

CONCERN WITH THE RURAL ENVIRONMENT: URBAN VIEWS ON THE USE OF AGRICULTURAL PESTICIDES AND CHEMICALS¹

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This paper explores the dimensions of agricultural chemical and pesticide concern, and its correlates. Concern was found to be broad, and not limited to food safety, environmentalism, or altruism. Social bases were found to be the best predictors of concern, followed by rural beliefs and attitudes, and rural visitation behavior.

Introduction

The use of agricultural pesticides and chemicals has been credited, in part, with the increasing productivity of the American farmer. These specific agricultural inputs have enabled grocery stores to stock large quantities of affordable and unblemished food stuffs (Sachs et al. 1987; Bunn et al. 1990). Nonetheless, the application of such products is associated with negative externalities including disruptions to the food chain, poisoning of wildlife, fish and birds, and groundwater, stream, and air pollution (Carson 1962; Rodgers et al. 1987). An expanding epidemiological literature suggests that acute and long-term effects can induce neural disorders, leukemias, organ failure, and various cancers (Headley 1967; Kitagawa and Hauser 1973; Rosenblatt and Moscovice 1982; Spindler 1983).

Pennsylvania's population of nearly 12 million people, includes a small minority, less than 2 percent, of farmers. Despite their small numbers, over 30 percent of the state's land base is in agricultural land use, and about 60 percent is forested. Many believe that farming is synonymous with rural areas (Swanson 1991). However, in Pennsylvania, the most rural counties are likely to be heavily forested, with much smaller percentages of farm land. In Pennsylvania, most urban centers are in close proximity to production land. The concern over agricultural chemicals and pesticides can be seen as a rural-urban interface issue, and the perceptions of these urban residents becomes a very important factor of influence within the state.

Farmers are a small minority, and great concern over their farming practices could impact their operations. In fact, regulations requiring certification of workers who handle these

Some exploration of the concern held by Pennsylvania's residents regarding pesticides and agricultural chemicals has occurred (Bealer and Willits 1968; Sachs et al. 1987; Weaver et al. 1991). These studies have suggested that concern over this issue is multidimensional. They have identified three areas of citizen concern: 1) food safety, 2) environmentalism, and 3) altruism.

Food Safety

Concern over agricultural pesticides has been primarily examined as a consumer food safety issue. This is especially true of pesticide residues. Surveys have shown that consumers are increasingly concerned about the occurrence of pesticides residues in food (Burbee and Kramer 1986; Sachs et al. 1987; Food Marketing Institute 1989; Bunn et al. 1990). Despite the high levels of reported concern regarding pesticide residues, most respondents still have confidence in the overall safety of the food supply (Food Marketing Institute 1989). However, recently Jussaume and Judson (1992) suggested that consumer confidence in food safety has eroded.

Environmentalism

Environmental awareness concerning the impact of pesticides and agricultural chemicals was heightened by Rachel Carson's *Silent Spring*. Soon after the publication of this work, Bealer and Willits (1968) conducted a survey to determine the level of concern with pesticides and agricultural chemicals in Pennsylvania. Two decades later a similar survey was conducted by Sachs et al. (1987) who determined that respondents' general concern with pesticides had increased greatly. They also found that the highest levels of concern being reported for the environment. Sachs et al. (1987) contribute much of this increase to an awareness among citizens that the environment is "an enduring social concern" (page 98).

Altruism

Sachs et al. (1987) determined that the highest levels of reported concern over the impact of pesticides was for the environment. However, the greatest percentage increase of concern over a two decade period was for farmers who handle pesticides. They suggest that this is partially due to increased consumer familiarity with pesticides and their application. Sachs et al. (1987) point out that many modern pesticides and herbicides have acute toxicity, but breakdown quickly leaving few residues. This places farmers, farm workers, and wildlife in the immediate area at greatest risk.

Weaver et al. (1991) suggest that concerns about pesticides could be grouped in two areas: 1) personal health risks and 2) impacts that go beyond the individual consumer. Personal health risks generally relate to food safety. The second set of concerns relate to all external impacts of pesticides. Weaver et al. (1991:13) list these concerns as "dangers to farm workers, wildlife, groundwater, and the environment." Though these items overlap with environmental concern, it is the thesis of Weaver et al. that they represent a more generalized concern to all aspects *external to the individual*, including the environment.

Research Objectives

Drawing upon measures of agricultural chemical and pesticide concern from past research (Bealer and Willits 1968; Sachs et al. 1987; Weaver et al. 1991), this analysis assesses the level and domains of this concern. Particular attention is given to the areas of food safety, environmentalism, and altruism. Determining the level and dimensions of pesticide concern for urban respondents would enable further analysis into why respondents hold such attitudes. Given the proximity of agricultural production to these respondents, their concerns are important, and may give insight into potential conflicts in the future.

¹ Support for this research was provided by grants from the Center for Rural Pennsylvania (CRP-CA-91-9) and from the Intercollege Research Competitive Grant Program of the College of Agricultural Sciences, Penn State University (Project 3208). inputs are placing more demands on their time. Further, current restrictions that have been placed on certain agricultural chemicals and pesticides are impacting the mode of agricultural production (Vandeman et al. 1992).

This paper has three interrelated objectives:

1. to explore the level and dimensions of pesticide concern held by urban residents;
2. to develop measures of such concerns and to identify social bases, attitudes, and behaviors that are related to pesticide concern; and
3. to develop a multivariate block model that establishes the strength of social bases, attitudes, and behaviors, while controlling for all variables.

Approach

A mail survey following the Dillman (1978) method was conducted seeking information on the level of concern for agricultural pesticide and chemical use of urban residents. A total of 3,611 residents of the nine cities in Pennsylvania with a population of 50,000 or more in 1990 were contacted. Completed questionnaires were returned by 1,524 respondents, representing a 42 percent response rate (Willits, et al. 1992).

Exploring the Dimensions of Pesticide Concern

The urban residents were asked a battery of six items concerning agricultural pesticide and chemical use (Table 1). The frequency of responses show great concern about the usage of these products. Many respondents strongly disagreed, or disagreed that food safety was *not* threatened by these inputs. However, of all these items, respondents were more likely to be undecided on these two issues. Majorities strongly agreed or agreed that agricultural sprays pollute the environment and that such pesticides threatened the safety of wild birds and animals. A majority of the urban respondents rejected the notion that chemical fertilizers pose *no* serious threat to the environment. The last item, farmers who handled pesticides are endangered, elicited a similarly high amount of concern. These six items were factor analyzed to see if the respondents conceptualized these differing threats from pesticides and chemicals as separate concerns (i.e. food safety, environmental, or altruism concern). It was hypothesized, on the basis of previous research, that items 1 and 2 would form a food safety factor, items 3, 4, and 5 would load together on a factor that would represent environmentalism, and that items 3, 4, 5, and 6 would also load together to represent an altruism domain.

Table 1. Responses of urban residents to questions about agricultural pesticide and chemical concerns.

Statements	Response				
	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
	----- Percent -----				
It is safe for people to eat fruits and vegetables that have been sprayed or dusted with pesticides on the farm.*	2.7	26.3	31.4	28.6	10.9
Agricultural pesticides do not contaminate meat and poultry.*	1.2	11.3	38.4	36.7	12.5
Agricultural sprays used to control insects and weeds pollute the environment.	21.0	43.8	21.9	11.4	1.9
Chemical fertilizers in agriculture pose no serious environmental problem.*	2.0	11.2	22.5	44.8	19.5
The use of agricultural pesticides threatens the safety of wild birds and animals.	17.7	49.6	23.1	7.9	0.9
Farmers who handle pesticides place themselves in danger.	12.0	53.1	24.7	8.8	0.7

* These items were reverse coded for the analysis.

Surprisingly, despite support for multidimensional concerns, when the analysis was conducted only one factor was extracted. This single factor solution suggests that concern with pesticides is not limited to food safety, environmental, or altruism issues, but rather is conceptualized as a broader concern. This factor accounted for 51.7 percent of the variation within the model. The Eigenvalue was 3.2, all items had factor loadings of .650 or higher, and using Armor's (1974) theta reliability for factor scales, a coefficient of .86 was generated, indicating a high level of internal consistency^{2,3}.

^{2/} Responses to the questions concerning agricultural pesticide and chemical uses were scored 1 to 5 with 1 = strongly disagree and 5 = strongly agree and scaled (with a range of 1 to 5). The items that rejected the possibility of safety threats were reverse-coded, so that for all items, a higher score reflected greater concern with the use of these items in agricultural production. The mean of the responses for the six items was derived for each respondent.

Correlates of Pesticide Concern

The three major groupings of *social bases*, *behaviors*, and beliefs *and attitudes* are expected to influence the level of general concern urban residents hold towards pesticides and agricultural chemicals. These specific variables, their hypothesis, and their operationalization follow.

Social Bases

More than a decade ago, Van Liere and Dunlap (1980) examined the social bases for environmental concern. They studied the major hypothesis regarding environmental concern and the variables age, income, education, sex, residence, party affiliation, and ideology. Van Liere and Dunlap's review was limited by several factors. First, they only reported bivariate correlations, and second, they focused only on the most commonly used variables. Despite these shortcomings, this article has been viewed as the best attempt to explain the relationship of these core variables to environmental concern (Scott and Willits 1992).

^{3/} The theta coefficient is interpreted similarly to Chronbach's alpha, and is used for factor scales because it does not assume that all items are weighted equally.

Following the work of Van Liere and Dunlap (1980), females and the young are expected to exhibit greater concern about the use of pesticides and chemicals. For income and education a positive relationship with concern is expected. Respondents raised in rural areas, were expected to be less concerned about the use of agricultural pesticides and chemicals. Those who identified themselves as Democrats and those who thought of themselves as liberals are expected to be more concerned.

Information about the respondents' personal attributes of age, educational level, income, and gender were obtained for each respondent. Age was coded into 3 categories: 1) 18-34; 2) 35-64; and 3) 65 years and over. Educational attainment was divided into four categories and coded 1 to 4 as follows: 1) less than high school graduation; 2) high school graduate, no further formal education; 3) some college; or 4) college graduate. Income level was measured in three categories coded 1 to 3: 1) less than \$15,000 per year; 2) \$15,000-44,999; and 3) 45,000 per year or over. Gender was coded so that females were 0 and males were 1. Party affiliation was coded so Republicans were 0 and Democrats were 1. Ideology was scored so conservatives were 1, moderates were 2, and liberals were 3. A question asking the respondents where they grew up as children was asked. These responses were coded so that those who responded in the countryside outside of a city or town were assigned a score of 1. Those raised in suburbs, towns, or cities were scored as 0.

Rural Visitation Behavior

Experience with rural areas gained through visitation was expected to relate to concern about agricultural chemicals and pesticides. Those who visit rural areas frequently to interact with the environment were expected to display more concern. This reflects the increased awareness of the environment that such respondents were thought to have developed. For those respondents who visit rural areas frequently for social reasons, less concern is expected, as these respondents may be more concerned about the importance of agricultural production to the rural economy.

Behavioral information was obtained on the respondents frequency of visits to rural areas for recreation, vacation, outdoor activities, to enjoy the natural environment, and to visit people.

The possible responses were assigned the following values for each question: 1) never, 2) seldom, 3) often, and 4) frequently. The scores were summed for each case to form a scale called Environmental Visits. The grand mean for this scale was 2.8. A similar series of questions were asked regarding frequency of visits to rural areas for Social Contacts. Respondents were asked if they went to rural areas to visit: friends, relatives, rural people, or to participate in rural lifestyles. The grand mean for this scale was 2.3. Alpha reliability for the two indices were .82 and .79 respectively.

Rural Beliefs and Attitudes

Perception and attitudes were also expected to relate to concern over agricultural pesticide and chemical use. A Positive Images scale was used to represent the "rural mystique" (Willits, 1993). The rural mystique, as measured through the Positive Images scale assess support for stereotypical rural attributes, including, friendly people, low crime, low stress, and satisfying lifestyle. The blanket association of rural things being good may reduce the concern one holds over chemical and pesticide issues.

One's position on rural development options could influence the level of concern about pesticides. Those favoring agriculture as a development tool, may be pro-agriculture, and are expected to be less concerned about agricultural pesticides and chemicals. Though all respondents are urban residents, those who wish to live in rural areas may be more concerned because of the future possibility of living in a polluted environment.

Responses to the Positive Images items were scored 1 to 5 with 1 = strongly disagree and 5 = strongly agree, with a mean of 3.6. The alpha reliability coefficient of this scale was .58. A specific question asked how respondents felt about the role of agricultural production in rural economic development policy. Those responding low priority were coded as 1, those assigning a middle priority were coded as 2, and the highest priority was coded as 3. One item asked where the respondent would most like to live. Responses were coded so that those who responded in the countryside outside of a city or town were assigned a score of 1. Those favoring suburbs, towns or cities were given a score of 0.

Table 2. Multivariate relationships for the agricultural chemical and pesticide concern index and the independent variables.

Variable	Model I	Model II	Model III	Complete Model
	B	B	B	
Social Bases				
Age	-.019		-.016	-.013
Income	-.067***		-.058***	-.065**
Sex	.220***		.205***	.225***
Education	.050*		.050*	.033
Party	.089***		.094**	.082**
Ideology	.104***		.101***	.102***
Childhood residence	-.225***		-.157**	-.186**
Rural Beliefs/Attitudes				
Positive images	.002	-.006		.000
Negative images	.030	.021		.020
Development options	-.058*	-.048		-.048
Desired residence	.099	.061		.089*
Visitation Behavior				
Environment visits		.124***	.148***	.121***
Social visits		-.172***	-.166***	-.136***
Constant	3.293***	3.486***	3.588***	3.310***
Adjusted R square	.13	.06	.11	.15

* significant at the .05 level

** significant at the .01 level

*** significant at the .001 level

The Bivariate Models

The expected relationships with age, sex, party affiliation, and ideology were found (data not shown). Though Van Liere and Dunlap (1980) found strong differences by educational level, this relationship was not statistically significant in the bivariate model. Further, a weak negative relationship with income was found when a positive relationship was expected.

Younger respondents, females, and those with low or medium incomes, were more concerned about the impact of these products. Democrats, and those with liberal ideologies were also more concerned. If, as a child, the respondent lived in a rural area, they exhibited less concern.

Among the attitudinal items, the Positive Images scale and the Desired Residence variable did not produce significant differences. However, those who thought agriculture was a *poor* economic development strategy were more concerned about pesticide and chemical use.

For the Social Visitation scale, those who frequently visit were more concerned -- the opposite of the anticipated relationship. The Environmental Visitation scale did not produce any significant differences.

The Multivariate Model

Multiple linear regression was used to model the three correlates of pesticide concerns (social bases, attitudes and beliefs, and visitation behaviors). The social bases were found to be the strongest indicators of concern, as shown by the 9 percent decrease in explained variation (R^2), when these variables were excluded from the complete model (Table 2). The belief and attitude block and visitation behaviors block were roughly equal in explanative power. Income, sex, party affiliation, ideology, and childhood residence were the significant social bases variables. As income increases, concern decreased. Females, Democrats, liberals, and those raised in non-rural settings all displayed more concern. Those who visit rural areas for social reasons were more concerned. The traditional development options variable was significant in two of the partial models, but was insignificant when all variables were controlled for. Those wishing to move to rural areas, and those that visit rural areas to be in the environment displayed more concern. No relationship in the multivariate model changed from the bivariate model. However, frequency of environmental visits did become significant, influencing the level of concern.

Discussion

The availability of data from an urban sample of Pennsylvania residents, provided information on how concerned these respondents were about agricultural pesticide and chemical use. Their reported levels of concern were great. Moreover, this issue is not limited to consumer-food safety, but rather is viewed by the public as a more comprehensive threat. For the most part, this analysis affirms the social bases hypothesis discussed by Van Liere and Dunlap (1980), particularly at the bivariate level. The only major exception is that of education, which was only mildly related in two of the block models. In spite of the fact that many of these variables were statistically significant, their combined power is not overwhelming. In an attempt to extend the social/demographic analysis of the type done by Van Liere and Dunlap, attitudes, beliefs, and behaviors were included in the analysis. However, these variables did not add substantively to the model's explanation.

Implications Stemming from Agricultural Chemical and Pesticide Concern

These findings suggest that agricultural production in close proximity to suburban and urban areas will probably face new challenges in the years ahead. Concern for the environment, food safety, and farm workers may lead to significant restrictions on pesticide and chemical use. Although these challenges to farmers may seem daunting, they may initiate agricultural innovations that are more profitable, as well as reduce the environmental

impacts of these inputs. As the cost of agricultural chemicals and pesticides, training, and certification increases, the economic incentive to adopt alternative strategies will increase. Some of these innovations are well underway, and include: low input sustainable agriculture, use of beneficial insects, pest resistant hybrids, insecticidal soaps, and bacterial based insecticides (Musser 1990; Vandeman et al. 1992). In fact, many of these "alternative" methods are rapidly becoming accepted as conventional techniques. The level of concern shown in this study suggests that pursuing alternatives to chemicals and pesticides would be a prudent course of action, especially for those who farm on the rural-urban interface.

Literature Cited

- Armor, David J. (1974). Theta reliability and factor scaling. in Herbert L. Costner. (ed.). *Sociological Methodology*. San Francisco: Josey-Bass.
- Bealer, R. C. and F. K. Willits. (1968). Worriers and non-worriers, among consumers about farmers use of pesticide. *Journal of Consumer Affairs*, 2:189-204.
- Bell, M. (1992). The fruit of difference: The rural-urban continuum as a system of identity. *Rural Sociology*, 57 (1):65-82.
- Bunn, David., Gail W. Feenstra, Lori Lynch and Robert Sommer. (1990). Consumer acceptance of cosmetically imperfect produce. *Journal of Consumer Affairs*, 24:268-279.
- Burbee, C. R. and C. S. Kramer. (1986). Food safety issues of the eighties. *National Food Review*, 33:17-20.
- Carson, Rachel. (1962). *Silent Spring*. Boston: Houghton Mifflin.
- Dillman, Don A. (1978). *Mail and Telephone Surveys: The Total Design Method*. New York: Wiley and Son.
- Food Marketing Institute. (1989). *Trend 1989: Consumer Attitudes and the Supermarket*. Washington D. C.: Author.
- Headley, J. C. (1967). A Dilemma for consumers: Pesticide use vs. food costs. *Journal of Consumer Affairs*, 1:161-169.
- Jussaume, Raymond., and D. H. Judson. (1992). Public perceptions about food safety in the United States and Japan. *Rural Sociology*, 57:235-249.
- Kitagawa, E. M. and P. M. Hauser. (1973). *Differential Mortality in the United States: A Study in Socioeconomic Epidemiology*. Cambridge, MA: Harvard Press.
- Musser, W. (1990). *Low input sustainable agriculture in Pennsylvania*. in Cathy Hamlett (ed.). *Pennsylvania's Agricultural Economy*. The Pennsylvania State University, Department of Agricultural Economics and Rural Sociology, #212: University Park, PA.
- Rodgers, Everett M., Rabel Burdge, Peter F. Korschin and Joseph F. Donnermeyer. (1987). *Social Change in Rural Societies* (third edition). Englewood Cliffs, NJ: Prentice Hall.
- Rosenblatt, R. A. and I. S. Moscovice. (1982). *Rural Health Care*. New York: Wiley.
- Sachs, C., D. Blair. and C. Richter. (1987). Consumer pesticide concerns: A 1965 and 1984 comparison. *Journal of Consumer Affairs*, 21:96-107.
- Scott, David. and Fern K. Willits. (1992). *Environmental Concerns of Pennsylvania Citizens: Data from a Statewide Survey*. The Pennsylvania State University, Department of Agricultural Economics and Rural Sociology: University Park, PA.

Spindler, M. (1983). DDT: health aspects in relationships to man and risk/benefit assessment based there upon. *Residue Reviews*, 90:1-34.

Swanson, Louis E. (1991). Never confuse farming with rural America. In William P. Browne, Jerry R. Skees, Louis E. Swanson, Paul B. Thompson, and Laurian J. Unnevehr (eds.). *Sacred Cows and Hot Potatoes: Agrarian Myths in Agricultural Policy*. Boulder, CO: Westview Press.

Vandeman, A., D. Shank, R. Chandran and U. Vasavada. (1992). Addressing pesticide residues: Lettuce provides indication of pesticide use and residues. *Food Review*, 15(3):2-5.

Van Liere, K. D. and R. E. Dunlap. (1980). The social bases of environmental concern: a review of hypothesis, explanations, and empirical evidence. *Public Opinion Quarterly*, 44:181-97.

Weaver, Robert D., David J. Evans and A. E. Luloff. (1991). Pesticide Use in tomato production: consumer concerns and willingness-to-pay. *Agribusiness*, 8(2):131-142.

Willits, F. K., D. M. Crider and A. E. Luloff. (1992). *Urban Perceptions of Rurality*. Harrisburg, PA: Center for Rural Pennsylvania.

Willits, F. K. (1993). The rural mystique and tourism development. *Journal of the Community Development Society*, 24(2):159-174.