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Diffusion of Innovation Explaining Support for Septic to Sewer System Conversion Programs Among Florida Residents: Lessons for Educators and Related Stakeholders[1]

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Introduction

Excess nutrients can impair water quality and have harmful effects on human health, the environment, and the economy. Residential septic systems (i.e., onsite sewage treatment) contribute to these excess nutrients. Conversion from a septic system to a sewer system (hereafter referred to as S2S) is one way to mitigate pollution from excess nutrients. There are voluntary and mandatory S2S conversion programs throughout and beyond Florida. S2S conversion provides multiple benefits; it reduces the property owner's maintenance burden, improves environmental health, frees up land for other uses, reduces water pollution, mitigates flooding after storms, and increases property values. The S2S conversion process, however, is complex and costly. This publication was developed to aid environmental management professionals, policymakers, and communication and education professionals (e.g., Extension agents) in understanding residents' perceptions pertaining to S2S conversion. The information contained here may be used to design outreach, communications, and policies that support residents' participation in S2S conversion programs. This publication presents a study of homeowner support for S2S. The study is described in greater detail in the publication "Using a diffusion of innovation lens to understand homeowner support for septic system to sewer system conversions," by Warner et al. (2022), available at: https://doi.org/10.1016/j.jenvman.2022.115651.

Research Approach

The research summarized here used social science principles to explain how an innovation (e.g., S2S) is diffusing through certain social systems. Innovation is defined as "an idea, practice, or project that is perceived as new by an individual or other unit of adoption within a social system" (Rogers, 2003, p. 12). The diffusion of innovation depends upon adopters, communication channels, the social system, and time. In a social system, when innovation is diffused, the first 2.5% of the population will take a risk and adopt new ideas. They are often called innovators. As diffusion continues with time, it may be adopted by the next 13.5% of the population (early adopters), followed by 34.0% (early majority), another 34.0% (late majority), and lastly remaining 16.0% (laggards).

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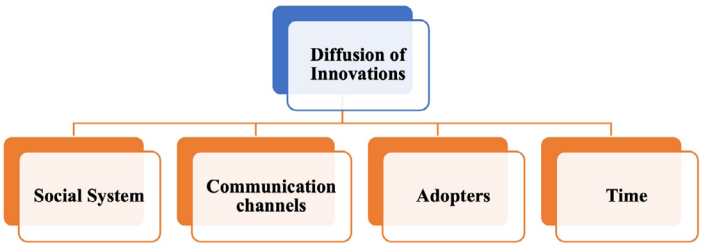

Figure 1. Four main elements determine the diffusion of innovation. Credits: Adapted from: Rogers, 2003

At the individual level, the Innovation-Decision process may progress through five stages known as knowledge, persuasion, decision, implementation, and confirmation. At the knowledge stage, an individual learns "what the innovation is and how and why it works" (Rogers, 2003, p. 21). According to Rogers, knowledge is generally of three kinds: awareness knowledge, how-to knowledge—i.e., knowledge on how to correctly use the innovation—and principles knowledge (on how and why an innovation works). After an individual gains knowledge about an innovation, they form a positive or negative attitude in the persuasion stage. Uncertainty about the innovation's outcomes and subjective evaluations from peers, neighbors, or others may affect individuals' attitudes. Rogers (2003) described the innovation-decision process as "an uncertainty reduction process" (p. 232), where he proposed attributes of innovations that help to decrease uncertainty about the innovation. Our study examined these attributes to understand support for S2S conversion.

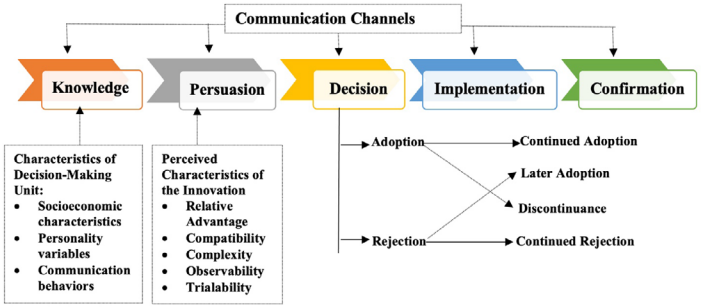

Figure 2. Innovation-Decision Process and Its Five Stages. Credits: Adapted from: Rogers, 2003

These perceived characteristics of innovation, also called traits or attributes of innovation, are critical in predicting the rate of adoption of innovation by a social system (Rogers, 2003). According to Rogers, a potential adopter judges an innovation based on these five characteristics. These five attributes may collectively or singly influence the adoption of an innovation (Minishi-Majanja & Kiplang'at, 2005). Here are the definitions of those five traits of innovation in the context of S2S conversion:

- Relative advantage: whether an innovation (e.g., sewer) is better than what it might replace (e.g., a septic system). The advantages may include increased economic profitability; the improved health of the environment; and the prevention of septic-related problems such as human health hazards, water pollution, etc.
- Compatibility: how well the innovation (e.g., S2S) aligns with respondents' values, beliefs, and routines. Individual needs, sociocultural needs, and existing values and beliefs may influence compatability.
- Complexity: how difficult or easy something is to use, considering affordability, ease, and knowledge of the converting process.
- Observability: whether there is an opportunity to see the results of adopting the innovation. This trait assessed whether respondents knew others who have converted or whether they had been able to observe the process in their communities.
- Trialability: the extent to which an innovation can be experimented with on a limited basis. This trait was not applicable to S2S conversion and thus was not included in the study.

Innovations offering greater relative advantage, compatibility, trialability, observability (noticeable outcomes), and less complexity are expected to have a greater adoption rate than other innovations (Rogers, 2003). To assess these perceptions, researchers sent an electronic survey questionnaire to a total of 1,604 Florida homeowners aged 18 or older who were on a septic system. A total of 518 Floridians provided complete responses which were analyzed to draw study findings.

The dependent variable was support for S2S, and the other variables helped to understand residents' perceptions of S2S. These perceptions developed during the innovation-decision process's persuasion stage—after participants gained an awareness and knowledgeof S2S. Researchers analyzed focus-group discussions to understand the perceptions of the target audience and used the perceptions to create the independent variables: four of the five characteristics of S2S. These four were compatibility, observability, complexity, and relative advantage (Rogers, 2003). Trialability was excluded because this characteristic was not applicable to the particular innovation. All these items were measured using a Likert scale from which respondents could select responses from strongly disagree to strongly agree.

In addition to the S2S dependent variable, there were four other variables related to the status of such projects in the community. The first was whether respondents previously were on a sewer system. The other three variables were collected from only the participants who indicated that

there were conversion plans in their communities. The "mandated conversion-variable" represented whether a respondent's conversion was mandatory. "Progress-conversion started" referred to whether the community had begun the process, and "progress completed" referred to whether the community had completed the process.

For analysis, the researchers used descriptive statistics—such as mean, standard deviation, frequency and percentages—to analyze septic system owners' S2S conversion status and also to understand perceptions associated with S2S programs among those with and without conversion plans in place. A mathematical model was used to evaluate how these perceptions related to residents' support for conversion projects and to determine if conversion-project status improved the predictive power of residents' support. Researchers presented the main conclusions from these investigations in the section below.

Findings

S2S Conversion Status among Septic System Owners

Out of 518 respondents, 203 reported there were plans for S2S system conversion in their community. When asked about the nature of these programs, the majority (144) reported it as voluntary. Only 50 residents mentioned such plans were mandated. Residents were asked about the current progress of such plans; nearly half (94) of the reporting households were in a region where the S2S plan was already completed. Another 70 households noted that the process in their region had started but had not yet finished. Most of the respondents who had an S2S plan were located in urban and suburban areas outside of city limits and previously lived in a home they owned that had a sewer system.

The Perception among Residents Regarding Conversion Plans

When residents were asked about their stance on the different aspects of S2S conversion plans, researchers found that people who already had S2S plans had more positive perceptions than those without plans. Compared to residents without conversion plans in place or those unsure about such plans, residents who had conversion plans in place perceived S2S as

- relatively advantageous;
- compatible (in terms of their needs, lifestyle, responsibility toward to community, and values);
- having recognizable outcomes (observability); and
- being simpler/less complex.
- Also, the majority of residents (60.0%) who had S2S conversion plans were found to be *very supportive* of these plans.

Relationship between Residents' Perception and Support for a Conversion Plan

A mathematical model confirmed that two of the different perceived traits of S2S conversion predicted support for S2S conversion. The model suggested that residents' support for the S2S conversion plan significantly increased alongside an increase in perceived compatibility of innovation or recognizable outcomes (observability).

When the effect of conversion status was observed along with perceived traits of S2S conversion, residents with finished conversion plans and greater perceived compatibility traits of S2S conversion were found to be more supportive of conversion plans.

Conclusions

With this 2021 study related to Florida residents' support for S2S conversion, we reached the following conclusions:

- Only 39.2% of respondents had S2S conversion plans, whereas more than 60.0% of residents reported either they had no plan or they were unsure about this conversion plan.
- In most cases, conversion plans were voluntary rather than mandatory. Only 46.3% were completed, and the rest (53.7%) were either not yet started or started but not yet finished.
- Most of the residents with such conversion plans (65.0%) belonged to either urban or suburban areas outside of city limits. Only 13.3% of those having such plans belonged to rural areas.
- Most of the residents who reported having plans (85.2%) previously lived in a house connected to a sewer system.
- Perceptions of relative advantage, compatibility, observability, and complexity for S2S programs were favorable, suggesting a good likelihood of adoption.
- Among the four perceived traits of S2S conversion, compatibility was the strongest predictor of S2S conversion support, followed by observability. In addition, people with a completed conversion plan and higher perceived compatibility were expected to be more supportive of S2S conversion.

Suggestions for Applying This Information

Extension educators, government agencies and staff, environment management professionals, policymakers, and other related stakeholders who are involved in developing policies and promoting the conversion of septic systems to sewer systems should consider the following key recommendations drawn from the study findings.

The majority of the respondents in the survey indicated that there were no plans or that they were unsure about S2S conversion plans. This implies an opportunity for educational interventions to make residents aware of S2S conversion plans. It is recommended to focus on educating homeowners about the benefits of the sewer system over the septic system, explaining how S2S conversion plans align with their lifestyle and environment. Understanding their perceived barriers and motivations helps educators design appropriate educational programs.

The diffusion process for any innovation starts with awareness, but being aware does not necessarily mean an individual is adequately knowledgeable. According to Rogers, an individual may have awareness knowledge, how-to knowledge (procedural), and principles knowledge (how and why innovation works). But, to reiterate, a greater number of residents knowledgeable in all possible facets does not necessarily lead to the adoption or rejection of innovation; individuals' perceptions determine adoption or rejection. Thus, to reinforce individual knowledge, residents must be swayed through direct or indirect experience(s) during the opinion-making process (persuasion) to support decisions in favor of S2S. Reducing uncertainties about the innovation's outcomes among residents would be invaluable; subjective evaluation from peers or important persons of those residents is critical at this stage.

The study revealed the prevalence of septic systems in urban and suburban areas. This should open the conversation about urban planners' role in prioritizing sewer systems instead of septic systems and promoting conversion of S2S where available.

Drawing from our study, we recommend programs related to S2S conversion should prioritize attributes such as the relative advantages of conversion, simplicity, compatibility with clients' lifestyles or needs, and other noticeable outcomes. Particularly, there needs to be a greater focus on the compatibility and observability of the conversion plan. This means that S2S conversion will be perceived as compatible when it meets residents' needs (increased space or property values), lifestyles (less maintenance), and priorities (public and environmental health). Also, the outcomes of conversion plans must be made clear. Residents should be able to immediately comprehend the benefits of conversion after replacing septic with sewer. These benefits may include a plunge in the number of necessary maintenance jobs, often to zero; an increase in household capacity; and the elimination of the risk of water contamination and its health impacts.

Because most people who previously lived in a house with a sewer system positively perceived the S2S conversion plan, we strongly recommended engaging those kinds of residents in interventions or Extension programs to activate the social diffusion process. For example, practitioners could target opinion leaders so that when those leaders adopt the innovation, others will observe that behavior and be more likely to adopt new ideas (Rogers, 2003). Communication through mass media, local government, change agents, and relatives or neighbors with sewer systems is essential. When people are exposed to innovation, they seek more information, and based on the innovation's relative advantage, compatibility, complexity, and observability, they will decide to adopt or reject it.

Those residents who are in the implementation phase of S2S should be provided with consistent technical assistance by educators, such as Extension agents, to reduce existing uncertainties about the outcomes of the innovation. In addition to that, individuals in the confirmation stage (those who have decided to adopt) seek support for their decision. Delivering a positive message about S2S conversion plans would help to encourage adoption at this stage. In contrast, negative or conflicting messages about this innovation may reverse the decision to adopt. Change agents are a critical part of this innovation adoption process. Their role in making residents aware about the S2S conversion plan and in granting them time to decide is of great value.

Besides these different traits of innovation, which significantly predict the rate of adoption, there are some other elements which also affect the rate of adoption to a certain extent. These include communication channels (mass media or interpersonal channels), innovation-decision type (optional, collective, or authority), social system (norms or network interconnectedness), and change agents. Thus, educators and program planners should focus on these elements, too, while designing intervention programs encouraging S2S systems. For example, the homeowner association's collective decision regarding the adoption of a sewer system could be more influential and impactful than the optional decision.

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