PUBLIC PARTICIPATION GIS RESEARCH AND AGRICULTURAL FARMWORKERS IN CALIFORNIA

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ABSTRACT

This project employs a mixed-method sociospatial approach to studying agricultural worker health issues in rural California. Sociospatial means considering space, place and social indicators in a holistic and integrated fashion (Steinberg and Steinberg 2008a). The California Center for Rural Policy, funded from the California Endowment, worked in partnership with Poder Popular, a community-based networked group, to empower farmworker communities throughout the state of California. We created sociospatial maps that highlight the interplay between environmental and social issues for farmworkers in the region. The project equally involves both environmental mapping of pesticide use and application rates as well as qualitative data related to farmworker health concerns, issues and patterns of social interaction in Monterey and Tulare counties. Methods used include key-informant interviews, field tours, and participatory community mapping. We highlight how community-based participatory research approach is a means to understand community members' interests and knowledge about pesticides.

INTRODUCTION

This project employed a mixed-method sociospatial approach to study agricultural worker health issues related to pesticide use in rural California. Sociospatial analysis considers space, place and social indicators in a holistic and integrated fashion (Steinberg and Steinberg 2008a). This project accomplished this through the use of Geographic Information System (GIS) to effectively integrate and overlap environmental and social data related to farmworker health and pesticide use. GIS is a computerized system for analysis and mapping of information. The sociospatial approach is valuable because in that it allows for the spatial portrayal of social and environmental data. In this case, our sociospatial approach highlights the interplay between environmental and social issues for farmworkers in the region. We have found a visual approach to data portrayal to be effective across language and literacy barriers.

The California Center for Rural Policy (CCRP) and the Institute for Spatial Analysis (ISA), located at Humboldt State University, worked in partnership with Poder Popular, a community-based networked group to empower farmworker communities throughout the state of California to conduct this study. The analysis combines sociospatial data, consisting of both mapped and interview data, integrated to tell the story of farmworkers, their communities and pesticide drift using sociospatial analysis approach (Steinberg and Steinberg, 2008a). The project equally involves environmental mapping of pesticide use and application rates and qualitative data related to farmworker health in two California counties: Monterey and Tulare (Figure 1).

Figure 1: Location of Monterey and Tulare Counties in California.

MATERIALS AND METHODS

Pesticide application data was obtained from the California Department of Pesticide Regulation's 2005 statewide pesticide database. This database provides detailed information regarding pesticide applications for individual active ingredient in pounds for each public land survey section in the state. This database was linked to a geospatial database for each study county using ArcGIS 9.2. Additional data obtained included county parcels and zoning information and locations of schools in each of the six cities analyzed for the study. California State Senate and Assembly districts were also mapped to identify representatives whose regions contained the highest levels of use of agricultural chemicals.

Environmental data included topography derived from the 10m resolution National Elevation Dataset (NED). To examine winds, we obtained wind forecast data from the National Oceanographic and Atmospheric Administration (NOAA) for the week of July 1-7, 2006. This data included hourly wind speed and direction forecasts at 5 meter^2 resolution. Wind data was used to develop maps showing a weekly average wind speed and direction at four hour intervals during a representative week of the growing season when pesticide are typically applied. Wind data was preprocessed using NDFD GRIB2 version 1.85 (www.nws.noaa.gov/mdl/degrib/) and exported as shapefiles for use in the GIS analysis (Figure 2).

Sociospatial methods include key-informant interviews, ethnographic methods, public participation GIS, participant observation at community meetings, and environmental mapping. Prior to field visits, we interviewed key informants (targeted individuals from government agencies, community groups and non-profit organizations working on pesticide issues) to determine the issues and active chemical ingredients of greatest concern. Field visits to both counties were made in the summer of 2006 to carry out a community-based participatory research (CBPR) approach as a means to understand community members' interests and knowledge about pesticides. Particular emphasis was placed on the amount and types of specific pesticides and fumigants used near schools, neighborhoods and community gathering places.

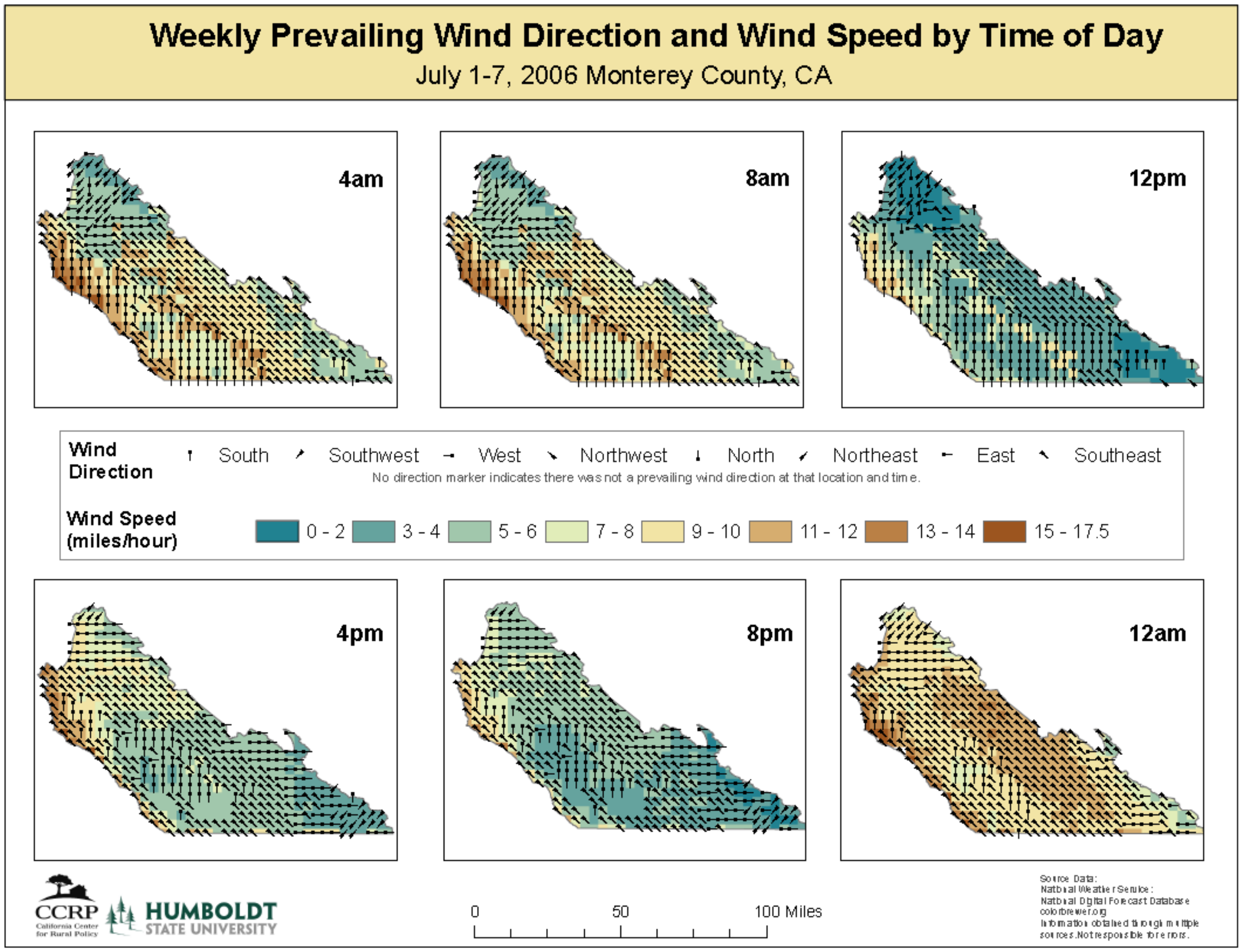


Figure 2: An example of weekly prevailing wind direction and speed averaged for four hour blocks throughout the day for Monterey County. Arrows indicate the prevailing wind direction in 45° intervals and color indicates wind speed. Strongest winds occurred during the overnight and early morning hours.

Public participation GIS (PPGIS) is a technique for obtaining georeferenced data derived from local knowledge. We overlaid National Aerial Photography Program (NAIP) color images of the six study communities with GIS data showing roads and parcels as a base for community members to provide input on locations where they had observed or experienced pesticide drift. The PPGIS process also was used to identify places when community members participate in outdoor activities such as parks and open spaces, as well as locations where farmworkers live. The PPGIS approach provided an additional and extremely rich dataset based on local knowledge. Where existing geospatial data sources (e.g. United States Census Data and the respective county assessor's office) were available, the results of the PPGIS were cross-referenced as a means of accuracy assessment (Figure 3).

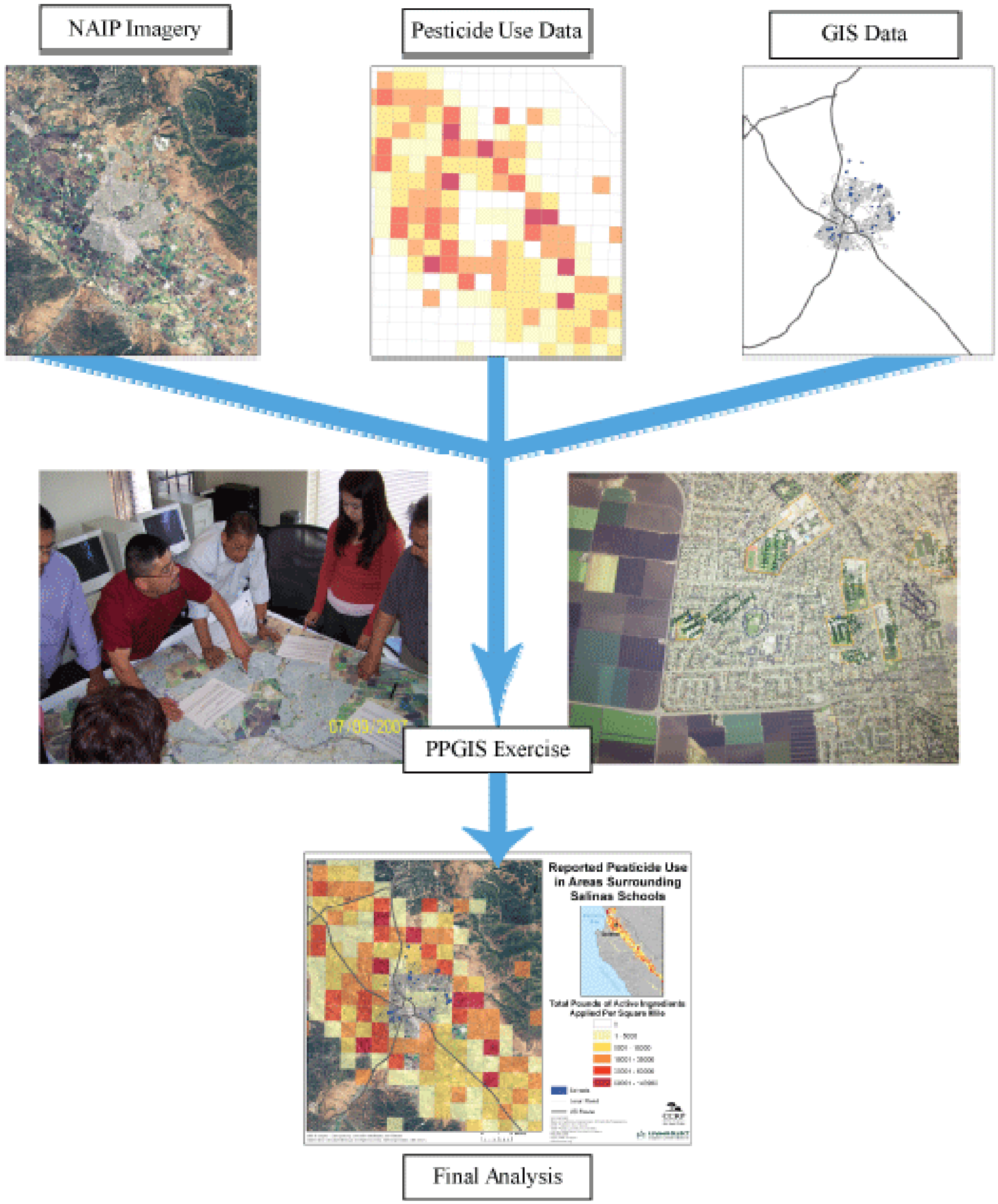


Figure 3: PPGIS workflow used in this project. Data from a multiple geospatial sources, including aerial imagery, existing GIS data and modeled GIS data was brought together to produce large format maps of each study community. Community members annotated maps through a public participation mapping exercise to provide information about sensitive sites, areas where pesticide drift occurred and other relevant information relating to the analysis.

RESULTS

These interviews provided insight into primary issues of relevance related to pesticide use, pesticide drift, agricultural worker health and community issues for these regions. Analysis of these interviews helped us to understand issues related to pesticide drift, how farmworkers are affected by drift, where and how they go to seek treatment in instances of possible exposure to pesticides and other specific areas of concern in these communities. Furthermore, by conducting interviews with various parties related to this issue including non-profit groups, agricultural and county officials, farmworkers and community members, issues of importance for policy emerge. The interviews provide the basis of the farmworker/pesticide drift interaction and perspective presented in the final report (Steinberg and Steinberg 2008b).

Pesticide data was examined for the region surrounding the three Poder Popular communities in each of the study counties. We examined both the total amount of pesticide applied in 2005 as well as the amount of individual pesticides of concern. Figure 4 shows the distribution of pesticide application in pounds per acre of active ingredient. The Department of Pesticide Regulation summarizes application rates by public land survey sections of approximately 1 mi^2 (640 acres). As an approximation of the total pesticide impact associated with a particular community we examined a region approximately three times the diameter of the developed area of the community. For the five smaller communities of Gonzales, Greenfield, Cutler & Orosi, Woodlake and Lindsay, the developed area of the community was approximately one mile in diameter. Thus we totaled all pesticide applications for 2005 within a three mile radius of the center of the community (approximately 28.3 $miles^2$).

The city of Salinas in Monterey county is substantially larger in size, measuring approximately three miles in diameter, so for Salinas, we totaled all pesticide applications for 2005 within a nine mile radius of the center of the city (approximately 254.5 $miles^2$). Salinas has a unique layout representing a doughnut with a significant area of agricultural production remaining in what is now the middle of the developed area of the city, and located literally across the street from a major hospital. Total pounds of active ingredient applied in and around these communities are summarized in Table 1.

Table 1: Amount of active ingredients applied around each study community in 2005 reported in total pounds and average pounds of per square mile.

Community	Total pounds of active ingredients applied in 2005 (area considered)	Average pounds of active ingredients applied in 2005 per square mile
Salinas	210,733 (254.5 mi^2)	828
Gonzales	19,668 (28.3 mi^2)	695
Greenfield	27,087 (28.3 mi^2)	957
Cutler & Orosi	45,933 (28.3 mi^2)	1623
Woodlake	28,111 (28.3 mi^2)	993
Lindsay	37,525 (28.3 mi^2)	1326

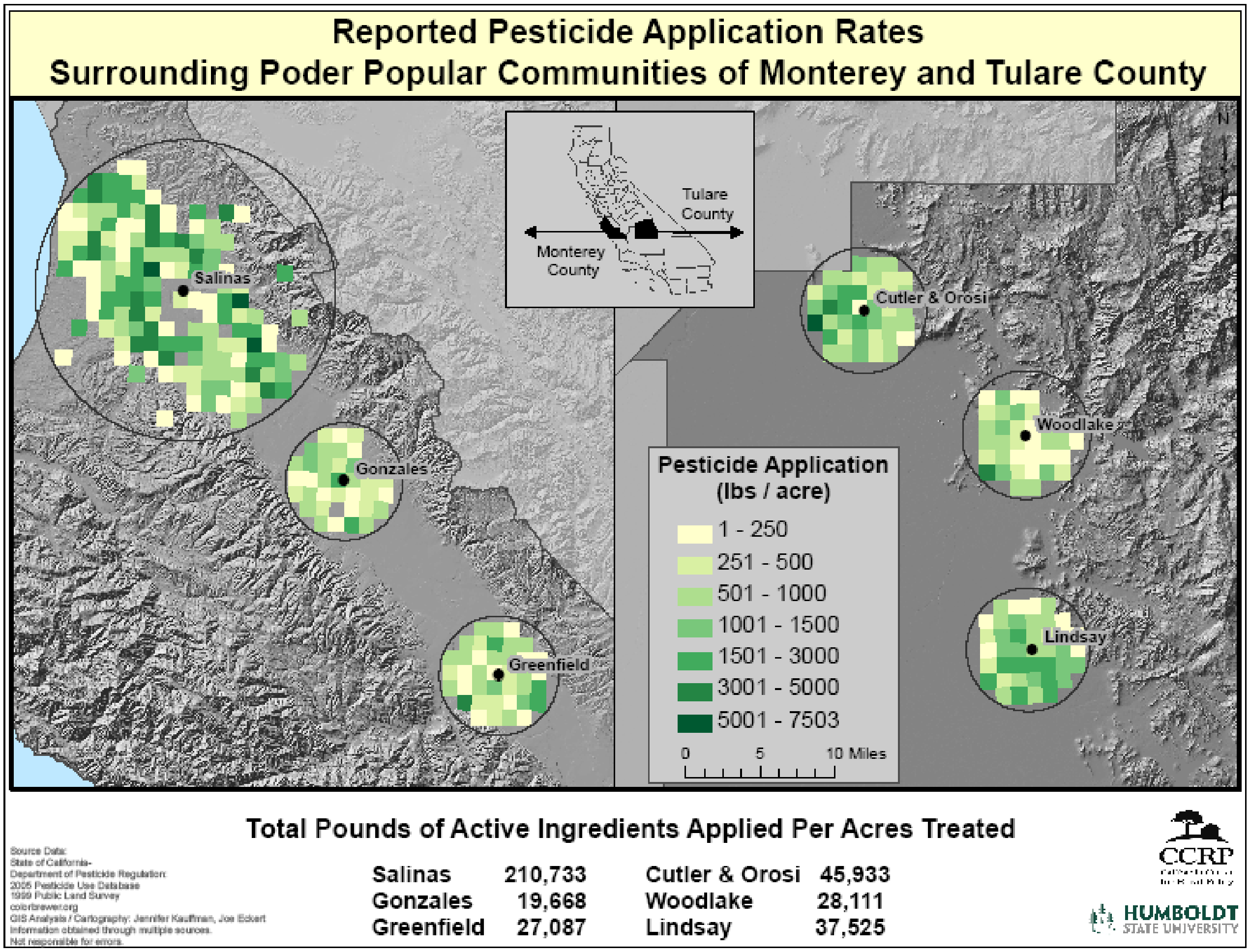
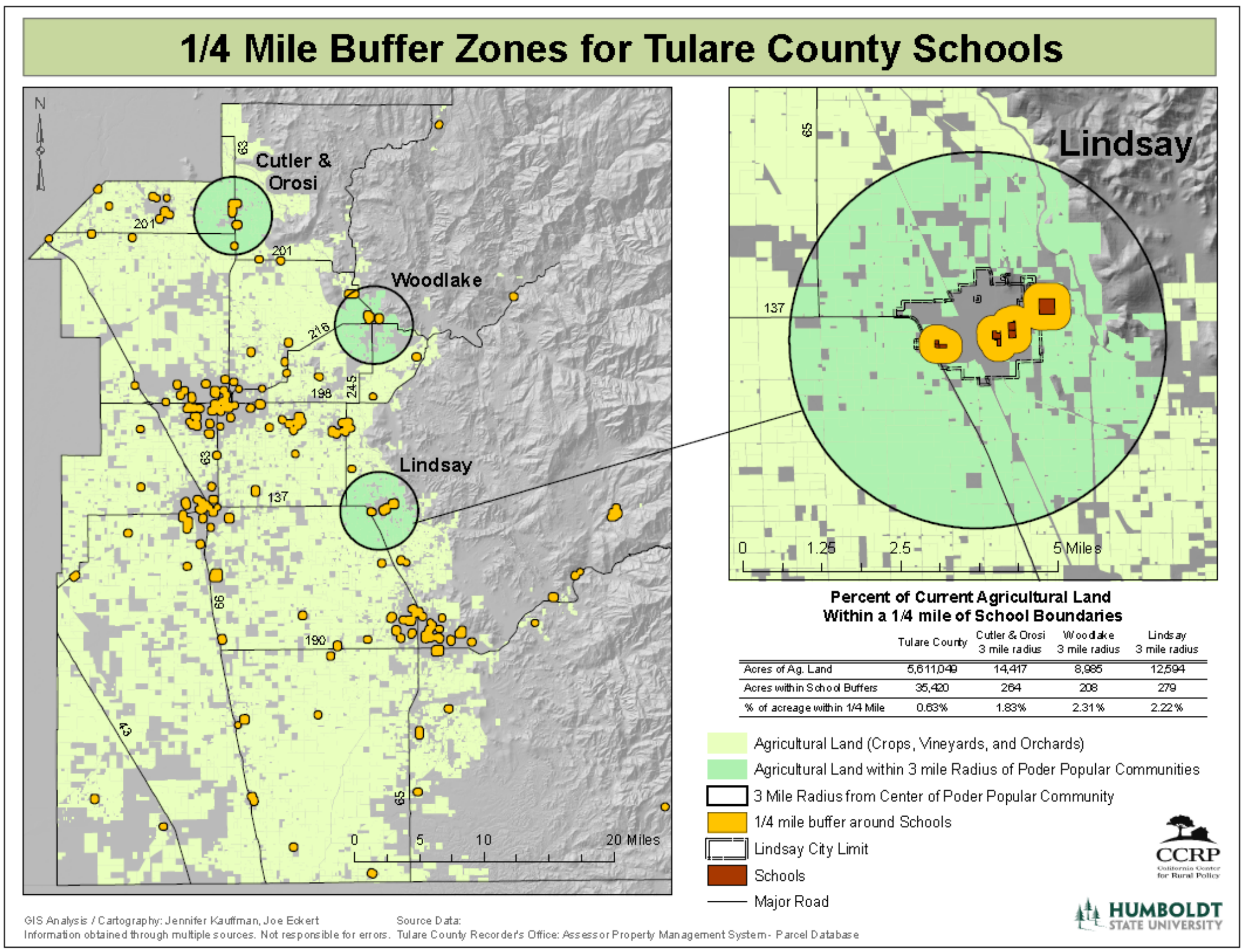


Figure 4: Rates of pesticide application surrounding the three Poder Popular communities in each Monterey and Tulare counties, California.

A topic of particular interest among community members interviewed in this study was the establishment of buffer zones around schools. A buffer zone is a region of some specified distance around school grounds with limitations on how and when particular pesticides may be applied. At the present time the creation of buffer zones and the size and other regulations are determined on a county by county basis. To assist in illustrating the impacts of a proposed buffer zone of ¼ mile (1320 feet), the maximum proposed at the time of this study, we identified schools for the entire county as well as for each of the study communities. Assessors parcels associated with school structures were overlaid on the NAIP photography and inspected to ensure all playgrounds and athletic fields associated with the school were included in the analysis. In many cases a school owned multiple parcels and buffers had to be generated for the total extent of the grounds rather than just the location of the school building (Figure 5).

For each study community, we aggregated the total acres of agriculturally zoned land falling into the ¼ mile buffer zones as well as the percentage of the total amount of agricultural lands surrounding the community. For areas surrounding towns this naturally overestimates the percent of agricultural lands affected relative to the outlying areas of the county. For example, in Tulare county, of the over 5.6 million acres of agricultural land, 35,420 acres are located within ¼ mile of a school or school grounds, representing 0.63% of the total. In Tulare County, within the three mile radius (28.3 miles^2) surrounding each of the Poder Popular communities, buffer zones would have the largest impact upon agricultural lands in the community of Woodlake with just over 2.3% (208 acres) of agriculturally zoned lands falling within ¼ mile of a school. In Lindsay just over 2.2% of these lands are within ¼ mile of a school and for Cutler & Orosi just over 1.8% (Figure 5).

Exploring this further, it is apparent that many schools are located at the periphery of these and other communities, perhaps due to the availability and price of this land as urban and suburban development grow outward from the city center. We observed very similar patterns and results in Monterey County.



	Tulare County	Cutler & Orosi 3 mile radius	Woodlake 3 mile radius	Lindsay 3 mile radius
Acres of Ag. Land	5,611,049	14,417	8,985	12,594
Acres within School Buffers	35,420	264	208	279
% of acreage within 1/4 Mile	0.63%	1.83%	2.31%	2.22%

Figure 5: An examination of the impact a hypothetical ¼ mile buffer zone around schools would have upon agriculturally zoned lands in Tulare County, California.

DISCUSSION

The PPGIS methodology offered insight to perceived conditions affecting a community where gaps exist in the scale of publically available data. While no pesticide data was available at a finer scale than one square mile, participants were often able to identify streets or fields related to incidents of experienced pesticide drift. Cross-referenced demographic data confirmed the validity of differences perceived by participants; however, participants were often able to identify demographic regions at a much finer scale than the U.S. Census block group level. Sensitive sites within the community are often not included in land use or parcel data, as some community locations, like churches or residential homes, had secondary purposes unique to the community served and would have otherwise gone unnoticed as sensitive.

The methodology used can be improved through closer attention to community perceptions of space. Participants were largely unfamiliar with aerial imagery and map-reading and required assistance finding locations on the maps produced for the exercises. Community members found location less difficult when the main local roads through town were labeled, despite the labeling of freeways and interstates. It would have been useful to include questions regarding local landmarks and heavily utilized streets within the interviews for labeling maps previous to beginning PPGIS exercises. Including a number of insets displaying the study area at varying scales without the background confusion of aerial imagery would also increase cartographic orientation on the part of community members.

One final challenge facing researchers is obtaining community-based knowledge in the face of widely available online mapping programs. During one exercise, researchers observed one participant utilizing a laptop to confirm the locations of schools and obtain their listed names, labeling these on the map. Care should be taken to remind community members that the goal of the process is obtaining information specific to their experiences as opposed to data already publically available.

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