Geographical Information Systems as a Tool for Non-Profit Organizations

Thesis for B.S. Sustainable Built Environments Degree

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Abstract

The study is on non-profit organizations use of data to analyze and plan projects. It looks at Geographical Information Systems as a tool that could benefit organizations in their data management, project creation, and community collaboration. Case study research was used to analyze three different tree maps created by non-profit organizations. The case studies looked specifically at the organizations' use of GIS in the data management, project creation, and community collaboration aspects of the maps. By looking at these aspects, it was concluded that GIS is a beneficial tool for non-profit organizations, even on the most basic level. As the organizations become more financially able to afford better software, the GIS capabilities become more beneficial. Non-profits should try to incorporate GIS at any level into their organization.

Introduction

Documenting events has been an important part of the human experience. All types of history, from major events to family gatherings, have been passed down for centuries through written work. The recording of history is important in the realm of societies all the way down to individual organizations. Documentation is important because it gives a written record of what has been done in the past. This work can give insight to what caused major problems to occur, how problems were fixed, or how future problems could be avoided.

Information gathered by any type of society or organization is important to the progression of that group. In organizations, information is vital to its continuing growth and project development. Lack of information or data can cause an organization to continuously forget projects that they have completed or reinvent the same project. Keeping track of what an organization has accomplished can help them develop further projects and move their organization forward rather than staying in place with the same work.

How the information is stored can be even more important than the information itself. If the information is disorganized, unreadable, or done in a way that new eyes will not understand it, it is useless. There are various ways to record data from hand written documents to tables to digital files. Data can be kept in Excel files, Word documents, the Cloud but regardless of the type of record, the data must be organized in a consistent manner with consistent attributes.

Non-Profit Organizations and Data

Non-profit organizations work hard to effectively make a difference in their communities. Effectively initiating new projects can be hard and non-profits often struggle to decide where to work. Generally, the theory is to work first in places that need it most such as areas that struggle with poverty, racial discrimination, or negative environmental impacts. These areas are known as social injustice areas. Most non-profits are quick to jump into these areas to help the community improve themselves. However, if all non-profits are helping those same areas or are continuously completing projects in these areas, their work could become insignificant, overlap with each other and cause other neighborhoods to be ignored.

Groups need a way of organizing past projects to assist them in determining the next project location. Geographical Information Systems (GIS) can be one of the several appropriate and efficient tools that can be used to solve this problem. By using location tools, such as Geographical Positioning Systems (GPS), organizations can track where they have worked. GIS software allows for database creation and mapping of information. The

database feature allows for organizations to keep records in a consistent format and can be easily created with the use of easier software such as Excel. Maps can be created from these databases that give organizations the ability to visualize their community efforts. Organizations can export maps into various formats to post the graphic on their website, create a poster, or print for project site work.

This paper looks at the use of GIS in work completed by non-profits in Tucson, San Diego, and Seattle. While there may be many non-profits working with GIS in these areas, the specific non-profits used for data are all environmental and include: Tucson Clean and Beautiful, Tree San Diego, and Seattle Audubon Society. All of these organizations have a map that they have created showing trees that are in their communities.

Literary Review

Sustainability

Since the Industrial Revolution, the condition of the earth has been declining rapidly due to an increase in population and the concomitant increase in pollution. An increase in population has created a greater demand on the earth's limited resources. The population that the earth can sustain is called the carrying capacity and as the earth quickly approaches carrying capacity, becoming sustainable is more important than ever. The Environmental Protection Agency states that "sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations," (EPA n.d.). Sustainability uses social, economic and environmental aspects to create a society that can sustain itself, bear less of a burden on the earth's resources, and continue to thrive. Many individuals and organizations are working to educate people and create a more sustainable society. Businesses, government agencies, and non-government organizations are just some examples of groups that work towards a more sustainable future.

Non-Governmental and Non-Profit Organization Definitions

The organizations in this project are all non-governmental organizations (NGOs) as well as non-profits. Non-governmental organizations are organizations that are not part of the government or overseen by them. These organizations are also non-profit meaning they do not have a motive of making money for the sake of the organization. They are not for profit

or overseen by the government however they often receive grants and funding from the government. Instead of profit, they strive to have an effect on "social, political, or economic change," (Kanji and Lewis 2009). Some NGOs go past just social, political, and economic change and work on promoting environmental change. Famous environmental NGOs in the United States include Green Peace, World Wildlife Fund, and the Sierra Club. The Sierra Club for example, aims to protect the wild lands of the United States. They helped pass the Clean Air Act, Clean Water Act, and Endangered Species Act. Currently the Sierra Club is working towards more sustainable energy sources that are cleaner for the environment (Sierra Club n.d.). Organizations such as the Sierra Club function on a national and international level. There are organizations however that function on a state and city level as well.

Non-profits help their communities with sustainability through education and projects. The social aspect of sustainability is achieved by finding areas of need in the community and those neighborhoods impacted by social injustice. Projects such as low-cost housing built by Habitat for Humanity and Community Action Toolkit by the Ironwood Tree Experience are a few examples. Economic sustainability can be promoted by these organizations through education as well as providing low cost options. For example, Watershed Management helps communities build rainwater harvesting basins and rainwater runoff drainages. This helps the neighborhood avoid damage that can occur during monsoon season and save on water costs for landscapes. Tucson Clean and Beautiful in partnership with Tucson Electric Power and VICO Energy, provide low cost shade trees to Tucson citizens that will lower their electric bills. Most importantly, non-profits that are geared towards sustainability focus on the environmental aspect of sustainability. This is achieved through educational programs and projects. Examples include tree plantings, Adopt-A-Park programs, bike friendly streets, and community gardens. Whether a local non-profit such as Watershed Management or a national organization such as Green Peace, non-profits play an active role in creating a sustainable future.

Non-Profit Organizations and Data

A study was conducted by the Nonprofit Technology Network (NTEN) in 2012 to look at what types of data non-profits collect and how they use it. Included in the study are 398 non-profits that responded to a survey sent out by NTEN. Almost all of the organizations responded that they collect data, only three responded that they do not (The State of Nonprofit Data n.d.). This shows that data has a place within organizations and that organizations have some intent to use it. The study found that the data most of the

organizations collect is related to finances and operations. There is an evident problem with organizations knowing how to track data, having the technology to track data, or having the time or money to do so. For example, the study asked why organizations are not collecting data on how many new donors they have per year. The least common reason why, with only 5% is that the organization does not know how. Not having the time or money and not having the technology was almost even with 12% and 11% respectively (The State of Nonprofit Data n.d.). Not having the resources is a common problem for non-profits simply because they are not for profit, making it more difficult to pay for newer technology that will allow for them to do this type of work. NTEN points out that the most important data for non-profits to collect is data regarding the outcome of programs. Less than two-thirds of the survey respondents are collecting this type of data. They found however that those organizations who track this information find it beneficial in program and budget planning. Through focus groups, NTEN found that organizations often do not start collecting data because they wish to use it, the collect it because the government requires it to be sent to them. Non-profits "evolve" from collecting data out of requirement to collecting data for personal use and organizational growth. Not knowing how to collect, understand, or apply data is a problem addressed from the study. The authors suggest to start somewhere, invest in having someone who understands the data or teaching someone to understand the data, and how to apply it. Once organizations can collect, understand, and apply data they can collect the right data they need to further their efforts.

GIS Definition

Geographical Information Systems are defined by the Environmental Protection Agency as "a computer system that allows you to map, model, query, and analyze large quantities of data within a single database according to their location," (Geographic Information Systems n.d.). It allows for spatial data to be represented visually. GIS is used by researchers in research visualization, government agencies to analyze demographics, and non-profit organizations to track their progress. Using collected data, a database is formed and from it, a map can be created. The map shows the data based on point, line, or polygon features depending on the type of data the user is wanting to show. The features can then be symbolized in manners that further the visualization. For example, on a map showing fire patterns, the darker red areas may be the areas that are more susceptible to burn while yellow areas are less likely to burn. By using layers and multiple data types, databases can contain large amounts of data that can be placed on the map at the same time, allowing for a

deep analysis. Examples of GIS software include GRASS GIS, Smallworld, and Esri ArcGIS (List of geographic information systems software n.d.).

Geographical Information Systems is different from Geographical Information Science. The latter was conceptualized by Michael Goodchild in 1992 but defined in 2003 by David Mark, a professor at the University of Buffalo. Mark defined Geographical Information Science, or GI Science, as "the development and use of theories, methods, technology, and data for understanding geographic processes, relationships, and patterns," (Gould n.d.). Put simply, GI Science is the science behind Geographical Information Systems.* Even with GI Science, there is still a debate over whether GIS is a scientific method or just a tool to use within a science. Most people argue that it has to be one of these, however, Dawn J. Wright, Michael F. Goodchild, and James D. Proctor suggest there is a third option, GIS as tool making. In their paper, *Demystifying the Persistent Ambiguity of GIS as 'Tool' versus 'Science'*, they describe the three positions. The first, GIS as a tool, sees GIS as simply software being used to further a study (Wright, Goodchild and Proctor 1997). They describe the science position as seeing the "intimate and reciprocal connection between tool and science." The authors suggest that the problems GIS aims to solve have always existed and are now just being analyzed and solved in a new, more effective manner. The third, tool making, combines the two other positions but limits the impact of science. This position sees GIS as its own subject, people try to further the capabilities of the software and research new ways to use or improve the software but it is not science per say. Another author, David J. Maguire, suggests that GIS and GI Science are co-dependent and that this is a modern science (Maguire 2010). The debate may never end and it is possible that GIS is a tool when used in its basic form and science when used in advance methods. Non-profits that use GIS use the most basic features. They may look at demographics and research into more than just mapping their projects however, they are not using it on a scientific level. Therefore, for the non-profit use, it could be argued that GIS is not a science but a tool.

GIS As Data Collection

Data collection in the digital age has developed from data collection a few decades ago. The digital age has allowed for information to be shared faster and more frequently than ever before. One way to collect data in the digital age is through the use of GIS. By using

* From this point on, Geographical Information Systems will be abbreviated as GIS and Geographical Information Science will be abbreviated as GI Science.

remote sensing, global positioning systems (GPS), and analysis tools, such as ArcGIS, data can be analyzed and shared in more visual manners. GIS software such as ArcGIS is an effective tool to organize data. The software requires for data to be organized. Since the data is organized in tables, it is possible to search for certain attributes. For example, in a map showing Florida's population, it would be possible to query cities that have populations greater than 80,000 people. This level of organization allows for organizations to keep track of data, easily add data, and have a definite layout for data.

Applications of GIS

Using GIS for data collection, analysis, and representation is not a new concept. Government agencies and businesses use it for various types of work. The City of Tucson uses GIS and specifically ArcGIS to map the city, neighborhoods, schools, and demographics that include income, education level, and age. Examples of applications of GIS are management of coastal aquifers and tourism planning. In coastal aquifer management, the Democritus University of Thrace, located in Greece, used GIS to manage the "groundwater resources in the area" and map the water in the area (Kallioras, et al. 2006). This is important for agencies that supply water from the area because of the possible water contaminants. The map allows people to know where they can collect water from or areas where water needs to be purified before being used (Kallioras, et al. 2006). The database created here does not help only one person or organization but multiple. The digital data created allows for people to access the information easily, quickly, and are able to see the data visually rather than just in numbers or words.

Project Creation Using GIS

Professors from the University of Lincolnshire and Humberside, in the United Kingdom, did a study on applications of GIS in sustainable tourism planning. They suggest that due to sustainability aspects, tourism planning has become difficult because there is a substantial amount of aspects that must be taken into account (Bahaire and Elliot-White 1999). GIS proved to be a good tool for tourism planning because it allows all these different aspects to be considered simultaneously (Bahaire and Elliot-White 1999). A database and map can be created with layers allowing each aspect to have a layer in the final product. The economic layer may not be impacted by a project but if social and environmental layers are all shown at the same time, the planner may find that the project effects the social layer which then will affect the economic layer. Having the ability to visualize where an organization has

been allows for them to see what areas they are missing. For example, an organization may be under the impression they are working in all income-level areas. However, when mapped, they see that they are not involved in areas that are middle class. Projects can be created by finding gaps or be created based off locational needs. A middle-income area may have three parks and street trees so a tree planting project may be unnecessary. The non-profit could see this and decide instead of a tree planting project they could trim the current trees or put in basins to catch rainwater that will help water the existing trees.

Community Collaboration Using GIS

Geographical information systems can be used for community collaboration in a few ways. The first is as a resource. A GIS map can be posted through a city's website to allow citizens to search for parks or neighborhood associations. Having access to a map as a resource allows the community to be involved in different city aspects as well as having an understanding of their surroundings. Community collaboration can be achieved through using the community as data collectors. By allowing community members to upload data to the map, such as the tree in their backyard, allows for them to have a role in the organization's efforts. It also creates an easier job for the organization because they do not have to go around uploading GPS coordinates for every tree in the city. A third way that GIS can be used for community collaboration is through organizations themselves. By creating a single map to be used by all non-profits to track their progress together, organizations can work together in planning projects. The Ironwood Tree Experience in Tucson, AZ, is starting this process. Their map contains their projects along with those projects completed by the Tucson Audubon Society. The goal is to see if their projects overlap in neighborhoods and then work on benefiting each other's projects or even create projects together. Eventually, ITE would like for more organizations to join in the collaboration so that the non-profits in Tucson can work together in their efforts. This would allow for larger projects or for one organization to not be doing all of the work. For example, if Trees for Tucson has planted trees in a neighborhood that Watershed Management would like to work in, then Watershed Management can plan a project that will benefit the trees planted by Trees for Tucson. Community collaboration is necessary for a successful sustainable environment and GIS can help to achieve this.

Methodology

Three maps will be analyzed in terms of data collection, project creation, and community collaboration. The maps are tree maps created by non-profits, Tree San Diego, Seattle Audubon Society, and Tucson Clean and Beautiful. All three maps show trees planted in the cities of the organizations. This method of analysis is called a case study. Case studies have become difficult to define according to John Gerring, a Political Science professor at Boston University. To understand a case study, he first defines case then tackles the definition of case study. A case is "a spatially delimited phenomenon (a unit) observed at a single point in time or over some period of time," where for each case observations can be made (Gerring 2007, 19). Cases are projects or situations that can be looked at for information. A case study is the "intensive study of a single case where the purpose of this study is – at least in part – to shed light on a larger class of cases (a population)," (Gerring 2007, 20). Looking at multiple case studies to draw conclusions on a larger phenomenon is called case study research. In this case, there must only be a few case studies being observed and they must be in depth. If the case studies being looked at are plentiful and not in depth, it is called cross-case study (Gerring 2007, 20). For this project, three cases are being researched and they are analyzed in depth, therefore, it is case study research.

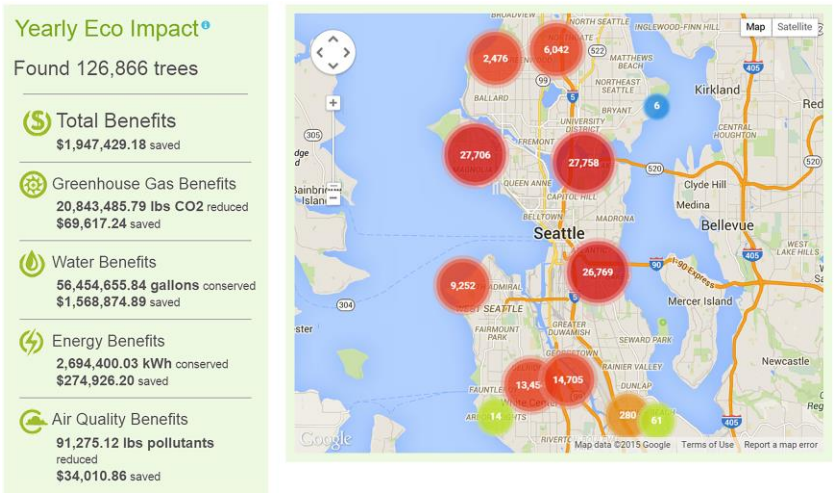
Using case study research as the method for this project is appropriate because conclusions can be drawn about the effectiveness of GIS as a tool for non-profits based off of work that has already been done. It is possible to understand the benefits and limitations of GIS by looking at the three cases. The cases here are the maps created by Seattle Audubon Society, Tree San Diego, and Tucson Clean and Beautiful. To have a balance between cases, maps were chosen based on the organizations being environmental non-profits that have created a map to show tree plantings. Using the mission of the organizations, information from their websites, history of their maps, and the maps themselves, the cases are researched and analyzed. Specific aspects of GIS that are being looked for in each map are data collection, project creation, and community collaboration.

Results and Discussion

The sources of data all came from maps created by non-profit organizations in three different cities. One source came from the Seattle Tree Map created by the Seattle Audubon Society. This map gives an example of how a non-profit uses GIS as a way to bring the

community and organizations together in an effort to build the urban forest, educate on sustainability, and collaborate on future projects.

Figure 1 Seattle Audubon Society Tree Map

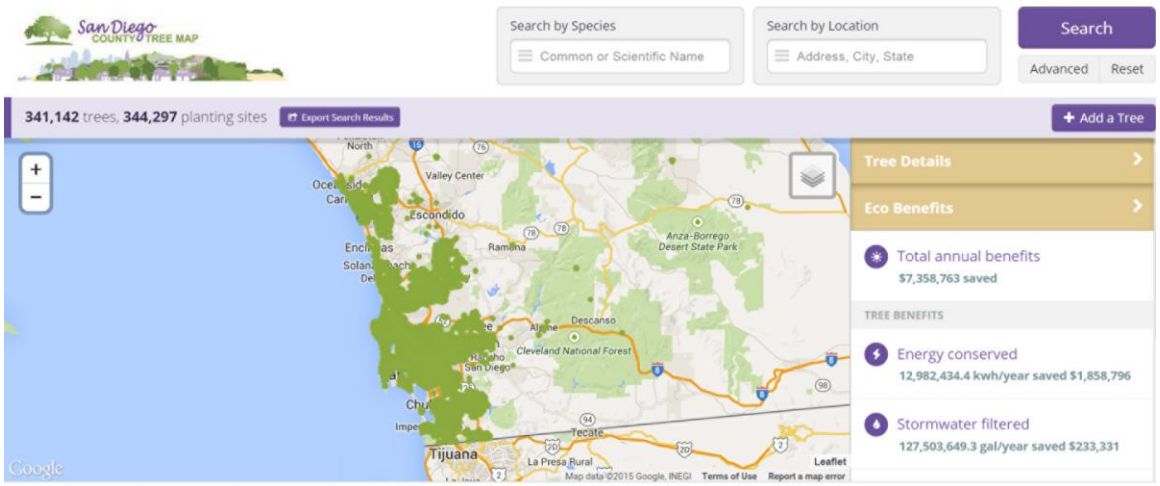


Source; Seattle Audubon Society Tree Map, n.d..

A snapshot of Seattle's Tree Map

The second source of data comes from San Diego's Tree Map created by Tree San Diego. This map gives an example of GIS being used on a large scale to progress sustainability and urban forestry. This data also gives an example of GIS being used on a large scale to progress sustainability and urban forestry.

Figure 2 San Diego County Tree Map

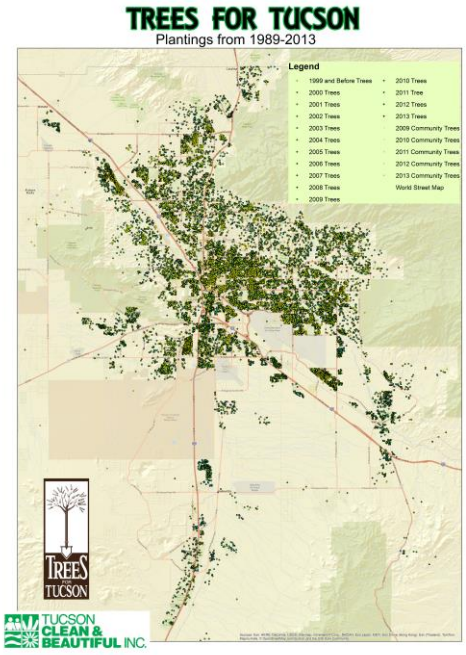


Source; San Diego County Tree Map n.d..

Tree San Diego's tree map interface on their website.

The third source is from Tucson Clean and Beautiful's tree map which shows the trees that have been planted by the organizations Trees for Tucson program. This map gives an example of GIS being used in a small scale non-profit with limited funding. Using data collection, project creation, and community collaboration, the maps will be analyzed and compared.

Figure 3 Tucson Clean and Beautiful's Tree Map



Source; Tucson Clean and Beautiful n.d..

A department in Tucson Clean and Beautiful, Trees for Tucson's Tree map.

GIS as Data Collection

The Seattle Tree Map was started by the Seattle Audubon Society. The data they started with came from Seattle's Department of Transportation. When discussing this map as a tool for data collection, it is essential to understand this data was not initially collected by the non-profit itself. This means that Seattle's Department of Transportation had to keep their data organized and readable so that Seattle Audubon had the ability to use it even though they were not a part of the collection process. The organization continues to collect data from Seattle's Department of Transportation as well as community members. Their map is created through a source, Open Tree Map. This website allows users to upload data and create maps that can be updated through the participating organizations website. This feature allows Seattle citizens to take a picture of their backyard trees, and upload them with

the GPS coordinates, adding them to the Seattle Audubon Society's Tree Map. Citizens can also add information about their tree such as the type. Once the tree is uploaded, viewers can look at the information for the tree and edit a mistake or add more information to it. The organization looks over the added trees and updates to look for obviously wrong information; if information is found to be wrong, they remove it. The economic data included in the site comes from both the Open Tree Map software calculations and from i-Tree. The software i-Tree is program ran through the United States Department of Agriculture's Forest Service. Economic data includes the total yearly monetary benefit from the trees, greenhouse gas benefits, water benefits, energy benefits, and air quality benefits. All of these benefits are calculated by the amount reduced or conserved as well as the money saved. This data can be viewed for the total amount of trees in Seattle, a group of trees, or a single tree.

San Diego Tree Map uses the same Open Tree Map software as Seattle, which means most of the same economic benefits, are calculated. San Diego's map also calculates storm water filtered and carbon dioxide stored. No information can be found on how the organization initially retrieved data for the map however, the map was started before it went live for community input. It can be concluded that data was collected through surveying and possibly from other sources as done in Seattle. Again, as done in Seattle, Tree San Diego stresses citizens to only provide the best information possible. They note that the tree information may not be correct but they are continuously checking and researching the validity of community input. They plan on continuing to have the community be the sole surveyors unless it becomes an obvious unreliable source.

Tucson Clean and Beautiful's map is radically different in terms of data. The data does not include any economic benefits nor is it available to the public to update. The map shows trees planted by the local non-profit however, it is not symbolized by each tree but by the address trees are located at. Each point may reference one to forty trees. This is due to the data collection. As the department developed over fifteen years, the organization of data changed. Throughout the years, it varied whether or not data included how many trees were planted at each address. Data for tree location was based on the address trees were delivered to, not their GPS planted location. Due to these factors, the way the map was created had to be based on what was present for every tree planting and that was only the delivery address. While this data is not the same or allow for a map to show each and every tree, it shows where the organization has had impact. With the organization now using GIS, their data can stay consistent and organized. The attributes within the database can stay the same for the map

to be updated and the organization knows that they need to have that information for every tree planted.

GIS as Project Creation

Seattle Audubon Society is working on a project, Canopy Connections. The project is to help the City of Seattle reach its goal of having 30% tree canopy cover by 2036. The map was created to help in this effort. By tracking trees, and continuously updating the map, the organization can help determine if the city is on track to meet this goal. By using this map, the organization and city can determine where there may be a lack of canopy. The Seattle Audubon Society's website also has a link for Neighborhood Activities through the Canopy Connections program. Neighborhoods can follow it to team up with the organization to develop a project in their area to build the urban forest. GIS helps here as well since the neighborhood can view their area on the map and determine if it is lacking trees or where a tree could be planted.

Tree San Diego has a mission "to significantly impact the quantity of quality urban forest in San Diego County." They define quantity as percentage of urban forest and quality as the right type of tree, places, and maintenance (San Diego County Tree Map n.d.). This mission creates an abundance of potential for project creation from their map. The map can be used to see where urban forestry is lacking and project can be created in that area. Also, with the ability in GIS to connect attributes such as tree type, the organization can see what types of trees are in the area. It is possible that there may not be the right type of trees in places, such as trees that are invasive and dangerous to the surrounding area or trees that interfere with power lines. Projects can then be created to fix this problem.

Tucson Clean and Beautiful's map was produced for the sole purpose of project creation. It was created using the software ArcGIS so that additional demographic layers could be added to the map, such as income levels. This allows the organization to look at what areas they are hitting and missing. Do they need to plant more trees in low income areas or are they missing neighborhoods in higher income levels? By analyzing their map against map layers showing demographics they can create projects that will broaden their efforts and not focus too much on one area. Trees for Tucson hit the 100,000 tree mark in 2014. Being able to visualize 100,000 trees allows them to process their impact in ways that they could not with just numbers in an Excel sheet.

GIS as Community Collaboration

Seattle Audubon Society and Tree San Diego encourages their communities to help in its efforts to build the tree canopy. By using the Open Tree Map software, the organizations can have their communities help track trees. Making data entry easy and accessible, keeps the community involved in the process of building their urban forest. Not only does this involve the community and help the organizations track trees but it educates the community on the importance of urban forestry. By being hands on, the community can play a bigger role in the effort and therefore fully understand the importance of the project. It also creates opportunities for the community to come together for projects. Whether it is a planting created by the organization or one created by a neighborhood, it gets people together for a great purpose.

The San Diego Tree map allows for an abundance of community collaboration similar to the Seattle Audubon Society's map. The two organizations use the same OpenTree mapping software. For the San Diego map, community members can upload GPS locations of trees, add pictures and information about the tree. If community members come across an entry that is incorrect, for example, the tree species is wrong, then they have the ability to edit it. The edit goes under review and if correct, the edit will be made. This process allows for a greater amount of collaboration coming from the community. It is also helpful to the organization because there are more eyes looking for mistakes and they can gather more data easily. In this map, GIS encourages community collaboration by making it possible for the community to be extremely involved in the map making process.

Tucson Clean and Beautiful's map does not have the ability to be updated by the public. This is due partially to not having the software capability as well as not having a live interactive map that is available online. While the community does not have a chance to upload their own trees to the map, it does not mean they are not involved in the process. By using the map as an educational tool, the community can learn about the Trees for Tucson program and buy shade trees from them, adding to the trees that will be on an updated map.

Conclusion

The San Diego Tree Map, Seattle Tree Map, and Tucson Clean and Beautiful Tree Map, all used GIS as a tool to collect data, create projects, and engage the community in their efforts. As a tool to collect data, the Seattle and San Diego maps are the most successful because they use many sources to obtain this data. They also involve their community in collecting data,

giving them a chance to impact their city's urban forestry efforts. Tucson's map shows that small organizations can use GIS to organize data and that progress is necessary. For project creation, all three maps are successful but for individual organization efforts, Tucson Clean and Beautiful might be the most successful. The reason is that their map only shows their progress which can help them determine the areas they need to be in. While this is good for the organization, it may not be an accurate representation of the areas that need more trees. The organization's presence does not necessarily mean that there is not an abundance of trees there already. In this sense, Seattle and San Diego's maps are more successful because they are able to visualize more of the city's trees and weaknesses as a city overall versus just an organization. Community collaboration is evident in Seattle and San Diego's maps. Being able to have citizens upload trees onto the map is a great asset. Tucson needs to find ways to incorporate their community more. This does not mean that their map does not have community collaboration however, they could get better and involve the community more. These organizations show that GIS is an effective tool for non-profits and can be used to further the organization.

Tucson can be compared to these other two cities and the city can learn from their work to take Tucson Clean and Beautiful's Map to the next level. This next level could be making the site interactive, collecting data for all Tucson trees and not just those planted by Tucson Clean and Beautiful, as well as mapping all of the trees rather than just the addresses a group of Tucson Clean and Beautiful trees are at. Tucson also used the ArcGIS software rather than OpenTree Map. OpenTree Map does not have any non-profit discounts and for Tucson to build a suitable map, the cost would be roughly 800 dollars a month. This is very expensive. A better route would be for Tucson to continue to build up a map using ArcGIS which for non-profits is roughly 200 dollars per year. Once a map is created that has more data, transferring to OpenTree Map can be considered. It should also be considered what is wanting to be done with the map and who would like to use it. If the city as a whole is trying to build the urban forest than it would be useful to have an OpenTree Map. However, if just Tucson Clean and Beautiful is interested in the map and uses it solely as data collection and project creation, OpenTree Map is unnecessary.

Limitations in this study was time, data collection, and access to resources. The study time did not allow for more case studies to be added such as ones with different data types or mapping software. Data collection was difficult since two of the case study organizations were not local. It would have been helpful to have had more interaction with the

organizations and their actual data. GIS as a tool for non-profits is a relatively new idea, this made literature on the specific topic limited. The limited work that has been done on the subject created a necessity to look at GIS use in other places and draw parallels. Further research on this topic should be completed in other non-profit organizations, not just those devoted to urban forestry. It would also be beneficial to follow a non-profits work with GIS from the beginning through them using it for project creation and until they have several projects completed using this technique. With GIS slowly making its way into non-profits, there is an abundance of research that can be and should be completed.

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