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Master Gardeners' Role in Encouraging Water Conservation Using a Rain Gauge Network

Abstract
Simplicity is the key toward New Mexico residents saving water. Farmers, ranchers, and residents are more likely to learn and adopt irrigation efficient technologies that are convenient and not management intensive. They can receive instruction in one such technology through the Community Collaborative Rain, Hail, and Snow network (CoCoRaHS), a community-based network of volunteers working together to measure and map precipitation. The implementation and growth of this network in New Mexico began with the Master Gardeners Program. Through the act of routine measurement and spatial comparison of precipitation, participants may gain a better appreciation of their limited water resources.

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Introduction

Despite its generally dry climate, agriculture in New Mexico is a major contributor to the state's economy. The majority of the productive farmland is located along the Rio Grande, Pecos, San Juan, Canadian, and Gila River valleys, where crops can be irrigated with river water. The rural, agricultural ambiance of these areas has resulted in their being targeted for development (Skaggs & Wiltgen, 2000). Consequently, they have experienced rapid population growth and decreasing municipal groundwater supplies. Residential or lifestyle agriculture is widespread and is practiced by both newcomers and residents whose roots in the region are hundreds of years old.

Many irrigation technologies and management practices are available to improve water conservation and increase irrigation efficiencies. Effective precipitation is important in irrigation decisions. In arid regions such as New Mexico, where little or no rainfall occurs during the growing season, irrigation water can be applied at fairly routine intervals and in routine amounts. However, adoption level of technologies and management practices is ultimately determined by individuals. Recent studies (Smith, 2002; Fernandez-Cornejo & Hendricks, 2002) conclude that convenient technologies that are not management intensive and take no extra thought are most likely to be adopted (Skaggs & Samani, 2005). While this article does not address the effective use of rainfall to adjust irrigation schedules, it identifies that precipitation is one of the components of the irrigation equation to improve water use efficiencies.

One such technology is the simple and routine measurement of precipitation for use in irrigation scheduling. By engaging New Mexico residents in a Web-based project of precipitation measurements and mapping, new data resources for water budget calculations are being developed and increased awareness of the spatial variability of water resources is occurring. The development, implementation, and growth of a statewide rain gauge network in New Mexico began with the Master Gardeners Program, because its participants could use the data and help educate the community about water efficiency practices.

New Mexico Master Gardeners

New Mexico State University established the New Mexico Master Gardeners program in 1981 to assist their local Cooperative Extension Service (CES) office in providing accurate, research-based gardening information to county residents <http://cahe.nmsu.edu/mastergardener/>. In 2004, there were approximately 350 active members in 14 counties and the Navajo Nation Extension Service.

To receive the title of Master Gardener in New Mexico, individuals must:

- Receive 40 to 90 hours of initial instruction,
- Annually participate in 12 to 25 hours of additional training, and
- Volunteer 40 to 50 hours of service, depending on their local CES requirements.

Most participants usually donate 100 hours of volunteer time each year. After graduating the Master Gardener program, volunteers work under the guidance of their local CES agent to perform a variety of extension and outreach activities.

CoCoRaHS

The Community Collaborative Rain, Hail, and Snow Network (CoCoRaHS) was first established in Colorado in 1998 as a grassroots volunteer network of backyard weather observers of all ages and backgrounds working together to measure and map precipitation in their local communities.

Participants in CoCoRaHS:

- Measure rainfall and snow water equivalent to the nearest 0.01 inch using a standard 4-inch diameter rain gauge,
- Submit daily precipitation data to the CoCoRaHS Web site (www.cocorahs.org), and
- Provide intense rain or hail reports during major storms, for use by the National Weather Service in the issuance and verification of flood and severe thunderstorm warnings.

By using low-cost measurement tools, stressing training and education, and using an interactive Web site, CoCoRaHS provides high quality data for natural resource, education, and research applications and supplements existing official precipitation networks with more detailed local data (Doesken, 2000).

Master Gardeners Working Together with CoCoRaHS

One of the earliest and most successful efforts in expanding the CoCoRaHS Network in New Mexico has been through the CES agents and the Master Gardeners program. Since March 2005, CoCoRaHS training has been delivered to approximately 150 Master Gardeners. Additionally, CoCoRaHS information is being incorporated into new trainees' initial instruction.

Training provided to the Master Gardeners includes:

- Training and instruction in the measurement of rain, hail, and snow;
- Guidance on where to place equipment for accurate measurements;
- Information as to why the data are important; and
- Instruction on how to submit their daily observations to the CoCoRaHS Web site (http://www.cocorahs.org) and how to access precipitation maps and reports.

Master Gardeners active in the CoCoRaHS program are being credited with one volunteer hour, per month. Some Master Gardeners' also serve as county coordinators, in which they:

- Act as a local contact for questions, information, and equipment;
- Assist with data quality control for their region; and
- Help recruit and train new volunteers

CoCoRaHS volunteers exist in all counties with active Master Gardeners Programs. In fact, of the 311 registered volunteers in New Mexico (as of December, 2005), approximately 47% said that they heard of the project through either their county Extension agent and/or the Master Gardeners Program (Table 1).

Table 1.
Referral Source for New Mexico CoCoRaHS Observers

Referral Source	Number of Referrals	Percentage
Cooperative Extension Service/Master Gardeners	145	47%
Family/Friend/Co-Worker	26	8%
Media	24	8%
State Climate Office	19	6%
New Mexico Floodplain Managers Association	17	5%
National Weather Service	6	2%
Other	10	3%
None Listed	64	21%
Total	311	100%

Master Gardeners and CoCoRaHS Influencing Water Conservation

During their volunteer service, Master Gardeners are in an ideal position to recruit new CoCoRaHS volunteers and to educate the community about the importance of taking local precipitation into account when scheduling irrigation. For example, by simply considering local precipitation to calculate irrigation needs for Santa Fe, Albuquerque, and Las Cruces, over 60 million gallons of water could be conserved in these three cities alone (Table 2). Given the current residential water rates in these cities, this translates to an unnecessary water cost of nearly $113,000.

Table 2.
Savings Obtained by Considering Rainfall into Lawn/turf Irrigation Needs

	City			
	Santa Fe	**Albuquerque**	**Las Cruces**	**Totals**
Area				
(Square Miles)	35	400	52	
Average Rainfall				
(Inches per year)	13.84	8.66	9.21	
Rainfall over Landscape = Saved Water				
(Acre-ft per year)	20.18	144.33	19.96	**184.47**
(Gallons per year)	6,576,759.35	47,031,161.00	6,502,356.71	**60,110,277.06**
Cost of Water				
(Value of 1000 gallons)	$4.50	$1.63	$1.00	
Value of Rainfall				
($ per year)	$29,595.42	$76,660.79	$6,502.36	**$112,758.57**
Note: The calculations assume 50% of the city area to be either turf, lawns, trees, or shrubs (Faurus, Wagner, & Podmore, 2005). City areas were obtained from <http://www.itsatrip.org/abqinfo/faq/> and <http://www.city-data.com>. Precipitation totals were obtained from <http://www.wrcc.dri.edu>.				

Water use outdoor varies depending on climate and irrigation requirements for lawns and

landscapes in New Mexico. Outdoor water use for New Mexico generally accounts 50% to 70% of the total residential water use. "In a study of 20 residents in Las Cruces, NM, annual water use for landscape irrigation ranged from 108,000 gallons to 204,000 gallons to irrigate 5219 square feet" (Wilson, 2003). According to the U.S. Geological Survey, residential water demand in the U.S. averages more than 26 billion gallons per day, and an estimated 30% is devoted to outdoor use, primarily lawn irrigation. Whether it is an agricultural field, home lawn, commercial landscape, or athletic field, over watering is a common mistake, which oftentimes occurs simply because individuals irrigate regardless of the environmental conditions outside.

Using the knowledge and expertise of our local Master Gardener's, our future plans for CoCoRaHS include developing:

- Educational training packets that will assist New Mexico residents in outdoor water conservation practices and
- An interactive Web site using rain gauge data and landscape information to assist homeowners, water managers, planners, and farmers in water conservation measures on irrigation.

Conclusion

What started as a collaborative data collection venture has developed into an exciting community-based, science education program that includes classroom presentations, field trips, training, picnics, and informal seminars. CoCoRaHS includes over 2,500 active volunteers from New Mexico to Pennsylvania. The initial development of CoCoRaHS in New Mexico began through the Master Gardener program and is now being expanded to address the issue of efficient water use throughout New Mexico.

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