Journal of Extension
www.joe.org

June 2013
Volume 51
Number 3
Article # 3RIB6

Rain Barrels: A Catalyst for Change?

Abstract

Over the past 4 years, rain barrel programming for residents has been implemented in both Northern Virginia and New Jersey as a method for educating the public about stormwater management and water conservation. Program participants demonstrated a significant increase in knowledge of water resource issues. Follow-up surveys showed 58% of New Jersey respondents and 48% of Virginia respondents adopted at least one additional best management practice at home. Results show that the enthusiasm for rain barrels can be used as an opportunity to educate and enable residents to be water resource managers on their own properties.

Michele E. Bakacs
Environmental and Resource Management Agent
Rutgers, The State University of New Jersey
Cooperative Extension of Middlesex and Union County
North Brunswick, New Jersey
bakacs@njaes.rutgers.edu

Mike Haberland
Environmental and Resource Management Agent,
Rutgers, The State University of New Jersey,
Cooperative Extension of Camden and Burlington County
Cherry Hill, New Jersey
haberland@njaes.rutgers.edu

Salvatore S. Mangiafico
Environmental and Resource Management Agent
Rutgers, the State University of New Jersey
Cooperative Extension of Salem and Cumberland County
Woodstown, New Jersey
mangiafico@njaes.rutgers.edu

Aileen Winquist
Arlington County Environmental Services
Environmental Management Bureau
Arlington, Virginia
awinquist@arlingtonva.us

Christopher C. Obropta
Extension Specialist in Water Resources
Rutgers, the State University of New Jersey, Cooperative Extension
New Brunswick, New Jersey
obropta@envsci.rutgers.edu

Amy Boyajian
Program Associate
Rutgers, the State University of New Jersey, Cooperative Extension
Water Resources Program
New Brunswick, New Jersey
boyajian@envsci.rutgers.edu

Sara Mellor
Program Associate
Rutgers Cooperative Extension
Water Resources Program
New Brunswick, New Jersey
saramellor@envsci.Rutgers.edu

Introduction

This article describes the results of a study investigating the use of rain barrels as a tool for encouraging homeowners to adopt best practices for water resource protection in New Jersey and Northern Virginia. Homeowners normally manage small areas of land, but their voluntary aggregate

impacts have the potential to protect and improve local water resources, so they are an important audience for Extension professionals to engage.

Frequently, educational programs targeting residential property owners are implemented in order to improve water resources with varying degrees of success (Geller, Erikson, & Buttram, 1983; Dietz, Clausen, Warner, & Filchak, 2002; Taylor, Curnow, Fletcher, & Lewis, 2007). Dietz, Clausen, and Filchak (2004) showed that educational workshops and individual consulting in one Connecticut residential neighborhood resulted in only a few behavioral changes and minimal improvement of water quality. Alternatively, an evaluation of a Maine watershed education program showed that lakefront landowners who participated in the program had a greater knowledge level and were more motivated to take action to protect their lake watershed than non-program participants (Jemison, Wilson, & Graham, 2004).

Rain barrels are connected to the downspout of a roof to collect stormwater runoff for later use for outdoor watering needs. The average rain barrel holds 50 to 90 gallons of water and provides only modest benefits to the environment for stormwater runoff reduction and water conservation (Jones & Hunt, 2010). Regardless, Build A Rain Barrel programs for homeowners are very popular in New Jersey and Northern Virginia and frequently fill to capacity. The potential exists to build upon the popularity of rain barrels and implement an integrated educational approach that effectively trains residents to install additional best management practices (BMPs) with a greater potential to improve water quality, reduce flooding, and conserve water.

In 2007, a number of Northern Virginia-based organizations (Arlington County, Fairfax County, Arlingtonians for a Clean Environment, City of Alexandria, City of Falls Church, Northern Virginia Soil and Water Conservation District, and the Reston Association) established the Northern Virginia Rain Barrel program using a model developed by Clean Virginia Waterways. The organizations began offering Build A Rain Barrel workshops to local residents focused on stormwater management and runoff reduction. In 2009, Rutgers Cooperative Extension (RCE) adapted the program for New Jersey. New Jersey's large population combined with increasing demand for potable water has left many municipalities vulnerable to water supply shortages, despite receiving on average 45 inches of rainfall per year (DePaul, Rosman, & Lacombe, 2008). For this reason, RCE added water conservation education to the rain barrel program.

Limited information exists in peer-reviewed literature on the results and impacts of community organized rain barrel programs (Thurston, Taylor, Shuster, Roy, & Morrison, 2010; Ando & Freitas, 2011). Few studies have examined whether rain barrel programs can act as a catalyst for changing behavioral practices.

The goal of the Build A Rain Barrel program is to enable residents to be water resource managers on their properties through education and training. This article describes the effectiveness of the program for meeting this stated goal and demonstrates the results of our investigation into whether rain barrels can be used to encourage the adoption of additional practices for water resource protection.

Program Description

Build A Rain Barrel programs are typically held in the spring and summer and are conducted by Extension agents and staff, and conservation district and municipal employees. By keeping the program to approximately 2 hours and holding it in the evening or on weekends, the program is designed to appeal to the maximum number of individuals who have limited time to dedicate to a longer course on water resource management. The program includes information about how residential properties contribute to stormwater runoff and nonpoint source pollution, and in New Jersey, how much water savings can be achieved through indoor and outdoor water conservation practices. Residents are encouraged to think about changes they could make indoors and outdoors to reduce their environmental footprint. BMPs such as diverting downspouts to pervious areas and installing low flow water fixtures inside their homes are reviewed. The second half of the presentation includes demonstrating how to build, maintain, and install a rain barrel. Fifty-five gallon, plastic, food grade barrels are then retrofitted into rain barrels by program participants. All materials and tools are provided during the program.

Starting in the spring of 2010, in New Jersey only, a pre- and post-program survey was used to determine knowledge gained and change in self-assessed skills and abilities by participants. Survey data was not collected at every program, and therefore, the number of responses is lower than the actual number of program participants. For questions measuring knowledge gain, McNemar's test was used to compare pooled pre- and post-test differences for individual questions (PROC FREQ, SAS, 2011). For questions in which participants self-assessed their abilities, one-tailed, paired sample t-tests were used to determine pre- and post-test differences for individual questions. A significance level of $p < 0.05$ for all statistical tests was considered significant.

In both Northern Virginia and New Jersey, an online follow-up survey was sent to all participants who provided contact information to determine program impact for encouraging behavioral changes and adoption of BMPs. In New Jersey, the survey was sent 3 to 6 months after the program and included additional questions concerning water conservation actions taken by the participant. In Northern Virginia, the survey was sent approximately one year after the program.

Results

From 2008 through 2010, 36 rain barrel programs were conducted in Northern Virginia with approximately 1,400 residents. In New Jersey from 2010 through 2011, 42 rain barrel programs were conducted with approximately 777 residents in communities throughout the state. New Jersey survey participants showed a significant increase in knowledge and abilities from pre- to post-survey on 14 of the 15 questions (Tables 1 and 2). The results in Table 1 show that before the workshop, participants did not have accurate information about the maintenance and installation of rain barrels. Additionally, although participants knew before the workshop that rain barrel water should not be used for drinking and cooking (99%), many did not know that the water should be tested before being used to water a vegetable garden (22%). Participants self-reported an increase in knowledge for understanding how to install a rain barrel at a home or building (Table 2). Many participants had prior knowledge of the environmental benefits of rain barrels (78%), methods for saving water in the home garden (83%), and how to reduce rainwater runoff from their home (91%). Similarly, Table 2 shows participants indicated a prior inclination to take steps at home to save water (96% pre-test "Agree" or "Strongly Agree") and reduce stormwater runoff (88% pre-test "Agree" or

"Strongly Agree").

Table 1.

Increase in Knowledge from Pre- to Post-Test

Multiple Choice Question and Answer	**# of Responses**	**Pre-test % Correct**	**Post-test % Correct**	**Increase in Correct Answers**	**p-value**
1. The environmental benefits of using rain barrels include reducing rainwater runoff from a home and reducing water pollution in lakes and streams.	236	78	95	+16	$p < 0.0001$
2. Methods for saving water in a home garden include using mulch on the soil around plants and planting native plants.	237	83	96	+13	$p < 0.0001$
3. The largest water user in a home is the toilet.	237	69	92	+23	$p < 0.0001$
4. A homeowner can reduce rainwater runoff from their home by diverting downspouts to a pervious area like a lawn or garden.	237	91	98	+7	$p < 0.01$
5. The water collected in a rain barrel should NOT be used for cooking and drinking.	236	99	99	0	*n.s.*
6. To prevent mosquitoes from entering the barrel keep a hose on the overflow and keep a screen on the top of the barrel at all times	236	62	86	+24	$p < 0.0001$
7. Before using a rain barrel to water a vegetable garden you should get the water tested at a laboratory.	222	22	63	+41	$p < 0.0001$
8. The types of barrels that are safe to convert to rain barrels are food grade barrels that previously contained soap or food.	224	51	80	+28	$p < 0.0001$
9. The first step when installing a rain barrel at a downspout on a house is to level the ground underneath the barrel.	224	43	74	+32	$p < 0.0001$

10. A 55 gallon rain barrel, when full will weigh approximately 400 pounds.	223	49	94	+45	$p <$ 0.0001
n.s. indicates not significant at the alpha = 0.05 level.					

Table 2.

Change in Self-Assessed Abilities and Skills from Pre- to Post-Test

Statement	# of Answers	Pre-Mean Responses*	Post-Mean Responses*	Pre-Percent Agree or Strongly Agree	Post-Percent Agree or Strongly Agree	*p*-Value
11. I know how to install a rain barrel at my home.	203	2.57	4.42	34	96	$p <$ 0.0001
12. I know how to install a rain barrel at my building.	141	2.38	4.31	24	93	$p <$ 0.0001
13. I will redirect my downspouts to a pervious area such as a lawn or garden.	186	4.02	4.50	88	95	$p <$ 0.0001
14. I will install products in my home that are certified as water efficient by the EPA.	183	4.12	4.39	96	99	$p <$ 0.0001
15. I plan to install a rain garden at my home.	175	3.57	3.72	74	82	$p<0.05$
*Responses were based on a 5-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). *n.s.* indicates not significant at the alpha = 0.05 level.						

Follow-up surveys showed that 73% of New Jersey respondents and 83% of Virginia respondents installed their rain barrel at home (Table 3). Most respondents indicated that their primary reason for having a rain barrel was to save water as opposed to reducing stormwater runoff or reducing wet areas on their property. Respondents also indicated that they use their barrel at least weekly and that their primary use was to fill up a watering can.

Fifty-eight percent of New Jersey respondents and 48% of Northern Virginia respondents indicated they had adopted at least one BMP learned from the program. Table 4 shows the most frequently adopted practice was to re-direct existing downspouts to a garden or mulched area (New Jersey- 54%, Virginia- 64%), which New Jersey respondents indicated on the pre-program survey as a

strong likelihood that they would adopt. Other actions that respondents took at home were to reduce lawn areas (Virginia- 35%), apply mulch to garden areas (New Jersey- 33%), or install a low-flow showerhead (New Jersey-32%). Not surprisingly, these are the most low cost, simplest actions to adopt.

Interestingly, although many New Jersey participants indicated on the program survey that they had plans to install a rain garden on their property (Table 2, question 15), few individuals actually had adopted this practice. It is possible that the rain garden requires more labor, money, and technical skill and would require further training for residents to install at home. It is also possible that additional time is needed to document rain garden installations, as indicated by the higher adoption rate in Virginia verses New Jersey for this practice. Virginia allows at least an additional 6 months to send out the follow-up survey than New Jersey. More of an effort should be made to connect participants with available rain garden trainings since many indicated an interest in this area.

Table 3.

Summary of Responses from Follow-Up Survey

	New Jersey	**Virginia**
Years of data collection	2009–2011	2008–2010
Number of surveys sent*	553	700
Did you install your rain barrel?	(n=201) 73% Yes	(n=482) 83% Yes
What was your primary motivation for getting a rain barrel?	(n=200) 80% Saving Water	(n=463)85% Saving Water
How often do you use your rain barrel?	(n=162)	(n=415)
Daily	22%	14%
Few times a week	41%	33%
Weekly	18%	22%
Less than weekly	22%	32%
Are you satisfied with the performance of your rain barrel?	(n=172) 87% Yes	(n=428) 92% Yes
Have you taken any other actions to reduce stormwater runoff or conserve water (NJ only) on your property?	(n=201) 58% Yes	(n=482) 48% Yes
*The number of follow up surveys sent was lower than the number of		

participants because not everyone provided contact information.

Table 4.

Breakdown of Other Actions Taken at Home by Follow Up-Survey Respondents
(– indicates question was not asked)

Best Management Practice	New Jersey (n= 116)	Virginia (n= 231)
Created a rain garden	4%	12%
Re-directed downspouts to gardens or mulched areas	54%	64%
Reduced pavement area	2%	11%
Added porous surfaces on walkways, patios and/or driveways	3%	8%
Installed a cistern	2%	1%
Installed a swale	0%	11%
Reduced lawn area	–	35%
Added mulch	33%	–
Installed a low flow showerhead	32%	–
Installed a low flow toilet	20%	–
Installed a faucet aerator	17%	–
Installed front loading washer	14%	–
Installed a low flow garden hose	12%	–
Installed a toilet tank bank	4%	–
Other	7%	8%

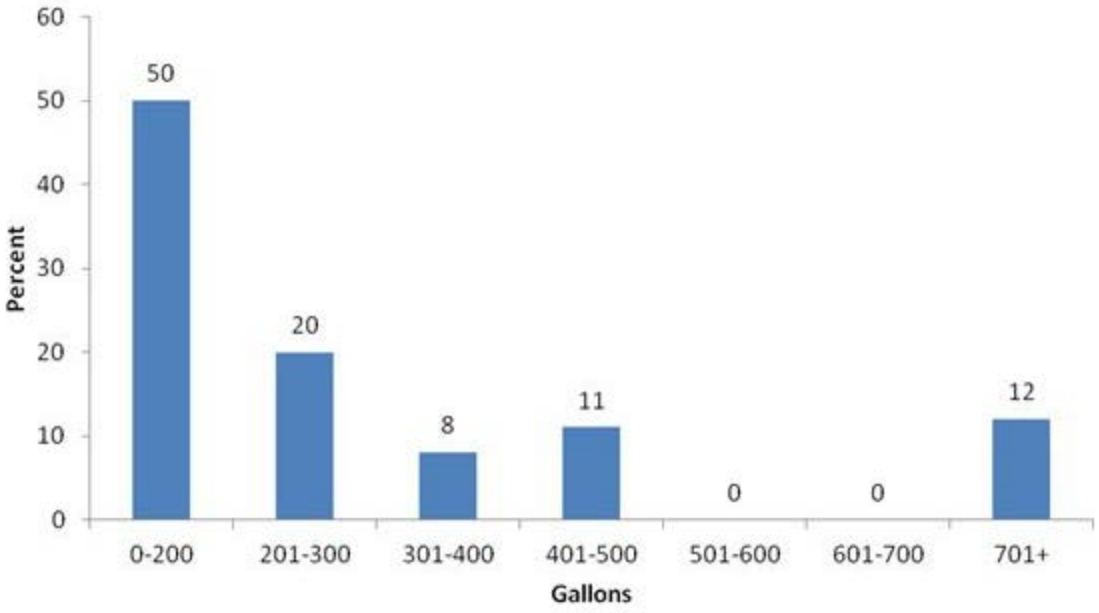
Other practices respondents indicated they have adopted at home are as follows.

- "We collect more water waiting for shower to warm up."
- "Have drawn up a stormwater plan (including drainage and rain garden)"
- "This spurred me on to have solar panels on my roof for electric…Signed the contract last Thursday."
- "We've reinstituted a few family water rules- timers on showers, washing pre-teen hair in kitchen sink instead of shower (drastically reduces pre-teen shower time), am/pm yellow/mellow rules."

New Jersey respondents were asked to estimate the number of gallons of water they had used from their rain barrel by considering the number of times the 55 gallon barrel had been emptied since installation. On average, respondents estimated using 352 gallons of water (n=66), with 70% of respondents reporting using less than 300 gallons from their rain barrel (Figure 1). There was no significant difference in estimated water use between 2010 and 2011, despite the fact that 2011 was the wettest year on record in New Jersey (Office of the New Jersey State Climatologist). Extension agents are currently working with residents to monitor water levels in their barrels for more accurate estimates of water use. Regardless, this information is useful for initiating studies of water savings achieved through small scale rainwater harvesting.

Figure 1.

Histogram of the Estimated Number of Gallons Used by Survey Respondents from Their Rain Barrel (n=67)



Discussion and Conclusion

Results showed that the enthusiasm generated by rain barrel programs can be used as an effective means for encouraging adoption of additional BMPs that protect water resources. Admittedly, a substantial number of respondents did not take any additional action at home (42%- New Jersey, 52%- Virginia) to reduce stormwater runoff or conserve water. Some respondents indicated that they had previously installed many of the water saving devices indicated on the survey. Others indicated they had future plans to install a rain garden, plant native plants, or reduce lawn area.

Future surveys should include questions about why additional actions were not taken and differentiate between actions taken before attending the program. Additionally, we cannot state definitively that rain barrels can act as a catalyst for changing behaviors without collecting data on a control group that did not participate in the program. Future research should compare program participant results to those of non-participants to determine whether there is a significant difference between BMP adoption rates. Last, an effort should be made to follow up with survey non-

respondents to account for their actions after participating in the program.

Results also showed that the program participants already have a high degree of understanding of how their actions at home affect the environment and were already inclined to take action to reduce their impact. Despite these results, the authors feel this program has much value. Considering the training is only 2 hours long, during which little time exists to review each BMP in detail, results are positive for using rain barrels as a hook for encouraging homeowners to adopt additional practices that reduce stormwater runoff, conserve water, and improve local water resources. Future programs should attempt to increase the technical information given at the program because attendees already seem to have a basic understanding of the environmental issues. Additionally, current programs are open to all geographic areas. A more focused approach in specific watersheds is needed that can better quantify the environmental impacts of an integrated rain barrel educational program on water quality and stormwater runoff volume.

References

Ando, A. W., & Freitas, L. P. (2011). Consumer demand for green stormwater management technology in an urban setting: The case of Chicago rain barrels. *Water Resources Research*, 47(W12501). doi:10.1029/2011WR011070.

dePaul, V., Rosman, R., & & Lacombe, P. (2009). *Water-level conditions in selected confined aquifers of the New Jersey and Delaware Coastal Plain* , 2003. Reston, VA.: U.S. Geological Survey. Retrieved from: http://pubs.usgs.gov/sir/2008/5145/pdf/SIR2008-5145.pdf

Dietz, M. E., Clausen, J. C., & Filchak, K. K. (2004). Education and changes in residential nonpoint source pollution. *Environmental Management*, 34 (5), 684-690.

Dietz, M. E., Clausen, J. C., Warner, G. S., & Filchak, K. K. (2002). Impacts of extension education on improving residential stormwater quality; monitoring results. *Journal of Extension* [On-line], 40(60) Article 6RIB5. Available at: http://www.joe.org/joe/2002december/rb5.php

Geller, E. S., Erikson, J. B., & Buttram, B. A. (1983). Attempts to promote residential water conservation with educational, behavioral, and engineering strategies. *Population and Environment*, 6(6), 96-112.

Jemison, J. M., Wilson, L., & Graham, J. (2004). Effecting land-use changes through education and implementation: Assessing the the effectiveness of the watershed stewards program. *Journal of Extension* [Online], 42(3) Article 3RIB4. Available at: http://www.joe.org/joe/2004june/rb4.php

Jones, M. P., & Hunt, W. F. (2010). Performance of rainwater harvesting systems in the southeastern United States. *Resources, Conservation and Recycling*, 54(10), 623-629.

Office of the New Jersey State Climatologist. (n.d.). Monthly Precipitation in New Jersey from 1895-2011. Retrieved from: http://climate.rutgers.edu/stateclim_v1/data/njhistprecip.html

SAS. (2011). SAS 9.2 product documentation. Retrieved from: http://support.sas.com/documentation/92/index.html

Taylor, A., Curnowb, R., Fletchera, T., & Lewisa, J. (2007). Education campaigns to reduce stormwater pollution in commercial areas: Do they work? *Journal of Environmental Management*, 84(3), 323-335.

Thurston, H. W., Taylor, M. A., Shuster, W. D., Roy, A. H., & Morrison, M. A. (2010). Using a reverse auction to promote household level stormwater control. *Environmental Science and Policy*, 13(5), 405-414.
