ASSESSING IMPACT OF EDUCATION ON PUBLIC AND PRACTITIONERS IN ONSITE WASTEWATER ARENA

Anish Jantrania¹ and Ryan Gerlich²

ABSTRACT

Public education and participation (outreach) activities are on the top of the list of program elements specified in United States Environmental Protection Agency’s (US EPA’s) Voluntary National Guidelines for Management of Onsite and Clustered (Decentralized) Wastewater Treatment Systems. Educating home/business owners, students, policy makers, and practitioners (license-holders) on the fundamentals of onsite systems evaluation, design, installation, and responsible management is vital for protecting public health, environmental quality, and property value in areas served by onsite/decentralized systems. Texas is home to approximately 2.2 million onsite sewage systems and this number is projected to increase with population growth in the state. More than 20,000 new permits are issued every year in Texas since the mid-90s. A group of Extension program specialists, engineers and researchers at Texas A&M University have been providing education and public outreach for students, homeowners, service providers and regulators since early 1990. This paper presentation highlights the tools used for assessing the impact of these educational programs in Texas to determine changes in public awareness and interests on adequate use of onsite systems. The main objectives for impact assessment are to determine effectiveness of program in terms of knowledge gained, and to document benefits of the programs to state funding agencies and to taxpayers in terms of practices adopted by the participants that would reduce adverse environmental impact from poorly managed onsite systems.

INTRODUCTION

Onsite wastewater treatment systems are called On-Site Sewage Facilities (OSSFs) in Texas and are regulated by the Texas Commission on Environmental Quality (TCEQ) and are enforced locally by more than 350 authorized agents. The Texas A&M University Biological and Agricultural Engineering (BAEN) department in conjunction with Texas A&M AgriLife Extension & Research offers state-wide extension, research, and education services related to OSSF. The overall mission of BAEN’s OSSF program is to provide information on the technologies available for managing wastewater onsite so people can make informed decisions when selecting, operating, and maintaining their onsite wastewater treatment system. Since the early 1990s, the OSSF team at BAEN also operates a research, training, and demonstration center on Texas A&M’s RELLIS (Respect, Excellence, Leadership, Loyalty, Integrity, and Service) Campus in Bryan, TX (www.rellis.tamus.edu). The center was originally built in early 1990s under the leadership of Dr. Bruce Lesikar and recently rejuvenated in 2016 under the leadership of Dr. Anish Jantrania with support from both the public and private sectors. Ongoing assessment of

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education programs is necessary for internal reporting and documenting impact of the programs on public understanding of safe, adequate, and proper use of onsite systems.

It is important to know the number of onsite wastewater systems within one’s service area in order to provide better services. Since 2014, the OSSF program at BAEN tracks changes in the number of systems by county. The 1990 US Census records were used to initially estimate the OSSF count. Information from the TCEQ On-Site Activity Reporting System (OARS) database is used to update the OSSF count every year since early 1990s. Figure 1 shows the system density for each county. Note the total number onsite systems has almost doubled in Texas over the last 16 years and so has the number of counties with more than 10,000 systems.

![Fig. 1. Onsite system density map of Texas as of 1990 (left) and as of 2016 (right). This information was compiled from 1990 Census data and permitting data from TCEQ.](image)

The TCEQ Regulations for OSSF (Title 30, TAC Chapter 285, 2016) offers eight choices for land-based dispersal of treated effluent, which allows an OSSF designer to find an onsite wastewater solution for any given soil and site condition (AgriLife Extension, 2005). They are the following: 1) Standard drainfield, 2) Low-pressure distribution, 3) Subsurface drip distribution, 4) Spray distribution (for secondary-quality effluent and disinfection only), 5) Mound system, 6) ET bed, 7) Soil substitution drainfield, and 8) Pumped effluent drainfield.

Figure 2 shows the trend in types of dispersal systems used in Texas since the early 1990s. Spray distribution following an aerobic treatment unit (ATU) with effluent disinfection is typically used on properties with limited soil and site conditions for subsurface dispersal. Since early 2000, use of ATU and spray system has become prevalent (~50%) in Texas.
Fig. 2. Distribution in types of onsite wastewater systems installed in Texas. Information compiled from TCEQ’s OARS database (Onsite Activity Reporting System).

BAEN’s OSSF team offers the following educational programs to Texans:

1. Homeowner Education and Outreach
   a) Two- and six-hour programs for homeowners wanting to understand more about the operation and maintenance of their septic system or aerobic treatment unit.
   b) Publications and an e-learning course also provide additional information for homeowners and policy makers

2. Continuing Education Units (CEU) for onsite wastewater practitioners licensed through the Texas Commission on Environmental Quality
   a) The 16-hour “Analyzing Wastewater Treatment Systems for High Strength Waste” course covers describes how to analyze facility management practices for estimating wastewater characteristics. Wastewater treatment train configurations and components are described for managing high strength wastewater residential and commercial wastewater (AgriLife Extension BN-020).
   b) The 8-hour course “Overview of Advance Wastewater Treatment Course” covers a broad spectrum of technologies and maintenance practices.

3. Research and Demonstration
   a) The Onsite Wastewater Treatment Training Center located on the RELLIS Campus in Bryan, TX, provides a means for bench and field scale research, performance testing, and demonstration.
   b) Research and Extension Experience for Undergraduate (REEU) summer program for hands-on training on learning about reuse water quality.

Impact assessment is done for four out of above mentioned six programs; which are 1-a, 2-a, 2-b, and 3-a.
Homeowner education programs are offered based on requests received from the County Extension Agents, watershed coordinators, river authorities, homeowners’ associations and council of governments. The two-hour program focuses on basic information related to use of conventional septic systems and it is offered at no cost to participants, however the six-hour program related to use of aerobic treatment unit is offered at a cost or is included in grant programs. CEU programs are offered based on the demand from the private sector and once a year during the Texas Onsite Wastewater Association (TOWA) annual conference. These CEU programs are fee-based to recover the cost of offering them.

METHODS

To assess changes in subject matter understanding and willingness of respondents to adopt improved practices, pre- and post-program surveys are conducted at the end of each education program. The survey instrument was a two-page form (Figure 3) developed by the AgriLife Extension Agency. The form allows the program instructor to include up to twelve questions related to subject matter understanding and up to nine topics related to practices or technologies that could be adopted by homeowners for improvement in their use of onsite systems. The same form was also used for CEU classes offered to the practitioners licensed through TCEQ for design, installation, and operation of OSSFs. Questions in the survey instrument may vary depending upon the topic offered during a program. More recently, a ten question pre- and post-quiz was developed to quantitatively judge the impact of the CEU program.

Survey forms collected after each education program were sent to the AgriLife Extension program evaluation office for analysis. Participants feedback was analyzed to determine the demographics of the participants (age, sex, and race), % change in their understanding of the subject matter before and after the program. Other key items analyzed include economic benefit to the participants and whether they would recommend the program to others. Figure 3 shows the scale (1 to 4, from Poor to Excellent) used by the participants to gauge their subject matter understanding for various topics. Mean values before (Pre) and after (Post) for each topic is used to calculate the % change in understanding using the following formula:

\[
\text{Percent Change} = \left(\frac{\text{Post-Mean} - \text{Pre-Mean}}{3}\right) \times 100
\]

Note that post- and pre-mean values are divided by 3 (4 – 1 = 3) to measure the change in understanding on the scale of 1 (Poor) to 4 (Excellent). For example, if a response to the first question “How septic systems are part of our wastewater infrastructure” was 1 (Poor) before program and 4 (Excellent) after program then the percentage change is calculated as ((4 – 1)/3) * 100 = 100%. Survey forms collected after each education program are sent to AgriLife Extension Organizational Development where a computer system scans the forms and calculates mean values for pre- and post- responses for each question to determine value for the percent change in understanding.

Page 2 of the survey form is designed to assess overall satisfaction and economic value of the education program experienced by the participants. It also provides open space where participants can offer their thoughts about the program. Participants are also asked to input demographic information related to sex, age, and ethnic background.
Texas A&M AgriLife Extension Service Participant Survey

Your views on the quality and effectiveness of Extension programs are extremely important. Please take a few minutes to tell us about your experience with this activity. Your answers to the following questions will help us better meet your needs. Please do not write your name on this form so that your responses are anonymous. Thank you!

1. For each item listed below, mark the ONE number in the left column that best describes your level of understanding BEFORE the program; and then mark the ONE number in the right column that best describes your level of understanding AFTER the program.

<table>
<thead>
<tr>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Your understanding of . . .</th>
<th>BEFORE Program</th>
<th>AFTER Program</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>How septic systems are a part of our wastewater infrastructure.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>How practices in the home affect sewage characteristics.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>How changing water quality goals impact sewage treatment reg.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Safety issues associated with maintenance of aerobic treatment unit (ATU).</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>How aerobic treatment units remove waste from sewage.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Aerobic treatment unit operation and maintenance criteria.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>How a malfunctioning septic system can impact water quality</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Importance of proper septic system operation for protection of public health.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Tools and practices for maintaining an ATU.</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Importance of keeping disinfection component operating properly.</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

2. Please indicate your intentions to adopt each item listed below or indicate if you have already adopted the item listed or if it does not apply to your situation.

<table>
<thead>
<tr>
<th>Practice or technology that could be adopted . . .</th>
<th>Definitely Will Not</th>
<th>Probably Will Not</th>
<th>Probably Undecided</th>
<th>Definitely Will</th>
<th>Already Adopted</th>
<th>Not Applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement water conservation practices to limit water to the OSSF</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Limit organic loading to the OSSF</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Perform operation and maintenance activities on my aerobic treatment unit</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Keep disinfection component of ATU system operating properly</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>Service contract with a licensed service provider</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
</tbody>
</table>

Fig. 3. Survey tool used for determining impact of 6-hr Homeowners’ education program in TX. Page 1
3. **Overall, how satisfied are you with this activity?**
   - Not at all
   - Slightly
   - Somewhat
   - Mostly
   - Completely

4. **How satisfied are you with the following aspects of the activity?**
   - a. Information being **what you expected** to receive
   - b. **Accuracy** of information
   - c. Information being **easy to understand**
   - d. **Timeliness** of information (being received in time to be useful)
   - e. **Helpfulness** of the information in decisions about your own situation
   - f. **Relevance** of the examples used
   - g. Instructor’s **knowledge level** of subject matter
   - h. Instructor’s response to questions
   - i. Physical setting’s contribution to ease of listening and participation

5. **Do you anticipate benefiting economically as a direct result of what you learned from this Extension activity?**
   - Yes
   - No

6. **Would you recommend this particular activity to others?**
   - Yes
   - No

7. **Your thoughts on the program (perhaps what you liked most, liked least, additional information you would like, etc.).**

Please tell us a little about yourself . . .

8. **You are . . .**
   - Female
   - Male

9. **Your age?**
   - 18 - 24
   - 25 - 29
   - 30 - 34
   - 35 - 39
   - 40 - 44
   - 45 - 49
   - 50 - 54
   - 55 - 59
   - 60 - 64
   - 65 - 69
   - 70 - 74
   - 75+

10. **Racial / Ethnic background?**
    - African American (non-Hispanic)
    - Asian American
    - Hispanic
    - Native American
    - White (non-Hispanic)
    - Other

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**Thank you**

Fig. 3. Survey tool used for determining impact of 6-hr Homeowners’ education program in TX.
Page2
RESULTS AND DISCUSSION

The pre- and post-program survey form yielded numerous analytics related to the demographics of the participants, their level of overall satisfaction with the program, and the level of change in understanding they experienced from the program. For the fee-based programs, participants were also asked about their anticipated economic benefit from participating in the program and whether they recommend the program to others. Both questions were designed to gather information about the value of the program to the participants. Summary of the results from the 6-hr program offered during the last fiscal year are presented in Table 1.

Table 1. Results from the 6-hr homeowner education program for FY-19.

<table>
<thead>
<tr>
<th>FY-19</th>
<th>N</th>
<th>Age &lt;50</th>
<th>Age ≥ 50</th>
<th>Female</th>
<th>Male</th>
<th>Mostly or completely satisfied</th>
<th>Anticipate benefiting economically</th>
<th>Would recommend this activity to others</th>
<th>Δ in understanding (Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept - Nov</td>
<td>16</td>
<td>19%</td>
<td>81%</td>
<td>38%</td>
<td>62%</td>
<td>94%</td>
<td>88%</td>
<td>94%</td>
<td>75% to 94%</td>
</tr>
<tr>
<td>Dec - Feb</td>
<td>49</td>
<td>31%</td>
<td>69%</td>
<td>32%</td>
<td>68%</td>
<td>100%</td>
<td>96%</td>
<td>100%</td>
<td>82% to 96%</td>
</tr>
<tr>
<td>March - May</td>
<td>19</td>
<td>25%</td>
<td>71%</td>
<td>31%</td>
<td>69%</td>
<td>100%</td>
<td>94%</td>
<td>100%</td>
<td>45% to 60%</td>
</tr>
<tr>
<td>June - Aug</td>
<td>17</td>
<td>24%</td>
<td>76%</td>
<td>18%</td>
<td>82%</td>
<td>100%</td>
<td>82%</td>
<td>100%</td>
<td>71% to 100%</td>
</tr>
</tbody>
</table>

As indicated in Table 1, most of the participants in homeowner education programs tend to be male of age group ≥ 50 and their level of satisfaction with the program was >90%. Most of the respondents (> 80%) indicated that the program would benefit them economically in terms of reduced cost for managing their onsite wastewater system. The last column in Table 1 shows the change (Δ) in understanding of subject matter as measured by 10 questions. Details of change in understanding of each question is reported in the summary report and will be discussed during the presentation of this paper at the NOWRA annual conference.

For assessment of the CEU program for licensed professionals and the REEU program for students, a ten-question quiz was prepared, and it was given to the participants before starting the program and at the end of the program. The results were analyzed for the number of Right (R) and Wrong (W) answers to determine if the subject matter understanding was improved due to the program. The questions were related to basic water and wastewater knowledge. One question, for example, asked “Air is composed mainly of which gas?” with three choices, Oxygen, Carbon Dioxide, and Nitrogen. It was shocking to see how many wrong answers were given in the Pre-Quiz. Details on all the ten questions are not included in this paper because this assessment tool is currently used and distribution of questions in public forum is not appropriate. The important point is to discuss the results obtained during the last year to determine change in % of right and wrong answers in pre- and post-quiz conducted both in the 2019 CEU and REEU programs.

Figure 4 and 5 shows the impact of the 16-hr CEU program offered during the TOWA Conference in March 2019 and the five-week REEU program offered in June-July 2019. The %R to %W response ration changed from 62/38 in pre-quiz to 81/19 in post-quiz during the CEU program, and from 41/59 in pre-quiz to 90/10 in post-quiz during the REEU program. Statistical analysis presented indicated a significant improvement in subject matter understanding resulted from the 16-Hr CEU program offered during the TOWA Conference as measured by a t-test. 20 out of 29
students (69%) show improvement in subject matter understanding as a result of participating in the 16-Hr CEU program. Similarly, all eight REEU students showed 40% to 70% improvement in subject matter understanding resulting from the participation in the five-week program.

Fig. 4. Change in understanding, %R to %W ratio changed from 62/38 in pre-quiz to 81/19 in post-quiz conducted during the 16-Hr CEU program.

Fig. 5. Change in understanding, %R to %W ratio changed from 41/59 in pre-quiz to 90/10 in post-quiz conducted during the five-week REEU program.
CONCLUSIONS

Public education and participation are important elements for continuous progress of the onsite wastewater industry. Both the customers (users of onsite systems) and the practitioners (licensed professionals) need continuing education to improve quality of products and services offered by the onsite industry. An educated customer is a valuable commodity for the onsite industry. To support the growing onsite wastewater industry in Texas, the Texas A&M Biological and Agricultural Engineering department is actively offering extension, research, and education programs for improving the understanding of onsite systems. To assess changes in subject matter understanding and willingness of respondents to adopt improved practices (i.e., the impact), pre- and post-program surveys/quizzes are conducted at each education program. The main objectives for impact assessment are to determine effectiveness of programs in terms of knowledge gained, and to document benefits of the programs to state funding agencies and to taxpayers in terms of practices adopted by the participants that would reduce adverse environmental impact from poorly managed onsite systems. Results from the programs offered to homeowners in FY-19 indicate high level of overall satisfaction by the participants (>90%) and significant improvement in understanding of the subject matter (45% to 100%). Similarly, results from the 16-hr CEU program offered to licensed practitioners and the five-week REEU program offered to undergraduate students showed significant improvement in subject matter understanding as indicated by greater number of right answers in post-program quiz compared to pre-program quiz.

LITERATURE

