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Ideas at Work

An Extension Education Program to Help Local Governments with Flood Adaptation

Abstract

Education is an important tool to increase the capacity of local government officials for community flood adaptation. To address flood adaptation and post-flood stream management in municipalities, Cornell Cooperative Extension and collaborators developed an educational program to increase municipal officials' knowledge about how to work effectively in streams after a flood. Overall, the program significantly increased knowledge of stream science, post-flood stream response, and structural techniques. To increase the effectiveness of the programs, future workshops should strive to increase participant knowledge retention over time and actively recruit participants with a low level of starting knowledge of streams and flooding.

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Introduction: Research-Based Education

Over the next century, climate change is predicted to expand the areas at risk for flooding in the U.S. by 40-45% (FEMA 2013). Local government can play an important role in flood adaptation (i.e., taking steps to reduce the impacts of future flooding). Education can build local capacity for disaster preparedness, response, and resilience, including community flood adaptation (Myron, Hall, Sahr, Gebeke, & Hvidsten, 2012; Boteler, 2007; Keim, 2008; Roberts, 2008). In fact, 62% of percent of municipal officials interviewed in the Hudson Valley identified a lack of information about streams and flood issues as a barrier to community flood adaptation (Gary et al., 2013). To mitigate flooding, a frequent practice in municipalities is to channelize (deepening or widening streams) or build berms (to raise the stream's banks) along streams. However, these practices do little to address flooding issues and, in most cases, cause increased stream velocity and erosion (Thigpen, 2006).

Program Description

To address flood adaptation and post-flood stream management in municipalities, Cornell Cooperative Extension collaborated with the Lower Hudson Coalition of Conservation Districts to develop an educational program offering two Post Flood Stream Intervention training workshops in the Hudson Valley during 2013. One workshop was held in Greene County (Greene) and one in Dutchess County (Dutchess), NYS. The workshops were conducted as part of the Hudson Estuary Watershed Resiliency Project, which

provides assistance to communities in developing effective flood readiness response plans. Each training workshop included two parts: a 6-hour classroom session followed by a 5-hour field-based session 6 months later.

Purpose of Workshops

The purpose of the Post Flood Stream Intervention workshops was to increase participants' knowledge of stream and flood science and to improve decision-making ability when working in streams after a flood. The workshops introduced basic concepts of stream science and techniques related to working in streams after floods.

Content of Workshops

- Classroom sessions were organized into presentations on flood emergency response, recovery, and restoration. Presenters used local case studies to present information on basic stream science, post flood stream response, channel stabilization, and construction techniques.

- Field sessions included visits to several stream restoration sites to view techniques to restore stream channel dimensions and bank stability. Participants learned emergency response techniques that protect infrastructure and property, while minimizing negative impacts on stream channels.

Target Audiences

- Town highway personnel (e.g., Highway Superintendents, equipment operators, Deputy Highway Superintendents)

- Hudson Valley Soil and Water Conservation District staff

- Contractors who perform work in streams

Participation

- Greene Classroom Session: 24 participants

- Greene Field Session: 24 participants

- Dutchess Classroom Session: 37 participants

- Dutchess Field Session: approximately 12 participants

Program Evaluation Methods and Results

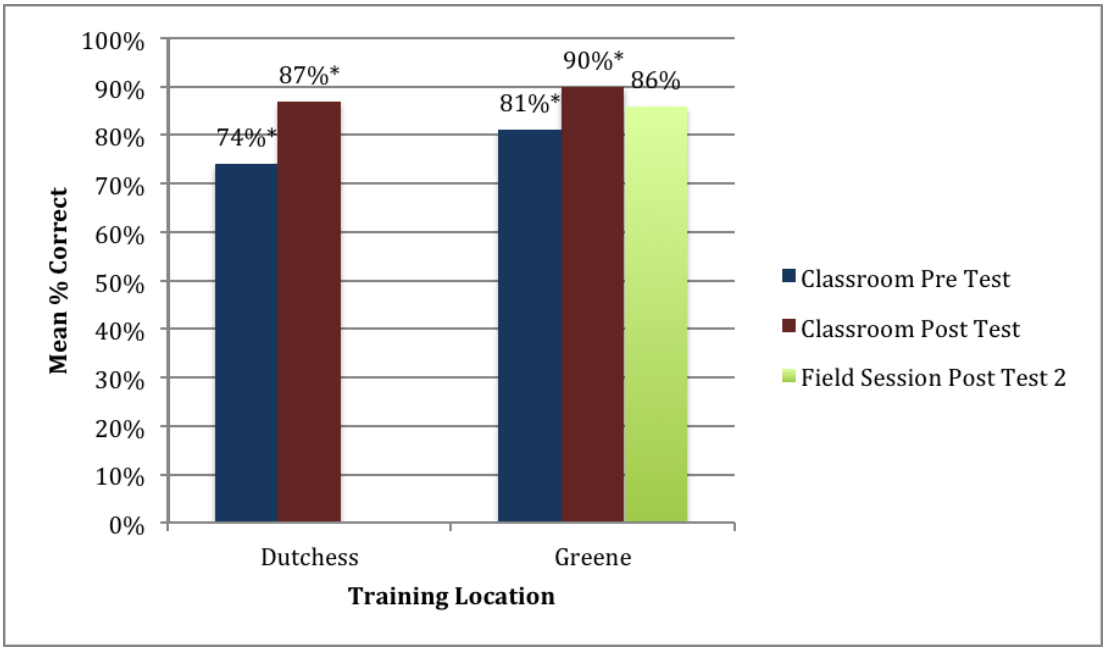
We used a pre-test/post-test design to gauge changes in knowledge as a result of participating in the educational program. Program participants were asked to complete a series of true/false and multiple-choice knowledge questions. The questions tested participant knowledge of flooding, stream function, and post-flood stream intervention prior to the beginning of the workshops and immediately following the workshops. To measure knowledge retention, participants were asked to answer the same set of

knowledge questions immediately after the conclusion of the field session held 6 months after the initial workshop. Additional questions asked participants about their municipalities' flood preparedness and the overall usefulness of the workshops. Due to staffing limitations, the post-test evaluation was not administered at the end of the Dutchess field session. T-tests and Fisher's exact tests were used to determine significant differences between correct responses on the pre and post-tests.

Participants experienced significant knowledge gains between the pre- and post-tests for the classroom sessions (Figure 1). In Dutchess, the average knowledge gain in terms of correct responses was 13%, and in Greene, 9%. In Greene, where a second post-test was administered to the same participants following the field session, there were no significant differences between the mean scores 6 months later, indicating knowledge retention (Figure 1). Both classroom sessions resulted in knowledge increases of over 40% on the topic of woody debris management (Table 1). Additionally, the Dutchess classroom session resulted in significant knowledge increases on the topics of stream damage, stream equilibrium, and floodplains (Table 1). Sixty-nine percent of participants in Dutchess and 74% in Greene classroom sessions planned to implement the stream management techniques recommended in the workshops; 40% of participants from Dutchess and 32% from Greene felt their municipality was not well prepared for floods.

Figure 1.

Knowledge Gain and Knowledge Retention from Post-Flood Stream Intervention Trainings in Dutchess and Greene Counties, New York



*significantly different at p<.05

+No evaluation data available for post-test following Dutchess field session

Table 1.

Percent Change in Correct Answers Between the Pre- and Post-Tests Administered Before and After the Classroom Sessions in Greene and Dutchess Counties and Between the Classroom and Field Session in Greene County

Questions	Dutchess Classroom Session % Change Pre --> Post	Greene Classroom Session % Change Pre --> Post	Greene Field Session % Change Post --> Post
True/False (Correct answer in parentheses)			
a. Floods are the most common natural hazard in the Hudson Valley. (T)	+12%	+17%	0%
b. The dominant size sediment in a stream depends on the stream's energy. (T)	+13%	0%	+5%
c. "Emergency Response" includes immediate repairs to prevent loss of life and property, and opening roads. (T)	-4%	-4%	+4%
d. Topography does not influence stream type. (F)	+3%	0%	-8%
e. The pattern, profile and dimension of a stream results from flow and sediment characteristics. (T)	-1%	+4%	-8%
f. Streams can withstand flooding without major damage. (T)	+31%*	+22%	-12%
g. Stream reaches that are in not in equilibrium are subject to erosion and deposition. (T)	+26%*	+17%	-4%
h. Floodplains are an integral part of a stream. (T)	+20%*	-4%	+9%
i. Development in a floodplain does not impede floodplain function. (F)	+2%	0%	-24%
j. A step-pool is a common category of stream. (T)	+21%	+13%	-16%
k. Changing a stream's width/depth dimensions can contribute to erosion. (T)	+3%	-4%	-4%
l. In almost all cases, dredging will solve flooding problems. (F)	+9%	-13%	+13%
m. Stream channelization will cause	+13%	+9%	-11%

downstream flooding. (T)			
n. Gravel berms are effective flood control structures. (F)	+18%	+39%*	-12%
o. Woody debris should always be removed from streams. (F)	+42%*	+48%*	0%
p. Dredging a stream deepens it, which reduces problems of flooding and erosion. (F)	+11%	+22%	-4%
q. After a channel is straightened, water will get to downstream areas faster and increase the risk of flooding. (T)	-2%	+9%	0%
r. Disturbing the streambed substrate will increase the stream's potential for erosion. (T)	+10%	-4%	-4%
Multiple Choice (respondents provided with 4 alternative choices for each of the following questions)			
s. If streams were to be dredged, it would make them deeper and would prevent all flooding and erosion problems. What do you think?	+2%	+9%	-8%
t. Streams should be straightened to keep them from washing out the streambank. If the water flows through streams faster, it won't flood the neighboring properties. What do you think?	+12%	+9%	+5%
u. Bulldozers should be used to build up streambanks for flood protection. What do you think?	+15%	+9%	-16%
significantly different at p<.05			

Conclusions

The evaluation results indicate that the Post-Flood Stream Intervention program effectively increases knowledge of local government officials and other first responders about post-flood stream response techniques. Results demonstrate significant knowledge gains for both training locations, but also that the audiences came to the trainings with a fairly high level of understanding (see pre-test scores, Figure 1). Thus, it is necessary to make a concerted effort to reach audiences that may not have an understanding of flood issues, streams, or climate change and may be undertaking harmful post-flood stream intervention techniques.

The Post-Flood Stream Intervention workshops are positively affecting peoples' knowledge about important

issues regarding flood response, as seen by a significant overall increase in knowledge (Figure 1) and significant knowledge gain of up to 48% on some topics (Table 1). However, there were topics for which there was no knowledge gain from pre- to post-workshop or a knowledge decrease. For example, stream channelization (dredging) does not prevent flooding and can even worsen flood conditions (NYSDEC 2013). The pre-post knowledge change scores for this topic were largely in the positive direction; however, there was no statistically significant knowledge gain on this topic. The negative change in knowledge scores on some questions following the field session may indicate a lack of knowledge retention in some areas. Several months elapsed between the sessions, and many of the questions with negative changes in post-test scores were tied to terms and definitions of stream science. The topics with negative retention scores may require more repetition or depth for the audience to retain the information. Key information should be reviewed at the beginning of each session of the training.

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