

The Relation of Income Level and Quality Green Space in Contra Costa County

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ABSTRACT

Green space is an essential part of any city that provides a free area to enjoy nature, exercise, and build community. However, not everyone has equal access to green space and it is not guaranteed that green spaces are of the same quality across cities. In this study, I looked at the cities of Contra Costa County to determine which cities have more access to quality green space, and to see if this is correlated with income level of those cities. To do this I worked in ArcGIS Pro to map all of the parks in each city in the county to determine green space by area, I then used online data and in person measurements to assess the quality of the parks. Surveys were sent out to the cities and interviews were conducted with city council members to assess the green space maintenance and budgets. I found that San Pablo has the least access to quality green space and Lafayette has the most. The residents in both cities felt that safety should be a main priority at their green spaces. Policymakers need to address the green space in lower income cities to help ensure that it is of the same quality as other cities. In order to generalize my findings through this study, there needs to be future research done on the other cities in Contra Costa County, to see how a middle-income level cities' green space would relate to the other ends of the spectrum, and if the cities I chose were just exceptions.

KEYWORDS

environmental justice, parks and recreation, disproportionate access, income inequality, urban planning

INTRODUCTION

Access to green space in one's community is extremely beneficial for an individual's mental health. A park's aesthetics can provide a relaxing space for someone to take a mental break and it can also provide opportunities for physical activity, which can be beneficial for both physical and mental health (Croft et al. 2013, Foster et al. 2006). One study, comparing two neighborhoods with the same amount of green space but different accessibility showed that the area with more accessible and usable green spaces had residents that were happier with their area (Van den Berg et al. 2017). This suggests a link between accessibility and mental health, which means that policymakers could consider how to make green space more accessible as a strategy to improve community well-being. Since the start of the Covid-19 pandemic, green space has become more valuable in terms of use and relaxation benefits (Knobloch, 2021). Due to this and the benefit green space has for one's mental health, it is important to ensure every individual has equal access to usable green space.

Communities have disproportionate access to green space which can be related to socioeconomic factors. Residents in middle to low-income cities are less likely to have access to green space due to the affordability of housing options, since a neighborhood with expensive property is more likely to have access to green space (Chen et al. 2020). Additionally, it is shown that low-income communities would benefit more from green space in regards to physical health (Browning et al. 2021). Since the area one lives in defines this access, your zip code can be the most powerful predictor of your health and wellbeing (Mascarenhas, 2020). The correlation between access to green space and income level needs to be studied further, so that we can better ensure that the usability is equal amongst all socioeconomic groups.

Community members can be disadvantaged not only by the amount of green space that their city has but also by the quality of those spaces. There are several quality metrics that factor into whether or not a green space is of high quality. These can include safety, accessibility, amenities and aesthetic features (Smith, 2017). Residents feel that green spaces in their area are useful and beneficial when they are clean and feel safe (Balram and Dragičević, 2005). If citizens felt afraid or threatened to walk around their community park, this could induce feelings of anxiety which may lower the beneficial value of these spaces. There are several quality metrics that should be considered when looking at improving urban planning in low-income cities (Kabisch and

Kraemer, 2021). If someone is not able to walk to a park in their neighborhood then there should be more green space added, there should also be free parking if one does drive or bike. Policymakers can use better quality green spaces as a welfare enhancing approach to cities (Van den Berg et al. 2017). The quality of the green space matters because if it is bad quality, it can prevent people from going to the parks which would take away the improvement in mental and physical health that the residents could be attaining.

This study will investigate how city income level relates to quality green space in Contra Costa County, California. I will be using a case study approach to examine the following questions: (1) How does city income-level relate to green space access by area?; (2) What is the quality of green space in Lafayette and San Pablo, measured by safety (crime), aesthetics (littering and vandalism), amenities (sport courts, playgrounds, seating, and water) and accessibility (bus stops and bike/car parking)?; (3) What is the public perception of these green spaces in each city?; (4) What are the park budgets and cleanup plans for the two cities? I expect the higher income city, Lafayette, to have the most open-access green space by area and the lower income city, San Pablo, to have the least amount of green space by area. Based on these assumptions, I assume the city of Lafayette to have better quality parks and for their residents to be happier with their community green spaces. I also expect this city to have a larger budget for their parks, as well as a more organized and well-managed cleanup crew. The analysis of these questions will consist of gathering geospatial data per capita for the cities in Contra Costa County, using secondary data analysis on quality metrics such as crime and amenities for each park, surveying communities, and interviewing city council officials to have a comprehensive understanding of the relation between income level and quality green space in my study area.

Value of green space to communities

Residents' thoughts on their cities' green space can influence who utilizes these spaces and how they are maintained. If citizens rarely utilize their parks, then it is more likely that these parks will not have priority maintenance. If residents have a negative view on the spaces because of aesthetics or safety concerns, then this can influence others to not use the spaces. Residents' opinions on green spaces in their community can be related to their socioeconomic background as well as how familiar they are with the development of their community parks (Cao et al. 2021). It

is crucial to consider these opinions when deciding to develop existing parks in a community. NextDoor, a social networking site for neighborhoods to share local news, sell items, and more, can play a big role in how and what opinions are being spread amongst a town (NextDoor, 2021). I will be using this site to get survey responses on the parks in Contra Costa County. Community members should feel positively about their parks so that they will use them and have motivation to keep them clean. This means that these spaces need to be good quality to begin with, so that positive messages can be spread.

City council plays a role in making green space more or less valuable to the community, depending on their maintenance plans and park budgets. Cleanup for the parks can come from paid workers who will provide maintenance. For example, Contra Costa County uses public and private funding to begin maintenance projects (Contra Costa County, 2021). Volunteer groups can be formed to clean the parks and local sport teams/school groups can also clean green space for community service (East Bay Regional Park District, 2021). Fiscal budgets for parks are outlined for the year; however, specific parks are not detailed and it can be difficult to track how the money is being used (Anderson et al. 2020). A city might be biased toward prioritizing funding and maintenance for its biggest and most prominent parks. If these parks are located in relatively affluent areas and are not accessible to all residents, then this prioritization can be discriminatory to low-income residents. To understand if this bias truly exists, I will be interviewing city council officials about their budget spending and cleanup plans.

Measuring the quality of green space

The quality metrics of safety, aesthetics, amenities, and accessibility are all important when assessing green space quality. According to the National Recreation and Park Association, most residents prioritize safety in their community parks, which means that these spaces lose their value and benefits when crime occurs. Many crimes go unreported, so it is important to evaluate how the community feels about their space's safety rather than looking at the crime statistics. Developing new programs and redesigning the parks can help to improve the safety by creating a new atmosphere. It is important to include the community in these efforts because it can encourage people to come and use the space as the word is spread about the redesign (National Recreation and Park Association, 2014).

Another important measurement of quality parks is their aesthetic features and amenities. This means ensuring that the spaces are appreciated for their beauty, maintenance, greenery, and cleanliness. Generally, nature is regarded as having its own worth and value within itself, which is why residents want their community parks to showcase this beauty (Mohamad Roslan et al. 2012). The parks should exhibit the natural beauty instead of the man-made aspects and it should be maintained to not have buildup of litter, vandalism, or plants that have not been properly taken care of. All kinds of amenities should be present at parks to attract different types of people whether that is with sports or playgrounds, etc. These extra facilities can improve the quality of life of residents by allowing extra opportunities for exercise, as well as an escape from one's residence (National Recreation and Park Association, 2019). These amenities can also provide a social benefit to one's life, such as meeting new people while playing sports, bringing your kids to the playground, walking on trails, etc. (Cox et al. 2019).

One of the most important aspects influencing the usability of city parks is accessibility. Parks should be within walking distance of homes and also have parking available. The mission of these public parks is to be accessible and free to everyone (NYC Parks, 2021). Parking lots are essential for those who access the park via private vehicles; however, for those that do not own a private vehicle, there needs to be bus stops or parks within walking distance (Smith, 2017). These parks within walking distance need to be safe and aesthetically pleasing so that residents are encouraged to take the time to use them. I will be looking at several quality metrics to assess this, including surveying the residents on what aspects of green space are most important to them.

Environmental justice

Environmental justice is a key component to my study because it involves the fair treatment and meaningful involvement of all people regardless of race or income in the development and implementation of environmental laws and policies (Mascarenhas, 2020). This is relevant when examining access to green space in one's city because people of color in low-income communities can be disproportionately affected (Browning et al. 2021). I will be delving into this issue to see if this holds true for the cities of Contra Costa County.

Another aspect to this environmental justice issue is that access to green space has a positive effect on one's mental health (Barton and Rogerson, 2017). This means that communities

that have less access to green space are being denied this mental health benefit and community well-being might be improved by increasing their access. Policymakers should be looking into the disproportionate access of quality green space amongst different cities, so that all people can have equal access regardless of income or race.

Study site: Contra Costa County

The site that I will be studying is Contra Costa County, which is made up of twenty cities that will be compared in terms of income and green space. I have chosen this site because of its wide range of economic disparity and a lack of research on green space access in this county (Brunner and McKetney, 2008). In Contra Costa County, the lower-income cities that have majority non-white residents are facing higher disease and death rates than the rest of the county (Brunner and McKetney, 2008). One reason for these health inequities can be different exposures to unhealthy environments. This is why it is important to consider if these cities have less access to green space and the quality of these spaces (Barton and Rogerson, 2017). If it is found that lower income cities in the county have less access to quality green space, then this is an environmental justice issue that will need to be addressed by the city council.

The cities of Contra Costa County all have access to green space, however, the quality and number of these spaces differs. It is important to not only consider green space by area, but also green space per capita since most of the lower income cities have higher population density than cities of higher income. Cities with more people should have more green space to prevent overcrowding and increase usability of these spaces. According to the Contra Costa County website, green infrastructure will be implemented and is intended to make man-made structures appear more natural. They mention how the benefits of doing this will improve resident's emotional and physical health, as well as improve quality of life (Contra Costa County, 2021). The county itself acknowledges these benefits, so it is important to assess the green space between cities to ensure equal access and quality. The U.S. Census Bureau has shown that the ratio for income inequality in Contra Costa County has grown exponentially over the last decade (U.S. Census Bureau, 2019). This is important to my study to assess whether this growth has had an impact on the access to green space in these cities. This research will hopefully improve access and quality for those who are disproportionately affected and raise awareness of equity issues.

METHODS

Study organization

My study assesses the cities in Contra Costa County to evaluate which cities have the highest and lowest green space per area. I compiled a list of all twenty cities in this county and listed all of the city average incomes and the populations. I then imported a data set of the city boundaries into ArcGIS Pro to be able to visually see all cities and their city limits on a California map (ArcGIS Pro, 2021). Then, on Google Maps the latitude and longitude of each park was found and reported into an Excel sheet with the park names (Google, 2021). This csv file was then added to ArcGIS pro to be able to plot all of the park coordinates to the map (Figure 1). ArcGIS was used to identify park boundaries and create a polygon layer around each park (Figure 2). Using a tool called calculate geometry, I was able to find the area of each polygon in square kilometers. This data was imported into Excel to compile all of the park areas in one city to have a final number for the green space in each city.

In Excel, all of the cities were listed with population, total green space, and average income level reported from the 2019 U.S. Census Bureau Data (see appendix). The boundaries of the city limits were given an area in km² in ArcGIS Pro, so this information was imported into Excel. The total green space was then divided by the total area of each city to give a number for the green space area. The green space was also divided by population to give a number for the green space per capita. These values were then compared across all cities to see which cities had the lowest and highest values and how this compared to the cities listed average income.

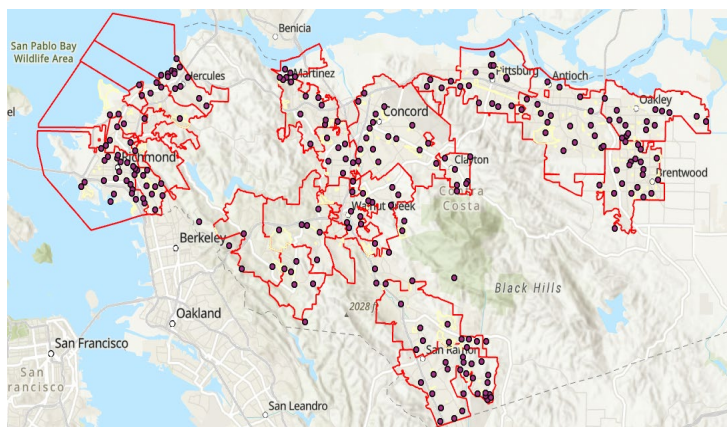


Figure 1. ArcGIS Pro map of Contra Costa County city boundaries and parks. All twenty cities in Contra Costa County are outlined in red and all parks are plotted by the circles.

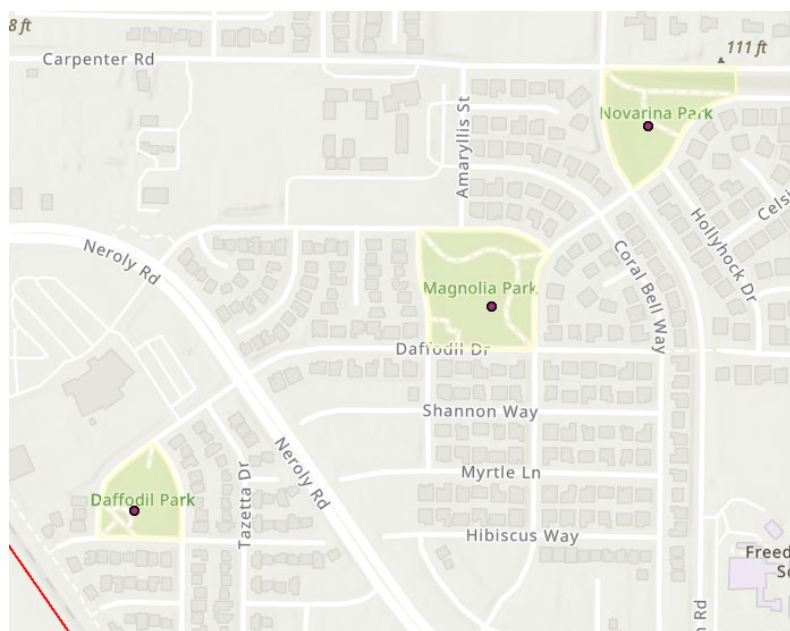


Figure 2. ArcGIS Pro map of parks and polygon layer. Each park was outlined in yellow using the polygon layer tool. These layers then showed an area (km²) of each park to be imported into Excel.

Assessing quality metrics

The quality of parks was analyzed and scored using google map reviews, crime reports, online images and personal reports. Safety was assessed by looking at online crime reports on LexisNexis community crime map to view all crimes including vandalism reported within the last 3 months (LexisNexis, 2022). Aesthetics was scored by seeing how much litter and vandalism is present at the park, from park reviews and in person assessments. Amenities were measured by seeing if sport courts, water features, playgrounds, and seating areas were present at the parks. Accessibility was measured by seeing if there were bike roads, bike parking, bus stops and parking lots within a 100-meter buffer of the park. Parking lots, bike parking and some bike roads were assessed in person, however bus stops and other bike roads were assessed using Google Maps and plotting a buffer around each park to see if they were present in the range (Google Maps, 2022). Both safety and aesthetics are given negative point values if any of the subcategories are found at that park, since these metrics might deter someone from going to their local green space. While amenities and accessibility metrics are given positive point values if any of the subcategories are

found at or around the park. These point values and rationale for choosing the specific quality metrics can be seen in Table 1.

To assess safety, research has been conducted to view crime reports on the crime that occurs at each cities' parks. This is not an entirely reliable method since many crimes go unreported, to account for this the resident's surveys have elements in them that allow these individuals to discuss and rate the safety at each park in their city. Each park can be rated from very unsafe to very safe and these are allotted points based on how negative or positive the rating is (Table 2). Then the points for each park will be chosen based on the majority of survey results out of all of the five safety options to choose from. These results are then taken into account when calculating the total score for safety at each park in both cities. Aesthetics are evaluated using park reviews on google maps as well as viewing images on the city's websites (Google, 2021). I also visited each park in both cities to evaluate the litter and vandalism to assure the accuracy of the online research.

Amenities were assessed in a similar way to aesthetics, but using park reviews on google maps and online research. I also traveled to the parks to assure that all amenities were accounted for. Accessibility was assessed by research and google maps to view bike roads, bus stops and parking lots. These subcategories were also cross examined with in person measurements. All quality metrics are given a total score that reflects the points added up for each subcategory that is seen and has occurred at the park.

Table 1. Quality metrics are listed along with their subcategories. These are given a negative or positive rating based on how they will affect the park's quality. This chart has been modified from Audrey Smith's chart in her research on Oakland's green space (Smith, 2017).

Quality Metric	Subcategory	Points	Rationale
Safety	Violent Crime	-3	Crime can affect the way green space is viewed and is a factor when people decide to go to certain areas. Crimes against people are rated more than other crimes, since these will heavily affect decisions to come to the park.
	Property Crime	-2	
	Other Crime	-1	
Aesthetics	Litter	-1	Aesthetics can be hard to measure, however, litter and vandalism are easy to see. These factors may make a park seem
	Vandalism	-1	

			dirtier and discourage people from coming.
Amenities	Sport Courts	1	Amenities can make parks more desirable to a wide range of people. The sport features can provide a form of social and physical activity. While other features can allow for relaxation or a break from mental stress.
	Water features	1	
	Playgrounds	1	
	Seating Areas	1	
Accessibility	Bike Roads	1	If you cannot get to a park then it is not useful. I want to be sure that the surrounding area of the park has bike roads and bus stops so that it is accessible to those that don't own a car and offers a more sustainable option.
	Bike Parking	1	
	Bus Stops	1	
	Parking Lot	1	

Table 2. Safety metrics and point values assigned. These results are specifically coming from the survey answers only and the point value reflects how negative or positive the rating is.

Quality Metric	Very Unsafe	Unsafe	I don't know	Safe	Very Safe
Point Value	-2	-1	0	1	2

Perception of green space

I surveyed community members in both cities to understand public perception of green space in their communities. Qualtrics was used to make two surveys, each unique to the city in which it is intended (Qualtrics, 2021). These surveys have been sent out online through sites such as Facebook and NextDoor, and I have also traveled to the parks and handed out paper copies as well as offering a QR code to scan to take the survey online (NextDoor, 2021).

The survey was split into three different sections: personal opinion, quality metrics and demographics. The survey format along with some of the survey questions were adapted from Daisy Knobloch's research on green space in a pandemic, and the full survey can be viewed in the appendix (Knobloch, 2021). The first section on personal opinion focuses on how the residents

feels about their green spaces, what they feel should be changed and why they do/do not choose to spend time at their parks, The second section lists the positive and negative quality metrics separately and asks the participant to rate on a scale from 1-5 how they feel about the metrics. For the positive metrics it asks if they feel the benefit from the addition of this metric or not and for the negative metrics it asks if they do/do not want to be at a park where this metric occurs. This section also lists all the parks in their city and allows the resident to rate the safety at each park, to account for the unreported crimes in the quality metric assessment. The final section asks questions about age, gender, income, and race; however, this section is optional to complete and all responses are anonymous.

Assessing maintenance and budget spending

The parks and recreation department in the city council plays a role in paying for park maintenance as well as distributing the yearly budget they are allotted. A city council member from the parks, recreation and trails department was contacted from Lafayette and in San Pablo I reached out to the coordinator in the facility and fields reservation department. Those who accepted the invitation were interviewed and asked about the maintenance plans and allocation of park funding. Research was done to look into cleanup plans and assess whether or not there is regular maintenance done by paid workers of the government, or if cleanup is solely relied upon by the community members. Volunteer groups may be formed to clean up the city's parks, as well as different community groups cleaning up areas of the parks for community service.

Park budgets can be found online for both cities, however, how this money is spent was hard to determine. This is why city council officials are interviewed about the topic, however, in general the park budgets are compared between both cities to see if the higher income city has a bigger budget. The city council interviews also give insight into the plans that these departments have for the upcoming year in regards to improvement of the cities' green space.

RESULTS

Contra Costa County cities

The city in Contra Costa County with the highest green space per area is Lafayette, while San Pablo has one of the lowest green spaces per area and is the lowest income city in this county. After working in ArcGIS Pro, I found Lafayette to have 0.09 km² green space per 1 km² of city land area. This was the highest green space per area out of all the cities in Contra Costa County and Lafayette has the third highest average household income of \$178,889. The lowest green space per area was in Hercules with a value of 0.005 km² green space per 1 km² of city land area, however San Pablo has the lowest average household income and its green space per area differs from Hercules only by a few points, 0.009 km² green space per 1 km² of city land area. Therefore, I will be looking at San Pablo instead because it is the lowest income city with an average household income of \$53,198.

Lafayette has the highest green space per capita with 1.4×10^{-4} km² green space per person while San Pablo has the lowest green space per capita with 2.1×10^{-6} km² green space per person (Table 3). Lafayette has 6 parks in the city and San Pablo has 5 parks, which makes the number of parks comparable when evaluating quality metrics. While each city has a similar number of parks, Lafayette has a much larger city area along with housing the Lafayette Reservoir that has a very large area on its own.

Table 3. Lafayette and San Pablo's green space per area and capita. Both cities' numbers can be compared across income level, green space access, and population.

City	Average Household Income Level in 2019 (\$)	Sum of Park Areas (km ²)	City Area (km ²)	Green Space by Area (km ²)	Population in 2019 (people)	Green Space Per Capita (km ² /person)
Lafayette	\$178,889	3.66	39.38	0.0929	26,305	1.39E-04
San Pablo	\$53,198	0.07	6.75	0.0097	30,967	2.12E-06

Quality of green space

The quality of parks was measured and scored in both cities and San Pablo, on average, has lower quality parks. There was shown to be increased crime in the parks of San Pablo, but

none of the parks had any violent crimes occurring at them. The survey results also showed that the residents of San Pablo felt that their green space was less safe than the residents of Lafayette. The aesthetics of all parks were assessed in person and online to find that San Pablo, on average, has more litter and vandalism than Lafayette. Amenities were assessed at all parks and it was found that there are more sport courts, water features, seating areas, and playgrounds at Lafayette. Accessibility was assessed at all parks and it was found that there are more bike roads, bike parking, bus stops and parking lots within a 100-meter buffer of each park in Lafayette. The park scores for both cities are shown in Table 4 and the overall average score for the city of San Pablo is 6.6 and 11.2 for Lafayette. From this we can see that overall San Pablo has a lower score than Lafayette, as well as having lower individual park scores.

In Lafayette, Lafayette Community Park scored a total of 12 points, this was due to the many amenities the park had as well as lots of accessibility such as two parking lots and two bus stops nearby. Lafayette Reservoir Recreation scored a total of 22 points and is Lafayette's biggest park with lots of amenities, mostly due to the amount of seating areas. It also had lots of accessibility; however, it is noteworthy that you have to pay for parking. Lafayette Plaza Park scored a total of 13 points and was the only park in Lafayette to exhibit any signs of littering; there were lots of seating areas and accessibility which accounts for the higher score. Olympic Boulevard Staging Area scored a total of 6 points and these points came from the parking lots and some seating, but there were hardly any amenities since it was more of a trail and hiking spot than a traditional park. Leigh Creekside Park scored a total of 6 points and was the only park in Lafayette to exhibit any crime. It didn't have much amenities or accessibility, it only had street parking and was a smaller, hidden residential park. Lastly, Buckeye Fields scored a total of 8 points mostly due to the sport courts since this is what the park is mainly used for.

In San Pablo, Wanless Park scored a total of 8 points due to a relatively even number of amenities and accessibility along with some litter. Green Slide Park scored a total of 6 points due to the many amenities including several sport courts, however there was some crime which brought the overall score down. Rumrill Sports Park scored a total of 2 points because the litter and crime deducted points from the positive metrics like sport courts and parking lots. John Herbert Davis Park scored a total of 9 points and also lost points due to crime and litter, however there were lots of amenities so the point value stayed high. Lastly, Wildcat Canyon scored a total of 8 points and

these points came from the large amounts of seating areas, playgrounds, and parking lots, however this park had the most crime and litter and it was the only park to have any property crime occur.

Table 4. Lists the park in each city and the overall score for each park. Total scores are reported and the safety metric includes negative points from the crime reports as well as negative or positive points from the survey results.

City	City Parks	Safety	Aesthetics	Amenities	Accessibility	Total
Lafayette	Lafayette Community Park	2	0	4	6	12
Lafayette	Lafayette Reservoir Recreation	2	0	14	6	22
Lafayette	Lafayette Plaza Park	2	-1	8	4	13
Lafayette	Olympic Blvd Staging Area	1	0	2	3	6
Lafayette	Leigh Creekside Park	1	0	4	1	6
Lafayette	Buckeye Fields	2	0	4	2	8
Average						11.2
San Pablo	Wanless Park	0	-1	6	3	8
San Pablo	Green Slide Park	-1	0	7	0	6
San Pablo	Rumrill Sports Park	-1	-1	2	2	2
San Pablo	John Herbert Davis Park	-1	-1	9	2	9

San Pablo	Wildcat Canyon	-6	-1	12	3	8
Average						6.6

Survey outcome

The survey results show that the residents of Lafayette are more satisfied with their cities' green space compared to San Pablo. The responses show that the majority of Lafayette residents would like to see more amenities and facilities for mixed use, more parks within walking distance of their residence, and expanding their parks (Table 5). While the majority of residents in San Pablo would like to see crime deterring strategies, rangers or staff on-site during peak use, and cleaner facilities at their green space (Table 6). In Lafayette, the majority of residents either said that nothing discourages them from spending time at their parks or that the lack of amenities does. In San Pablo, the majority of residents said that unclean facilities and safety concerns discourage them from using their green space.

It is shown that the majority of residents in both San Pablo and Lafayette do not want to see any negative quality metrics in their parks such as crime, litter, or vandalism. Survey results show that residents in San Pablo view having parking lots as a necessity and view amenities such as seating and sport courts as having less importance. In Lafayette residents value seating areas and bike parking/roads more than any other positive quality metric. In regards to negative metrics, crime is viewed as a lot more important in deterring residents from going to their green space in both cities. There are more people saying they would not want to go to their green space if there was crime occurring, the more negative a quality metric is the more people do not want to go to their green space if the metric is there (Figure 3). When asking residents what they would like out of their green space, some quotes from Lafayette include, “The green aesthetic in an otherwise concrete vista providing a visual and physical breathing space”, “Close to amenities like restaurants and shops. Reduced street noise. Trees.” and a “Beautiful place to enjoy the outdoors”. Some quotes from San Pablo include, “A place to get away from the hustle and bustle of the city.”, “Clean and safe”, and “Native plants, pathways, benches, accessible to disabilities” (Qualtrics, 2022).

Table 5. Lafayette’s residents respond to what their local green spaces are lacking that if present would make them more likely to use them. We can see that the residents prioritize accessibility in terms of being able to walk to their parks and also amenities, like adding more facilities.

#	Answer	%	Count
1	Expanding the park to make it larger	18.18%	6
2	More facilities for mixed use (i.e. skate parks, lawns, playgrounds)	24.24%	8
3	Crime deterring strategies	3.03%	1
4	Rangers or Parks & Recreation staff on-site during peak use	3.03%	1
5	Lacks cleanliness	6.06%	2
6	Parks need to be in walking distance of your residence	24.24%	8
7	Other	6.06%	2
8	Nothing, I am content with my local parks.	15.15%	5
	Total	100%	33

Table 6. San Pablo’s residents respond to what their local green spaces are lacking that if present would make them more likely to use them. We can see that the residents prioritize safety and aesthetics in terms of implementing crime deterring strategies and cleaning facilities.

#	Answer	%	Count
1	Expanding the park to make it larger	10.00%	8
2	More facilities for mixed use (i.e. skate parks, lawns, playgrounds)	11.25%	9
3	Crime deterring strategies	17.50%	14
4	Rangers or Parks & Recreation staff on-site during peak use	12.50%	10
5	Lacks cleanliness	17.50%	14
6	Parks need to be in walking distance of your residence	12.50%	10
7	Other	5.00%	4
8	Nothing, I am content with my local parks.	13.75%	11
	Total	100%	80

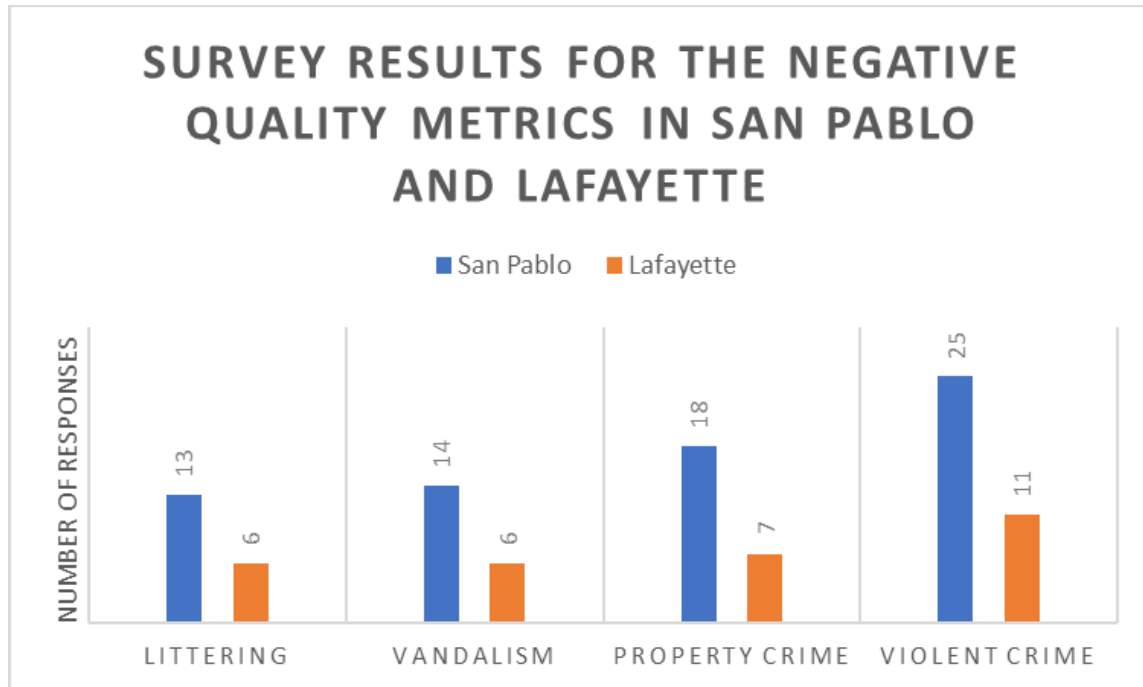


Figure 3. San Pablo (left) and Lafayette (right) Both cities show that they do not want to go to a park where these negative quality metrics occur. Violent crime has the most votes in regards to the residents not wanting to go to their park if this occurs, and the feeling that their green space is better quality without this metric and others.

City council's response

The park maintenance and cleanup plans are clear for Lafayette and this city has a bigger park budget than San Pablo. Lafayette has a clear fiscal budget plan listed online that is accessible to everyone with money designated to maintenance of green space and money for the parks themselves (City of Lafayette, 2022). San Pablo also has a budget listed online, however, parks are not mentioned anywhere on the list and the document even says, “City infrastructure replacement for aging City facilities, and/or upgrades to existing City parks lacks a consistent and dedicated funding source” (City of San Pablo, 2022). There is also a clear difference within the city council itself, since Lafayette has a Parks and Recreation Department on their website with several sub departments and San Pablo has a Recreation department with what is called Facility and Field Reservations as the only sub department within that.

A city council member from each city in the appropriate department was contacted to be asked to participate in an interview. In Lafayette the city council member initially agreed to be

interviewed, however, after sending over some mock questions through email, he then stopped responding after several attempts of reaching out. In San Pablo, Joanna Pulido the Community Services Coordinator in the Facility and Fields and Reservations department was interviewed. She was asked several questions about park budgets, maintenance, and future plans to increase the quality of the cities' parks. However, she could not answer most of my questions and said that she would redirect me to other people who would have paperwork on their budgets and have more information. She did not send me any further information or give me any contact information for anyone that I could talk to that would have a better understanding of budgets and maintenance. These interview attempts show that the park budget is not as clearly allocated in San Pablo, and the city council is more organized and has more budgeting for parks and maintenance in Lafayette.

DISCUSSION

The research showed that there is a correlation between city income level and access to quality green space. This was expected, however, surprisingly results showed that there are major disparities between the low income and high-income city in terms of safety and aesthetics of parks and city council's role in green space. The quality of green space in terms of amenities and accessibility was similar for both San Pablo and Lafayette. Survey responses showed that residents of both cities would like to see more safety measures put into place and all negative quality metrics are deterrents from going to parks. The role of city council was very different between the two cities, mainly due to the fact that San Pablo does not have a Parks and Recreation department while Lafayette does. Further research should be done on the other cities of Contra Costa County; however, my research can act as a case study and a starting point to possibly help create change in policy so that there is accessible quality green space regardless of income level.

City income and green space access

Of all the cities in Contra Costa County, it was found that Lafayette has the highest green space per area and green space per capita while San Pablo has one of the lowest scores for green space per area and the lowest green space per capita. This demonstrates a clear correlation between city income level and accessible green space. Research has shown that green space access is

important for improved mental health, which is why it is important that everyone have equal access to these spaces (Croft et al. 2013). However, benefits of having access to green space in regards to health are not proportionally distributed, usually depending on socioeconomic status and education background (Anguelovski et al., 2019). For example, in the city of San Pablo they have access to Wildcat Canyon Regional Park which was the park with the highest overall positive score in their city. However, it is located in a wealthier region of the city and most residents of San Pablo may be unaware it is even available to them.

When traveling to the parks, social connection was seen everywhere whether that was parents taking children to play, friends catching up on a walk, or a family throwing a party and barbeque. This is one of the many benefits that green space brings, and according to Fong et al., (2018) it also has beneficial impacts like physical activity, lower mortality rates and lower rates of depression. The lower mortality rates were attributed to an increase in levels of physical activity, a setting for social connection, and positively affecting mental health (Fong et al., 2018). If having access to green space can lower death rates, then this is a crucial addition to every city that politicians need to implement, especially in cities with low green space per area. There should be equal access amongst all cities everywhere, and green space per capita needs to be taken into account too. There are a lot of people in San Pablo per the small city area, so there needs to be more parks to accommodate everyone. Green space is a free commodity and should be accessible everywhere, independent of the socioeconomic status of a city.

City income and quality green space

On average the parks in the city of San Pablo had lower quality scores than the parks in the city of Lafayette. Not only does San Pablo not have enough access to green space, but this green space is also of lesser quality. One of the quality metrics assessed was accessibility, by looking at parking lots, bike roads, bus stops, etc. These metrics were extremely important to residents and it was preferred that parks were within walking distance from their residence, this follows findings of other research that show the farther green spaces are from residents, the less used they are and the proximity of green space to you can lower anxiety (Kingham et al., 2013). Decreased distance to green space and access to better quality green spaces all correlated with decreased anxiety and

mood disorders (Kingham et al., 2013). This is important to note that the quality of green space is just as crucial as the accessibility to those spaces in regards to improving one's health.

This is a major Environmental Justice issue since the few available parks San Pablo has, are unsafe, not clean and don't have as many amenities as the parks in Lafayette. City council members and California politicians need to take this research into account and should start allocating more of their budget to projects that will increase the overall wellbeing of residents. Putting in measures to increase the quality of these parks could have a multitude of benefits including less crime, more physically active and inclined individuals, and overall happier residents. This is consistent with findings in research that show access to quality green space lowered mortality rates, heart rate and violence and also showed better moods, more physical activity and better attention span (Branas et al., 2018). Improving access to quality green space could reduce the negative quality metrics like aesthetics and safety, since it can make people happier and less violent, as well as wanting to keep the spaces clean if they already are. The addition of vegetation can decrease vandalism since this usually occurs in most barren areas (Dieye et al., 2011). Thinking about small elements such as this, adding vegetation and fostering a sense of community can all be crime deterring strategies and improve parks' positive metrics along with the negative ones.

Residents' perception of their green space

Results show that in each city the residents value safety as a top priority, however, the residents of San Pablo feel that their parks are more unsafe and of lesser quality than the residents of Lafayette. It is one thing for there to be less access to quality green space and it is another for the residents to actually voice their opinions in saying that they want the quality of their green space to change and that they don't go to their parks because they are unsafe. This is consistent with survey findings of other research, that residents' top priorities of green spaces are safety, accessibility, and connection to the environment (Liang et al., 2022). Parks should be a space to go and improve physical and mental health, providing an escape from their home, however this will not happen if the parks are unsafe, dirty, and not within a 10-minute walk from homes. San Pablo residents were adamant about safety being a top priority and that almost all of their parks are unsafe or very unsafe. Different crime deterring strategies can be implemented that can help improve this negative quality metric, research shows bringing positivity to green spaces can deter

crime. The social benefits, sense of community and a place together as well as elements like sustainability can all deter crime since this generates positive activity instead (Dieye et al., 2011).

If policymakers see that residents are voicing their opinion and want their green space to change, then this should give more than enough incentive to implement those changes. Even residents of Lafayette who have access to quality green space, want more safety measures put in. This is something policymakers should deliberate and come up with a solution - possibly a park ranger hired on site during peak hours. Research studying different policy scenarios showed that policies need to be tailored to specific areas and the needs of the residents. Also, policies promoting social interaction were the most appealing in regards to promoting green space use (Liang et al., 2022). This was a common theme seen in the results of my fieldwork, since the people who were using the parks were almost never alone and always with family and friends. It is important to involve the residents and community members in the decision-making process so that the results are specific to the city and what the residents want out of their green spaces.

Green space maintenance and budgets

City council plans outlined park budgets and maintenance for Lafayette, but not for San Pablo. This city lacks a parks and recreation department within city council; therefore, the funding isn't allocated proportionally. Most of the negative scores for the San Pablo parks came from litter and crime, if this city had paid maintenance at the parks like Lafayette, then the overall park scores would dramatically increase. From the survey results, residents want to enjoy safe, clean accessible green space and they need this access for an improvement in overall mental health and wellbeing. A start to addressing the problem would be to better allocate the funding San Pablo receives to put more care into their parks and possibly build upon the sense of community. Wanlass park in San Pablo looked as if there had been a garden that was started by the community, however, it was clearly abandoned. If projects like this were rebooted, the sense of community would become stronger which would help deter crime and it would add elements of vegetation that would help stop vandalism and litter (Dieye et al., 2011).

Limitations and future directions

Major limitations of the study include the two cities I have chosen to do case studies on. These cities are only a small look into the county as a whole, so my results are very specific to each of these cities and it can be hard to make claims about all low-income cities or all high-income cities. It would be better to look at a set of high-income cities with high green space per area and a set of low-income cities with low green space per area, this way if the results were consistent among cities, then we know the correlation is most likely constant. This would make it so that my results could be representative of the whole county, especially if I added a middle-income city as well to see how the green space compares to the extremities. The study was also limited by my survey results since I posted flyers at the green spaces, therefore, my survey results are only coming from people who already use the parks. While I tried to also reach out to people on NextDoor, the majority of my responses are from people at the parks and it would be better to hear from everybody. This is especially important since I want to know why people don't use the parks and I didn't have the opportunity to hear from a lot of these residents.

In the future a study could be done on all cities in Contra Costa County, or like I suggest a study done with more than just one low-income city and one high income city. This research can also act as a case study that other researchers can use to take this framework and apply it to another county or different cities.

Broader implications

This research study fills the gap of knowledge since there has not been a study like this done on Contra Costa County. This is important since decision makers can use my results to aid in how to make green spaces more usable and accessible to all residents. Contra Costa County is considered to be a wealthier county, and my research shows that even with this being true there are still disparities and disproportionate access to green space amongst residents. This research can be useful for policymakers and city council meetings to show how the residents feel about their spaces, and what they should be doing to solve this problem. The survey results showed a clear and strong opinion about safety being a number one priority amongst both cities. This shows a very strong opinion and an opportunity for funding to be allocated in a certain area to fix this

important need of the residents. There should be more public funding going into the parks and this is backed up by the results as well as public opinion in the survey. Green spaces are a great way to improve the health and wellbeing of residents, but there has to be proper care and safety measurements put in place so that community members want to use and enjoy the spaces. City council members should welcome community members into the planning and decision-making process of improving green space to add to the positive metrics already present. Having quality green spaces in residential areas can also add value to homes, which can be an incentive for policy makers to allocate more funding into the parks and help beautify and foster a sense of community in these areas.

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APPENDIX

Table 7. Green space per area and per capita listed for all cities in Contra Costa County. All income levels, area of the cities, area of the parks and green space per area and per capita are listed for all twenty cities.

City	Average Household Income Level 2019 (\$)	Sum of Park Areas (km ²)	City Area (km ²)	Green Space by Area (km ²)	Population 2019 (people)	Green Space Per Capita (km ² /person)
Alamo	\$239,545	0.76	25.04	0.0304	14,905	5.10E-05
Antioch	\$76,601	3.56	75.16	0.0474	111,200	3.20E-05
Brentwood	\$108,994	0.89	38.49	0.0233	61,961	1.45E-05
Clayton	\$157,768	0.16	9.92	0.0160	12,083	1.32E-05
Concord	\$89,564	1.35	79.07	0.0171	129,183	1.04E-05
Danville	\$160,808	3.68	46.82	0.0785	44,605	8.25E-05
El Cerrito	\$108,298	0.63	9.55	0.0660	25,398	2.48E-05
Hercules	\$117,078	0.26	49.90	0.0051	25,616	1.00E-05
Lafayette	\$178,889	3.66	39.38	0.0929	26,305	1.39E-04
Martinez	\$107,328	1.16	35.65	0.0327	38,290	3.04E-05
Moraga	\$140,378	0.77	24.51	0.0312	17,692	4.32E-05
Oakley	\$104,893	0.58	41.93	0.0139	41,324	1.41E-05
Orinda	\$223,217	0.52	33.33	0.0156	19,646	2.65E-05
Pinole	\$100,315	1.20	30.07	0.0399	19,279	6.23E-05
Pittsburg	\$74,459	1.12	49.60	0.0226	71,422	1.57E-05
Pleasant Hill	\$118,947	0.75	18.33	0.0411	34,840	2.16E-05
Richmond	\$68,472	4.48	136.21	0.0329	109,884	4.08E-05
San Pablo	\$53,198	0.07	6.75	0.0097	30,967	2.12E-06
San Ramon	\$160,783	1.04	48.25	0.0216	75,648	1.38E-05

Survey Questions

Q31

★

The following questions will ask how you utilize the green space in your city.

Why do you spend time in your cities' parks?

- To spend time with friends
- Spiritual reasons
- Provides a place for your children to play
- For exercise
- For mental well-being
- For privacy
- To experience nature
- To play sports
- To leave your home/residence
- Other
- * None of the above

Q2 Multiple choice | Do you value urban green spaces more for the social value they serve communities or the nature and b

★

Do you value urban green spaces more for the social value they serve communities or the nature and biodiversity?

- Social Value
- Natural Value

Q3

*

What currently discourages you from spending time in your cities' parks?

- Unclean facilities
- Individuals failing to physically distance / wear masks
- Overcrowding
- Lack of parking
- Lack of public transit
- Lack of green space near me
- Safety concerns
- Lack of motivation
- Lack of amenities (i.e. playgrounds, tennis courts, etc.)
- Other
- * Nothing

Q4

*

What is your primary mode of transportation?

- Public transport
- Private vehicle
- Bike
- By foot
- Other

Q5

What do you want out of green space?

Q6

*

What are your local green spaces lacking that would make you more likely to use them?

- Expanding the park to make it larger
- More facilities for mixed use (i.e. skate parks, lawns, playgrounds)
- Crime deterring strategies
- Rangers or Parks & Recreation staff on-site during peak use
- Lacks cleanliness
- Parks need to be in walking distance of your residence
- Other
- * Nothing, I am content with my local parks.

Q7



The following questions ask how you feel about certain aspects of your local parks. Choose only one number (1-5) for each quality metric listed.

Positive Quality Metrics

	Column Options ▾	Column Options ▾	Column Options ▾	Column Options ▾	Column Options ▾
	This addition to the park is crucial when thinking about going to any green space. If this is not there, you will not go to the park.	This is a great addition and benefit and if the park does not have this it might stop you from going to the park.	This is a great addition and benefit, however, if the park does not have this it will not stop you from going.	You are indifferent about this feature, and its addition doesn't have any effect on the way you feel about the park's quality.	This has no benefit to you or your decision in going to the park.
	1	2	3	4	5
Parking Lot	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bus Stops	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Bike Parking and Bike Roads	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Sport Courts (basketball, tennis, volleyball, baseball, soccer, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Water Features (fountains, lake, park is by a body of water, etc.)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Playgrounds	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Seating Areas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q8



Negative Quality Metrics

	Column Options ▾	Column Options ▾	Column Options ▾	Column Options ▾	Column Options ▾
	You do not want to go to a park where this occurs. You think a park is better quality without this.	You would prefer if this didn't occur at the park, and it might stop you from going to the park.	You would prefer if this didn't occur at the park, however, it won't stop you from going to the park.	You are indifferent about this occurring at parks. You are unsure if it affects the quality of the park.	You don't care if this occurs at the park. It does not deduct from the quality of the park.
	1	2	3	4	5
Littering	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vandalism	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Property Crime	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Violent Crime	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q9



The following question asks you to rank how safe you feel each park in your city is.

	Very Unsafe	Unsafe	Safe	Very Safe	<input checked="" type="radio"/> I don't know
Lafayette Community Park	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lafayette Reservoir Recreation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lafayette Plaza Park	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Olympic Blvd Staging Area	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Leigh Creekside Park	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Buckeye Fields	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q9



The following question asks you to rank how safe you feel each park in your city is.

	Very Unsafe	Unsafe	Safe	Very Safe	I don't know
Wanless Park	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Green Slide Park	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Rumrill Sports Park	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
John Herbert Davis Park	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wildcat Canyon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Q10 | Gender

The following are demographic questions. While the entire survey is anonymous, you may choose not to answer.

Gender

- Male
- Female
- Non-binary
- Other
- Prefer not to say

Q11

Age

- Under 18
- 18-24 years old
- 25-34 years old
- 35-44 years old
- 45-54 years old
- 55-64 years old
- 65+ years old
- Prefer not to say

Q12

Ethnicity / Race (Select all that apply)

- Black or African American
- White
- American Indian or Alaska Native
- Asian
- Native Hawaiian or Pacific Islander
- Hispanic or Latino
- Other
- Prefer not to say

Q13

Level of Income (Household)

- \$0
- \$1 to \$9,999
- \$10,000 to \$24,999
- \$25,000 to \$49,999
- \$50,000 to \$74,999
- \$75,000 to \$99,999
- \$100,000 to \$149,999
- Greater than \$150,000
- Prefer not to say

Q14

City of Residence

- Lafayette
- Other

Q14

City of Residence

- San Pablo
- Other

Q15

What is your zipcode?