

Lots of Potential: Urban vacant land identification from high resolution remote sensing imagery.

Introduction

The Phoenix metropolitan area is marked by substantial “undeveloped” lands closer to the urban core. This, combined with numerous housing projects that were either halted or abandoned due to the subprime mortgage crisis of the mid-2000s and the subsequent Great Recession leaves the Phoenix metroplex with an abundance of vacant parcels. Rather than being seen as a nuisance, this vacant land can instead be viewed as a source of opportunity for the communities and cities in which they are located through new land-use applications. One such application is urban agriculture (Drake & Lawson, 2014).

If taken beyond a local or neighborhood scale, the siting of urban agriculture requires inventories of suitable vacant parcels (Bowman & Pagano, 2004). Such data can be obtained from cadastral records maintained by tax assessors or appraisal districts, but these records typically do not contain details about physical parcel conditions that must be appropriate for development to proceed. Additionally, issues in data quality and accuracy are common. While still an important source of information, the use of cadastral data alone is not sufficient for evaluating large numbers of vacant parcels for potential urban agriculture development. This necessitates the need for the inclusion of some type of remotely-sensed data to allow for assessments of large metropolitan areas like Phoenix.

Study Area & Data

The boundary of the Phoenix metropolitan area was taken from the 2010 Census Urban Areas shapefile and applied to that portion of metroplex residing in Maricopa County, Arizona (Fig. 1).

For this study, vacant parcels (VP) are considered to be parcels which are categorized in the cadastral data as vacant and privately owned. Vacant Parcels for Potential Agriculture (VPPA) are VPs that also possess suitable land cover for urban agriculture (e.g., no structures or impervious surfaces) as well as suitable slope.

Three types of data sources were employed for the identification of VP: 1-m resolution National Agricultural Image Program (NAIP) imagery, 2010 cadastral data from the Maricopa County Tax Assessor’s Office, and physiographic data from the U.S. Geological Survey.

Methods

Cadastral data was refined, eliminating records except for those private parcels assigned a “vacant” property use code by the county. The number of parcels was further reduced by correcting for inconsistent code designations and by applying other constraints such as a minimum parcel size and a maximum. This reduced the 1,436,679 parcels for the metropolitan area down to 71,739 VPs.

Zonal statistics were calculated for the land cover of each VP using the NAIP imagery. Training samples were then used to create a classification scheme for the VPs based on those statistics. Five land-cover categories or classes were identified. Classes 1-3, Bare Soil, Scrub Vegetation, and Grass/Trees, respectively, were considered VPPA. Classes 4 and 5, Developed/Structure and Paved/Impervious surface, respectively, were eliminated from consideration. To better understand the distribution and clustering of the VPPA across the study area, a hot spot analysis was conducted.

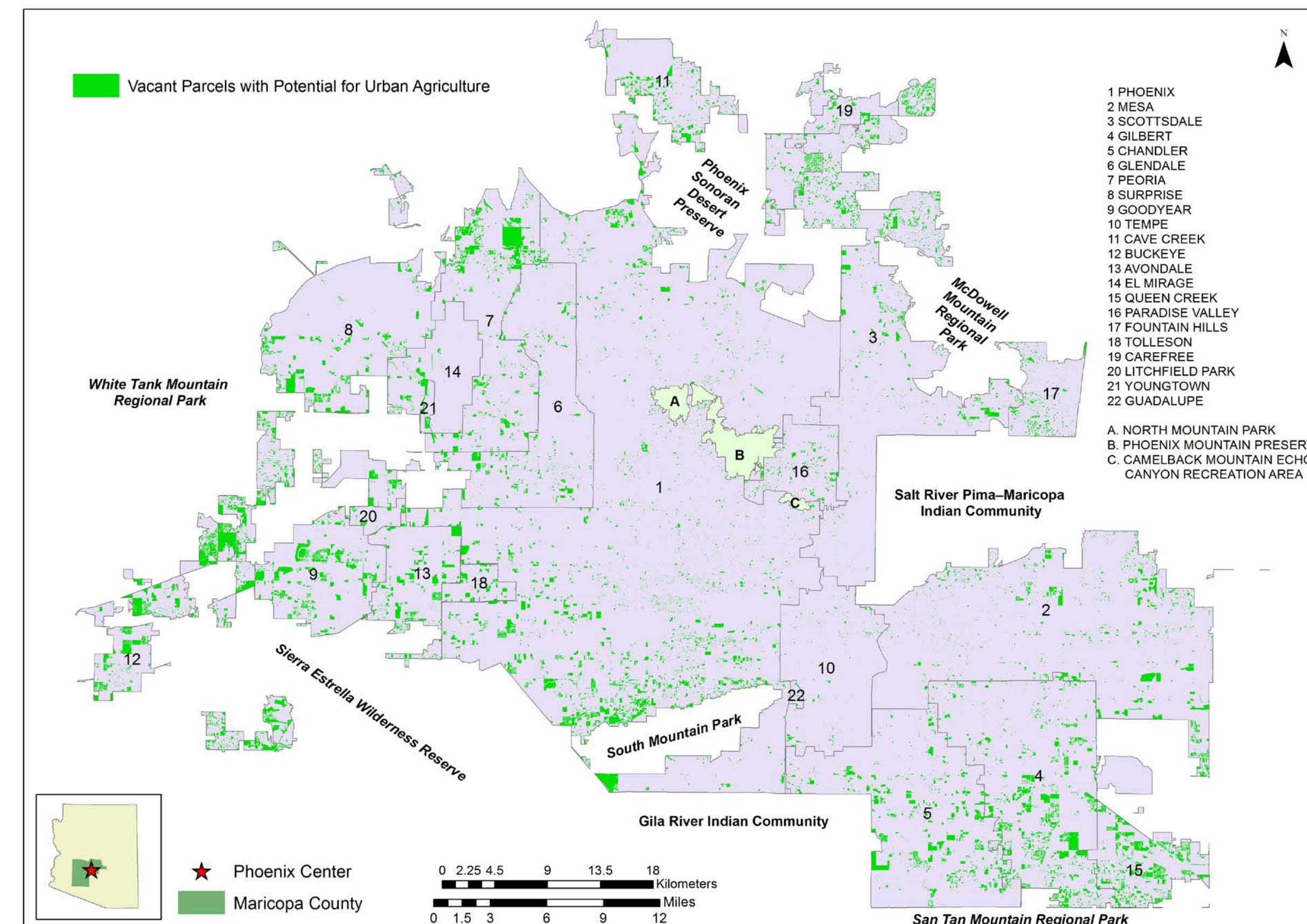


Figure 1. Phoenix metropolitan area and the distribution of vacant parcels potentially suitable for urban agriculture development

Results & Discussion

Of the 71,739 VPs identified, 67,032 were identified as VPPA (Fig. 1). Overall, 19,592 ha or approximately 196 km² (6% of total study area examined) of VPPA currently exist in the metroplex (Table 1). If geographically combined VPPA would constitute a square of land of 14x14 km in area (8.7x8.7 miles).

Total Number of Parcels within Urban Boundary	1,435,868
Number of Vacant Parcels Evaluated	71,739
Number of Vacant Parcels for Potential Agriculture	67,032
Total Vacant Parcel Area	21,643 ha
Total Vacant Parcels for Potential Agriculture	19,592 ha
Areal Coverage of Phoenix Metropolitan Study Area	3,069 km ²
Percentage Area for Potential Agriculture	6%

Table 1. Vacant Parcel Statistics

The hot spot analysis found that the fringes of the urban boundary, particularly in the southeastern, southwestern, and northern portions of study area, had the greatest concentration of VPPA; though, there are also some pockets scattered throughout the urban core as well. This clustering is likely the result of suburban expansion, in particular, a combination of halted development due to the collapse in the housing market and other tracts of land being held for speculation. In addition to this, there are also examples of large parcels which appear to be dedicated to agriculture in the aerial imagery which have had their PUC changed to denote vacancy even though land use has yet to change, either due to speculation or a cessation in development efforts. While there is still VPPA in the urban core of the metroplex, it tends to be restricted to more sparsely distributed in the form of individual lots.

Conclusions

Vacant land in urban areas can be a nuisance for many municipalities but can also be viewed as an area of opportunity for the communities in which they are located (Bowman & Pagano, 2004; Drake & Lawson, 2014). Urban agriculture serves as a potential development opportunity that provides a number of benefits to surrounding populations. Necessary for this development, however, are reliable inventories of vacant land that is appropriate for agricultural use (VPPA). This study presented a systematic and replicable methodology to classify vacant parcels (VP) and extract VPPA in expansive metropolitan areas. Through the use of both cadastral and remote sensing data, over 19,000 ha VPPA were identified in the Phoenix metropolitan area. The development of such VPPA into urban agriculture could create a source of locally grown produce, improve local health for both individuals and communities, and even potentially ameliorate the impacts of the urban heat island effect.

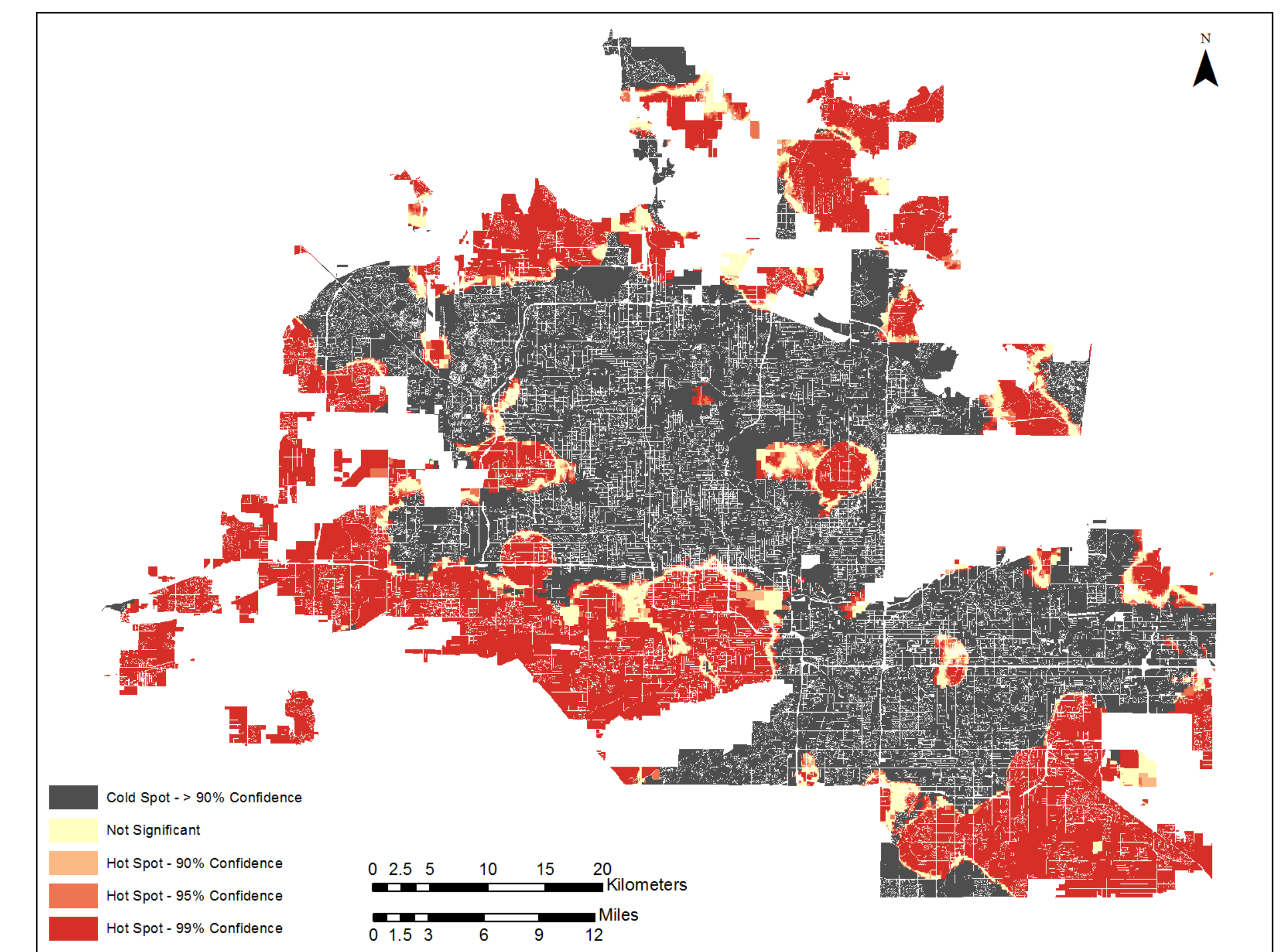


Figure 2. Results of the hot spot analysis with red indicating high clustering of VPPA

Acknowledgements

This project was supported primarily by NSF Grant No. DMS 1419593, the United States Department of Agriculture NIFA Grant NO. 2015-67003-23508, and NSF Grant No. GEO-0816168, Urban Vulnerability to Climate Change. Additional support was provided by the Central Arizona–Phoenix Long-Term Ecological Research (CAP-LTER).

Citations

Bowman, A. O., & Pagano, M. A. (2004). *Terra incognita: Vacant land and urban strategies*. Georgetown University Press.

Drake, L., & Lawson, L. J. (2014). Validating verdancy or vacancy? The relationship of community gardens and vacant lands in the U.S. *Cities*, 40, 133–142. <http://doi.org/10.1016/j.cities.2013.07.008>