Journal of Extension
www.joe.org

February 2013

Volume 51 Number 1

Article Number:

1FEA10

Assessing the Educational Needs of Urban Gardeners and Farmers on the Subject of Soil Contamination

Ashley Marie Raes Harms
Graduate Student
amrharms@ksu.edu

DeAnn Ricks Presley
Assistant Professor/Extension Specialist
deann@ksu.edu

Ganga M. Hettiarachchi
Assistant Professor
ganga@ksu.edu

Stephen J. Thien
Professor
sjthien@ksu.edu

Department of Agronomy
Kansas State University
Manhattan, Kansas

Abstract: *Participation in urban agriculture is growing throughout the United States; however, potential soil contaminants in urban environments present challenges. Individuals in direct contact with urban soil should be aware of urban soil quality and soil contamination issues to minimize environmental and human health risks. The study reported here assessed the needs of urban gardeners and farmers throughout the United States with respect to soil contamination. Our results suggest that urban gardeners and farmers need and want information and guidance on best management practices for safely growing food crops on mildly contaminated urban soils.*

Introduction

Urban Agriculture and Brownfields in the United States

Urban agriculture is defined as growing and distributing fruits, vegetables, herbs, and animal products through cultivation in cities and suburbs (Bailkey & Nasr, 2000). Gardening and farming in urban environments throughout the United States has grown in popularity over the last 40 years, and at present there are an estimated 18,000 community gardens in the U.S. and Canada (ACGA, 2011).

Pagano and Bowman (2000) found that approximately 15% of land in the 83 U.S. cities surveyed, or nearly 4,500 acres per city, was considered vacant or abandoned. Publically and privately owned vacant lands in many U.S. cities are quickly being converted to urban gardens and farms by individuals, families, neighborhoods, schools, nonprofit organizations, etc. A brownfield is an underutilized commercial or industrial site that potentially has environmental contamination (USEPA, 1995). More and more urban dwellers are coming into direct contact with urban soils through these gardening and farming activities. The United States has an estimated 450,000 brownfields sites (USEPA, 1995), many of which are these vacant lots within cities. Brownfields can potentially be safely used for agricultural proposes; however, soil quality must first be assessed.

Soil Contamination in Urban Environments

Natural and urban derived soils vary considerably and are often highly disturbed and/or contaminated due to human activities (Bullock & Gregory, 1991; Craul, 1999; Reimann & De Caritat, 2000). Previous land use and human activities on and around an urban site can lead to increased accumulation of trace elements and organic compounds, or soil contamination (Boyd et al., 1999; Mielke, Gonzales, Smith, & Mielke, 1999; Mielke & Reagan, 1998; Nriagu, 1979; Nriagu, 1996; USDA-NRCS, 2000). Lead (Pb), Cadmium (Cd), and Arsenic (As) are the most common contaminants in urban environments, and most of these urban soil contaminants are persistent, immobile, and non-biodegradable (Boyd et al., 1999; Finster, Gray, & Binns, 2004; Mielke et al., 1999; Mielke & Reagan, 1998; Nriagu, 1988; Watt, Thornton, & Cotter-Howells, 1993). Past and unseen sources of contamination, razing of aboveground materials, and soil mixing of urban soils can lead to sites with variably distributed contamination, making understanding and minimizing human health risks difficult (Craul, 1999).

Exposure Pathways and Human Health Risks Related to Gardening on Urban Soils

Urban soils are an important pathway for human exposure to trace elements and organic contaminants (Boyd et al., 1999; Gallacher et al., 1984; Mielke et al., 1999; Mielke & Reagan, 1998; Nriagu, 1988; Watt et al., 1993). This is troublesome because common urban contaminants (e.g., Pb, Cd, As) are toxic to humans, especially children (Boyd et al., 1999; Finster et al., 2004; Hettiarachchi & Pierzynski, 2004; Mielke et al., 1999; Mielke & Reagan, 1998). Gallacher et al. (1984) found that residents living in areas with highly contaminated soils had higher blood lead levels than residents of areas with minimally contaminated or uncontaminated soils. Humans may be exposed to soil contaminants through three main pathways: ingestion, inhalation, and dermal (Boyd et al., 1999; Mielke et al., 1999; Mielke & Reagan, 1998). Due to the growing urban populations and increased interest and participation in urban agriculture, a greater portion of the population is coming into direct contact with urban soil. Therefore, individuals in direct contact with urban soil should be aware of urban soil quality and soil contamination issues to minimize environmental and human health risks associated with soil contamination.

Needs Assessments in Extension Research

When Extension began, most of the U.S. population lived in rural communities and on farms (Brown, 1965). Today, the majority of Americans live within urban and suburban areas, and so the Extension programming must change to suit the needs of the public it serves (Beckley & Smith, 1985; Decker, Noble, & Call, 1989; Rogers, 1995). Needs assessment methods are tools used to reach this goal to meet the needs of the intended population (Berkowitz & Nagy, 2011; McCaslin & Tibezinda, 1997). A needs assessment is defined as the process of gathering specific information on a focal population or community, setting priorities, and making decisions about the development of a particular Extension program based on the needs identified, and a needs assessment should also differentiate between the needs, wants, and interests of the focal population.

Study Objectives

Surveys of urban agriculturalists have previously been conducted to determine the preferred information sources (Varlamoff, 2002), demographics of gardeners (Blaine, Hall, Downer, & Ebert, 2008), dietary choices and dietary changes (Alaimo, Packnett, Mies, & Kruger, 2008; Blair, Giesecke, & Sherman, 1991), as well as the many social and economic benefits of participating in urban agriculture (Blaine et al., 2008; Blair et al., 1991; Glover, 2004; Hynes & Howe, 2004; Patel, 1991), but none have focused on knowledge of soil contamination topics.

The purpose of the study described here was to assess educational needs of urban farmers and gardeners throughout the communities of Kansas City, KS/MO (KC), and Tacoma and Seattle, WA (TS) on the topic of urban soil contamination. This article discusses the knowledge gaps and informational needs of urban farmers and gardeners on the subject of urban soil contamination.

Materials and Methods

Populations Surveyed

According to staff of local urban agriculture organizations that serve the communities of KC and TS, both cities have growing populations of urban dwellers participating in agriculture. Cultivate KC of KC and P-Patch Community Gardens and Trust of TS are two organizations that indicated that they would benefit from the information gathered from our needs assessment survey and cooperated in distribution of the survey.

Our population for the needs assessment survey was urban gardeners and farmers in the municipalities described in the preceding section. Urban farmers and gardeners were defined, for the purpose of the study, as those individuals who produce fruits, vegetables, row crops, livestock, dairy, flowers, and/or herbs on any size plot of land within a city or suburb, on a brownfield site, or on any potentially contaminated soil, for personal consumption, to give away, or to sell.

Survey Design and Distribution Methods

Our survey was designed in the spring of 2010 and approved (#5531) by the Institutional Review Board of Kansas State University in July of 2010. Complete information on the survey design, distribution methods, etc., are available in Harms (2011). The survey consisted of 61 questions, including a combination of open- and closed-format questions including (multiple-choice, Likert scale, short answer, true-false, and yes-no). The paper survey was designed as a booklet with short, simply worded questions, as suggested by Dillman (2000). The Web-based survey was designed to resemble the paper survey and was created using Axio, a free Web-based survey and reporting tool through Kansas State University (Axio Learning, Manhattan, KS). Each surveyed location was assigned a unique link. Throughout the design of the survey, consistency between the paper and Web-based surveys was of greatest importance, and so both versions contained the same questions, question design, question order, opportunity to comment, and opportunity to not to answer any question throughout the survey.

We distributed our survey three times in KC. In late summer of 2010, distribution of the Web-hosted survey began in KC. An article in *Urban Grown*, an online and print newsletter published by Cultivate KC and distributed to hundreds of urban growers throughout Kansas City, encouraged readers to follow a Web link to participate in our Web-hosted survey. In early fall 2010 our second distribution effort in KC consisted of an email invitation containing a direct link to our Web-hosted survey. The email invitation was distributed directly to urban growers' personal emails through the Growing Growers listserv associated with Cultivate KC. A follow-up email encouraging non-respondents to reconsider participating in our Web-hosted survey was sent in late Fall 2010 through the Growing Growers listserv again. Our third distribution effort focused on reaching urban gardeners and farmers who do not have access to a computer or the Internet. Paper surveys with self-addressed stamped envelopes were handed out directly to 95 urban gardeners and farmers at the Annual Farmer's Meeting in Kansas City, MO in January 2011. This meeting of urban agriculture leaders, community leaders, and urban gardeners and farmers to discuss issues related to urban agriculture in their community, provided a unique opportunity to speak with over 100 urban gardeners and farmers about our survey efforts. Completed surveys were collected at the end of this meeting, as well as collected by mail later in the late winter of 2011. Overall, our three distribution efforts in KC yielded 30 completed survey responses.

Distribution of the Web-hosted survey began fall of 2010 in TS with the direct assistance of community leaders and the community garden organization, P-Patch. The online link to our Web-hosted survey was distributed to urban gardeners and farmers of Tacoma and Seattle through listservs associated with the P-Patch organization, community garden groups, and Washington State University. Urban agriculture leaders within these two communities contacted urban farmers and gardeners by email with a request to respond to our Web-hosted survey. Due to so many people disseminating the survey link throughout the community, a response rate is difficult to calculate. We estimate that approximately 1,000 growers were contacted in the Tacoma and Seattle, WA region.

Response Rates

In total, 111 surveys were returned from TS and KC, 50 of which were entirely complete. This response is normally considered very low; however, given the research constraints of time, funding, proximity to respondents, distribution limitations with current databases and regional contacts, and respondents' hesitation to participate, we believe that the responses offer a sufficient foundation for developing the intended Extension program. Response rate, as defined by Wiseman (2003), is the number of completed surveys over the number of surveys distributed or eligible for completion. For our study, response rates are difficult to calculate due to the selected distribution methods. We do not know the exact number of respondents contacted because survey requests were distributed by numerous individuals and organizations in each city. A total of 121 urban gardeners and farmers completed surveys, and our overall estimated response rate is roughly equal to 8%.

The low overall response rate requires a careful review of the potential for non-response error. Non-response error occurs when only a small portion of the population responds to the survey, which means that a large portion of the population of interest was potentially excluded from the survey results. Non-response error is an issue if there is a difference between those individuals who respond and those who do not respond. To test for non-response error it is recommended to compare the general demographic characteristics of late respondents to early respondents at each location (Miller & Smith, 1983) or to compare the characteristics (such as demographic information) of those who respond to those who do not respond.

In our case, there are so few responses and minimal additional information about this population that we were not able to test for non-response error. The responses were received periodically over several months and therefore early and late respondents could not be differentiated. We assume that non-response error has occurred in our research due to the low response rates at all location. Because of this error we cannot generalize about the overall population of urban gardeners and farmers in the study locations based on the completed sample (Lindner, Murphy, & Briers, 2001; Radhakrishna & Doamekpor, 2008; Wiseman, 2003). Based on our results, due to the low response rate and nonresponse bias, we can only make statements about the respondents themselves, not the overall populations of gardeners/farmers in these communities.

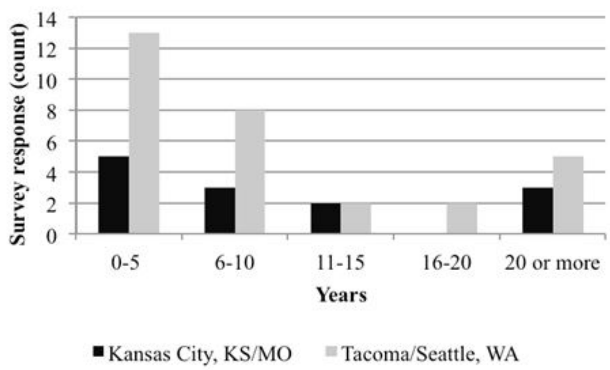
Results and Discussion

Respondents' Personal Experiences with Urban Agriculture and Soil Contamination

The survey questions were developed to assess growers' previous experience with urban agriculture and soils contamination. More than a third (39% of KC and 43% of TS) of respondents' have less than 5 years experience growing in an urban environment (Figure 1). As indicated previously, participation in urban agriculture has grown in these cities in recent years due in part to the efforts of Cultivate KC and P-Patch Trust to create more and more urban agriculture areas in their municipalities.

Figure 1.

Respondents' Years of Urban Agriculture Experience



The data in Table 1 indicate that a third or more of respondents to our survey (41% of KC and 33% of TS) have encountered soil contamination of some sort during their time gardening/farming in an urban area. A greater percentage of TS respondents (35%) indicated that they didn't know if they had ever encountered soil contamination during their time gardening/farming in an urban area. Urban growers in these two communities are encountering soil contamination, which is a strong indication that informational resources on best management practices (BMPs) when soil contamination is present may be useful. Additionally, for the proportion of respondents who were unsure about whether they had encountered soil contamination throughout their urban gardening/farming experiences, informational resources on determining the presence of soil contaminants (e.g., soil testing) may be needed.

Table 1.

Respondents' Personal Experience With Soil Contamination

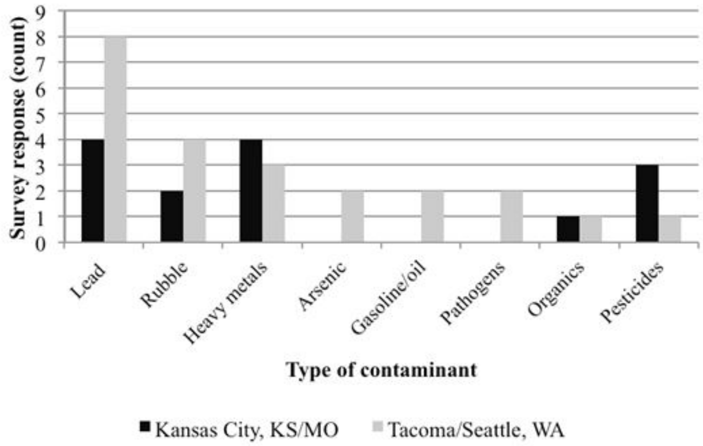
Have you encountered soil contamination of any kind throughout your work in urban agriculture?

Answers	**Tacoma/Seattle, WA Response Percent**	**Kansas City, KS/MO Response Percent**
Yes	32.5	40.7
No	32.5	44.4
I don't know	35.0	14.8
answered question (count)	80	23
skipped question (count)	1	7

Respondents who indicated that they had encountered soil contamination throughout their work in urban agriculture were asked to identify which contaminants were present (Figure 2). Respondents wrote in many different answers, which were grouped into like categories: lead, rubble, heavy metals, arsenic, gasoline or oil, pathogens, organic contaminants, or pesticides. A couple of these categories overlap content; however, to preserve respondents' choice of terminology we have kept these categories separate. Contaminants that respondents most frequently reported encountering were lead, heavy metals, rubble, and pesticides. Educational and technical assistance materials created with these respondents in mind should especially contain information BMPs for soils containing those specific contaminants.

Figure 2.

Most Frequently Encountered Types of Contaminants



Respondents' Interest in Soil Contamination Issues

Respondents were asked if they had interest in knowing more about soil contamination, soil testing, safe gardening on mildly contaminated soils, and urban land use. More than 80% of respondents at both location reported that they have interest in knowing about all four of these urban soil contamination related topics (Table 2). The majority (92.0% of KC and 81.2% of TS) indicated that they would like to know more about soil contamination specifically.

Table 2.

Respondents' Interest in Soil Contamination Topics

I have interest in knowing more about:		
Answer Options	**Response Percent**	
Soil contamination in urban environments.	**Tacoma/Seattle, WA**	**Kansas City, KS/MO**
Yes	81.2	92
No	18.9	8
answered question	74	25
skipped question	7	5
soil testing.	**Tacoma/Seattle, WA**	**Kansas City, KS/Mo**
Yes	83.8	84
No	16.2	16
answered question	74	25
skipped question	7	5
safe gardening/farming on mildly contaminated urban soils.	**Tacoma/Seattle, WA**	**Kansas City, KS/MO**
Yes	79.7	84
No	20.3	16
answered question	74	25
skipped question	7	5
urban land use.	**Tacoma/Seattle, WA**	**Kansas City, KS/MO**
Yes	79.2	84
No	20.8	16
answered question	72	25
skipped question	9	5

Respondents' Self-Reported Knowledge of Soil Contamination Issues

Questions were developed to assess the growers' self-reported knowledge of soil contamination, as well as their personal confidence in their understanding of key soil contamination concepts (Table 3). Although a large proportion of respondents correctly answered the knowledge-based questions previously reported, more than one third of respondents (35% of KC and 41% of TS) reported that they are not familiar with potential sources of contaminants in urban areas. A large proportion of respondents (75% of KC and 57% of TS) indicated that they are not familiar with the soil remediation processes; however, a large portion of respondents (52% of KC and 68.1% of TS) reported that they were familiar with health risks (Table 3).

More than 58% of KC and 70% of TS respondents reported that they don't know how to detect the presence of soil contaminants, and nearly half of all respondents (44% of KC and 54% of TS) reported that they don't know where to send their soil samples for analysis of soil contaminants, or who to contact for assistance.

Table 3.

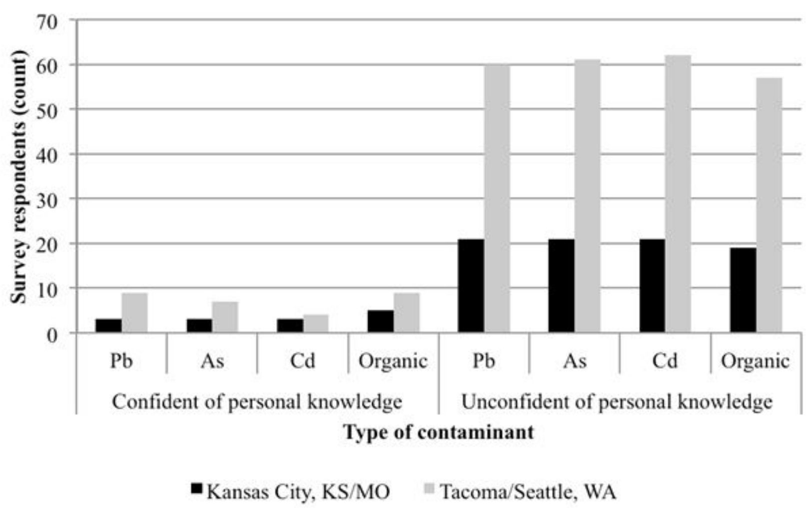
Respondent-Reported Knowledge of Urban Soil Contamination Topics

	Tacoma/Seattle, WA		Kansas City, KS/MO	
	Yes	No	Yes	No
Question	Response Percent			
I am familiar with the potential sources of contamination in urban environments.	59.4	40.6	65.2	34.8
I am familiar with the process of soil remediation.	43.3	56.7	25	75
I am aware of the potential risks to human health of the various contaminants commonly found in urban environments.	68.1	31.9	52.2	47.8
I know how to detect the presence of soil contaminants in an urban environment.	29.6	70.4	41.7	58.3
I know where to send my soil samples for analysis (or who to contact for assistance) if I suspected contamination.	46.4	53.6	56.5	43.5

Respondents were asked to report their confidence in their ability to manage a soil contaminated with Pb, As, Cd, and organic contaminants to minimize human health risks. Overall, respondents reported that they had low confidence in their abilities to manage contaminated soils (Figure 3). More than 80% of all respondents at both locations reported that they did not have confidence in their ability to manage soil to mitigate human health risks associated with Pb, As, Cd, and organic contaminants. These results indicate that the vast majority of respondents in both cities require additional informational resources and technical assistance on the BMPs for contaminated soils and for growing food crops on soil contaminated with Pb, As, Cd, and organic contaminants.

Figure 3.

Respondents' Reported Confidence in Their Knowledge of How to Manage Soil to Minimize Human Health Risks Associated with Soil Contamination by Lead (Pb), Arsenic (As), Cadmium (Cd), and Organic Compounds



Respondents' Use of Informational Resources on Soil Contamination Issues

Last, respondents reported on their use of different resources for information on urban soil contamination issues. These questions required respondents to indicate whether they have ever used an Extension agent, government resource, university resource, nonprofit organization, or the Internet to answer their questions on urban soil, urban agriculture, or contamination. Results of these questions can be found in Tables 4 and 5. The majority (more than 68%) of all KC respondents indicated that they had used all of these resources at one time or another in their work in urban gardening and farming, particularly non-profit organizations (64%). A lesser percent of the TS respondents reported utilizing these resources.

Table 4.

Respondent-Reported Use of Resources for Information on Urban Soil Contamination Issues

	Tacoma / Seattle, WA		Kansas City, KS / MO	
	Yes	No	Yes	No
Resources	Response Percent			
Extension agent	42.6	57.4	79.2	20.8
Government sources	37.3	62.7	68.4	31.6
University sources	44.6	55.4	68.4	31.6
Nonprofit organization	58.0	42.0	88.2	11.8
Internet	85.4	14.6	88.9	11.1

Table 5.

Respondent-Reported Usefulness of Resources for Information on Urban Soil Contamination Issues

	Tacoma / Seattle, WA				Kansas City, KS / MO			
	Not Useful	Limited Usefulness	Somewhat Useful	Very Useful	Not Useful	Limited Usefulness	Somewhat Useful	Very Useful
Resources	Response Percent							
Extension agent	0.0	7.4	33.3	59.3	0.0	11.1	50.0	38.9
Government sources	0.0	9.5	23.8	66.7	8.3	25.0	41.7	33.3
University sources	0.0	0.0	34.8	65.2	0.0	8.3	50.0	41.7
Nonprofit organization	0.0	0.0	20.7	79.3	0.0	7.1	28.6	64.3
Internet	0.0	10.3	48.7	41.0	0.0	14.3	28.6	57.1

Conclusions

The urban gardeners and farmers of KC and TS who participated in our needs assessment survey have minimal knowledge of, or confidence in, their abilities to manage contaminated urban soils. Urban growers expressed an interest in and a need for informational resources and technical assistance on urban soil contamination topics, specifically: how to determine the presence of common urban contaminants, soil sampling, soil testing, and the BMPs and protocols for gardening and farming on mildly contaminated urban soils. Information such as soil remediation techniques, crop selection, and produce handling techniques to reduce any potential human health risks would also be beneficial information for these urban growers, as many were not knowledgeable about these topics.

The survey reported here focused on members of urban gardening groups. We did not survey independent gardeners, nor did we target any people who are potentially considering becoming gardeners, and we hypothesize that new and independent gardeners might be even less informed of the potential contaminants in urban soils. The Internet, nonprofit organizations in the community, Extension agents, and university resources are all information sources used by growers in these communities and would be relevant educational avenues for Extension outreach to these urban gardeners and farmers on soil contamination topics. Because urban soil contamination could be experienced by any urban dweller, we feel that collaboration among soil scientists and agricultural and natural resources, horticultural, and family sciences Extension personnel must be sought in the preparation and dissemination of future Extension materials and programming.

References

Alaimo, K., Packnett, E., Mies, R. A., & Kruger, D.J. (2008). Fruit and vegetable intake among urban community gardeners. *J. Nutr. Educ.* Behav. 40: 94-101.

American Community Gardening Association (ACGA). (2011). *Frequently asked questions*. Retrieved from: http://communitygarden.org/

Axio Learning Software. Kansas State University Foundation, Manhattan, Kansas. Retrieved from: http://www.axiolearning.org

Bailkey, M., & Nasr, J. (2000). From brownfields to greenfields: Producing food in North American cities. *Community Food Security News*, Fall 1999/Winter 2000: 5-7.

Beckley, W. E., & Smith, K. L. (1985). Needs assessment for planning. *Journal of Extension* [On-line], 23(1) Article 1IAW5. Available at: http://www.joe.org/joe/1985spring/iw5.php

Berkowitz, B., & Nagy, J. (2011). *Conducting needs assessment surveys*. Community Needs Survey. University of Kansas Community Toolbox. Retrieved from: http://ctb.ke.edu

Blaine, T. W., Hall, F. R., Downer, R. A, & Ebert, T. (2008). An assessment of agricultural producers' attitudes and practices concerning pesticide spray and drift: Implications for Extension education. *Journal of Extension* [On-line], 46(4) Article 4FEA8. Available at: http://www.joe.org/joe/2008august/a8.php

Blair, D., Giesecke, C., & Sherman, S. (1991). A dietary, social, and economic evaluation of the Philadelphia urban garden project. *J. Nutr. Educ.* 23:161-167.

Boyd, H. B., Pedersen, F. Cohr, K. H., Damborg, A., Jakobsen, B. M., Kristensen, P., & Samsoe-Petersen, L. (1999). Exposure scenarios and guidance values for urban soil pollutants. *Regul. Toxicol. Pharm.* 30: 197-208.

Brown, E. J. (1965). Extension and the urban environment. *J. Coop. Extension*. Pennsylvania Agricultural Experiment Station journal series 3004: 95-102.

Bullock, P., & Gregory, P.J. (1991). *Soils in the urban environment*. Blackwell Scientific Publications, Oxford.

Craul, P.J. (1999). *Urban soils: Applications and practices*. John Wiley & Sons, Inc, New York.

Decker, D. J., Noble, L. A., & Call, D. L. (1989). Forward with the original land-grant concept. *Journal of Extension* [On-line], 27(2) Article 2TP3. Available at: http://www.joe.org/joe/1989summer/tp3.php

Dillman, D. A. (2000). M*ail and Internet surveys: The tailored design method*. John Wiley & Sons, Inc., New York.

Finster, M., Gray, K., & Binns, H. (2004). Lead levels of edibles grown in contaminated residential soils: A field survey. *J. Sci. Tot. Env*. 320: 245-257.

Gallacher, J., Elwood, P.C., Phillips, K.M., Davies, B.E., Ginnever, R.C., Toothill, C., & Jones, D.T. (1984). Vegetable consumption and blood lead concentrations. *J. Epidemiol. Commun. H.* 38: 173-176.

Glover, T. D. (2004). Social capital in the lived experiences of community gardeners. *Leisure Sciences* 26(2): 143-162.

Harms, A .M. R. (2011). *Determining and meeting the educational needs of students and urban gardeners and farmers on urban soil quality and contamination topics*. M.S. Thesis. Kansas State University. Retrieved from: http://krex.k-state.edu/dspace/handle/2097/13176

Hettiarachchi, G. M., & Pierzynski, G. M. (2004). Soil lead bioavailability and in situ remediation of lead-contaminated soils: A review. *Environ. Prog*. 23: 78-93.

Hynes, H. P., & Howe, G. (2004). Urban horticulture in the contemporary United States: Personal and community benefits. *Acta Horticulturae* 643: 171-181.

Lindner, J. R., Murphy, T. H., & Briers, G. E. (2001). Handling nonresponse in social science research. *J. Ag. Ed.* 42(4): 43-53.

McCaslin, N. L., & Tibezinda, J. P. (1997). Assessing target group needs. In Swanson, B.E., R.P. Bentz, and A.J. Sofranko. *Improving agricultural Extension: A reference manual*. Food and Agriculture Organization of the United Nations, Rome.

Mielke, H. W., & Reagan, P. L. (1998). Soil is an important pathway of human lead exposure. Environ. *Health Persp*. 106 (1): 217-229.

Mielke, H. W., Gonzales, C. R., Smith, M. K., & Mielke, P. W. (1999). The urban environment and children's health: Soils as an integrator of lead, zinc, and cadmium in New Orleans, Louisiana. *U.S.A. Environ. Res*. 81: 117-129.

Miller, L. E., & Smith, K. L. (1983). Handling nonresponse issues. *Journal of Extension* [Online], 21(2). Available at: http://www.joe.org/joe/1983september/83-5-a7.pdfhttp://www.joe.org/joe/1983september/83-5-a7.pdf

Nriagu, J. O. (1979). Global inventory of natural and anthropogenic emissions of trace metals to the atmosphere. *Nature (London)* 279: 409-411.

Nriagu, J.O. (1996). A history of global metal pollution. Science (Washington DC) 272: 223-224.

Pagano, M. A., & Bowman, M. O. (2000). *Vacant land in cities: An urban resource*. Center on Urban & Metropolitan Policy. The Brookings Institution Survey Series. Retrieved from: http://www.mrsc.org/artdocmisc/paganofinal.pdf

Patel, I. C. (1991). Gardening's socioeconomic impacts. *Journal of Extension* [On-line], 29(4) Article 4FEA1. Available at: http://www.joe.org/joe/1991winter/a1.php

Purves, D., & Machenzie, E. J. (1970). Enhancement of trace-element content of cabbages grown in urban areas. *Plant Soil*. 33(2): 483-485.

Radhakrishna, R., & Doamekpor, R. (2008). Strategies for generalizing finding in survey research. *Journal of Extension* [Online], 46(2) Article 2TOT1. Available at: http://www.joe.org/joe/2008april/tt1.php

Reimann, C., & De Caritat, P. (2000). Intrinsic flaws of element enrichment factors (EFs) in environmental geochemistry. *Envir. Sci. Tech.* 34: 5084-5091.

Rogers, E. M. (1995). *Diffusion of innovations*. 4th ed. The Free Press, New York.

United State Environmental Protection Agency (USEPA). (1995). *Brownfields national partnership action agenda*. EPA 500-K-95-001. EPA, Washington DC.

Varlamoff, S. M., Florkowski, W.J ., Latimer, J. G., Braman, S. K., & Jordan, J. L. (2002). Homeowners and their choice of information sources about gardening. *Journal of Extension* [On-line], 40(3) Article 3FEA7. Available at: http:www.joe.org/joe/2002june/a7.php

Watt, J., Thornton, I., & Cotter-Howells, J. (1993). Physical evidence suggesting the transfer of soil Pb into young children via hand-to-mouth activity. *Appl. Geochem. Suppl.* 2: 269-272.

Wiseman, F. (2003). On the reporting of response rates in Extension research. *Journal of Extension* [Online], 41(3) Article 3COM1. Available at: http://www.joe.org/joe/2003june/comm1.php

---