Local Government provides short answers to the questions raised by the survey results: What is a well water quality screening clinic? What resources do clinic hosts need? How does groundwater contamination happen? How to start conversations about safe drinking water?[2] The final reports by Ph.D. Candidate Emily Kreiter and Project Managers Dr. Mae Davenport and Dr. Amit Pradhananga are in the process of completion.

In 2020 during covid MNWOO pivoted to strategic planning and teamed up in a cooperative strategic planning effort with the Minnesota Groundwater Association Education Committee.

The MNWOO/MGWA COOP project empaneled seven teams with 27 Minnesota water professionals who met weekly for over a year, working to create a blueprint for conducting water screening clinics across Minnesota. At the same time, MNWOO received the first grant from the RSDP SE and Central Regions. The grants provided the opportunity to link us with faculty and students who focused on the challenges identified in the MNWOO/MGWA strategic planning and gave us the resources to continue private well-screening clinics and to pursue the development of multiple partnerships. The resulting 79-page COOP report finalized in early 2022 makes 63 recommendations for addressing the seven subjects and improving service to private well owners[3]. The scope of the RSDP projects addressed specific recommendations.

The original RSDP grant from August 2021 through 2022 linked NWOO/MGWA with the UofM School of Family and Community Medicine. We engage faculty and students to learn how to use a Public Health narrative and the importance of effective risk communication to encourage drinking water stewardship.

Along with more water testing clinics in Central and SE Minnesota, two new projects were completed: The first project addressed the need to understand water treatment options for private well owners. RSDP supported Betsy Vomacka in a half-time Research Assistant position to conduct a literature review of 43 academic publications. Ms. Vomacka prepared a 16-page assessment of water treatment options for private well owners[4].

---

[2] Davenport, M., Pradhananga, A., Kreitier, A., 2023, Toolkit for Local Government

[3] MNWOO/MGWA COOP, 2021, Expanding and Enhancing the testing of Private Well Water in Minnesota Report of Recommendations. 79p

[4] Vomacka, E., March, 2022, Summary of Literature Regarding Common Water Contaminants in Private Water Wells and Removal Strategies

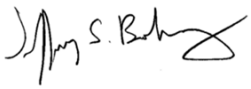
The second 2021-22 RSDP project, by Public Health Student Harmeet Kharoud, focused on communication about private water well safety with healthcare providers. Ms. Kharoud prepared a PowerPoint presentation to be offered to healthcare providers. The presentation discussed the health risks of drinking water contaminated with nitrates, arsenic, lead, and bacteria[5]. Most important are the seven recommendations for drinking water health risk discussions between primary care physicians, pediatricians, and obstetricians.

Concurrent with the 2022-23 RSDP work of Adriana Castillo-Castillo detailed in the following report Casey Johnshoy, a 3rd Year University of Minnesota Medical Student, conducted a survey of Family Medicine Physicians exploring where they practice, the importance of drinking water safety, health risks of common water contaminants, and their experience and training with water safety. Among the survey respondents, 95.2% have patients who currently drink well water, but 67% report never or rarely discussing well water safety with patients. A summary of the Physician survey was recently published in the Spring 2023 edition of the Minnesota Family Physician magazine.[6]

MNWOO's partnerships and the projects completed by the University of Minnesota students guided and supported by RSDP have laid a critical foundation for advancing state-wide service to private well owners. The attached report by Castilo-Castillo was built on this foundation. It provided analytical tools, guidance for public engagement with good owners, and strategic planning to help develop a robust system to advance safe drinking water at the kitchen sink of all private well owners in Minnesota.

We are grateful for the help and guidance from RSDP and IonE and thank RSDP Directors Molly Zins and Andi Sutton, UofM professors Katie Loth and RSDP supported students Elizabeth Vomacka, Harmeet Kharoud, Casey Johnshoy, Emily Krieter, and professors Mae Davenport and Crystal Ng, and student Emily Krieter supported by IonE. Thank you.

Sincerely:



Jeffrey S. Broberg, LPG
Director: Minnesota Well Owners Organization
Attachments:

[5] Kharoud, H., 2022, Water Well testing Communications, Power Point Presentation.
[6] Johnshoy, C., Loth, K., Stoner, J., Broberg, J., 2023, Safe Water from the Kitchen Faucet: A Family Physician's Role.

Executive Summary

Ensuring good quality drinking water for Minnesota households through private wells requires both quantitative and qualitative analysis. Throughout this graduate assistantship (Summer 2022 and Spring 2023), we compiled existing information from Minnesota Well Owners Organization (MNWOO), with existing data sources such as American Community Survey to better understand water quality and access measures throughout the state. With this data, we were able to identify how MNWOO can better incentivize drinking water improvements in Minnesota households and incentivise people to improve their drinking water sources.

Two main products were developed in this process. The first product entails analysis and description of qualitative information (such as: i. incentives to promote private well owner's participation, ii. Training manual for clinics, iii. value proposition design manual, and iv. increasing influence across the state). The second product includes development and analysis of quantitative information (such as i. assessment and GIS mapping of socio-economic profiles, and ii. R[7] package for data analysis).

These qualitative and quantitative products have utility not only for the MNWOO, but also for anyone within the public policy arena who works with (and for) local organizations (i.e., policy makers, local governments, and others). For instance, these products can provide useful information to know the population to be working with, and their socio-economic characteristics. In addition, these products also inform on guides on how to better approach and incentivize communities to participate in water screening programs. Moreover, the use of these products will allow to analyze and compile data from the water screening clinics, and to produce output documents that serve as support for advocacy for a better water quality.

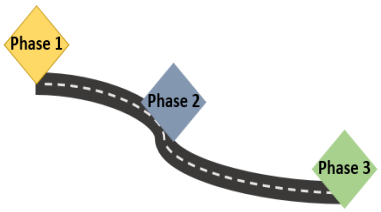
The development of all these products has been directly informed by private well owners, through their feedback at screening clinics and the IonE private well survey. As highlighted in the Letter from MNWOO's Director Jeff Broberg, the ever growing list of partners, including water resource professionals, municipalities, businesses and non-profit organizations, are continually helping to inform MNWOO's strategic goals and resource development.

[7] R (RStudio Team, 2020) is a free software that is developed for data analysis.

1. Main goal

The graduate assistantship aimed to support a project conducted jointly among the Minnesota Well Owners Organization (MNWOO) and the Minnesota Ground Water Association (MGWA) "*to promote education and action working with partners to build a sustained state-wide nongovernmental effort that can help assure that Minnesota households with private wells have safe drinking water at their kitchen tap. MNWOO's vision is to serve as a first mover protecting the interests of private well owners in Minnesota. We strive to advance drinking water safety by promoting and expanding water quality screening and well/water systems/aquifer stewardship to cultivate more vital community values around safe drinking water.*"

Figure 1. Job process.



This graduate assistant's work was developed in three phases, which focused on the development of analytical tools that can be used by the MNWOO for analyzing readily available data, and to help the project participants to more effectively organize future data collections. All data is displayed in ways that protect the privacy of well owners and users.

- The first phase is focused on **research**. Specifically the research of successful and unsuccessful multimodal outreach efforts to inform private well owners of screening and educational programs. In complement with these efforts, the first phase was also focused on understanding barriers that prevent participation, and to define possible motivations for private well owners -to engage in well screening, water stewardship and drinking water related educational programs- through the use of possible incentives.
- The second phase is based on **creating** tools that improve MINWOO's activities. An example of activities and products that belong to this phase are the manual guide document to conduct and facilitate a values proposition workshop seeking input from water professionals on the development and implementation of non-regulatory programs for private well owners. This manual guide document also provides teaching materials on how to "train the trainers'' (i.e.MNWOO's volunteers).
- The third phase is focused on **analyzing** the planned and collected data by the MNWOO. With this focus in mind, we developed analytic tools that allow socio-economic and water information comparisons. For example, with these tools we were able to compare how many households have wells in comparison with how many we're working with. Moreover, during this phase we were able to determine geographic distribution of who's participating - mapping the reach & population; and to analyze data from previous clinics.

2. Deliverables

Source: https://www.istockphoto.com/

The deliverables from this work are intended to be used by multiple types of stakeholders and audiences, including private well owners, local organizations working with water, and local governments. The final goal with the deliverables is then to help these stakeholders/audiencies to be more (and better) informed; and therefore, be able to make better decisions (Watkins, West, & Visse, 2012; Holden & Zimmerman, 2008). Specifically the deliverables help in three ways. The first one is that they provide tools to **better approach private well owners**. The second one, is that they provide tools to **understand the information** collected from the private well owners. Finally, they help to make better decisions on **how to help** private well owners to have better and **safe drinking water at their taps**, which is the final goal of this project.

This work produced 6 deliverables, which can be grouped into two categories: qualitative and quantitative tools. Qualitative deliverables are mainly tools that refer to documents, manuals and guides on how to improve the activities MNWOO does to promote safe drinking water in Minnesota (i.e., incentivize private well owners' participation, water sample data collection, volunteers' training). Quantitative tools are intended to help to analyze quantitative information from private well owners, for example socioeconomic characteristics such as household age, proportion of children without insurance, highest level of education, median income, poverty level, race, etc. In addition, the quantitative tools also provide analysis on the private well owner's water sample collected by MNWOO.

2.1. Qualitative tools

Table 1. Qualitative tools summary

Qualitative tools
1. Incentives as a tool to promote Private Well Owners' participation
2. Training manual for clinics
3. Value proposition design manual
4. Increasing influence across the State

In this work there are four final qualitative deliverables: 1) Incentives as a tool to promote private well owners' participation; 2) Training manual for clinics; 3) Value proposition design manual and, 4) Increasing influence across the State (see Table 1).

Figure 2. Incentives

Source: Tang, C. C. (2005).

2.1.1. Incentives as a tool to promote private well owners' participation

What are incentives? Incentives are rewards (i.e., recognition, material, etc.) to promote civic engagement in certain topics such as community decisions. As proposed by Tang (2005), "… incentives refer to positive inducements that motivate an individual, a group, an organization, or a government to take action, participate in, and contribute to local community planning and plan implementation"

What types of incentives there are? According to Tang (2005), there are four types of incentives (see Figure 2). The purpose-driven type of incentives are rewards "derived from the fulfillment of personal goals" (Tang, 2005). These types of incentives are for example rewards "achieving a sense of group mission or civic duty or contributing to positive changes in a community" (Tang, 2005). These incentives can be reinforced through activities such as public education, social awareness (Tang, 2005), and local meetings. A specific example of these types of incentives are: i) a sense of group mission and ii) making a change to a community (Tang, 2005).

- Social incentives are rewards materialized in social activities. In Tang's (2005) words: "These incentives work to create a sense of fun, encourage hard work, provide moments for reflection, and help to strengthen relationships". These types of incentives tend to work well with organized logistics. It also requires willingness to participate in these activities. Some

examples of social incentives are: i) potluck dinner before a meeting, ii) picnic to celebrate accomplished tasks (Tang, 2005).

- Status incentives are rewards "such as prestige and recognition, which can effectively boost motivation and morale." (Tang, 2005). Examples of these incentives are: i) Recognition ceremony, ii) press coverage (Tang, 2005).

- Material incentives are rewards that can be materialized in cash or physical rewards.

- In addition to the four types of incentives detailed by Tang (2005), other incentives such as Commercial Incentives are also identified. These types of incentives are within the material category, but they are specific to commercial purposes. These are for example discounts and vouchers for goods or services, group discounts, periodic service contracts for operation and maintenance, others.

The use of incentive should follow instructions from an ethics code. The use of these incentives can be problematic in the sense that may cause conflict between the communities that receive these incentives, and the communities that did not receive them. Examples of these types of incentives include: i) wage, ii) coupons, iii) travel reimbursement, iv) refreshments and snacks during the meetings (Tang, 2005).

Who can we use incentives with? Incentives can be used to promote participation by different types of key stakeholders. For example: local governments, local leaders, communities, organizations, and non-profit organizations.

Source: https://www.istockphoto.com/

How can we identify the appropriate incentives that we need to use? Table 2 from Tang (2005) provides an excellent summary of the types of incentives that should be used according to the people who will receive them. This table has multiple classifications, however the classifications and the groups of people depend specifically on the project.

This table is also useful because it provides information about the level of effectiveness of each type of incentive for each type of group of people/participants who will receive them. For instance, according to Tang (2005) all types of incentives except for “material incentives” are highly effective with the general public. For non-elected and elected officials on the other hand, it is mandatory to avoid material incentives.

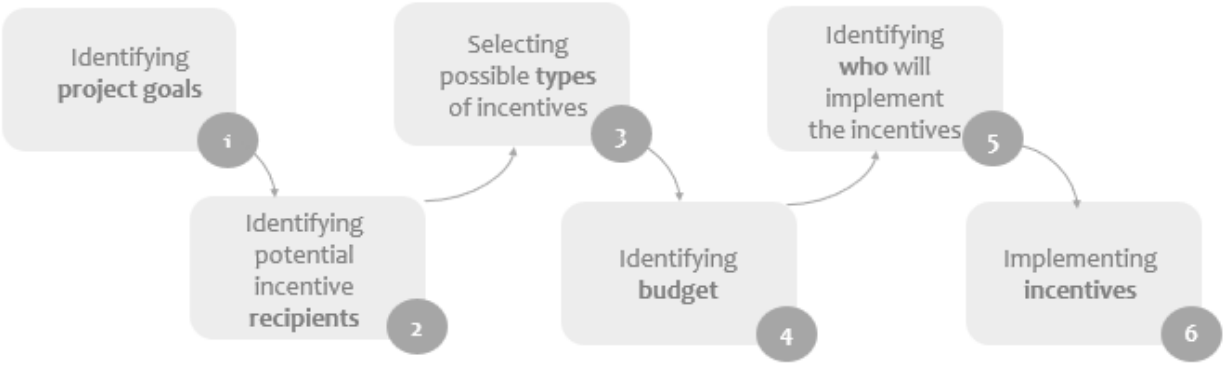
Table 2.

Community members	Incentives – Level of Effectiveness			
	Purpose-driven	Social	Status	Material
General public	★★★	★★★	★★	★
Non-elected officials	★★★	★★★	★★★	*(Avoid)*
Elected officials	★★★	★★	★★★	*(Avoid)*
Local government departments	★★★	★★★	★★	★★★
External organizations	★★★	★	★★	★★
★	Low			
★★	Moderate			
★★★	High			

Source: Tang, 2005.

How can we apply incentives? This is a key question during implementation of a program. The answer to this question depends on multiple factors. First, it depends upon the identification of the project goal. Incentives can be related to a project goal or they can be unrelated. Either works. Second, it is important to identify the potential incentive recipients: who is receiving the incentives? Are they private well owners? Are they female heads of household? Are they grandparents who own the house they are living in?

Figure 3.



Source: Author

Third, it is important to identify and select possible types of incentives (according to the previous question and to the information in Table 2). Fourth, it is important to identify the budget for incentives. Fifth, it is important to prepare all possible necessary logistics for the incentives' delivery. Finally, it is time to implement the incentives.

2.1.2. Training manual for clinics

The "training manual for clinics" was used to hold local clinics with regional partners which had a secondary goal of trying to understand larger socio-economic factors that impact private well stewardship. In these clinics, we expected and found that both local and regional differences occurred, though all had in common a generally poor understanding of Minnesota aquifers and of the operation of private wells. In addition to this, we found that there was no verifiable count for the number of private wells for most areas of the state. While some cities and a small number of counties have well inventories, the Minnesota Well Inventory only records wells drilled after 1975, a fraction of the wells currently in use.

The State Inventory claims over 470,000 wells in their database, but MNWOO/MGWA estimates suggest 930,000 wells across the state. Moreover, we quickly learned several key facts.

- Well owners like to talk about their wells with people who are knowledgeable about wells and water.
- Every well is different, and it is hard to make generalizations, especially for wells drilled before the well code.
- Water treatment for home owners is an important option that is often confusing for well owners.
- Public health professionals have more effective communication about risk than other professionals (geologists, hydrologists, engineers, well drillers).
- People tend to be more grateful for the well water screening service if the water tests reflect that they have good water quality
- There is no common narrative about well water quality shared by local, state and federal agencies dealing with private wells.
- A wide range of partners are willing and excited to help if they have the technical guidance and resources.
- We learned that incentives are important tools to encourage private well owners' participation.

2.1.3. Value Proposition Design Manual

The "Value Proposition Design Manual" is a guide for implementing workshops with water specialists with the aim of obtaining their input on the development and implementation of non-regulatory programs for private well owners. There are two main things to consider for a successful implementation of this workshop. First, the content of the meeting. Second, the logistics of the meeting (Figure 4).

Figure 4. Value Proposition Main Structure

Source: Author

The ***content*** of the meeting is the section that helps to build and achieve what the meeting is intended to. It has 6 important subsections: objective, identification of needs (from key water specialists), guiding questions, setting up the activities, and finally, measuring success of the meeting.

First, it is important to define the objective of the meeting. The objective must be clear to everyone involved, and it additionally helps to think ahead about *how water specialists can help achieve the main objective*. To respond to this question, there are 3 key points to keep in mind: i) what are we looking for from the water specialists?; ii) what type of information do we want to get from them (qualitative, quantitative)?; and iii) how can we classify the information we want from them (i.e. assure clean and safe drinking water and routine water quality screening/screening)? Next, it is important to *identify and invite key water specialists*. Once the key water specialists and their information are identified, we can proceed to write up the *Guiding questions*. These guiding questions are based on the information we want to get from the water specialists and the topics defined previously. The guiding questions for the discussion are, for example: i) How do we help assure clean and safe drinking water at the kitchen tap?, ii) How do we make routine water quality screening the norm?, etc.

The last part of the content section requires the measure of the success of the meeting. The following table (Table 3) is proposed. In this table the "*proposed number*" column informs about the expected number of achievements for each task to be performed. The "*achieved number*" column informs what is the real achievement the project had from each of the proposed tasks. Finally the "*success*" column will inform what is the percentage of success for each indicator.

Table 3.

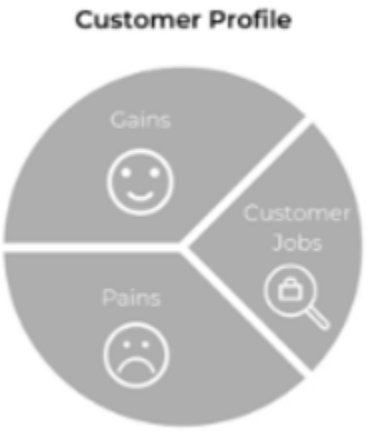
Topic	Product	Proposed number	Achieved number	Success
Topic 1	References about …	10	8	80%
	Future meetings for networking purposes	1	1	100%
	…			
Topic 2	Water specialists helping to organize future clinics	4	2	50%
	…			
Topic 3	…			
	…			

Source: Author

Activities

Good communication is one of the main important points for a successful workshop. It is important to consider and to invite the water specialists to participate in the two main following activities.

Figure 5. Activities



Source: Value Proposition Design: How-To & Example (+ Template) (gustdebacker.com)

Activity I: Customer profile

The first activity is to identify the "Customer Profile". In this case, customer profile means to gather information in order to better know about the private well owners, volunteers, local governments or anyone who is participating in the sessions.

In this first activity 3 main things are identified: jobs, pains, and gains. The job activity responds mainly to "how to incentivize private well owners?". The pain activity responds to "all possible bad outcomes, risks, failures, obstacles during the process of taking the job". The last activity of the customer profile section responds to the gains. In this case the main question is guided by "what are the benefits for private owners when participating?"

Figure 6. Value Map

Source: Value Proposition Design: How-To & Example (+ Template) (gustdebacker.com)

Activity II: Value Map

The Value map is a key activity to achieve goals. It will help to put words into action. In this second activity three main things are identified: product and service, pain relievers, and gain creators. These activities are based on the customer profile identified in Activity I. “Product and services” can be physical, intangible, digital, and financial incentives to explain private owners about benefits of participation. “Pain relievers” are solutions for possible bad outcomes, risks, etc. The last activity is “Gain creators”.

Additional points: A good meeting counts on well prepared ***logistics***. The following is a checklist that helps to keep in mind all possible

Table 4.

Item	Responsible	Task
Invitations		Sending invitations for water specialists
Team	1	Coordinator
	2	Assistant
Room		The place is ···
		Space reservation
		Preparation
Date		Setting up a date for all
		Test equipment
Snacks		Buying and serving snacks for # people
Handouts and other materials		Printing
Informed consent		

Source: Author

Final recommendations

Some final recommendations are made for a good implementation of a value proposition meeting agenda.

Good communication is one of the main important points for a successful workshop. It is important to consider and to invite the water specialists to:

1. DO's
   - Engagement with the water specialists
   - Invitation to dialogue
   - Address water specialists' concerns
   - Redirect a discussion when it is out of the topic
   - Balance participation by asking other participants
   - Remain impartial
   - Check with the participants to be sure the facilitators understood correctly the answers
   - Monitor time

2. DON'Ts
   - Read scripts
   - Favor a particular participant
   - Use technical concepts not known for everyone
   - Don't pressure anyone

- Protocol

The responsible person will conduct the workshop using the following steps. For each step, the responsible person should present each one and consider each of the points are mentioned here:

1. Pre-meeting tasks
   - Identify water specialists
   - Organize ahead place and date
   - Send invitations together with the agenda
   - Funding for snacks
   - Prepare handouts and material for the meeting
   - Prepare room and equipment at least 2 hours before the meeting

2. Introduction
   - Welcoming and sitting
   - Introduce yourself and other team members

- Provide informed consent to participants (rights, confidentiality, etc)

3. Objective
   - Make clear what the objective of the workshop is.
   - Is everyone committed to it? If not, how can we close this gap?
   - Explain the agenda

4. Explain rules
   - All responses are valid
   - Respect opinions
   - Try to focus
   - Help to protect other's privacy

5. Participants' introductions and Ice breaker

6. Activities' implementation
   - All responses are valid
   - Respect opinions

7. Ending the session
   - Summarize main points
   - Invite to reflection
   - Ask for additional thoughts
   - Thank for participation

2.2. Quantitative tools

In this work there are two final quantitative deliverables: 1) Assessment and GIS mapping; and 2) the MNWOO R package: a tool to develop statistical and social analysis (see Table 5).

Table 2. Quantitative tools summary

Quantitative tools
1. Assessment and GIS maping
2. MNWOO package in R: a tool to develop statistical and social analysis

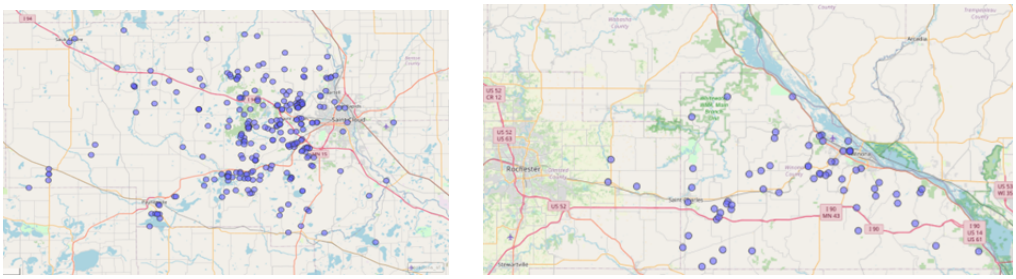
2.2.1. Assessment and GIS mapping at Township Scale of socio-economic profiles of water clinic participants: St. Joseph Greenwald and St. Charles

One of the main achievements of the quantitative work is the data analysis of the clinics' information collected by MNWOO over the years. For example, an analysis of St. Joseph and St. Charles' clinics was performed, which contains information about the water sampled data collected. Using GIS (Geographic Information System) tools, is useful to get the location from the participants and cross this information with socio-economic information from the American Community Survey 2021 (U.S. Census Bureau, 2021). The final report of this analysis is split into the following categories: 1) water sample analysis, 2) questionnaire response analysis, and 3) socio-economic analysis.

private well owners' geographic localization

Figure 7.

Panel a. Panel b.



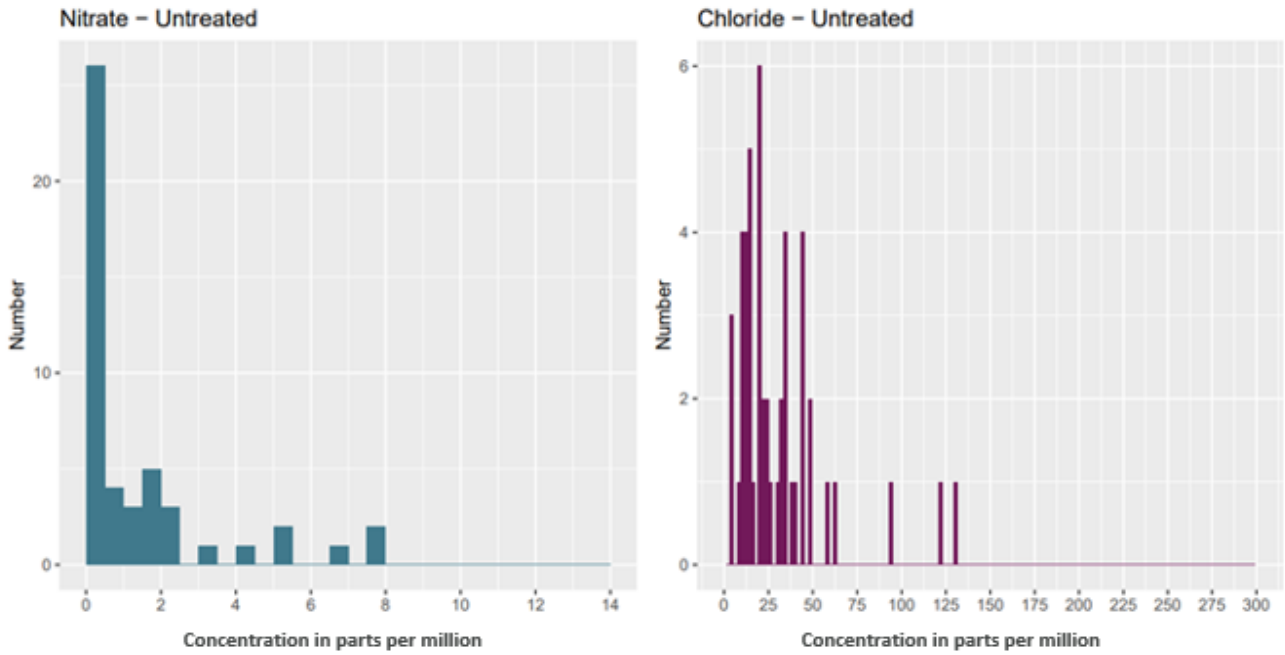
Source: Author

As mentioned before, GIS tools were applied to locate private well owners (see Figure 7, Panel a and b). This was done in the R software (RStudio Team, 2020) using the *ggmap* (Kahle, D. & Wickham, H, 2013) package which allows converting addresses to points in maps. This information is useful because it allows comparisons of water, and socio-economic information across regions. Moreover, once this information is processed, it provides useful insights such as : 1) what regions are doing better with respect to drinking water quality, 2) information on how to approach people differently according to their socio-economic characteristics.

In these two clinics, a total of 73.5% private well owners were located. It was not possible to locate the other 26.5 % of private well owners because they did not provide their address.

Water sample analysis

Figure 8. Nitrate and Chloride levels for untreated samples – Stearns County Clinic

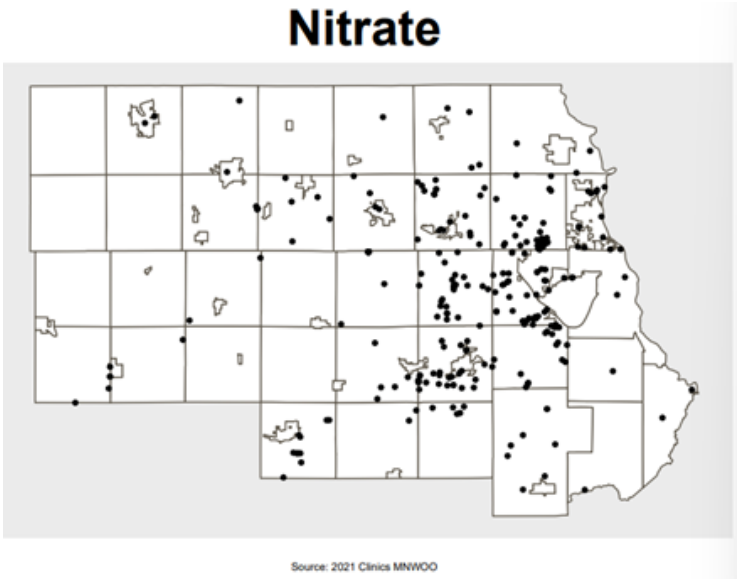


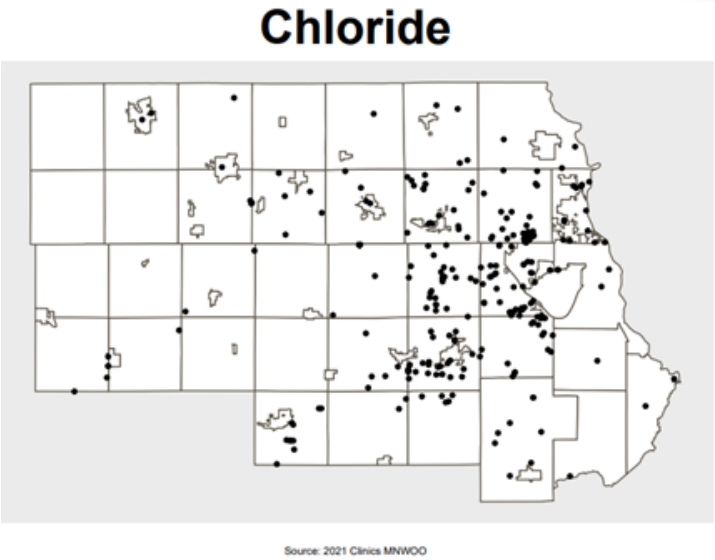
Source: Author

A total of 113 samples were collected for the St Charles clinic and a total of 343 samples in St Charles. From these samples, the untreated results show that most of the samples have similar

values for both Nitrate[8] and Chloride[9]. Specifically, 9% of private well owners have at least 10 mg/l levels of Nitrate; and a 7% of private well owners with levels of Chloride higher than 10 points in their drinking water. However, it is important to note that the Chloride data range is wider than the Nitrate range (see Figure 8). This means that within the analyzed samples, the values of Nitrate are more similar for the private well owners than the values of Chloride.

Figure 9 shows the distribution of the samples across Stearns County.





[8] According to the Minnesota Department of Health, values of Nitrate below 10 mg/l are recommended (Minnesota - Department of Health).
[9] The Environmental Protection Agency (EPA) recommends a Chloride level below 4 mg/L.

Questionnaire response analysis

The data analysis is based on the data collected by MNWOO in the clinics. For the data collection, the MNWOO asked a questionnaire for the private well owners. This questionnaire provides information of: i) source of drinking water, water tests and treatments, concerns about water, existence of households with children under 1 year old, interest on water tests and treatment follow-up, and information on how the private well owners knew about the clinics implementation.

- *Drinking water source:* About 98 % of the participants said that the water they brought to the clinic was from a well used as their primary drinking water. More than 94 percent also claimed that they drink their well water.
- *Water tests and treatments:* Responses showed that water was sampled mostly from the kitchen tap (38%) or outdoor spigot (7%). About 54% of participants did not answer this question. In addition, we also saw that mostly all respondents did not bring before and after treatment samples (82.4%) and that mostly none of them brought pictures of the well and/or water treatment equipment (87.5%).
- *Existence of households with children under one year old: M*ost of the private well owners responded "no" to the question of having a child under one year of age living at home.
- *Interest on water tests and treatment follow-up and Information on how the private well owners knew about the clinic's implementation: M*ost of the private well owners expressed interest in receiving follow up information/consultation about their water results.
- *Concerns about drinking water: Among the concerns* private well owners expressed about their drinking water were smell, other, and color.
- Time when the private well owner tested their well for the last time

Below, some graphs of the data collected in the clinics.

Figure 10 shows the huge importance of the MNWOO's work in Minnesota. As seen, more than half (55.7%) of the private well owners do not know when was the last time their wells were tested. In fact, it is worrying that there are still private well owners (2.2%) who have never tested their wells. And this is where the MNWOO's activities take a big importance.

Figure 11 shows what is the most effective way of reaching out to private well owners and inviting them to participate in testing activities. From the private well owners who respond, we can see that "Post card" (31.1%) is the main communication channel to receive information about the screening activities. This is followed by "Letter" (6.9%) and social media (2.5%).

Figure 10 . Last time well was tested

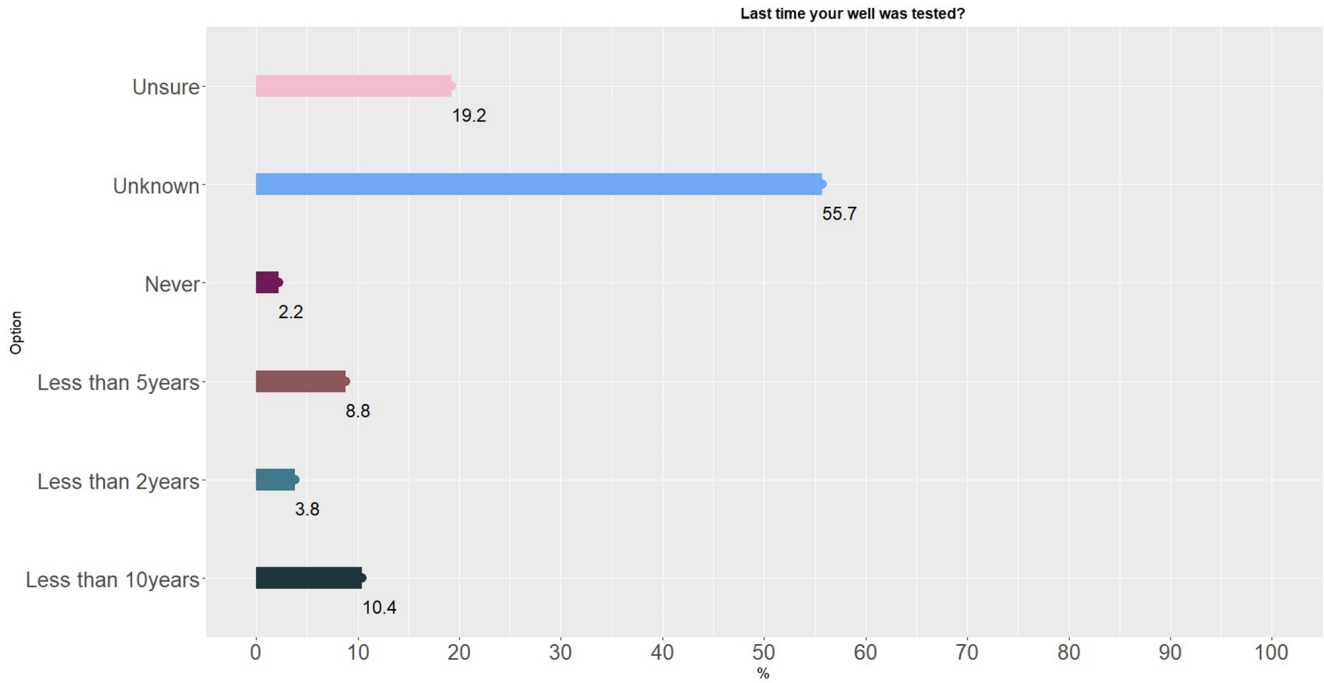


Figure 12. How did you hear about this event?

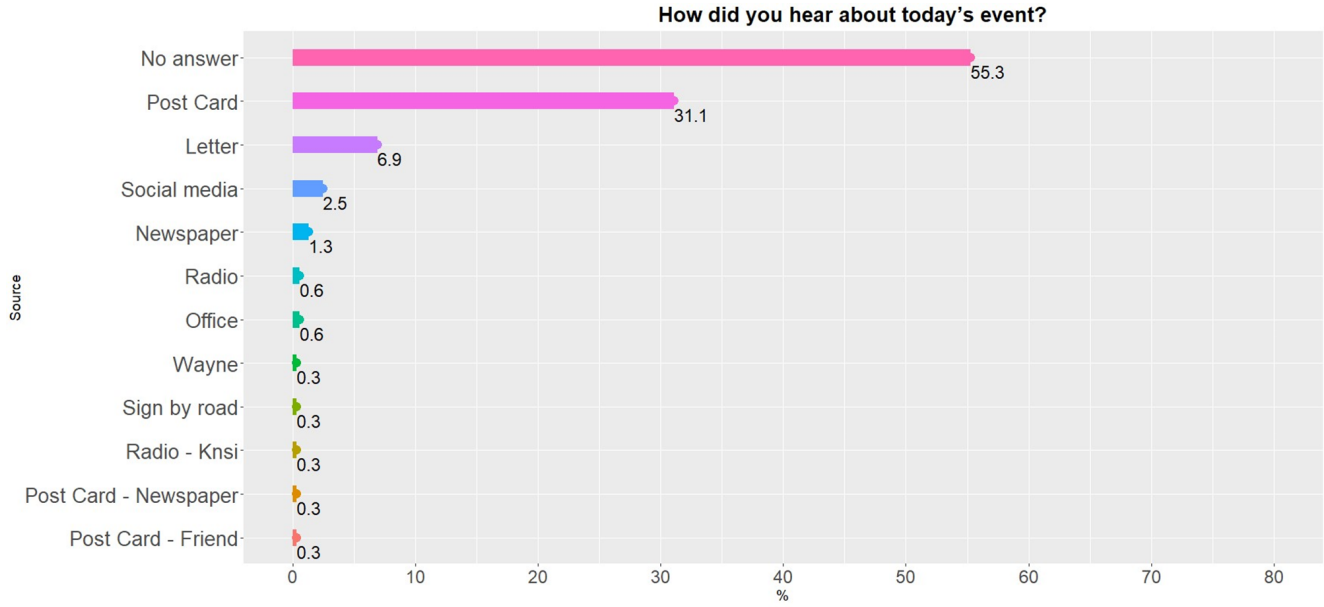
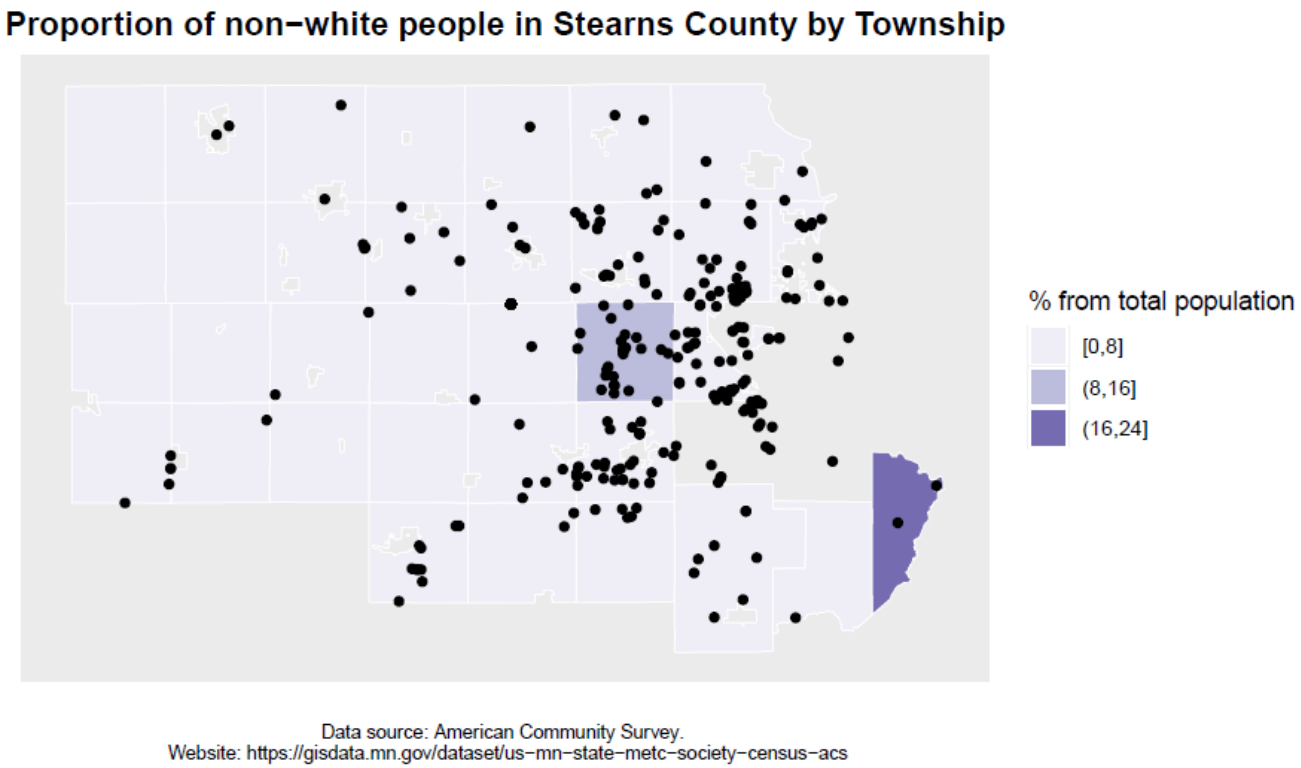
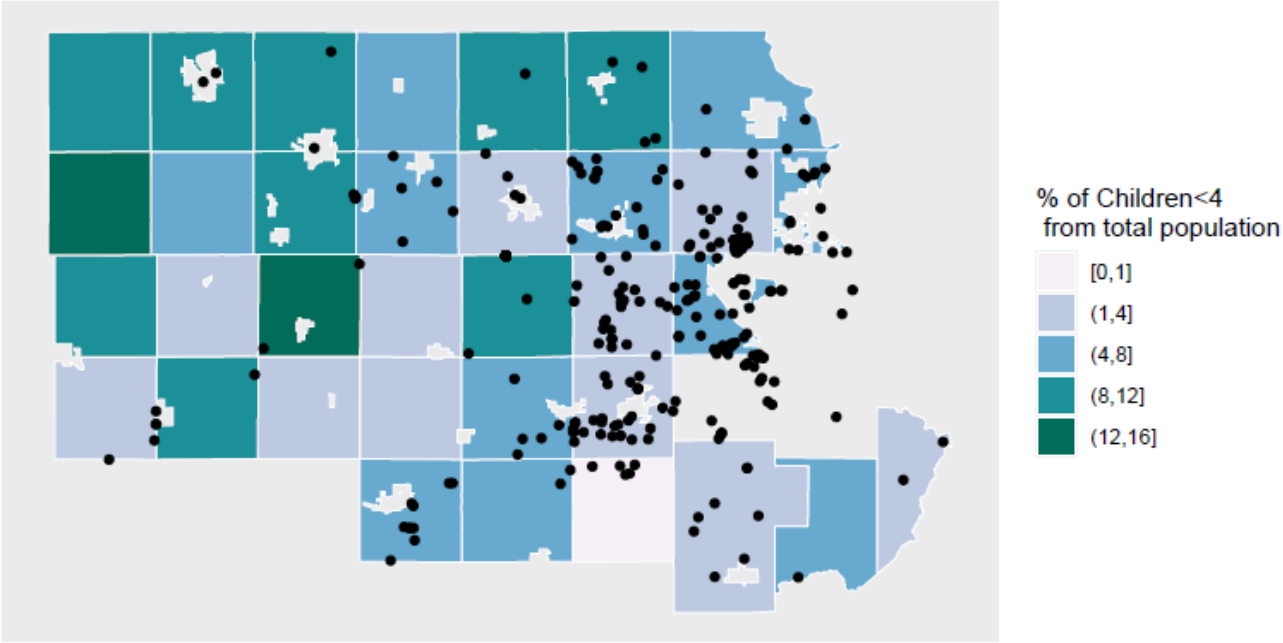


Figure 13. Socio-economic analysis.

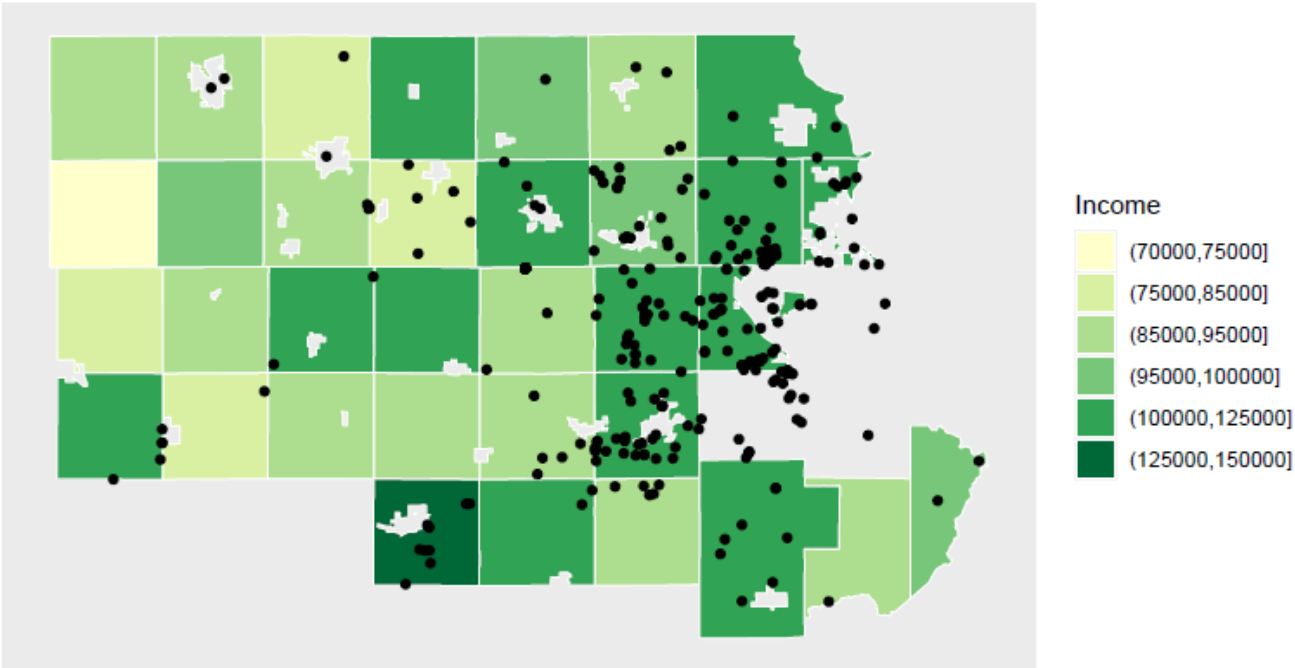


Children under 4 in Stearns County by Township



Data source: American Community Survey.
Website: https://gisdata.mn.gov/dataset/us-mn-state-metc-society-census-acs

Mean income in Stearns County by Township



Data source: American Community Survey.
Website: https://gisdata.mn.gov/dataset/us-mn-state-metc-society-census-acs

2.2.2. MNWOO package in R: a tool to develop statistical and social analysis

The final product of this work is an advanced quantitative data tool. This quantitative tool has two major functions. The first one is to describe the data that is collected by MNWOO from the clinics. The second one is to provide socio-economic and nitrate information for future places where clinics are planned to be held. Therefore, this tool takes information from three main sources: i) socio-economic information from the most updated American Community Survey[10]; ii) nitrate information data which was obtained from the Minnesota Department of Natural Resources (2023); and iii) private well owners' information collected by MNWOO.

Advantages

- Since this tool is updated automatically thanks to the use of the previously mentioned R packages, this tool can be used at any time either for present or future analysis. When this tool is used, it will automatically get the most updated information from both the American Community Survey and the Nitrate information.
- This simplified tool provides summarized information of three categories: socio-economic, nitrate, and water sample.
- It provides geographic information together with the previously mentioned categories.
- The tool produces PDF documents with graphs, tables, and maps as output.
- It is possible to choose the analysis for any county and/or township from Minnesota.
- It has the possibility of choosing between the preferred type of analysis according to the MNWOO staff (user) needs.
- The information from the private well owners is strictly private, and this tool keeps this privacy.

Requirements

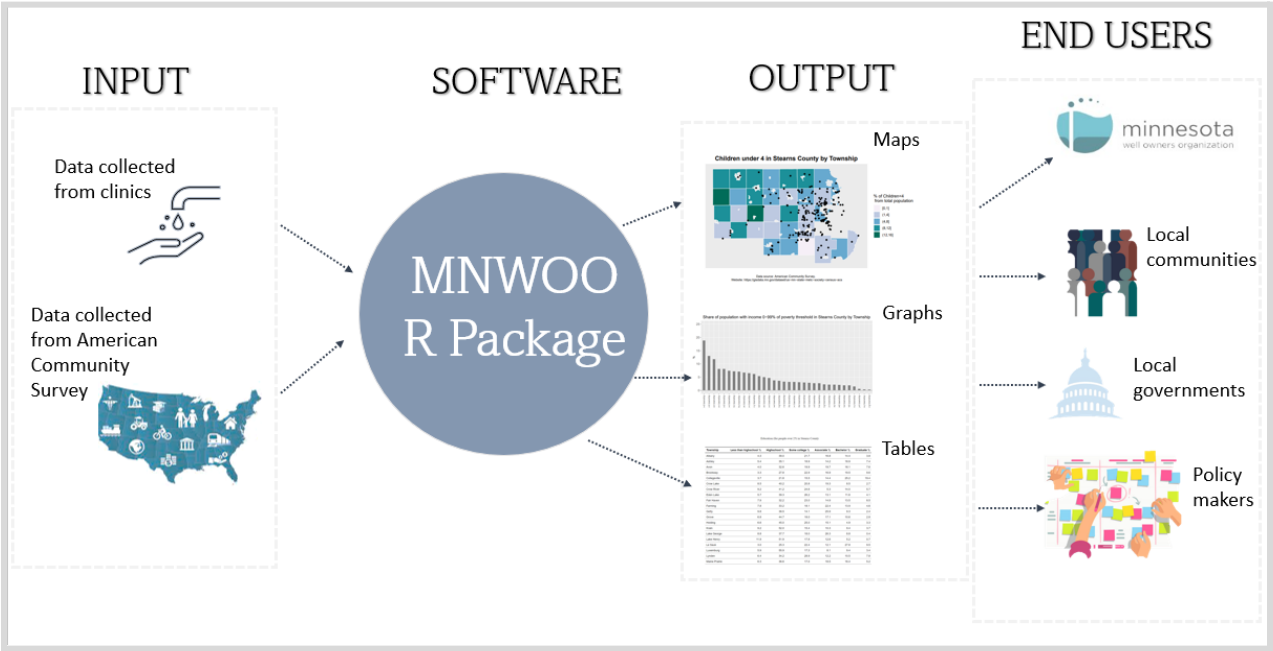
- This tool requires the installation of the R and RStudio software.
- To get the most recent clinics' data analyzed, it requires that the user uploads the Excel files with the required format.

[10] This is possible thanks to the use of the "tigris" package available in R software (Walker, 2016a)

How does the tool work?

How the tool functions is shown in Figure 14. The first function is the Input section. As mentioned before, the input is provided by three sources: American Community Survey, nitrate data information (both automatically provided by the tool), and nitrate data information (provided by user). It is also necessary that the user chooses which county and/or townships she or he wants the analysis for. Once the user chooses the counties the MNWOO tool puts together all this information using statistics and GIS techniques to analyze all the data, and to produce outputs such as PDF documents with maps, graphs, and tables.

Figure 14. MNWOO package functioning

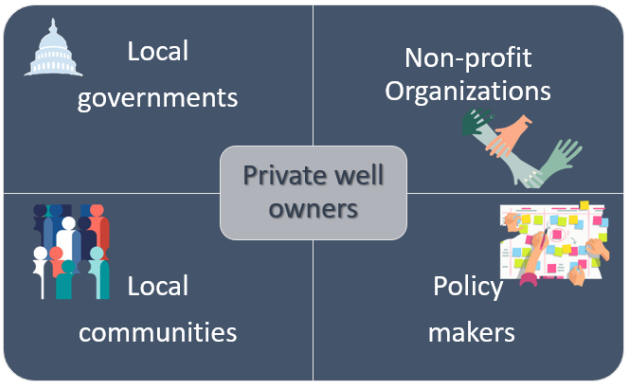


Source: Author

Confidentiality disclosure: Since the MNWOO package uses information from the clinics collected by the MNWOO staff, the MNWOO package contains private information from the private well owners. Therefore, the MNWOO package usage is limited to the MNWOO staff (user) and people they authorize.

3. Conclusions

Figure 15.



The work planned and implemented by MNWOO has had an impact on thousands of Minnesotans and dozens of communities of well owners across the state. These efforts have led to effective policy advocacy on water quality improvements across the state. However, MNWOO recognized that their activities can be improved by implementing qualitative and quantitative tools that provide important information about well users and their wells.

The graduate research assistantship described in this report supported the tasks and research prioritized by MNWOO. In general, this graduate assistantship was able to provide qualitative and quantitative tools for a better delivery of the tasks the MNWOO, as a small nonprofit organization, is providing communities across Minnesota.

With this work, MNWOO will be able to get better quantitative information (i.e., summarized charts, graphs, and tables) to both understand and demonstrate the impacts of their work across the state. In addition, the GIS tools (i.e., maps) will allow the user not only to plan where water screening is needed the most, but also how the MNWOO activities can be compared across locations.

In addition, the proposal of new qualitative tools such as the use of incentives will help MNWOO to increase the participation of private well owners in water screening activities. In the same sense, the "Training manual for clinics'' provides tools (i.e., such as goals, general logistics, do's and don'ts) that will improve how clinics are implemented. Furthermore, the "Value Proposition Design Manual" provides guides on how to approach conversations with private well owners and other key stakeholders.

These tools have already been implemented to support the MNWOO and other organizations in advocacy work. For example, the information gathered from this project was used as supporting material for the advocacy made for state policy and funding to assist private well owners. Additionally, the maps and geographic information analyzed was used to present to the Environmental Protection Agency (EPA) the need to improve drinking water quality across the state. This means this work provides supporting outreach for other organizations with similar goals to MNWOO.

Two main lessons are taken from this Graduate Assistantship. First, there is a need for implementing incentives to increase participation of private well owners in MNWOO screening clinics. Second, it is important to implement quantitative tools that allow MNWOO both to plan its activities (screening clinics, etc) and to analyze the data of their work.

MNWOO has already been utilizing the tools developed in this project and will continue to implement these evaluative processes in order to enhance their reach and impact, as well as that of partnering organizations and agencies, across Minnesota.

4. References

Environmental Protection Agency. “Drinking Water Regulations” . Drinking Water Regulations | US EPA Accessed [June, 2023].

Holden, D. J., & Zimmerman, M. A. (2008). A practical guide to program evaluation planning : Theory and case examples. SAGE Publications, Incorporated.

Kahle, D. & Wickham, H, 2013. ggmap: Spatial Visualization with ggplot2. The R Journal, 5(1), 144-161.

Minnesota Department of Natural Resources. “Watershed Health Assessment Framework: Watershed Map.” https://arcgis.dnr.state.mn.us/ewr/whaf2/. Accessed [May, 2023].

Minnesota Department of Health. “Nitrate in Well Water” https://www.health.state.mn.us/communities/environment/water/wells/waterquality/nitrate.html Accessed [June, 2023].

RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston, MA URL http://www.rstudio.com/

Tang, C. C. (2005). Enhancing involvement in community planning using incentives. Bulletin, Stevens Point, WI: Center for Land use Education, Retrieved from: http://143.236, 32.

Walker, Kyle. 2016a. “Tigris: An R Package to Access and Work with Geographic Data from the US Census Bureau.” The R Journal 8 (2): 231. https://doi.org/10.32614/rj-2016-043.

Watkins, R., West, M. M., & Visser, Y. (2012). Guide to assessing needs : Essential tools for collecting information, making decisions, and achieving development results. World Bank Publications.

U.S. Census Bureau. (2021). 2021 American Community Survey 1-year Public Use Microdata Samples. Retrieved from https://factfinder.census.gov/faces/nav/jsf/pages/searchresults.xhtml?refresh=t

5. Appendix

5.1.3. Value Proposition Design Manual: Meeting agenda draft

Location: Address or Room Number
Date: Date
Time: Time

Meeting Agenda

Attendees: Name(s)

8:30 **I. Welcome and introduction**

Facilitator Name called to order the regular meeting of the at time on date at location.

8:45 **II. MNWOO introduction of the workshop and background information**

Secretary Name conducted a roll call. The following persons were present:

9:15 **III. Participant introductions**

Ice breaker, introductions, general rules.

10:30 **IV. Activity I: Customer Profile**

11:30 **V. Activity II: Value Map**

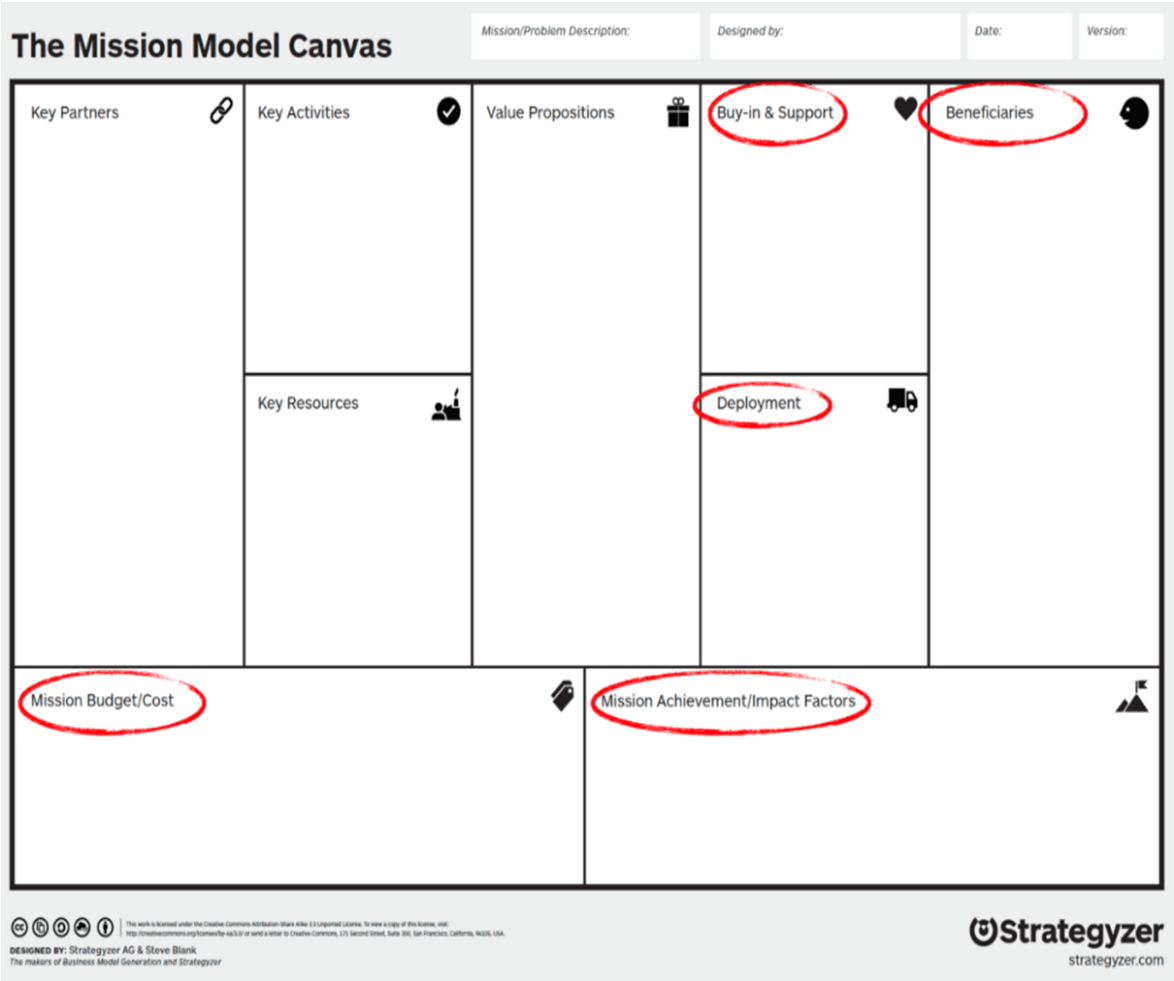
9:15 **VI. Break and snacks**

Ice breaker, introductions, general rules.

1:00 **VIII. Wrap-up and final thoughts**

1:30 **IX. Thank to the focus group**

- Canvas design


The Mission Model Canvas
Mission/Problem Description:
Designed by:
Date:
Version:
Key Partners
Key Activities
Value Propositions
Buy-in & Support
Beneficiaries
Key Resources
Deployment
Mission Budget/Cost
Mission Achievement/Impact Factors
DESIGNED BY: Strategyzer AG & Steve Blank
The makers of Business Model Generation and Strategyzer
Strategyzer
strategyzer.com