School Education and Model Assessment - Final Report

City of Davis

Project Summary

Through its Pollution Load Reduction Program, the City of Davis identified certain pesticides as pollutants of concern in the City's stormwater runoff and determined that the residential use of pesticides is the primary source of pesticides in its stormwater. As a result, the City launched the Healthy Gardens Program, an outreach program focused on reducing residential pesticide use and encouraging the use of IPM principles. During the first year of the program (1998) which was partially funded by a PESP grant, outreach included development of a fan brochure describing less toxic approaches to managing local pests, a movie theater slide with a message about using less pesticides, master gardener workshops, numerous newspaper articles and photos to raise public awareness, signs identifying the use of IPM in municipal areas, and signs explaining the connection between a local wildlife habitat, the City's stormwater, and residential pesticide use.

The Healthy Gardens Program directly impacts the 57,000 people in the City of Davis (approximately 6500 acres). The intended result of the project is to reduce the amount of pesticides entering receiving waters in and around Davis as a result of urban pesticide use. Reduced pesticide levels would contribute to protecting aquatic life in local waterways and preserving the wetlands and wildlife habitats that have been developed in and around Davis.

The objectives of the project funded by the 1999 PESP grant was to assess the effectiveness of the Healthy Gardens Program and to develop an education program targeting elementary age children and their families. The assessment results will be used to guide future planning with respect to scope and budget for the City's Pollution Prevention Program. The education program was developed in coordination with Explorit Science Center.

The information obtained about educating the public regarding pesticide use through the Healthy Gardens Program can easily be adapted and used by other communities around the country who are seeking an effective approach to encouraging residents to alter their pesticide use practices.

Project Description

Details of the education program and the evaluation effort have been described in the quarterly reports (August 11, 1999 and November 15, 1999). A third quarterly report was prepared describing the final tasks wrapping up the project and is attached. The education program, the evaluation effort, and project results are described below.

Education Program

The education program was developed in coordination with Explorit Science Center according to the following tasks:

- Create summer long exhibition 'How Does My Garden Grow?'
- Create a series of week long classes based on the garden exhibition
- Publicize summer program
- Evaluate course and exhibition

The summer exhibition at Explorit Science Center, How Does My Garden Grow, opened on June 26 and ran through October 3, 1999. It was based on interactive activities with the objectives of

understanding interactions between living and non-living garden components, learning about plant structures and their uses, and investigating the impact gardens have on the environment. The exhibition was divided into areas pertaining to water, photosynthesis, plant anatomy, soil, and seed planting. In each area, several activities are available pertaining to the topic. In addition to public hours, Explorit offers Discovery lessons to school groups and other organizations on weekday mornings. 1037 people (460 adults and 577 children) attended the exhibition during public hours. In addition, 56 Discovery Lessons were conducted with 1060 students attending and 325 adults (i.e., teachers, chaperones, etc.).

Publicity included development of brochures describing Explorit and the summer exhibition, distribution of information to local school districts on the exhibit and the summer classes, distribution of exhibit brochure in Davis and surrounding cities and counties, and press releases to local newspapers and radio stations. The exhibit brochures were distributed at libraries, nurseries, hardware stores and drug stores in Yolo, Solano, and Sacramento counties.

Two week long summer classes, one for 1st - 2nd graders and one for 3rd - 5th graders, were conducted. In addition, a three day class for preschoolers was also conducted. A total of 60 children attended the three classes.

To evaluate the exhibition, survey cards were placed at the exhibit entrance. Two types of surveys were available, one targeting adults and one targeting children. The results of these evaluations are discussed in the attached quarterly report.

Healthy Gardens Program Evaluation

The Healthy Gardens Program assessment attempted to answer the following questions:

- Do Davis residents recognize the logo and title of program?
- Do they remember the message of the program?
- Do they understand the connection between pesticide use and pollutants found in local waterways?
- Where have they seen this information displayed?
- Have they made any changes in their gardening or pest control practices as a result of the program?

The following strategies were used to answer the questions stated above.

- A random telephone survey of Davis residents was conducted to determine gardening practices, awareness of the Healthy Gardens program and the impact of its message. To supplement the telephone survey, a mailed survey was prepared containing several of the same questions which allowed the results to be combined. A total of 332 surveys were completed with 142 telephone surveys and 190 mailed surveys.
- A kiosk with survey cards and a display of outreach materials were developed. The kiosk was placed in several locations around Davis to assess the effectiveness of different locations and materials used in the Healthy Gardens program. A total of 124 survey cards were collected using this method.
- A survey was place on the Public Works web site and linked to the Healthy Gardens website. This did not turn out to be an effective way to assess the program. Approximately 30 responses were collected and none of the respondents had heard of the program.

Telephone and mailed survey results were compiled as reported last quarter. These results were further analyzed as discussed in the attached report. The objectives of the survey were to determine the impact of the Healthy Gardens Program on Davis residents' awareness of pesticide water pollution and behavior associated with pesticide use, and to determine the most effective

methods of providing information on pesticides. For most responses, there was no significant difference between the telephone and mailed survey responses so the responses were combined. Findings from the survey are summarized in the attached quarterly report.

Results and Conclusions

Conclusions regarding educating the public about pesticide use and its impact on water pollution are listed below:

- Using a Science Center as an alternative to working with the public schools was an effective way of reaching a large audience over a wide geographic area. In addition, this was a way for a program targeting a school audience to reach adults (who accompany their children to the exhibit) directly rather than hoping the children bring the message home from school. Based on responses to the exhibition surveys, this also appears to be an effective method for inserting a message about pesticides and preventing water pollution into a larger science topic.
- The Healthy Gardens Program was reasonably effective in that survey results indicate that approximately half the survey respondents recalled seeing program materials. In addition, 23% of respondents said they had received information on reducing pesticide use from the City and 18% knew what the message of the program was. On the other hand, while between 4% and 17% of survey respondents said they had changed their pesticide use practices as a result of the Healthy Gardens Program, more could be done to encourage behavior change.
- The most effective outreach materials appear to be the North Pond sign, the movie theatre slide, the demonstration signs and, possibly, the pesticide management guides. In addition, locations that are effective for conducting outreach on the topic of pesticides include the North Pond (and other wildlife ponds), the Farmers Market, the local movie theatres and local stores.
- Based on the result that a large portion of survey respondents indicated that they get information about gardening and pesticides from the University, the City should consider working more closely with the University on future outreach efforts.
- The City seems to have been successful in educating the public about the destination of wastewater and has begun to make a connection between residential stormwater runoff and local waterways (e.g., like the North Pond). The City should continue to reinforce that connection and provide more information about the connection between residential pesticide use and water pollution. In addition, the City should work on providing residents with a better understanding of IPM.
- The City should also continue to evaluate its program. Using a mail survey to follow up on changes in residents' knowledge regarding water pollution issues could be useful but mail surveys should strive to be brief to get the best response rate.

Future Plans

The City of Davis plans to continue the Healthy Gardens Program and enhance several aspects including movie theatre slides and increased publicity of the pest management guides, the signage around Davis, and its website. In addition, the City plans to expand its efforts related to school programs and explore further partnerships with Explorit Science Center. Some additional program evaluation is being conducted as part of a grant from the Water Environment Research Foundation. Additional stormwater monitoring is being conducted to assess changes in Davis urban runoff pesticide levels.

Key Personnel

The following people worked on the project:

Jacques DeBra, City of Davis
Jacques has worked in the city's Public Works Department for 10 years. He has responsibilities for oversight and management of water, wastewater and stormwater programs and projects. He is the project manager for the city's pollution prevention program and was involved as a primary participant on the city's 1998 and 1999 PESP Grant projects. Jacques has worked in managing public utilities for 14 years.

Betsy Elzufon, Larry Walker Associates
Betsy Elzufon is a Senior Engineer with Larry Walker Associates. She has developed pollution prevention programs and conducted source identification for several agencies including the City of Davis, Sonoma Valley County Water District, Novato Sanitary District, Palo Alto Regional Water Quality Control Plant, and the City of Woodland. She was the principle investigator for the WERF Residential and Commercial Source Control Assessment and is now working on a WERF grant to develop tools to measure source control program effectiveness. Betsy served as the project manager for the 1999 PESP project.

Reed Harris, Harris and Company
Reed is a Principal of Harris & Company. He has twenty years experience in developing community relations and public information strategies as a consultant on public works-related planning, design, and construction projects. Reed has developed and managed public information programs for stormwater projects, environmental remediation, wastewater collection and treatment, water quality, transportation planning, and stormwater projects. Some of his projects include directing the Davis Stormwater/Pollution Prevention Project and working on the City of Los Angeles' and Los Angeles County's Stormwater Programs. Reed provided technical review for several aspects of the 1999 PESP project.

Bobbi Cox, Harris and Company
Bobbi has ten years of experience with community outreach programs for public works projects that relate to watersheds, wastewater, biosolids management, solid waste disposal, stormwater, and groundwater. Some of the projects she has worked on recently include the Sacramento River Watershed Program, the Lopez Canyon Landfill Public Outreach Program, and Communications for the Sacramento Coordinated Water Quality Monitoring Program. For this project, Bobbi developed and conducted the card survey, conducted publicity for Explorit, and assisted with the mailed survey.

Linda Whent, University of California - Davis
Linda is the Master Advisor for the Agricultural Education Program at UCD. Her education includes a B.S. in Animal Science, an M.Ed. and a Ph.D. in Agricultural Education. During her ten years at UCD, she has had extensive experience in program and curriculum evaluation. For this project, Linda conducted the phone survey and analyzed the results of the phone and mailed surveys.

Suzanne Ullensvang, Explorit Science Center
As Explorit's Executive Director, Suzanne oversees the daily operations and long-term planning for Explorit Science Center. Her background includes over nine years of experience as a manager in science based, education organizations. She an M.S. in Biological Sciences and B.S. in Product Design Engineering. For the PESP project, Suzanne managed the overall development of the summer exhibition and classes.

Karen Cebra, Explorit Science Center
As Exhibits Director Karen develops, fabricates, and oversees the changing exhibit on the public floor and was therefore responsible for developing and constructing the summer exhibit, How Does My Garden Grow? Karen's experience prior to Explorit includes Curatorial Assistant; Collections Manager; Exhibits Consultant, Developer, and Fabricator at the Michigan State University Museum and at the California Academy of Sciences in San Francisco. She has a B.S. in Biology and an M.S. in Zoology.

Laura Bassein, Explorit Science Center
As program director Laura oversees all aspects of program development, marketing and delivery at Explorit Science Center and was therefore responsible for development of the summer classes sponsored by the PESP project grant. Her background includes over ten years of involvement in informal science education. She received a J.D. and B.A. in Environmental Biology from the University of Colorado at Boulder.

References

The following references are useful regarding planning and evaluation of pesticide related education and outreach programs.

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Public Research Institute, San Francisco State University. Educating the Public About the Use and Safe Disposal of Household Toxic Products. A Survey of San Francisco Households. Prepared for San Francisco Department of Public Works Water Pollution Prevention Program. June, 1996.

Public Research Institute, San Francisco State University. Survey of San Francisco Households. Prepared for San Francisco Public Utilities Commission Water Pollution Prevention Program. July, 1998.

King County Local Hazardous Waste Management Program (LHWMP). Flashpoint. www.metrokc.gov/hazwaste/pubs/flashpoint.html February, 1998a.

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Healthy Gardens Program Evaluation

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Introduction

The potential impact of pesticides on public health is substantial. The U. S. Environmental Protection Agency (U.S. EPA) reports that 69 million American households, or 85 percent of all families, store and use pesticides in and around the home. Poison control centers reports and hospital-based data suggest that the impact of acute pesticide poisoning may be significant (Blindauer et. al, 1999). Information regarding pesticide levels is vital in managing water quality. Discoveries of pesticides in unlikely places such as community drinking water should caution authorities regarding the nature of the contamination (Graffy, 1998).

Through its Pollution Load Reduction Program, the City of Davis identified certain pesticides as pollutants of concern in the City's storm water runoff and determined that the residential use of pesticides was the primary source of pesticides in its storm water system. As a result of this finding, the City of Davis initiated the Healthy Gardens Program. The Healthy Gardens Program focused on reducing residential pesticide use and encouraging the use of integrated pest management (IPM) principles. The goal of this community outreach program was to increase Davis residents' knowledge about the impact of residential pesticide use and disposal on area surface waters. To achieve this purpose, outreach efforts and information about alternative pest control practices were distributed in and around Davis. Specific logo information and outreach sites are presented in Appendices 1 and 2.

Purpose and Objectives

The purpose of this study was to determine the impact of the Healthy Gardens Program on Davis residents' knowledge of residential pesticide use and to determine changes in pesticide use and use of integrated pest management practices. In addition, the City of Davis sought to determine which types of public outreach materials were effective communication tools.
Specific objectives were:

1. To determine if differences existed between mailed survey and telephone survey respondents in their demographics, and knowledge and attitudes about gardening and pesticide use.
2. To determine the percent of Davis residents who remember receiving information about pesticide use from the city or community and in what form the information was received.
3. To determine where Davis residents generally receive information about gardening.
4. To determine Davis residents' knowledge of the Healthy Gardens Program as measured by:

    a. if residents recognize the logos of the Healthy Gardens Program,
    b. where residents have seen or heard information about the Healthy Gardens Program, and
    c. residents' knowledge about the message of the Healthy Gardens Program.

5. To determine if Davis residents have changed gardening or pest control practices as a result of information from the City of Davis and/or the Healthy Gardens Program.
6. To determine the effectiveness of chosen sites in displaying program information to the greatest number of people.
7. To determine single-family residents' awareness of at-home water pollution reduction activities, as measured by:

    a. residents' understanding of the connection between pesticide use and pollutants found in local waterways,
    b. residents' knowledge of IPM practices,
    c. residents' methods of household and auto chemical disposal,
    d. residents' knowledge of storm drain systems and water treatment, and
    e. residents' awareness of at-home water pollution activities when compared with data from a 1996 Davis water study.

Methodology

To achieve the purpose and objectives a research study using descriptive survey methodology was undertaken. The population consisted of 12,850 single-family residences in Davis, California based on the City of Davis water billing records. A random sample of 253 was needed for the 95 percent confidence level set apriori (Scheaffer, Mendenhall, and Ott, 1986).

Two questionnaires were used in this study: one questionnaire collected data from telephone respondents (Appendix 3) and the other, shorter version collected data from a mailed survey (Appendix 4). Data were collected from the telephone survey May through July 1999. Telephone numbers were randomly selected from the City of Davis phone directory. Only respondents who lived in single-family dwellings and had access to gardens were asked to participate in the telephone survey. A total of 142 telephone surveys were collected. The mailed questionnaire was sent to Davis residents living in single family dwellings during July through August 1999. A sample of 500 was generated using a random generator type program from the City of Davis Public Works Department list of 12,850 single-family residences in Davis. The surveys were addressed to "Resident" in an attempt to make sure that both owners and renters received the survey. Due to a tight time frame and the supporting telephone survey, nonrespondent mail surveys were not solicited. A total of 190 mailed surveys were received, providing a total of 332 completed surveys.

A review of the 1996 Davis Water Study questionnaire was used to obtain information regarding resident knowledge of chemical disposal methods and storm drain systems and water treatment. (Davis Water Study et. al., 1996). In addition, data from this study were used for water pollution knowledge comparisons.

The questionnaires used a Likert-type scale, containing five indicators representing gardening activities and pesticide awareness. Responses were recorded using the following scale:

Response Levels

No never	Rarely	Sometimes	Often	Always
0	1	2	3	4

Both questionnaires contained categories with "yes" and "no" answers and open-ended questions. Data were analyzed used Stat View Statistical Program. Descriptive statistics employed group means, standard deviations, counts and frequencies. Group comparisons employed group T-tests and Chi-Square analyses.

Results

Differences between mail and telephone survey respondents in their demographics
Data were analyzed to determine if differences existed between mailed survey and telephone survey respondents. No differences were observed between telephone respondents and mail respondents with regard to age, years living in Davis, number living in the home, residential area in Davis where they lived, and their educational levels. The mean age of respondents was 45.6, ranging from 17 to 92. They had lived in Davis a mean of 15.6 years, ranging from 1 to 84 years. Respondents reported a mean of 2.8 people living in the home.
Differences were observed between mailed and telephone respondents in the following areas. A Chi-Square value of 34.58 (p =.0001) indicated that significantly more homeowners responded to the mail survey than renters. Mail survey respondents reported higher income levels than telephone respondents, Chi-Square 34.9 (p = .0001). In addition, only two mail respondents indicated they did not garden whereas 28 telephone respondents said they had access to a garden but did not garden, Chi Square = 35.6 (p = .0001).

Of the telephone respondents who gardened, there was no difference between the degree of gardening reported by the mailed and telephone survey respondents. Both groups responded gardening often. Mailed respondents hired gardeners significantly more often than telephone respondents. Mailed respondents reported "rarely" hiring gardeners whereas telephone respondents reported "never" to "rarely" hiring gardeners. These data are presented on Table l.

Table 1. Comparison of group means between mailed and telephone responds on Likert scale items

Question	Mailed Mean	Telephone Mean	T value	Probability
How often do you or someone in your household garden?	2.80	2.86	.54	.59
How often do you hire someone else to take care of your garden?	1.02	.53	3.00	.003**

*Significant at 95% level ** Significant at 99% level

Information about pesticide use received from the city or community
Respondents were asked if they remembered receiving information about pesticide use from the city or community, 23% responded yes, n = 269. Interestingly, significantly more telephone survey respondents remembered receiving information about reducing pesticide use from the City of Davis compared to mail survey respondents, Chi Square = 4.8 (p = .03). Results of the open-ended questions asking how or where respondents received information is presented on Table 2. Most respondents remembered receiving information from the city through city pamphlets and/or other mailed information. A few respondents remembered specific programs or classes.

Table 2. Open-ended question asking how or where residents received pesticide information from the city or community.

Count	Frequency (%)	Information Source
13	37.1	City pamphlet
4	11.0	Mailed information
2	5.7	Can't remember
2	5.7	Inside recycling booklet
2	5.7	Department of Water Resources
2	5.7	Farmers market
2	5.7	Davis Enterprise
1	2.8	Something every year
1	2.8	Davis Lumber
1	2.8	News paper
1	2.8	TV or radio
1	2.8	Gardening store
1	2.8	City composting class
1	2.8	City Tree Program personnel

Where Davis residents generally receive information about gardening

Davis residents were asked where in general they received information about pesticide management and gardening. Approximately one quarter of those surveyed remembered receiving information about pesticide use from the city or community. When asked were else they received information, the majority of Davis respondents indicated they received information about pesticide use from the University of California, Davis either through extension education and/or environmental courses. This finding may be attributed to the close proximity and high impact of the University of California, Davis on the local community. The second greatest impact of pesticide information came from local nurseries and/or places selling pesticides. A large group of respondents reported receiving information from gardening magazines. Remarkably, Sunset magazine was listed by name many times by respondents. The next level of responses included product labels, family and friends, and Master Gardener's Programs. Master Gardener's Programs alone attributed to almost 5% of the information sources. Media fell into the next group with newspapers, City of Davis newsletters, and TV and radio information collectively attributing to 7 percent. These data are presented on Table 3.

Table 3. Open-ended Question asking where in general Davis residents received information about pesticide management and gardening?

52	24.8	UC Davis Extension
33	15.7	Nurseries and/or places where garden supplies were sold
29	13.8	Gardening books/magazines (Sunset)
23	10.9	Courses (i.e., in wetland ecology or the environment)
12	5.7	Product labels
11	5.2	Friends/family
10	4.8	Master Gardeners programs
6	2.9	Newspapers
6	2.9	City of Davis info (flyers, newsletters)
6	2.9	TV and radio shows on

		conservation
5	2.3	Organic gardening information
5	2.3	Sierra Club Articles
3	1.4	Internet
2	1.0	Public Library
2	1.0	IPM Collaborative Research project
1	.5	Work
1	.5	Davis Arboretum information
1	.5	Davis Coop
1	.5	Farmers Market
1	.8	Community Gardens

Davis residents' knowledge of the Healthy Gardens Program

Of great interest to this study was if Davis residents had heard of the Healthy Gardens Program, if the logos were recognized and if Davis residents knew the message of the program.

Table 4. Open-ended questions about resident knowledge of the Healthy Gardens Program

Question 1: Which of the Healthy Gardens Logos have you seen before?

Count	Percent	Logo
23	12.8	North Pond
20	11.0	Frog Logo
16	9.0	Ladybug Logo
16	9.0	Integrated Pest Management Demo Sign (roses)
5	3.0	Pest Management Guide
4	2.2	Other
96	53.0	Have not seen Logos

Question 2: Where have you seen the Healthy Gardens Program Logo or information?

Count	Percent	Location
22	24.4	North pond signs
17	18.9	Davis farmers market
14	15.6	Davis Movie theater
14	15.6	Local stores
9	10.0	Local newspaper
4	4.4	Program Web Page - community link
4	4.4	Community Television Station - Channel 6
2	2.2	Redwood Barn Nursery
2	2.2	City Hall
1	1.1	Mailed city information
1	1.1	Public school

Question 3: What was the message of the Healthy Gardens Program?

Correct Answers		
Count	Percent	Answer
14	7.8	Reduce pesticide use
5	2.8	Keep pesticides out of the environment especially the water
5	2.8	Use beneficial insects for gardening and other IPM strategies
3	1.6	A way to garden without damaging the environment
3	1.6	Use of natural pesticides
1	.5	Garden organically
1	.5	Don't pour pesticides down storm-drains
1	.5	Don't pollute
Incorrect Answers		
1	.5	Pests build up tolerance for pesticides
146	81.0	Did not answer the question

Twenty-two percent of telephone survey respondents said they had heard of the program.

Both surveys asked respondents if they had seen logos or information about the Healthy Gardens Program. Forty-seven percent said that they had seen information about the program. Logos most recognized were the North Pond Signs, Frog Logo, Ladybug Logo, and IPM Demo Sign. Respondents who recognized the logos, remembered seeing signs it the North Pond area, receiving information at the Davis Farmer's Market and seeing the Frog Logo slide in the local movie theatres. Respondents were asked if they understood the message of the Healthy Gardens Program. All, but one person who responded to this question gave correct answers. However, 81 percent of those surveyed did not answer this question. These Open-ended data are presented on Table 4.

Changes in gardening or pest control practices

Both surveys asked if respondents had ever received information about reducing pesticide use from the city or community. Twenty-three percent responded that they had received information. When asked if this information triggered them to change their gardening or pesticide use practices, 17 percent said yes. Telephone survey respondents were asked specifically if the Healthy Gardens Program caused them to change their gardening practices. Almost five percent of the respondents said "yes". When asked how they changed, respondents said: 1) I try to use less round-up and pesticides, 2) I think about water pollution more now, 3) I use IPM, 4) 1 have more awareness about pollution, and 5) the program has given me more ideas to work with.

Awareness of at-home water pollution reduction

Four Likert-type questions were used to address residents' awareness of at-home water pollution. Respondents said they: 1) rarely used pesticides in their gardens. 2) they rarely think about water pollution when they garden, and 3) they rarely use IPM practices. However, they sometimes think about water pollution when applying pesticides. When asked if they thought that residential pesticide use is a primary source of contamination in urban storm-water runoff, telephone survey respondents were neutral, indicating they sometimes thought this was a problem.

Differences between mail and telephone survey respondents in their knowledge and attitudes about gardening and pesticide use were observed. Both groups reported "rarely" using pesticides when they gardened, but mailed survey respondents indicated thinking about pesticide contamination significantly more often when gardening than telephone respondents. The greatest difference between the two groups was revealed when they applied pesticides. The mailed survey group reported between "sometimes" and "often" thinking about water pollution when applying pesticides, but the telephone survey group reported between "rarely" and "sometimes". A significant difference was observed between mail and telephone survey respondents and their reported use of integrated pest management practices (IPM). Telephone survey respondents reported drinking about IPM between "rarely" and "sometimes". Whereas mailed respondents reported they "never" or "rarely" used IPM. These data are presented in Table 5.

Table 5. Comparison of group means between mailed and telephone responds on Likert scale items.

Question	Mailed Mean	Telephone Mean	Pooled Mean	T value	Probability
How often do you use pesticides in garden or yard?	1.0	1.2	1.1	1.66	.09
How often do you think of Water pollution when gardening?	1.5	1.0	1.3	2.67	.007**
How often do you think of water pollution when applying pesticides?	2.6	1.6	2.3	3.37	.0008***
How often do you use IPM in your garden?	.9	1.4	1.1	2.7	.007**

*Significant at 95% level **Significant at 99% level ***Significant at 99.9% level

Do you think that residential use of pesticides is a primary source of contamination in urban storm-water runoff? n = 93 2.5 Telephone survey only

Pesticide Use

Residents who used pesticides were asked to identify specific pesticides they used in their yard and garden. Of the 68 respondents who indicated they used pesticides, 77 pesticides were named. The most common pesticide named was Round-up, followed by Diazinon. Almost 7% of those using pesticides did not know the name of the pesticide they used. These data are presented on Table 6.

Table 6. Open-ended responses listing specific pesticides used by Davis residents who used pesticides in their yards

Pesticide	Count	Percent
Round-up	30	33.7
Diazinon	18	20.2
Granulated	6	6.7
Don't know	6	6.7
Metaldehyde	5	5.6
Weed & Feed	3	3.4
Sevin Garden Dust	3	3.4
Insecticide	3	3.4
None	3	3.4
Dursban	2	2.3
Biological Control	2	2.3
Sulfur based	1	1.1
Pyrethrin	1	1.1
Raid	1	1.1
Bacillus	1	1.1
Copper based	1	1.1
Malathion	1	1.1
Ortho Lawn	1	1.1
Fertilizers only	1	1.1

Residents' knowledge of IPM practices

As an indication of public knowledge about pesticide reduction and water pollution, respondents were asked to define integrated pest management (IPM). Of the 124 Davis residents who answered the question, 91 % reported they did not know or gave an incorrect and/or incomplete answer to this question. Definitions and counts are presented in Table 7.

Table 7. Davis telephone respondent's open-ended definition of IPM or Integrated Pest Management

	Correct Answer 9%
10	Biological control & chemicals to control insects
	Incomplete Answer or Don't know 91%
23	No idea/don't know
23	Biological Control/natural means to control pests
18	Letting Lady bugs go in the garden/good bugs eat bad bugs
13	Use pesticides in a judicious way (when necessary)
12	Pest management in an environmentally responsible manner
8	Alternative pest control other than pesticides, nontoxic
5	Minimize conditions that promote pests
4	Program to Control insects
3	No pesticides or chemicals
2	A Spraying program
2	Putting in a plant that would attract certain insects that would harm plants
1	Used by counties in agricultural fields
1	Plant plants that keep insects away
1	Planting over growing plants
1	Program to extend the useful life of pesticides

1	Control methods of disease and pests
1	Sustainable agriculture

Residents' methods of household and auto chemical disposal practices today as compared with an earlier 1996 study

Open-ended questions were developed to assess respondents' knowledge of pesticide pollution as indicated by how they disposed of leftover or used households products, including motor oil, antifreeze, house paint, pesticides and fertilizers, and cleaning products since the 1996 survey. Few respondents indicated improper methods of disposing chemical. These data are presented on Tables 8.

Table 8. Comparison of 1996 and 1999 open-ended responses to "How do you dispose of leftover/ used household products?"

Number of Responses	% motor oil		% house paint		% fertilizer/ pesticides		% cleaning products	
	96	99	96	99	96	99	96	99
	n=224	n=119	n=210	n=117	n=206	n=116	n=218	n=128
City disposal program	46.8	38.3	50.0	45.3	38.3	35.3	29.4	21.1
Use-up put in Garbage	2.2	2.5	18.1	16.3	22.8	24.9	40.0	59.5
Commercial Garage	25.9	38.3	4.8	0	1.0	0.0	.5	0.0
Landfill	1.3	0.8	5.7	1.7	5.3	1.7	2.8	.8
Keep Don't Dispose	0.4	0.0	3.3	2.5	1.9	1.7	3.2	.8
Down the drain	0.0	0.0	0	2.6	0.5	0.0	9.2	9.4
Pour in yard	0.0	0.0	0	0	0.5	0.0	.9	.8
Don't Use	2.6	12.5	2.9	26.4	2.4	25.9	.5	3.9
Don't know/none	38.0	7.4	16.2	5.1	27.0	8.6	14.7	3.9

Respondents' disposal of leftover household products follows similar trends as these surveyed in 1996. However, this study found that fewer residents indicated using the City disposal program in all areas, and more respondents indicated using a commercial garage to change oil. More respondents in this study indicated they did not use the products when compared with the 1996 study. This finding may be reflected in the higher number of renters surveyed in this study. In general, respondents in this study tended to be more aware of how products were disposed.

Table 9. Open-ended questions regarding waste water and drain water disposal

Questions:
When you take a shower, do laundry, or flush a toilet, where do you think the wastewater goes after it disappears down the drain in your house?

When you wash your car and the water runs into the gutter and storm drain, where do you think the water goes from there?

Number of Responses	Waste-water				Gutter Water			
	1996	%	1999	%	1996	%	1999	%
Sewage treatment center	212	36.6	107	82.0	77	39.0	43	34
Don't Know	20	3.5	6	4.6	31	15.7	10	8
Ponds in Davis	43	7.4			5	2.5	18	14
River/Ocean/waterway	2	.4	6	4.6	27	13.7	37	29
Storm water system	2	.4	5	3.8	20	10.2	8	6
Arboretum, Putah Creek	5	.9			10	5.6		
Wetlands	1	.2			7	3.5		
Surface run-off	0				6	3.0		
Ground soil	2	.4			5	2.5	9	7
North Davis ditch	1	.2	1	.8	3	1.5		
Down pipes/somewhere	1	.2			3	1.5	2	2
Onto lawn	0				2	1.0		
Pump houses	0				1	.5		
Septic Tank	0		8	3.8	0	0		

Residents' knowledge of storm drain systems and water treatment

In order to assess respondent knowledge of the Davis storm drain system and wastewater treatment, respondents were asked to respond to open-ended questions regarding specific wastewater practices. Ninety-six percent of the respondents in the 1996 study indicated wastewater or sewage gets some form of treatment before being released to the environment, whereas 98% indicated that wastewater received treatment in this study. All Davis wastewater or sewage received

Respondents were also asked to describe specifically where both wastewater and drain-water go after they leave the residence. Findings from both studies revealed a multitude of answers. Open-ended responses, counts and frequencies are presented in Table 9. Eighty-six percent of the respondents answering this question indicated that wastewater goes to a sewage treatment plant or a septic system, compared to only 37% in the 1996 study. However, thirty-four percent of the respondents thought that storm drain water receives some kind of treatment before being released into the environment.

In order to obtain a sense of where respondents have seen program information or logos a contingency table was developed to show the observed frequency of where residents live and the program logos they remember seeing. These data are, presented on Table 10. Respondents who remembered Healthy Gardens Program logos were evenly distributed throughout sections of Davis. In general, respondents remembered seeing the North Pond signs more than other logos. This finding indicates that people living in other sections of Davis go to the North Pond area.

Table 10. Where residents live compared with program logos sited

	North	South	East	Central	Totals:
Frog	2	5	3	2	17
Ladybug	2	1	3	6	16
PM Guide	1	0	1	2	5
North Pond	6	2	5	4	21
IPM	2	1	5	3	14
Other	2	0	1	1	4

none	14	14	28	23	94
Totals:	29	23	46	41	171

Conclusions and Recommendations

The following conclusions were drawn from the findings of this study:

1. This study generated responses from a broad demographic spectrum, representing the Davis community. Respondents from both surveys reported gardening often. However, mailed respondents tended to make more money, gardened more and owned their own homes when compared with telephone respondents. Since mailed responses were self-selected, this finding suggests that the telephone survey generated a more accurate sample of the Davis population.
2. Although mail respondents reported thinking about pesticide contamination significantly more often when gardening than telephone respondents, means for both groups were marked as "rarely" and less than "sometimes", indicating that both groups needed more information about pesticide contamination.
3. Approximately one quarter of those surveyed remembered receiving information about pesticide use from the city or community. Most respondents remember receiving information about pesticide use from the City of Davis or community through educational city pamphlets and newsletters. This finding indicates that these newsletters are a viable way to disseminate information to the residents. In addition, residents listed all other avenues of information exchange from the Farmer's Market to the Healthy Gardens Pest Management Guide. This funding indicates that all methods of information dissemination were finding the target audience.
4. When asked were else respondents received information about pesticide use the majority of respondents indicated they received information from the University of California-Davis, either through extension education and/or environmental classes. The second greatest impact of pesticide information came from local nurseries and/or places selling pesticides. A number of respondents reported receiving information from gardening magazines. Future Healthy Gardens Program outreach efforts could benefit from closer working relationships with University of California extension education programs, the Master Gardener programs, and relationships with faculty teaching environmental courses on campus.
5. A large number of respondents recognized logos from the Healthy Gardens Program. Most recognized were the North Ponds Signs, the frog slide, and the ladybug logo. Interestingly, people who did not live in the North Davis area identified seeing the North Pond signs. Respondents living in all areas of Davis recognized the logos.
6. Less than 20% of the respondents indicated that information from the city or community had caused them to change their behavior regarding pesticide use. Five percent of the telephone survey respondents said they had changed their behavior because of the Healthy Gardens Program. This finding suggested that city programs can increase resident knowledge about pesticide pollution and help create changes in gardening practice.
7. Davis residents, in general, have little awareness of at-home water pollution. Respondents said they rarely used pesticides in their yards or gardens, rarely think about water pollution, and rarely used integrated pesticide practices. This last finding may be due to respondents having little or no knowledge as to the meaning of "Integrated Pest Management". When asked if they thought about water pollution when applying pesticides or that residential pesticide use is a primary source of contamination in urban storm-water runoff, respondents were neutral in both categories. These findings suggest that there is great need for continued education about pesticide water pollution issues.
8. Most respondents surveyed said they did not use pesticides. However, the Pollution Load Reduction Program identified residential use of pesticides as the primary source of

pesticides in the city's storm water system. We can conclude that those using pesticides are either using too much or unaware of their pesticide use.

9. Residents are conscientious about disposing of environmentally hazardous material. Respondents' disposal of leftover household products follows similar trends as those surveyed in 1996. However, similar to the 1996 study, some residents have little knowledge of the storm water system, believing that gutter water is treated before being released into the environment.

Recommendations

The findings of this study identified Davis resident characteristics, revealed relationships among selected variables, and determined differences between survey groups. Based on these findings, the following recommendations were made.

1. As residents have little knowledge of residential contamination of storm drain run-off and believe they are not polluting the environment, it is recommended that the City continue to provide information about surface water pesticide contamination through newsletters and other outreach activities.
2. Education programs to help Davis residents learn about integrated pest management (IPM) is essential. It is recommended to target outreach efforts to different populations such as school children, college students, and renters as well as homeowners.

Recommendations for Further Research

1. Further study is needed to determine appropriate outreach programs that will improve City communication and dissemination of information to residents.
2. Further study is needed to collect pesticide use data from landscape and yard maintenance companies to determine their pesticide use.

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Appendix 1

Healthy Garden Outreach Efforts

During the first year of the program (1998), outreach included development of:

- Informational Messages:
- Two theater information slides
- A brochure "Pesticide Management Guide for Davis Residential Landscapes and Gardens" (describing less toxic approaches to managing pests)

    - Numerous newspaper articles and photos to raise public awareness (Chamber of Commerce, The Davis Enterprise articles and column in the Environment section, Flyer distributed to Davis Elementary Schools, Redwood Bam Nursery newsletter)
    - Utility bill message "Keep our waterways clean and healthy."
    - City of Davis Healthy Gardens Pollution Prevention Program, Temporary Tattoos distributed to the Davis Elementary Schools
    - Davis Community Television message on air to raise pesticide awareness
    - Web page for the City of Davis Pollution Prevention Program
    - Signage at City of Davis locations identifying the use of integrated pest management practices in municipal areas
    - Signs explaining the connection between a local wildlife habitat, the City's stormwater, and residential pesticide use "We are all connected to our waterways"

- Master Gardeners Workshops

    - Beneficial Insects Booth/Display held at Davis Farmer's Market
    - Workshops at local nurseries

Appendix 2

(Note: The submitted version of Appendix 2 contained 5 images; all were not able to be reproduced here.)

Have you seen us before?

click on image to enlarge

click on image to enlarge

click on image to enlarge

Please help us by answering the questions on the reverse side of this page!

Appendix 3

City of Davis Healthy Garden

Program Survey

1. Do you live in a house with a yard or garden and or do you have a garden plot available to you? Yes No

   a. If yes, do you or someone in your household garden? Yes No
2. How do you dispose of the following leftover/used household products?

   a. Motor oil
   b. House paint
   c. Pesticides/fertilizers
   d. Cleaning products

3. When you take a shower, do laundry, or flush a toilet, where do you think the wastewater goes after it disappears down the drain in your house?
4. When you water your yard and the water runs into the gutter and storm drain, where do you think the water goes from there?
5. Which of the following get some form of treatment before being released into the environment?
   _____ Wastewater/sewage _____ gutter water into the storm drain

*If they do not garden skip to question 25

No Never
Rarely
Sometimes
Often
Yes Always

6. How often do you or someone in your household work in the yard or garden?

0
1
2
3
4

7. How often do you hire someone else to take care of your yard or garden?

0
1
2
3
4

8. How often do you use pesticides in your garden or yard?

0
1
2
3
4

a. What pesticides do you use? (e.g., Diazinon, Roundup, and/or Dursban).

9. How often do you think of water pollution when you garden?

0
1
2
3
4

10. How often do you think of water pollution when applying pesticides?

0
1
2
3
4

11. What is your definition of IPM or Integrated Pest Management?

12. How often do you use IPM in your garden or yard

0
1
2
3
4

13. Do you think that residential use of pesticides is a primary source of contamination in urban storm-water runoff?

0
1
2
3
4

14. Have you ever received information about reducing pesticide use (herbicides & insecticides)?

Yes
No

If yes, how or where did you receive the information?

15. Have you ever received information about reducing pesticide use from the city or community?

Yes
No

If yes, how or where did you receive the information?

16. Have you ever heard of or recognize a Healthy Gardens Program with a "ladybug" and or a "Frog" logo?

Yes
No

If so, where or how did you receive the information?

17. Where did you see information about the program displayed? (e.g., Program Web Site, local news paper, local store, movie theater, City signs, North Pond, channel 6, children's tattoos).

18. What was the message of the Healthy Gardens Program?

19. Did you, or someone in your household, attend a Healthy Gardens Program workshop?

Yes
No

If yes, where/when?

20. Did you, or someone in your household, stop at the Healthy Gardens Program display at the Farmers Market or Redwood Barn Nursery?

Yes
No

If yes, when and how often?

21. Did you, or a member of your household, pick-up a free Pesticide Management Guide from the Healthy Gardens Program?

Yes
No

If so, where did you obtain the material?

22. Since you have lived in Davis, have you changed your gardening practices or use of pesticides in your garden or yard?

Yes
No

23. Where do you get information about pesticide management and gardening?

24. Did information from the Healthy Garden's Program cause you to change your practices?

Yes
No

What practices did you change as a result of the program?

25. We would like to collect demographic information from Davis residents. Please ask callers to complete the following information:

Own? Rent/lease? Area of Davis: North South East West
Years in residence_____
Gender_____ Age_____
Student: Yes No
Full-time Davis Residence: Yes No
Highest year of education (circle one) 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
HS AA BS MS Ph.D.
Marital Status: Single Married
Number living in home: _____ Adults_____ Children_____
Annual household Income: <15,000 15,001-25,000 25,001-40,000
40,001-60,000 60,001-90,000 >90,001

26. Other comments:

Thank you for your participation in this important survey.

Appendix 4

City of Davis Healthy Garden Program Survey

1. Do you live in a house with a yard or garden and or do you have a garden plot available to you? Yes No
2. Have you heard of Integrated Pest Management (IPM) practices? Yes No
   If so, what is your definition of IPM?

No Never
Rarely
Sometimes
Often
Yes
Always

3. How often do you or someone in your household work in the yard or garden?

0
1
2
3
4

4. How often do you hire someone else to take care of your yard or garden?

0
1
2
3
4

5. How often do you use pesticides in your garden or yard?

0
1
2
3
4

6. How often do you think of water pollution when you garden?

0
1
2
3
4

7. How often do you think of water pollution when applying pesticides?

0
1
2
3
4

8. How often do you use IPM in your garden or yard?

0
1
2
3
4

9. Have you ever received information about reducing pesticide use from the city or community?

Yes
No

10. Has the information triggered you to change your gardening or pesticide practices?

Yes
No

11. Which of these items shown on the attached sheet have you seen before?

Frog Slide
Ladybug Logo
Pest Management Guide
North Pond Wetlands Sign
IPM Demonstration Signs
Other
None

12. If you have seen any of the items on the attached sheet, where have you seen them?

On the internet
Before a movie
In the Newspaper
On Television
At a Local Store
At the North Pond
At City Hall
At Davis Farmers Market
Have not seen any of the items

13. What was the message of the Healthy Gardens Program?

14. Where do you get information about pesticide management gardening?

Please help us by also filling out the following information:

15. Age_____ Education Level: High School AA BS/BA Masters Ph.D.
16. Annual household income <15,000 15,001-25,000 25,001-40,000
    40,001-60,000 60,001-90,000 >90,00
17. Full-time Davis Residence: Yes No Years in residence_____
18. Do you Own Rent/Lease your home?
19. Number living in home: _____ Adults_____ Children_____
20. Which area of Davis do you live in? North South East West Central Outside Davis

Thank you for your participation in this important survey.