Activating Public Land to Promote Urban Agriculture for Community Health, Equity, and Resilience through a GIS Decision-Making Webtool

by

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Executive Summary

This project aimed to tackle the challenge of identifying underutilized land suitable for urban agriculture in Los Angeles County by developing a web-based GIS tool. Leveraging Esri's ArcGIS Pro and ArcGIS Experience Builder, the team embarked on creating a comprehensive platform facilitating data analysis and interactive web experiences without the need for coding. The initiative aligned with Esri's mission of leveraging geographic information system (GIS) technology to create a more sustainable future, emphasizing the importance of spatial perspective in problem-solving.

Utilizing the Composite Index framework within ArcGIS Pro, the project amalgamated multiple indicators, such as proximity to grocery stores and low-income communities, to assess urban agriculture suitability. This approach provided a robust methodology for synthesizing diverse data into a coherent framework, enhancing decision-making processes. The resulting web dashboard, developed using Experience Builder, provided users with a user-friendly interface to interact with parcel data, customize criteria, and obtain detailed information on selected parcels. This platform offered flexibility, enabling users to tailor criteria according to their use cases.

The tool's efficacy was demonstrated through a user case example, showcasing how customized criteria influenced parcel evaluations. While approximately 300 suitable parcels were identified based on predefined criteria, the project encountered limitations such as the inability to ground-truth parcels and the exclusion of certain criteria like utility hookups and soil type. These limitations underscore the need for ongoing refinement and expansion of the tool to address broader challenges and ensure its relevance in diverse urban agriculture contexts.

Future research directions include implementing vacant land tax models, assessing long-term site usability, and addressing broader challenges such as climate change adaptation and community health. These efforts are crucial for enhancing the tool's effectiveness and ensuring it aligns with evolving needs and priorities. In conclusion, the project represents a significant step towards supporting sustainable urban agriculture initiatives in Los Angeles County, offering a pivotal resource for stakeholders seeking to revitalize vacant parcels and promote regenerative agriculture in urban settings.

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Introduction

Regenerative agriculture and soil improvement activities, such as community composting, can help mitigate issues of food insecurity, unhealthy soil, and water runoff. (Khangura et al., 2023) Low-income communities often experience high pollution levels and lack of access to basic amenities in Los Angeles County. However, identifying suitable land where landowners are willing to allow regenerative agriculture practices can be difficult. This is compounded by the lack of resources and knowledge among community members to implement sustainable agricultural systems.(Beacham et al., 2023) To overcome these challenges, solutions may involve partnering with public landowners, local governments, and community organizations to provide resources and opportunities to community members. The purpose of this capstone project was to address the dilemma of vacant parcels and underutilized land in Los Angeles County, particularly in unincorporated zones, by site suitability identification through a GIS decision making web tool.

The primary research question for this study was: how can we develop a geospatial web tool and flowchart to identify underused publicly available land for regenerative agriculture activities? Secondary questions were what social, environmental, and economic variables are impacted by these activities, especially for low-income and frontline communities in LA County? This research question guided the data collection and analysis which helped to ensure that the research remains focused on the key objectives of the project.

We hypothesized that a geospatial web tool and flowchart would facilitate the identification of underused publicly available land for regenerative agriculture activities, and these activities would have positive social, environmental, and economic impacts on low-income and frontline communities. Our hypothesis was based on the assumption that by identifying suitable sites for regenerative agriculture activities and providing guidelines and support for soil testing and amendment, community-based organizers and researchers in the area would be more likely to identify these areas and engage in these projects, leading to improvements in soil health, water quality, and food sovereignty.

Literature Review

A. Brief history of unincorporated lands in California

Unincorporated lands exist particularly disadvantaged unincorporated communities (DUCs) in California, represent a complex interplay of historical policies, economic limitations, and systemic disparities. Alford (2019) delves into the roots of DUCs, highlighting how these communities emerged as products of policies designed to restrict economic and physical mobility. Over centuries, Alford (2019) mentions that these policies have entrenched racial and class divisions, creating a system that continues to impact DUCs in the San Joaquin Valley. The characteristics of these areas are marked by limited infrastructure and service needs, reflecting the enduring outcomes of historical policies that have shaped inconceivable realities.

The examination of redevelopment policies in California, as articulated in the excerpt from LoPresti (2012), sheds light on the intricate dynamics shaping urban development, particularly in unincorporated communities. The threat posed by eminent domain looms large for low-income residents, who often struggle to comply with codes due to financial constraints. Moreover, the interplay between state-level policy changes and local agency autonomy, exemplified by initiatives such as the Emergency Revenue Augmentation Fund (ERAF) and Proposition 22, underscores the ongoing struggle for control over redevelopment funds. Despite mandates requiring the allocation of tax increment revenue to affordable housing, concerns persist regarding the efficacy and potential misuse of these funds. Additionally, the impact of redevelopment on sprawl development patterns raises complex questions about its role in shaping regional growth and environmental sustainability. However, amidst these challenges, the potential benefits of redevelopment, guided by persistent resident leadership and responsive agency practices, offer a glimpse of hope for addressing critical issues of urban development and environmental justice in California.

Bodek (2021) adds insights into housing policies on his work in unincorporated Los Angeles County, emphasizing the real-world implications for these communities and the need for nuanced understanding of housing issues. Within this context, Alford's exploration suggests that unincorporated areas, such as DUCs, have faced unfair and inequitable treatment. The disparities extend to difficulties in accessing government information, with internal guidelines and processes hindering transparency and communication. DUC are positioned at a disadvantage, leading to a disconnect between residents and local government, exacerbating inequalities in governance. The professional experiences of Alford underscore the challenges of navigating these issues, emphasizing the need for more open platforms and additional staff to facilitate communication and address the unique needs of unincorporated communities.

Food access is a critical consideration for unincorporated lands, particularly DUCs, facing limited access to fresh and healthy food options. Connecting these lands with urban agriculture initiatives in Los Angeles County can transform the situation, offering a sustainable solution to enhance local food production, improve food access, and alleviate challenges associated with food deserts.

The importance of access to nature and environmental education for primary schools becomes evident when exploring the characteristics of unincorporated lands, marked by limited resources. Initiatives providing educational opportunities centered around nature and the environment contribute not only to the academic development of students but also foster a deeper connection to the surrounding landscape.

Introducing the concept of a vacant land tax within the context of unincorporated lands becomes relevant. Implementing a vacant land tax can serve as a policy tool to incentivize responsible land use and contribute to the overall betterment of these communities by addressing neglected or abandoned properties.

Furthermore, the importance of neighborhood cohesion cannot be overstated when discussing the characteristics of unincorporated lands. Community health and resilience are linked to the strength of social bonds within neighborhoods. Strategies promoting neighborhood cohesion, including community gardens, shared public spaces, and collaborative initiatives, contribute to the overall well-being of residents, addressing physical and social aspects, creating a foundation for resilience in the face of challenges. Improved land revitalization, a key consideration in the characteristics of unincorporated lands, goes beyond aesthetics. Urban agriculture initiatives and strategic land-use planning can play a pivotal role in revitalizing vacant lots, transforming them into productive and green spaces that enhance neighborhood cohesion.

In conclusion, recognizing the characteristics of unincorporated lands, particularly in California, involves addressing multifaceted challenges and embracing opportunities for positive transformation. The integration of urban agriculture, initiatives to improve food access, environmental education, land revitalization, vacant land taxation, and the promotion of neighborhood cohesion represents a comprehensive approach to building healthier, more resilient, and interconnected communities within unincorporated areas. These key points underscore the potential for holistic interventions aiming for sustainable improvements in the well-being of residents and the overall vitality of unincorporated lands.

B. Land, soil, and water policies

The existing soil mapping in the Los Angeles Basin reflects substantial changes in landscape hydrology and drainage. The survey identified twenty-seven anthropogenic (urban) soil types, leading to the identification of 158 soil mapping units. Among the total identified soil types, 11% were classified as urban or anthropogenic, 32% had surface amendments of less than 50 cm, 12% were considered natural or native, and 43% of the land surface was covered by impervious surfaces(Chen et al., 2021). Notably, a significant portion of urban development is situated on alluvial plains and coastal plains with minimal slopes(Linovski, 2018). In sprawling residential neighborhoods, soil surfaces have often been altered to facilitate site development, accommodating foundations for residential or commercial buildings, terraces, lawns, community gardens, infrastructure, and other green spaces that contribute to ecological services.

Many private lands in urban areas are zoned for residential or commercial purposes, making it difficult to obtain the necessary permits for agricultural activities. Zoning regulations may restrict the type of land use allowed, and changing the zoning of private land can be a complex and lengthy process(Gabbe, 2018). Private landowners may face economic pressures to sell or develop their land for more lucrative purposes, such as housing or commercial projects. This can make it challenging to secure long-term commitments for urban agriculture, especially when there is strong demand for real estate development.

California's water distribution system relies on an intricate arrangement of water reservoirs and channels(Sunding et al.,1997). Much of the irrigation water in the Central Valley originates as snowmelt from the Sierra mountains to the east. Before World War II, farmers in the Sacramento Valley and the eastern part of the San Joaquin Valley built private aqueducts to access surface water for irrigation. Simultaneously, certain cities like San Francisco and Los Angeles developed their own water sources. Post-war, two significant public projects—the federal Central Valley Project (CVP) and the State Water Project (SWP)—were completed(Sunding et al., 1997). In conclusion, the water system in Los Angeles County plays a crucial role in supporting urban agriculture. While historically, the region has faced challenges in water supply and distribution, including reliance on imported water sources, advancements in infrastructure and management have enabled more sustainable practices. With initiatives such as water recycling, stormwater capture, and efficient irrigation techniques, LA County's water system is increasingly supporting urban agriculture while addressing concerns about water scarcity and environmental impact. Moving forward, continued investment in water infrastructure, along with conservation efforts and community engagement, will be essential for ensuring the resilience and viability of urban agriculture in the county.

As urban agriculture practices become more common, it is imperative to consider the inputs needed to succeed, such as water. Ongoing climate and water crises means that water usage in California is scarce, and the justification for extended use in urban agriculture needs to be established. London et al. (2021) delves into water access and equity in California's DUCs, revealing challenges tied to racial, ethnic, and class disparities. They frame water injustice as a violation of the human right to water, emphasizing both distributional and procedural inequities. The study unveils a spectrum of water access, from state-regulated systems to unregulated sources like wells, underscoring the role of formal and informal mechanisms in community well-being. Systemic challenges, compounded by historical marginalization, reflect enduring structural racism and discrimination, hindering public service provision and political agency. Comparing DUCs with other communities, the study highlights how race, ethnicity, and income intersect with informality to shape disparities in safe water access. These complexities underscore the need for comprehensive approaches to address inequities. Lastly, connecting DUCs with initiatives like urban agriculture, particularly in places like Los Angeles County, to mitigate economic and food-related disparities while fostering community health and cohesion.

C. Community and urban agriculture

The trend of cultivating food in urban areas is gaining popularity nationwide, and Los Angeles is following suit without exception(Horst et al., 2024). Before Los Angeles became a metropolis city, there was an extensive history of urban agriculture. In its beginnings, Los Angeles was mainly composed of farms(Horst et al., 2024). An exodus towards the Central Valley of California followed, and today, California is one of the largest producers of food products in the United States, and most of its roots began in Los Angeles County(Horst et al., 2024).

According to the USDA census in 2017, there were 57,809 acres of farms in Los Angeles County, which represented a 37% decrease since 2012(U.S. Department of Agriculture, 2017). Although Los Angeles County has a decent number of urban agriculture projects, there are both prospects and pitfalls of urban agriculture. Urban agriculture in Los Angeles County offers a multitude of benefits, including improved access to fresh produce, community engagement, and the creation of green spaces in urban environments. By reducing the carbon footprint associated with food transportation and distribution, urban agriculture contributes to environmental sustainability and promotes biodiversity(Golden, 2013). Furthermore, these initiatives provide opportunities for education and skill-building while creating employment opportunities and supporting local economies. Urban agriculture also plays a vital role in addressing food deserts by increasing access to fresh, healthy food in underserved areas(Ackerman et al., 2014). However, the agricultural policy framework in Los Angeles County presents a complex and varied landscape, with significant differences observed among its 88 municipalities. The county rules are more relaxed, especially for Community Development Projects. While 17 cities do not reject urban farms, most don't provide guidelines or regulations. This mix of rules shows that managing farming in cities in LA County has its share of challenges and opportunities(Jackson et al., 2013

D. Other web tools/studies for urban community garden planning

The USC Neighborhood Data for Social Change (NDSC) provides valuable insights for urban community garden planning in several key areas. First, it offers demographic data that can help identify areas with a high demand for fresh produce and green spaces, guiding decisions on where to establish community gardens to best serve the local population. Understanding the socioeconomic characteristics of neighborhoods can inform strategies for ensuring accessibility and inclusivity within garden projects, addressing potential barriers to participation such as income disparities or language barriers. Additionally, NDSC data on food access, socioeconomic status, and health outcomes can help prioritize areas with limited access to nutritious food options, supporting efforts to alleviate food deserts and improve community health outcomes through targeted programs to increase the availability of fresh produce. Moreover, the data can inform partnerships and collaborations with local organizations, schools, and healthcare providers to leverage resources and support community engagement initiatives within garden projects. Overall, leveraging NDSC data for urban community garden planning provides a proficient web tool model for more informed GIS decision-making, equitable distribution of resources, and targeted interventions to address the unique needs of diverse communities within Los Angeles County.

Our project used geographic information science as the main methodology because of its spatial visualization capabilities which enabled the assessment of land suitability based on factors like proximity to community organizations, land permeability, site size, etc. Previous GIS webtools have shown a capacity for integrating diverse datasets facilitates informed decision-making by identifying areas with high food insecurity or underserved communities. GIS visualization enhances communication with stakeholders fostering engagement and understanding of project benefits. Community members can contribute local knowledge through interactive mapping platforms which ensures that the projects align with their needs. GIS also supports monitoring and evaluation, enabling assessment of project impact over time and refinement of strategies for maximizing benefits(Esri: What is GIS, n.d.).

Methodology

A. Data collection

1. Filtering Process:

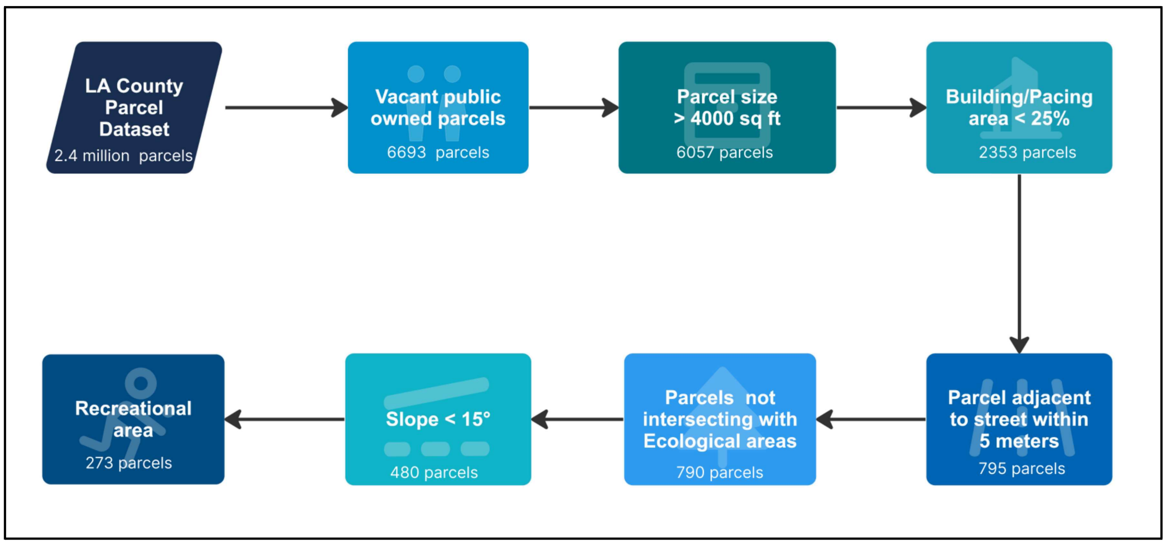
In the data collection process for site selection across LA County, numerous prerequisite factors outlined in Appendix A set the minimum suitability standards of urban agriculture. The initial step entailed a thorough assessment of parcels' status, specifically focusing on publicly owned vacant land for potential development. Subsequently, sites were prioritized, opting for areas greater than 4000 sq ft for public lands. Additional criteria involved ensuring that buildings or paved areas constituted less than 25% of the site, and the parcel was adjacent to a street within five meters. Avoidance of ecological areas such as parks, beaches, and golf courses was another key consideration. Furthermore, the optimal suitability for agricultural production was contingent upon selecting sites with slopes measuring less than 15°, a factor integral to maximizing productivity and operational efficiency. Figure 1 depicts the sequential steps involved in the selection process, showcasing how the final parcels emerged after undergoing the extensive filtering of prerequisites from the complete Los Angeles County parcel layer.

After filtering parcels with the prerequisite factors, we proceeded to collect data on various preferable criteria factors which were generally social or community indicators. These factors included proximity to grocery stores, where the nearest grocery store to each parcel was determined. We then assessed remoteness to existing gardens and parks, with the nearest local or state parks to each parcel identified. We also factored in proximity to community services by adding a calculation of the distance to the nearest community services layer for each parcel. This layer included a merge dataset showing locations of churches, senior community centers, and high schools. Moreover, parcels not feasible for housing were evaluated based on proximity to the freeway (within 500 feet) and whether any portion of the parcel was under electrical lines. For parcels not within

500 feet of a freeway or under power lines, 0 was assigned. Parcels meeting either criterion were assigned 1, while those meeting both were assigned 2. The study also considered proximity to low-income communities by identifying the population under

20% of the Federal Poverty Line and conducting area proportional disaggregation. Furthermore, low food access populations were analyzed by determining the number of individuals who did not live within close proximity to a grocery store (1 mile for urban residents or within 10 miles for rural residents). This layer was directly pulled from the Neighborhood Data for Social Change web map. Proximity to community members was assessed by calculating the nearby population within a 2-mile radius of each site, along with conducting area proportional disaggregation. Lastly, environmental burden was evaluated by assessing heavy environmental burden (over the >60th percentile of overall burden) and calculating the averaged environmental burden for the polygons intersecting vacant parcels.

Figure 1 : Site Selection Process for Urban Agriculture in Los Angeles County



2. Factors and Remaining Parcels:

Using the aforementioned filtering criteria, Table 1 highlighted the progressive reduction in parcel count as each filtering factor was applied, culminating in the final count of parcels deemed suitable for urban agriculture based on the prerequisite criteria. Initially, the dataset included around 2.4 million parcels throughout Los Angeles County.

These parcels were gradually narrowed down based on particular criteria to identify appropriate choices for urban agriculture. The pre-requisite filtering criteria included factors such as public ownership of vacant parcels, which totaled 6,693 parcels, parcel size greater than 4000 square feet, which amounted to 6,057 parcels, limited built-up area, resulting in 2,353 parcels, proximity to streets within 5 meters, encompassing 795 parcels, absence of ecological areas intersecting the parcel, which accounted for 790 parcels, gentle slope (< 15°), yielding 480 parcels, and exclusion to recreational areas, totaling 273 final parcels.

Table 1: Parcel Filtering Process for Land Suitability In Los Angeles County

Filter Criteria	**Number of Parcels Remaining**
Initial LA County Parcel Dataset	**~2.4 millions parcels**
Public Owned Vacant Parcels	6,693 parcels
Size of Parcels > 4000 sq feet	6,057 parcels
Buildings/Paved Area 25 %	2,353 parcels
Parcels Adjacent to Street within 5 Meters	795 parcels
Parcel Not Intersecting with Ecological Areas	790 parcels
Slope < 15°	480 parcels
Recreational Area	273 parcels
Final Parcels Meeting Prerequisite criteria	**273 parcels**

3. Rationale for Filtering Factors
    a. Prerequisite Criteria:

We chose the following criteria as prerequisites for urban agriculture from public lands based on prior analysis from a consultant from the LA Chief Sustainability Office. Below was an extended explanation of the reasons behind the criteria.

i. Parcel Status

Initially, we aimed to consider only public parcels as potential parcels for urban agriculture because the avenues for land regeneration would be easier if public rather than private. It would also be simpler to identify public department owners of sites and sway regenerative agriculture practices.

ii. Size of Parcels

The size of the parcel plays a crucial role in determining its suitability for urban agriculture. To ensure both feasibility and efficiency of urban agriculture initiatives, parcels must meet minimum size requirements to accommodate the intended agricultural practice. For community gardens and small-scale urban farms, a minimum size of 4,000 square feet was recommended(Jenkins et al., 2021). This size was considered adequate for establishing a productive garden or farm with enough space for basic infrastructure, including storage and composting areas.

iii. Buildings/Paved Area

For urban agriculture to thrive, the proportion of the parcel covered by buildings or paved areas should be minimal. Ideally, parcels with less than 25% coverage by buildings or pavement are preferred, as more open space is available for cultivation. However, existing structures can be repurposed for agricultural uses, such as greenhouses or storage, if they are in suitable condition.

iv. Street Access

Accessible street access is essential for urban agriculture sites, ensuring easy transportation of materials, produce, and access for community members and workers. Parcels should have direct access to public roads that can accommodate vehicles for delivering supplies and distributing produce. The accessibility would facilitate the efficient operation of urban agriculture projects and enhance their integration into the local food system. Additionally, pedestrian access is important for community gardens, encouraging local participation and engagement. Street access also plays a role in emergency services and security, making it a critical criterion for selecting suitable parcels.

v. Avoided locations

In identifying parcels for urban agriculture, our aim is to extend green, natural spaces to communities that are presently underserved in this regard, rather than concentrating these efforts in areas already well-endowed with urban green spaces. Consequently, parcels located within or immediately adjacent to established parks, ecological areas, and beaches will be excluded from selection. This strategy ensures that urban agriculture serves as a tool to democratize access to green spaces, spreading the environmental, social, and health benefits more evenly across the urban landscape. By focusing on areas where green spaces are scarce, urban agriculture projects can significantly enhance the quality of life, promote biodiversity, and improve environmental sustainability in underserved communities.

vi. Slope

The slope of the parcel is a critical factor in determining its suitability for agriculture. Flat or gently sloping lands (less than a 15% slope) are preferred as they are easier to cultivate, irrigate, and maintain. Steep slopes can present challenges for water management, increase soil erosion risk, and require additional labor and infrastructure to make the land arable. However, for certain types of agriculture, like vineyards or terraced farming, moderate slopes may be suitable. This criterion ensures that the physical characteristics of the parcel support efficient and sustainable agricultural practices. The slope of the land is a critical factor in runoff and soil erosion(Gao et al., 2020). With increased slope, the amount of soil loss and runoff increased. Also when the slope increases, the soil development is slow, and soil depth and fertility decrease(Feizizadeh & Blaschke, 2013).

vii. Recreational Area

Los Angeles County opted to exclude recreational areas from potential urban agriculture sites to preserve these spaces for community well-being, which provide vital outdoor and social activities. Maintaining recreational areas can support community health, legal and planning needs, and property values while providing ecological benefits. In addition, urban agriculture, though beneficial for food security and local produce access, requires specific conditions that recreational spaces might not meet, and altering these spaces could lead to community pushback due to the high value placed on existing recreational activities.

b. Preferable Criteria:

By integrating the preferred criteria into the site selection process, the urban agriculture initiative can more effectively address food insecurity and promote socio-economic resilience within vulnerable communities in LA County. Below were the rationales for the eight preferable factors we chose.

i. Proximity to grocery stores

According to the United States Department of Agriculture (USDA), the term "Low Access Population" refers to the number of individuals who do not live within proximity to a grocery store, with close being defined as within one mile for urban area residents or within 10 miles for rural area residents(Neighborhood Data for Social Change, 2024). Congress directed the USDA to identify 'characteristics and factors causing and influencing food deserts'—referred to as an area 'with limited access to affordable and nutritious food, particularly in areas composed of predominantly lower-income neighborhoods and communities(Johnson, 2021). After considering the definition of food deserts, congressional interest in addressing food access, and criticisms of existing methodologies, we chose proximity to the nearest grocery store as a key criterion in our analysis. This is because access to a grocery store within a reasonable distance is essential for ensuring residents' access to various affordable and nutritious food options, particularly in lower-income neighborhoods where food access may be limited.

ii. Remoteness to existing gardens/ parks

Urban agriculture can offer urban open space, education about climate change, food security, biodiversity, pollinators, and nutrition to the community. It can increase food access and green spaces in parts of the city that have historically been disadvantaged. For moderate park users, parks within a walking distance of 500m were deemed very important. For frequent park users, a distance within 1000m was preferable. To further address accessibility to food and urban green space, urban agriculture spaces were not encouraged inside the current park service radius(Li et al., 2023). The same rationale was applied to further address accessibility to food and urban green space.

iii. Proximity to community

According to the 15-minute neighborhood theory proposed by urbanist Carlos Moreno (2021), the 15-minute city concept ensures that urban residents can fulfill six essential functions within a 15-minute walk or bike ride from their dwellings: living,

working, commerce, healthcare, education, and entertainment. The framework of this model consists of four components: density, proximity, diversity, and digitalization. Research suggests that the average distance for a 15-minute walk is around 0.75 miles.

Building urban agriculture within this 15-minute walking distance will significantly improve urban accessibility(Moreno et al., 2021.).

iv. Parcels not feasible for housing

From the Metropolitan Housing and Communities Policy Center, there is evidence that shows that people living, working, and learning within 150 to 300 meters (about 500 to 1,000 feet) of highways are disproportionately subject to dirty air and loud ambient noise. This, in turn, causes health problems, including lung disease, stroke, and premature birth(Samuels & Freemark, 2022). Housing is permitted as a land use near most high-traffic roadways. This assertion is supported by Rowangould's (2013) findings, which indicate that a significant portion of the US population resides near high-volume roads, exposing them to elevated levels of mobile source air pollutants. Furthermore, the study suggests that most counties with residents living near high-volume roads lack a co-located regulatory air quality monitor. Another rationale for including parcels not feasible for housing is to reserve these spaces for housing opportunities as housing instability is salient in the city.

v. Low-income community

When identifying vacant land in LA County for urban agriculture, we focused on addressing the needs of low-income communities that may have lack of access to green space or nutritious food options. We included areas with a high poverty if the census block was at least 20% at the federal poverty line, ensuring that the chosen locations align to provide economic opportunities for underserved communities.

vi. Low food access populations

We assessed the prevalence of low food access populations by characterizing individuals living beyond a specified proximity to grocery stores. Specifically, for urban areas, the definition of "close" is within 1 mile, while for rural areas, it extends to within 10 miles. This data-driven approach ensures a nuanced understanding of the social issues, directing the search toward areas where residents face economic hardships and limited access to essential resources.

vii. Proximity to community members

Building relationships within the community early in starting an urban farm is critical to gaining community support by learning about the area environment and how an urban farm may provide valuable services to people(Poulsen, 2014). Community services are in various locations, including churches, senior community centers, high schools, etc. The intent was that proximity to these community organizations could potentially increase community buy-in and keep the project sustainable. Urban agriculture activities contribute to economic and community development, particularly chances for youth and career training for those interested(Papanek et al., n.d.).

viii. Environmental Burden

When talking about urban agriculture it relates to health, environmental contamination in soil, air, and water by industries, whether large factories or small kiosks, is likewise essential to consider(Lee-Smith & Prain, 2006). California Office of Environmental Health Hazard Assessment (OEHHA) created and is currently maintaining and updating the CalEnviroScreen tool on behalf of CalEPA to address the combined effects of both pollution burden and these additional factors and identify which communities might require specific policy, investment, or programmatic interventions. It mentions that the mere presence of a contaminated site or high-profile facility can have tangible impacts on a community, even if actual environmental degradation cannot be documented according to CalEnviroScreen(Zeise & Blumenfeld, 2021).

B. GIS software tool

1. Introduction to ESRI, ArcGIS Pro and ArcGIS Experience Builder

Esri is a global leader in geographic information system (GIS) software, location intelligence, and mapping. It provides customers with geographic science and geospatial analytics, which it refers to as 'The Science of Where. Esri approaches problem solutions from a spatial perspective, enhanced by current, enterprise-grade GIS technology. It is devoted to leveraging science and technology to create a more sustainable future(About Esri, n.d.).

ArcGIS Pro is Esri's comprehensive professional desktop GIS program, offering a wide range of functionalities for data exploration, visualization, and analysis. Users can utilize ArcGIS Pro to create both 2D maps and 3D scenes, and easily publish their findings to ArcGIS Online or their ArcGIS Enterprise site(Introduction to arcgis pro, n.d.).

Esri recently released ArcGIS Experience Builder, a web-based application development tool created. It enables users to create and customize web experiences without the need for coding. Experience Builder allows users to develop dynamic web applications by mixing components such as web maps, apps, pages, widgets, and data in both 2D and 3D forms. The platform offers a flexible drag-and-drop interface, allowing users to easily alter the look and functionality of their online apps. Users can also customize how their web apps look on various screen sizes and devices(ArcGIS experience builder, n.d.).

We utilized ESRI's ArcGIS Pro for comprehensive desktop GIS analysis and ArcGIS Experience Builder for developing interactive web experiences. Presented below is a table detailing the software tools employed for our project. This table includes a comprehensive overview of the software tools utilized, encompassing their descriptions, versions, usage, and respective web links. Screenshots of the web pages referenced in this table could be found in Appendix B, C and D.

Table 2 : Overview of ESRI Software Tools and Web Links

Software	Description	Version	Usage	Web Link
ArcGIS Pro	Esri's comprehensive professional desktop GIS program, facilitating spatial data exploration, visualization, and analysis, as well as the creation of 2D maps and 3D scenes, and publication of results to ArcGIS Online or ArcGIS Enterprise.	3.2	Data exploration, visualization, analysis	N/A
ArcGIS Experience	An Esri web-based application development	1.13	Interactive map	https://experience.arcgis.com/e

Builder	tool enabling the creation of custom web experiences incorporating maps, charts, and other data-driven content without coding. It supports the development of interactive web apps.			xperience/ecfb0ac4be57454680eb2411805e7263/
			Website	https://experience.arcgis.com/experience/cca35a0861794a638115dc65d511ea6f/

2. Composite Index

a. Introduction of Composite Index

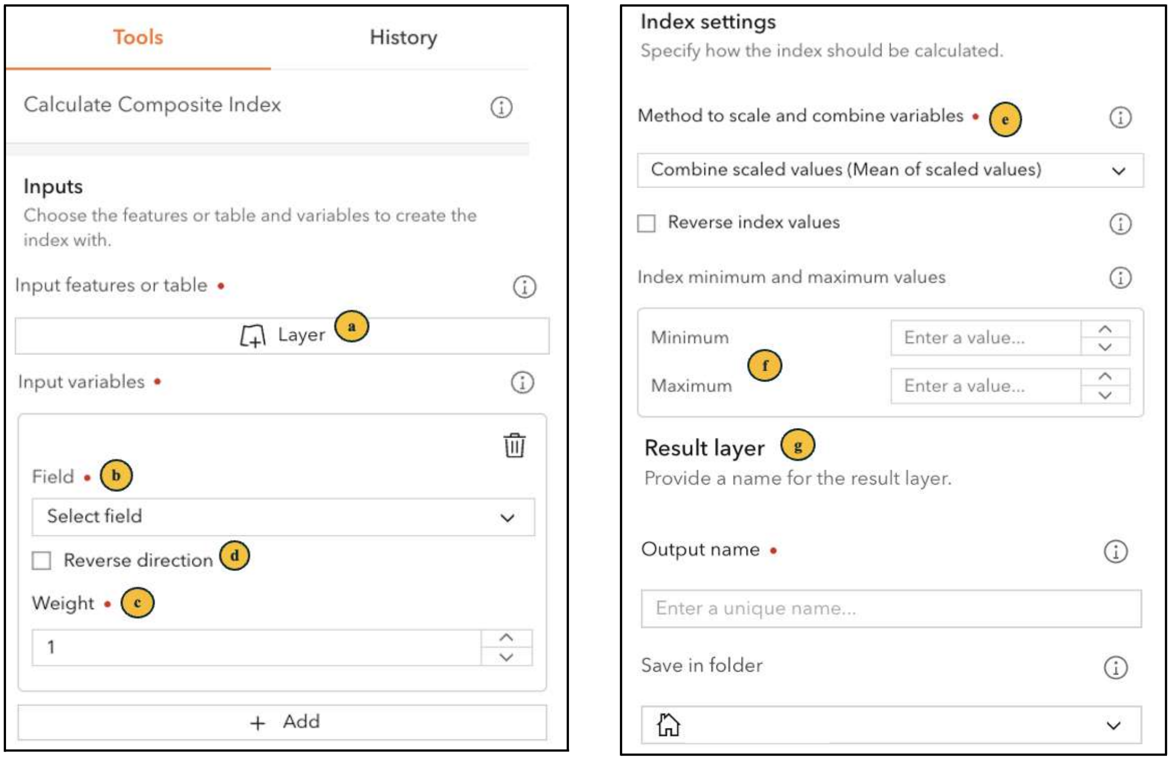
The Composite Index is a spatial statistic that combines multiple indicators to create a single metric that can measure progress toward a goal and make decisions. Composite indices are meant to characterize social and environmental areas and reflect multifaceted information as a single metric that may be used to track progress toward a goal or make decisions(Calculate composite index, n.d.). It uses a three-step process of preparing the data, integrating data, and refining the final index.

After collecting all the data, we utilized the 'Composite Index' tool in ArcGIS Pro to combine disparate indicators into a comprehensive single index, which served as a powerful tool for synthesizing diverse data into a coherent framework. We began by selecting and processing eight indicators reflecting various aspects of urban agriculture. These indicators included proximity to grocery stores, remoteness to existing gardens/parks, proximity to community members, parcels not feasible for housing, low-income communities, low food access populations, proximity to community services, and environmental burden.

b. Components of the Composite Index

Below, we outlined the functions included in the Composite Index framework and their operationalization within the assessment of urban agriculture suitability in Los Angeles County. Figure 2 presents a screenshot of the web interface displaying the Composite Index, showcasing various functionalities such as layer management, field selection, weighting option, ability to designate reverse direction, method options, and result visualization.

Figure 2 : Composite Index in Web Interface



a. Layer

Within this function, we identified layers of potential parcels, filtering out vacant lands that met the prerequisite criteria. A total of 273 potential parcels are highlighted. Additionally, there is another layer named parcel ranking, which is based on prerequisite criteria. We normalized each preferable criteria and assigned equal weights to each factor, resulting in a ranking from 1 to 10 representing the potential for urban agriculture.

b. Field

In the field function, there were provisions for ten criteria, allowing the selection of one criterion for analysis in each field. Users have the flexibility to incorporate additional fields as required to suit their specific use case. Table 3 delineates the file names alongside their respective interpretations

Table 3 : File Names and Interpretations of Preferable Criteria and Additional Fields

File name	Interpretation
Below_FPL	Population Below Poverty Line
Housing _Fe	Not feasible for housing
Low_Food_A	Distance to Low Food Access Populations
NEAR_COMMU	Distance to Community Centers
NEAR_GROCE	Distance to Grocery stores
NEAR_PARK_	Distance to Nearest Park
PolBurdSc_	Pollution Burden Score
Population	Pollution within 2 Miles
Area	Area (not included in the preferable criteria)
Perm_Area	Impermeable Area sq-ft (not included in the preferable criteria)

c. Weighting

Variables were weighted to show the relative importance of each factor in relation to the overall index. It may be necessary to indicate differences in a variable's relative contributions compared to the others. Assigning a weight of two to one variable while maintaining the others at one, would indicate that the variable should be considered twice as essential as the others in terms of contribution to the final index. This weighting process allowed index customization based on the analysis's priorities and objectives.

d. Reverse direction

Considered the meaning of low and high values in each variable and ensured they were consistent with each other. For example, in a social vulnerability index, locations with lower median incomes are more vulnerable, but locations with low percentages of people without insurance were less vulnerable; the direction of these variables were opposed in the context of the purpose of the index, so the reverse direction was checked. Table 4.1 indicated which factors required reverse direction in their assessment criteria. On the other hand, Table 4.2 showed factors not requiring reverse direction.

Table 4.1 : Factors Requiring Reverse Direction in Assessment Criteria

Factor	Direction	Reason
Proximity to grocery store	Reverse	Lower distance to grocery stores indicates higher suitability
Proximity to community services	Reverse	Lower distance to community services indicates higher suitability
Low food access populations	Reverse	Lower distance to low food access populations indicate higher suitability
Environmental Burden	Reverse	Lower environmental burden indicates higher suitability

Table 4.2 : Factors Not Requiring Reverse Direction in Assessment Criteria

Factor	Direction	Reason
Remoteness to existing gardens/park	No reverse	Higher distance to existing gardens/parks indicates low suitability
Parcel not feasible to housing	No reverse	Higher non-feasibility value freeway indicates low suitability
Low-income community	No reverse	Higher the population within 2 mile under the 20% Federal Poverty Line indicates low suitability

e. Method

Within the tool, there were seven methods available for creating the composite index, each offering different approaches to scaling and combining input variables. After careful consideration, we chose to utilize the "Combine values (Mean of scaled values)" method for conducting the parcel ranking. This approach created the index by scaling the input variables between 0 and 1 and averaging the scaled values. It generated a readily interpretable index, with the shape of the distribution and outliers in the input variables influencing the end value. Individuals had the flexibility to choose their preferred method for creating the index according to their specific needs and preferences.

f. Minimum and maximum

The "Minimum and Maximum" function defined a custom data range, allowing users to specify the range within which parcel ranks were assigned. For example, setting the minimum to 1 and the maximum to 10 ensures that each parcel was ranked 1-10. A score of one denoted the least acceptable parcel for land suitability, whilst a higher number closer to ten indicates parcels that were best suited for their intended use. Users could customize the ranking system to meet their individual needs and tastes.

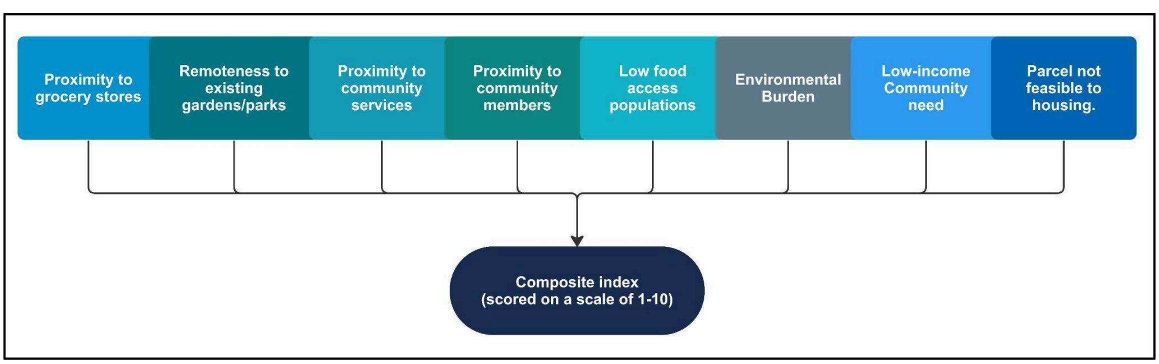
g. Result layer

The result layer represented the culmination of the composite index analysis, visually depicting the combined effects of the selected factors on the map. This layer provides a comprehensive overview of the potential parcels, highlighting areas of interest based on the composite index values. It served as a tool for decision-making, enabling stakeholders to identify and prioritize parcels with the most favorable characteristics for their intended use or development.

C. *Flow chart*

The workflow diagram in Figure 3 depicted the essential procedures involved in creating the composite index. It began with identifying key characteristics, such as proximity to grocery stores, community services, and environmental impact. These elements were then processed and merged to provide the composite index score. The graphic depicted the flow of data from input variables to the end index output.

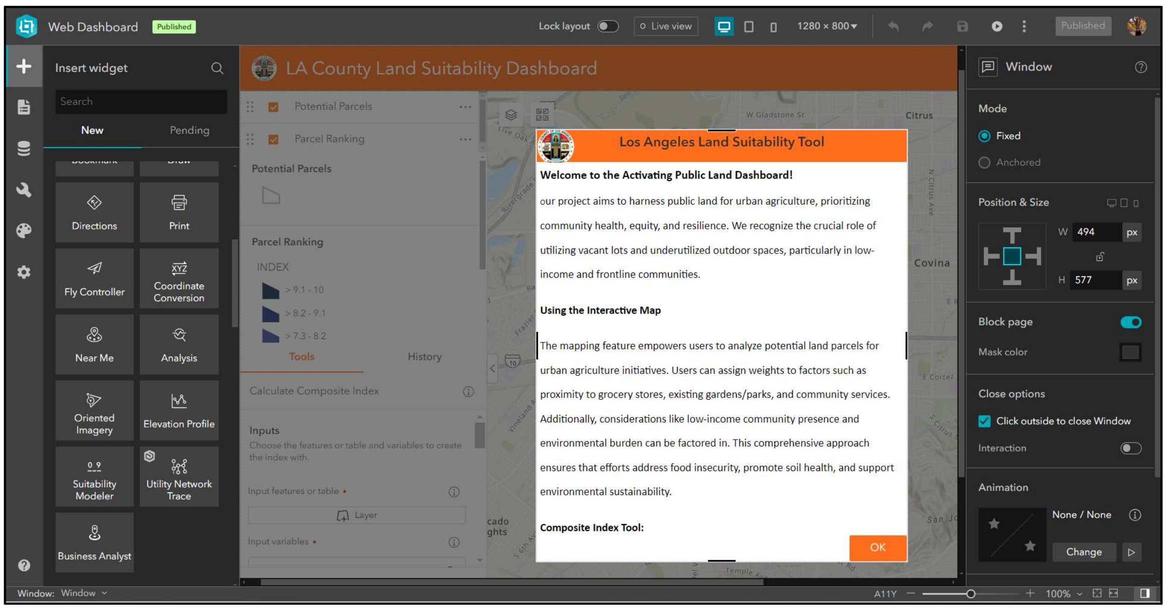
Figure 3 : Workflow for Generating the Composite Index



D. Web tool development beta

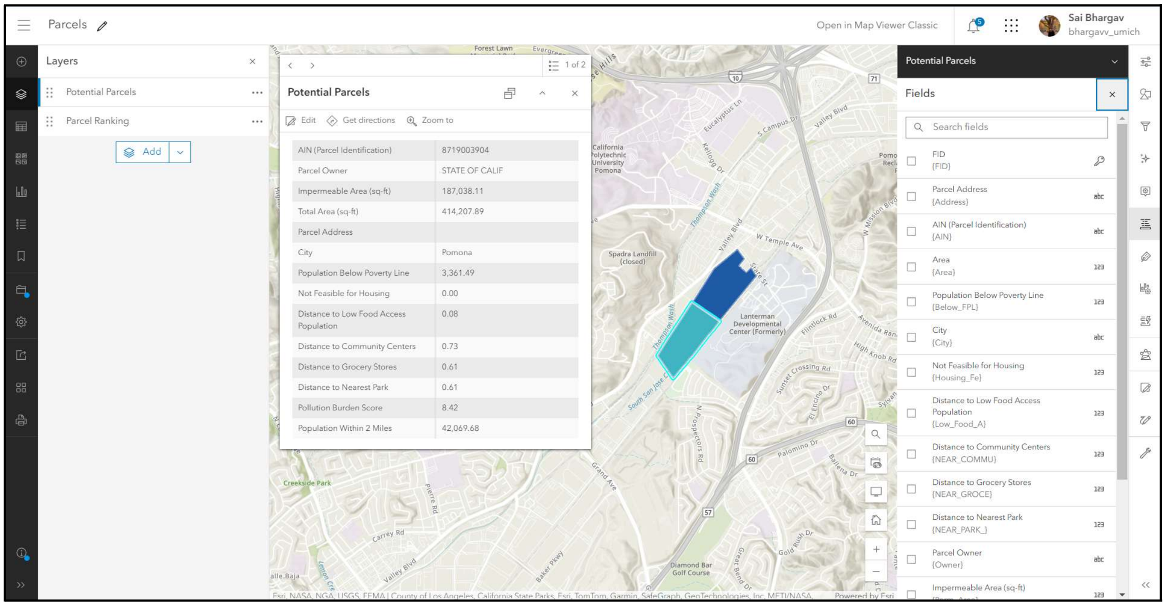
To ensure our tool was accessible to everyone, we created a web dashboard that allows users to interact with parcel data and evaluate parcel rankings. We chose to use Experience Builder for its versatility in creating dynamic dashboards and ability to achieve a platform that could seamlessly adapt to various user requirements. Figure 4 illustrated the experience builder interface with the widget plane.

Figure 4 : Experience Builder interface with widget pane



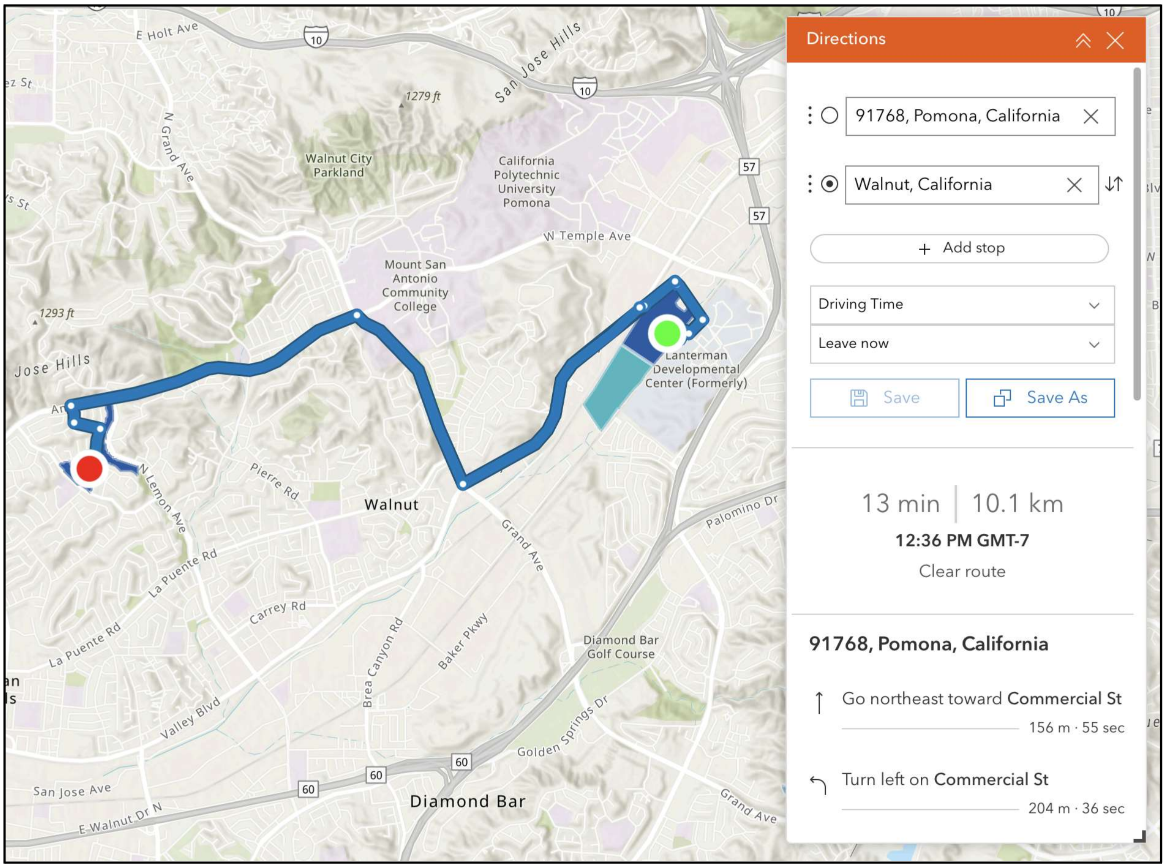
We began by filtering parcels based on predetermined criteria, detailing each parcel's preferable criteria distinctly. Figure 5 shows the web map with the layers loaded and the parcel information such as Assessor's Identification Number (AIN), address, parcel owner, impermeability area, address and any other pertinent factors associated with the selected parcel. By accessing this detailed information, users could make well-informed decisions regarding the suitability and potential of each parcel for their urban farming endeavors. Users can also customize their preferences according to their user-story. These details are subsequently uploaded as a feature layer (A feature layer is a grouping of similar geographic features, for example, buildings, parcels, cities, roads, and earthquake epicenters. Features can be points, lines, or polygons) to ArcGIS Online. Likewise, the parcel ranking layer, determined using default weights, was computed using the Composite Index tool in ArcGIS Pro and uploaded as another feature layer. Both feature layers were utilized to create a web map, styled to meet our specifications.

Figure 5 : Web Map with the layers loaded



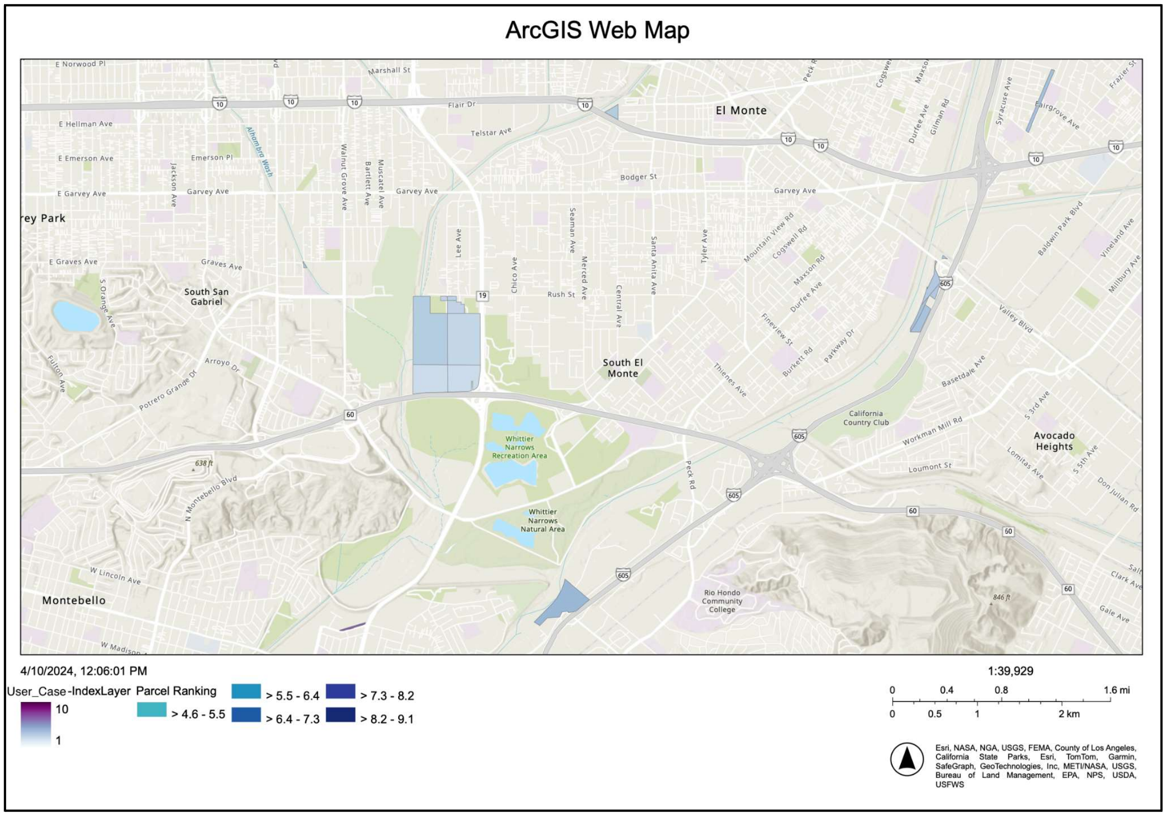
The web map serves as the foundational element of our Experience Builder dashboard. Our objective with this tool was to ensure it could be easily tailored to various user scenarios. In support of this flexibility, we incorporated the Composite Index tool directly within the dashboard, enabling users to create custom parcel rankings based on the attribute data linked to the parcel layer from the web map. This feature allows users to apply their own factors and weights to compute a Composite Index tailored to their specific needs and to compare this custom layer against the default parcel layer available in the dashboard. To further enhance the user experience and provide an intuitive way for users to compare different layers, we updated the dashboard to include the Swipe Widget tool. Additionally, the experience builder interface offered functionalities for importing spatial datasets for visualization or exporting existing layers. Figure 6 illustrates the navigation tool in the web ma

Figure 6 : Built-in Navigation in Web Map



Following customization based on the user's specific case, users had the capability to zoom in or out to focus on their area of interest. Subsequently, Figure 7 shows an output of the printing function which allows for the generation of a printable version of the results. Upon selecting the print option, a new webpage was opened, presenting the map alongside a legend. This feature enabled users to discern the rank of each parcel within the selected area.

Figure 7: Printed Output Web

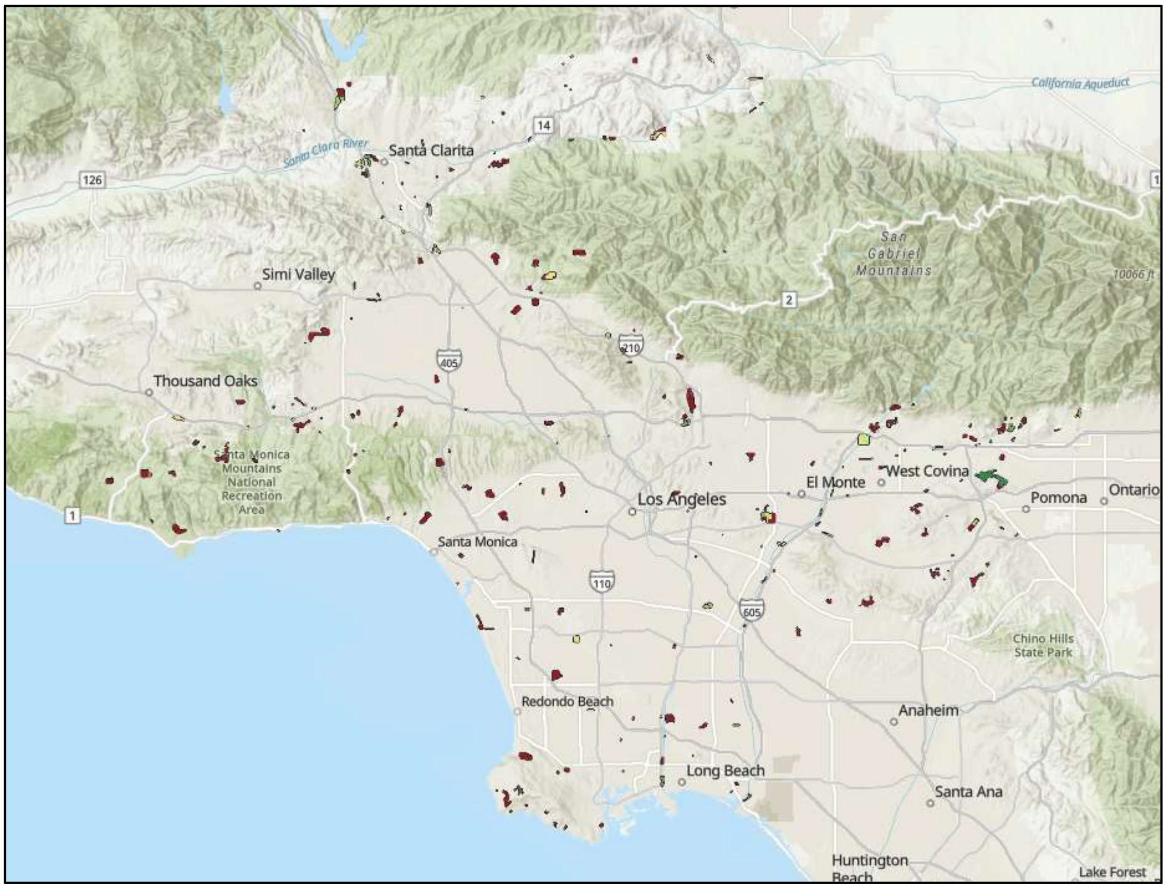


Results

A. Number of eligible parcels

Under the section displaying eligible parcels meeting the prerequisite criteria in Los Angeles County, Figure 8 provides a visual representation of approximately 300 parcels identified as suitable based on the specified criteria.

Figure 8: Highlighted Parcels Meeting Prerequisite Criteria in Los Angeles County



B. User Case Example

We provided various prospective use cases for various examples to simulate different possibilities. These can have different implications for community well-being and environmental sustainability. Community composting efforts could thrive in specific locations, promoting trash reduction and soil enrichment. Identifying ideal nursery areas would promote vegetation growth, hence improving urban attractiveness and air quality.

Expanding parks and greenspaces can improve leisure opportunities and biodiversity conservation, resulting in a healthier urban environment. Identifying the best places to plant oak trees helps to restore ecosystems and build resilience. Exploring soil banking opportunities also correlates with sustainability goals, as they provide possible sites for soil storage and enhancement.

In this example, it shows how criteria can change based on a specific user-story:

> *"As an urban farmer, our first goal was to secure a parcel of land strategically positioned in close proximity to grocery stores. This location provided multiple benefits, including easy access to new markets and quicker commercialization paths for my produce, which improves the overall profitability and sustainability of my farming operation. Additionally, we want a site characterized by minimal pollution levels. By focusing on environmental sustainability and health issues, we hope to uphold the integrity of my farming operations, assuring the development of high-quality, nutritious crops while minimizing negative effects on the surrounding ecosystem."*

Based on the user case, only two factors - environmental burden and proximity to grocery stores - are considered in the assessment. In Figure 9, the highlighted parcel, indicated by a red highlight, has an index score of 6.87. This score reflected a composite index value generated using default criteria including the eight preferable criteria weighting the same as one. On the other hand, Figure 10 showed a tailored approach for the user case that resulted in an index score of 3.51 for the highlighted parcel that considered only two factors.

Figure 9: Default - Composite Index Score: 6.87

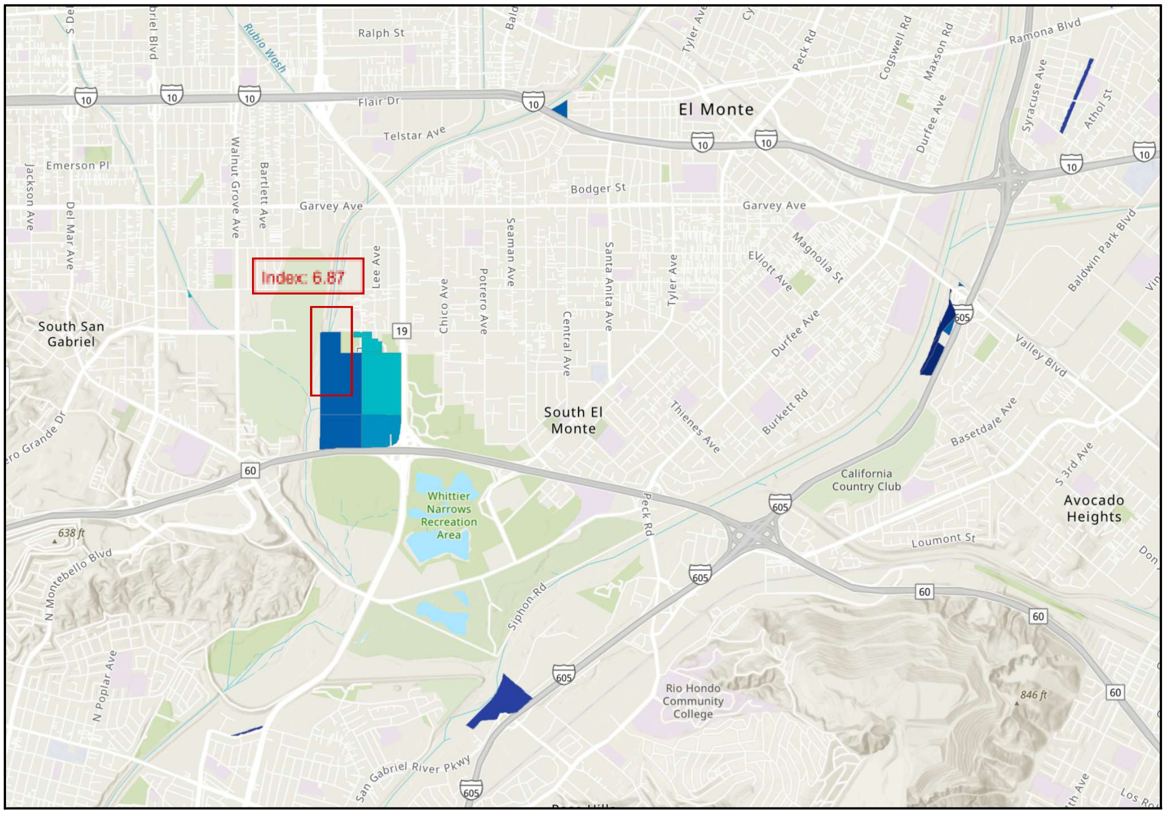
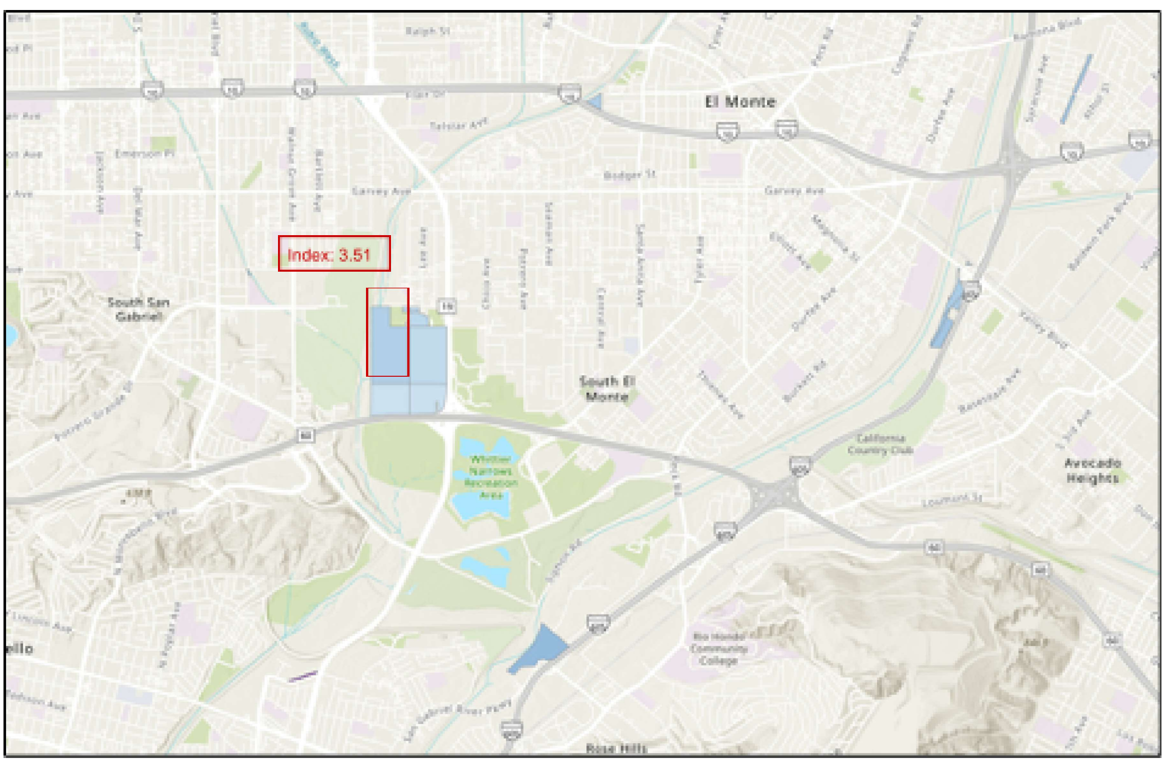


Figure 10: After Customization - Customized Index Score: 3.51



C. Focus Group Reflections

We collected feedback regarding our webtool from ten professionals in the Los Angeles area connected to our client and interested in the possibility of an interactive map identifying vacant parcels for specific use cases. Participants of the focus group consisted of people of various roles from the University of Southern California, Occidental College, and LA City and County Offices. Their roles range from sanitation department, sustainability, spatial sciences, green infrastructure policy management, parks and recreations, and environmental services.

In our focus group presentation, we posed several key questions to gather diverse perspectives and insights after briefly introducing our methods, results, and a live demonstration of the webtool. Firstly, we sought to understand stakeholders' overall reactions to the tool, aiming to gauge its perceived usefulness, usability, and potential impact. Furthermore, we explored potential additional use cases where the tool could be applied beyond its primary function.

The stakeholders' diverse perspectives ensured that the web tool caters to a wide range of user needs and potential use cases. One response emphasized the self-contained modeling and inclusion of additional factors like proximity to composting location, proximity to community garden, public transportation, etc. Another participant alluded to the necessity of live parcel database access which can enhance its real-time functionality. A few participants supported the capability for reverse directionality since the factor of proximity to grocery stores and the opposite is also valuable to consider, however there was also mention that it can be confusing and more plain language should be ascribed somewhere in the tool. There was also a proposal for addressing homelessness and filtering out appropriate public buildings that can be used as a voting center might be other helpful cases of this tool. It highlights the tool's potential societal impact. There were other interests on water access to sites and suggestions regarding multi-family housing proximity underscore its utility for urban planning. There was also recommendations for park expansion analysis further expands the tool's potential applications, reflecting a collaborative effort towards comprehensive urban development solutions.

Discussion

A. Summary of findings

Our primary objective was to create a web tool for identification of vacant parcels in the LA County area using GIS decision-making methods. The final product serves as a baseline for which future clients can add different attribute layers to tailor their user story. This flexibility of on-the-fly mapping and how user-defined criteria affected the appropriateness evaluation showed how particular criteria could have a big impact on the index result. It shows how it can rapidly change depending on the use case. The swipe tool lets users easily compare the default parcel layer with their custom-generated parcel ranking layer by swiping between them. This interactive feature dramatically improves the ability to visually assess differences and similarities between layers, facilitating a more comprehensive analysis. It caters to many use cases, making complex parcel data easily accessible and understandable for those unfamiliar with GIS analysis. The experience builder's built-in navigation and an automated layout generator also promoted accessibility and simplified the user experience. Finally, the print option served as a valuable tool where tangible copies of the assessment results enhanced analytical capabilities and decision-making processes.

Overall, the focus group of experts in the Los Angeles area showed positive responses with the tool and provided new considerations that have led to the identification of our strengths, limitations, and future directions. Despite the wealth of insights provided by stakeholders that were not particularly centered around urban agriculture, the breadth of perspectives introduces complexity and potential avenues in decision-making and feature prioritization for other projects. In order to include more up to date information, we plan move into the LA County's GIS infrastructure. The GIS team can being the next process in incorporating live parcel database to update to see the most current visuals like Lariac imagery. Additionally, challenges such as obtaining reliable soil data underscore the practical hurdles in implementing stakeholder recommendations. What we found for the soil data set covers huge areas, and the resolution was not easy to incorporate. Balancing outside perspectives with project feasibility and user experience remains a critical challenge in the development process, requiring careful management and consideration of factors to ensure successful outcomes.

Community indicators were a critical aspect of implementing a successful urban agriculture project in LA County. To foster support and address the needs of the local community, it is essential to actively engage with residents (Malberg Dyg et al., 2020). Factors such as proximity to grocery stores, remoteness from existing gardens or parks within the same radius can play a crucial role in enhancing accessibility and convenience for residents. Additionally, considering key community services, such as schools, religious centers, community centers, and senior citizen homes, is an opportunity to strengthen the project's integration into the fabric of the community (Austin et al., 2006; Bice et al., 2018). The sense of connectivity between the urban agriculture initiative and essential community services can foster a collaborative and mutually beneficial environment.

Conducting an environmental impact assessment will be crucial for an urban agriculture project in LA County. Malberg Dyg (2020) revealed that it is imperative to thoroughly evaluate the potential environmental burdens associated with the initiative and ensure strict adherence to environmental regulations. The potential project should strive to keep these indicators within acceptable limits while identifying vacant land in LA County for urban agriculture. Focusing on addressing the needs of low-income communities proved to be crucial in incorporating comprehensive social issues data collection and consideration. Additionally, the prevalence of low food access populations, characterized by individuals living beyond a specified proximity to grocery stores, should be directed toward areas where residents face economic hardships and limited access to essential resources. By integrating such social metrics into the site selection process, the urban agriculture initiative can more effectively contribute to addressing food insecurity and promoting socio-economic resilience within vulnerable communities in LA County.

B. Strengths

In the process, the project was able to find a relevant way to conduct an interactive web map where interested stakeholders can select potential parcels based on what their preferred criteria are. Many different approaches were explored including a raster calculator web tool, however the composite index allows the end-user to select different weights based on varying factors, allowing for multiple different use cases. This element serves as the most crucial workflow and design set up and can vary based on new layers and variable inclusion. One of the other strengths is that the prerequisite criteria was able to slim down the processing power and only showed the most usable sites. Another strength of the project was feedback from professionals in the area and environmental field. This feedback ranged from those who were savvy in geospatial data science and those who would heavily benefit from a webtool identifying vacant parcels.

C. Limitations

There were several limitations that were encountered by the end of the project. The inability to ground truth the parcels was one of the obvious factors. There are some parcels that we were able to identify but upon further inspection, there were some filtering criteria that perhaps were not considered that made these areas unsuitable. For example, some parcels are potentially over bodies of water or include recreational areas where ownership may be difficult. To potentially address this challenge, extra time to visit the sites as well as incorporate feedback from community-based organizers would have been valuable.

Another limitation is that prefiltering the parcels based on prerequisite criteria could have limited the possibility of other potential use cases. Since it was heavily related to urban agriculture, there are some other parcels that were potentially relevant to other use cases but not considered because of prerequisite criteria filtering. Possible routes to avoid this limitation is to also have suggestions based on prerequisite criteria and allow the end-user to add weights onto that section as well.

Long-term management of the site is another factor that needs to be considered. The possible sites shown in the webtool require other information if used for urban agriculture. There were a few key layers that were not included in the analysis such as utility hookups (ie water and electricity). A site with available water and electricity access would be necessary for operations otherwise it would be impossible without installation. Another key layer that was not included was soil type. Soil type would be imperative for implementation practices (i.e. garden beds) or remediation needs. These two factors are particularly pertinent to the use case of urban agriculture and potentially other uses as well.

Another soft limitation that would have been useful in this project is the harmonizing temporality in these layers. There are varying differences in when layers are captured which results are based on the assumptions that there had not been drastic changes to elements such as federal poverty levels, low food access populations, vacant parcel status, etc. Future directions would include adding API services wherein new information is pulled from up-to-date information online.

This webtool can also be very instrumental in identifying the number of unused vacant parcels in low-income areas and what they may mean for land regeneration and community building. The possibility of community gardens can provide healthy foods, education, and recreational opportunities to communities that may otherwise lack all three of those assets. A simple, user-friendly tool can provide community partners with the necessary resources to easily identify and navigate potential sites in the Los Angeles County area.

D. Future research

There are many future directions to solidify the beginnings of this project. A more thorough analysis and implementation of a vacant land tax model would be helpful in identifying what the potential mechanisms are for encouraging public owners of vacant land parcels to regenerate their properties or put empty space into use. Initially, we initially investigated the potential vacant land tax models used in Washington DC as well as Oakland and Long Beach in California. Efforts included envisioning a land tax model for the Los Angeles County area, but then focus shifted toward the data collection and implementation of a GIS decision-making webtool.

Another future direction is investigating the usability of sites. Long-term partnerships and collaboration between Los Angeles County Sustainability Office with the urban agriculture stakeholders would include surveying the selected and potential sites and assessing the usability of sites. For example, did the criteria for slope seem correct for the purposes of urban agriculture? Are there still other key attribute layers that are missing from the analysis? What other projects need to be investigated to make the end-goal of urban agriculture function? What other social vulnerability factors need to be accounted for? These questions would be addressed in more long-term collaborations that can ground truth and be on the ground. In the short-term, integrating the feedback from the focus group can be paramount.

While we were not able to ground-truth at this time, virtual ground truthing with aerial imagery is a strong possibility for the the LA County to explore. This would entail visually inspecting sites solely based on aerial imagery and potentially incorporating a supervised or unsupervised remote sensing approach.

Further consideration will also need to understand the ongoing challenges with climate change and adaptation. Resilience measures would need to integrate the ongoing water crisis in California. An improved analysis of Los Angeles Climate Vulnerability Assessment would elucidate some overarching challenges this project may have missed such as extreme heat days, frequency of flooding and flood zones, and drought challenges. This can also include a potential survey of challenges regarding urban agriculture in other cities that may face heightened risks. Another consideration is better understanding food access challenges from community members. One method to characterize this is through a community health assessment, where a team can survey members about specific challenges and perceptions about urban agriculture. A qualitative analysis can be useful in ensuring that any effort on the technical side is addressing the right questions.

Conclusions

This project has demonstrated the potential of leveraging a geospatial web tool and flowchart to identify underused publicly available land in Los Angeles County for urban sustainable agriculture. The primary goal was to address the dual challenges of vacant parcels and underutilized land, particularly in low-income and low-food-access communities suffering from limited green space and lack of access to basic amenities. The research hypothesized that such a tool would facilitate the discovery of suitable sites for urban agriculture, thereby providing a toolkit for community based partners to easily identify land for potential gardens. In this study, the development of a GIS-based decision-making tool aimed at optimizing urban agriculture initiatives in Los Angeles County is presented as a promising approach to address systemic disparities in land use, enhance community resilience, and improve access to nutritious food in underutilized urban spaces.

The development of the GIS-based web tool represents a significant advancement in how stakeholders, including urban planners, community leaders, and residents, can interact with and utilize data to make informed decisions about land use. By integrating various data sets—ranging from proximity to grocery stores and community services to environmental burden assessments—the tool provides a robust platform for identifying underutilized parcels that are suitable for urban agriculture. This innovative approach not only optimizes land use but can be adaptable to other use cases.

Throughout the project, the team faced several challenges such as the inability to physically verify the condition and suitability of parcels and the exclusion of certain important criteria like utility hookups and soil type. These limitations highlight areas for further development and refinement of the tool, suggesting that future iterations could incorporate more detailed local data and perhaps real-time updates to enhance its accuracy and reliability.

The results were promising, indicating that approximately 300 parcels met the criteria for urban agriculture suitability, underscoring the tool's effectiveness in streamlining the selection process. User feedback highlighted the tool's practicality, especially its customizability and ability to provide detailed parcel information, significantly aiding in decision-making for urban agriculture endeavor.

Future directions for this research include a more comprehensive analysis and implementation of vacant land tax models, an exploration into the long-term usability of sites, and the integration of climate change resilience measures. These efforts, coupled with ongoing collaboration with local stakeholders and community members, will enhance the tool's efficacy and ensure it addresses the nuanced needs of urban agriculture in Los Angeles County.

Looking forward, the potential impacts of this project on community health are profound. By increasing the availability of green spaces and local food sources, urban agriculture initiatives can help mitigate food deserts, improve dietary health, and enhance overall community well-being. These initiatives also provide educational opportunities and can foster a sense of community among participants, further strengthening social cohesion within urban environments.

Moreover, the project aligns with broader environmental and sustainability goals. Urban agriculture contributes to the reduction of carbon footprints associated with transporting food products and can improve economic and social benefits such as reduced cost of food imports, more nutritional education, and more pleasing green spaces(Goldstein et al., 2017; "Policy Briefs Archives," n.d.). These environmental benefits are critical in the context of global climate change and urban sustainability.

In conclusion, the GIS decision-making web tool developed by the research team is a step forward in the use of technology for sustainable urban development. It provides a valuable example of how technology can be harnessed to address complex social, environmental, and economic challenges. Continued investment in such technologies, coupled with collaborative efforts among governmental bodies, private stakeholders, and local communities, will be essential to realize the full potential of urban agriculture in Los Angeles County and beyond. Future research should focus on overcoming the current limitations of the tool, exploring the integration of additional relevant data sources, and expanding its applicability to other regions facing similar urban agricultural challenges. This work not only contributes to the academic field but also serves as a practical model for other urban areas globally, advocating for a sustainable and inclusive approach to urban development and land management.

Appendices

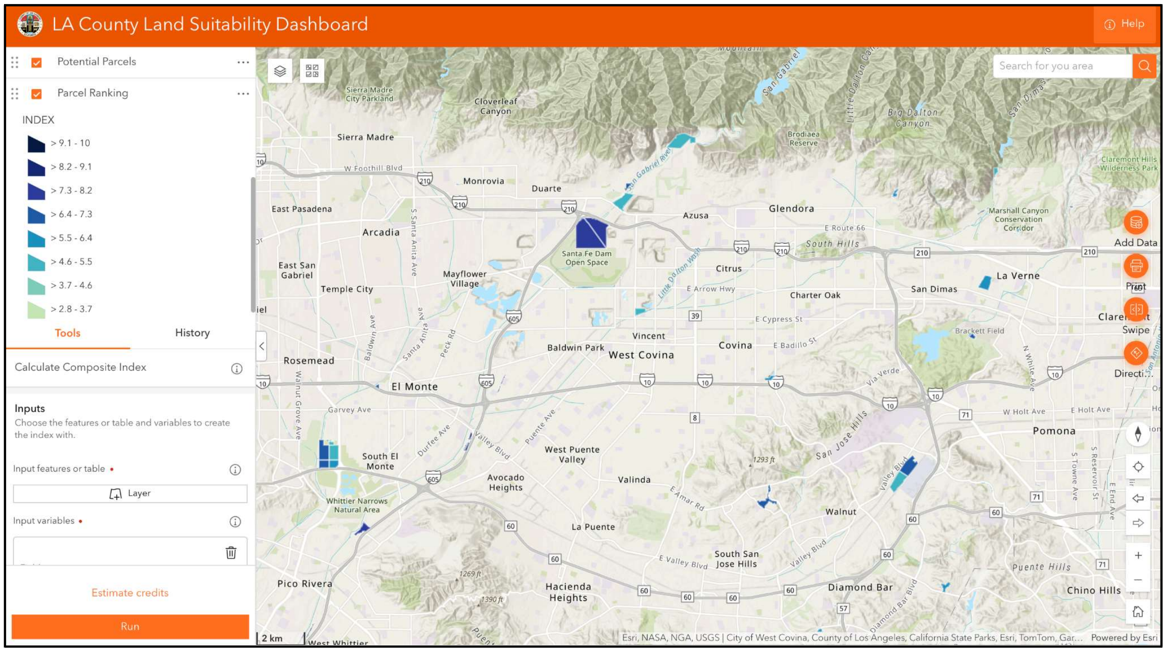
Appendix A: Potential Land Suitability Analysis Factors

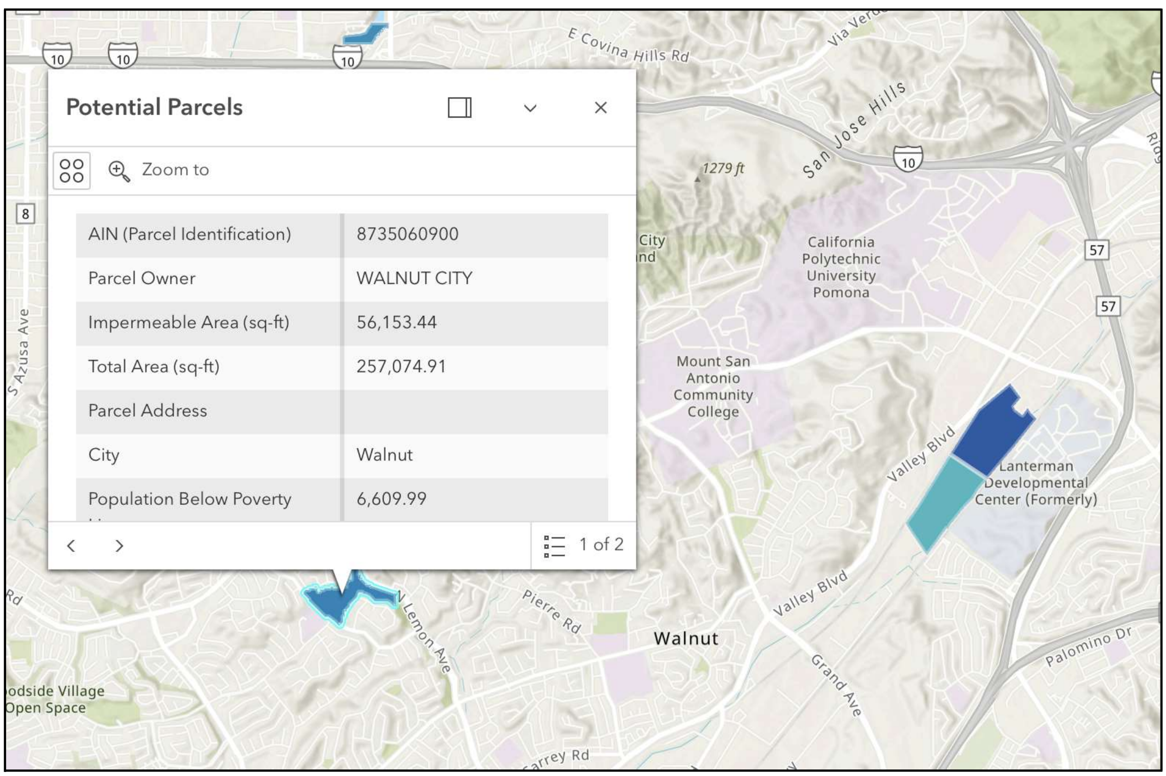
Pre-requisite criteria				
Variable	**Indicator**	**Scale**	**Source**	**Data type**
Parcel Status	Publicly owned vacant (Government & Recreational)	Parcel	County of Los Angeles Assessor's Office	Polygon
Size of Parcels	Area > 4000 sq ft for public lands	Parcel	County of Los Angeles Assessor's Office	Polygon
Buildings/paved area	Less than 25%	Parcel	County of Los Angeles Assessor's Office	Polygon
Avoided locations	Ecological areas, parks, beaches	Local	County of Los Angeles Enterprise GIS	Polygon
Slope	Slope < 15 degrees (based on pixel majority)	Parcel	USGS	Raster
Street Access	The parcel is adjacent to a street on at least one side.	Parcel	County of Los Angeles Dep of Public Works	Line

Preferable criteria				
Variable	**Indicator**	**Scale**	**Source**	**Data type**
Proximity to grocery stores	Nearest grocery store to each parcel	Local	Neighborhood Data for Social Change	Polygon
Remoteness to existing gardens/ parks	The nearest local parks/state parks to each parcel	Local	California State Parks	Polygon
Proximity to community services	Distance to community services layer for each parcel **(Merged churches with senior community center, high schools)*	Parcel	County of Los Angeles Data Portal	Polygon
Parcel not feasible to housing	Proximity to the freeway (within 500 feet) / The portion of the parcel is under electrical lines (0,1, 2 for road lines and powerlines)	Parcel	Pacific Urbanism; Sites suitable for housing	Lines
Low-income community	Population under 20% Federal Poverty Line; area proportional disaggregation	Census block	LA County	Polygon
Low food access populations	The number of individuals who do not live within close proximity to a grocery store (1 mile for urban residents or within 10 miles for rural residents)	Census block	Neighborhood Data for Social Change	Polygon
Proximity to community members	Nearby population (within 2-mile radius of the site) Did area proportional disaggregation	Census block	US Census	Polygon
Environmental Burden	Heavy environmental burden (over the >60th percentile of overall burden). Averaged environmental burden for the polygons intersecting vacant parcels	Census block	Cal Enviroscreen	Polygon

Appendix B: Interactive Map

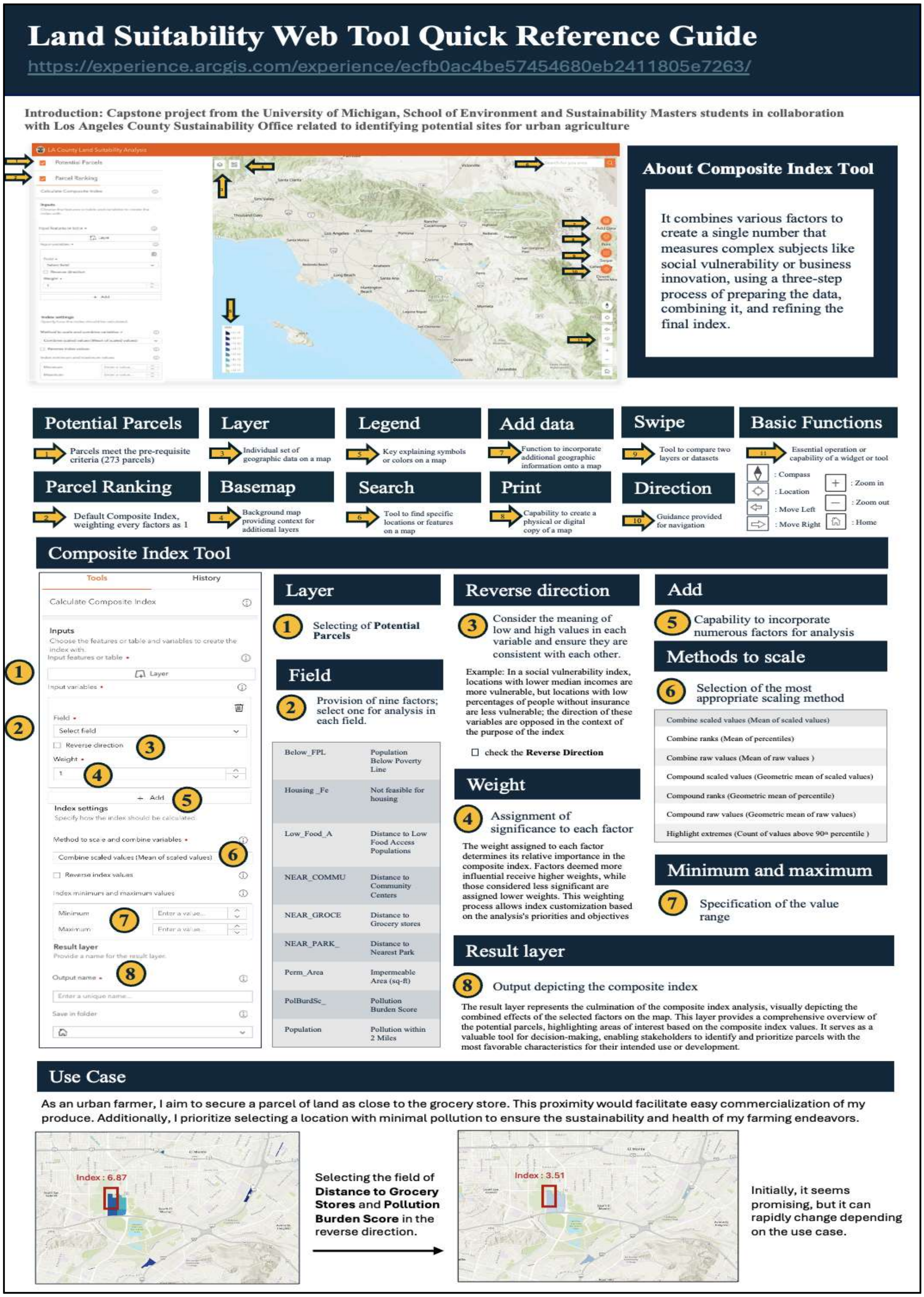
https://experience.arcgis.com/experience/ecfb0ac4be57454680eb2411805e7263/





Appendix C: Interactive Map Reference Guide

https://drive.google.com/file/d/1wVMUD1AReZ4wa6ICa8JxQFLSMYqEDXVN/view?usp=sharing



Appendix D: Website

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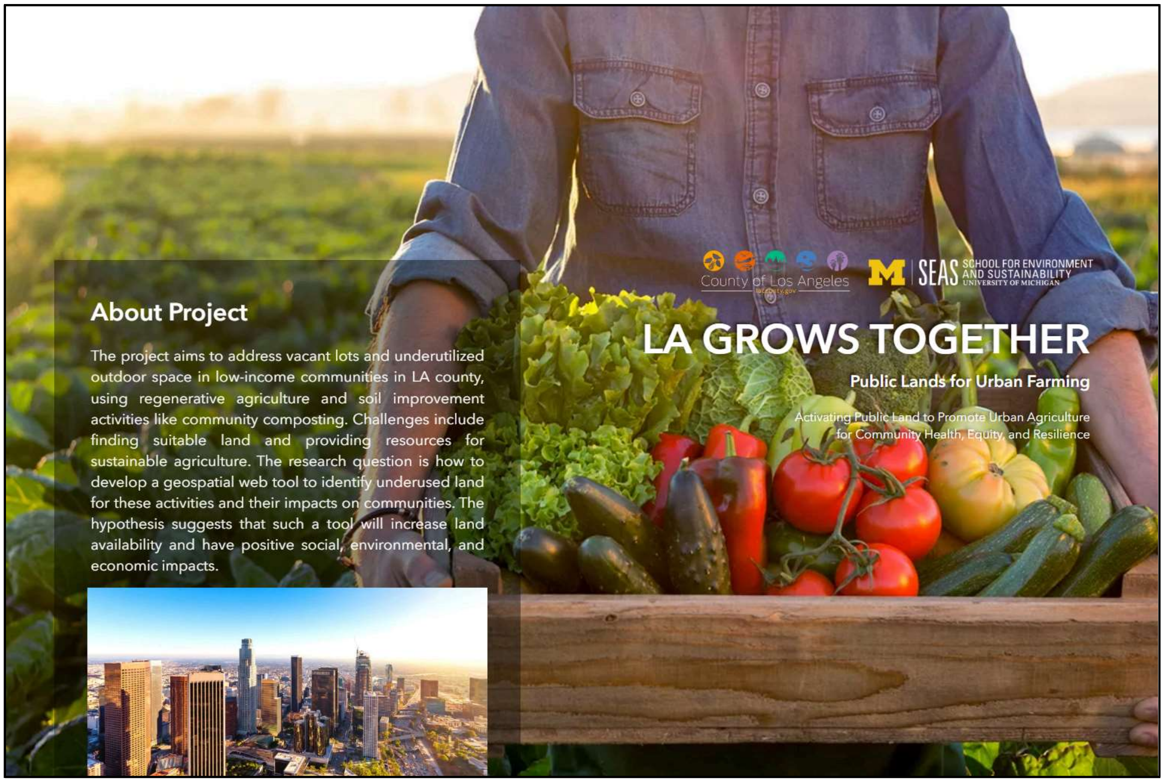
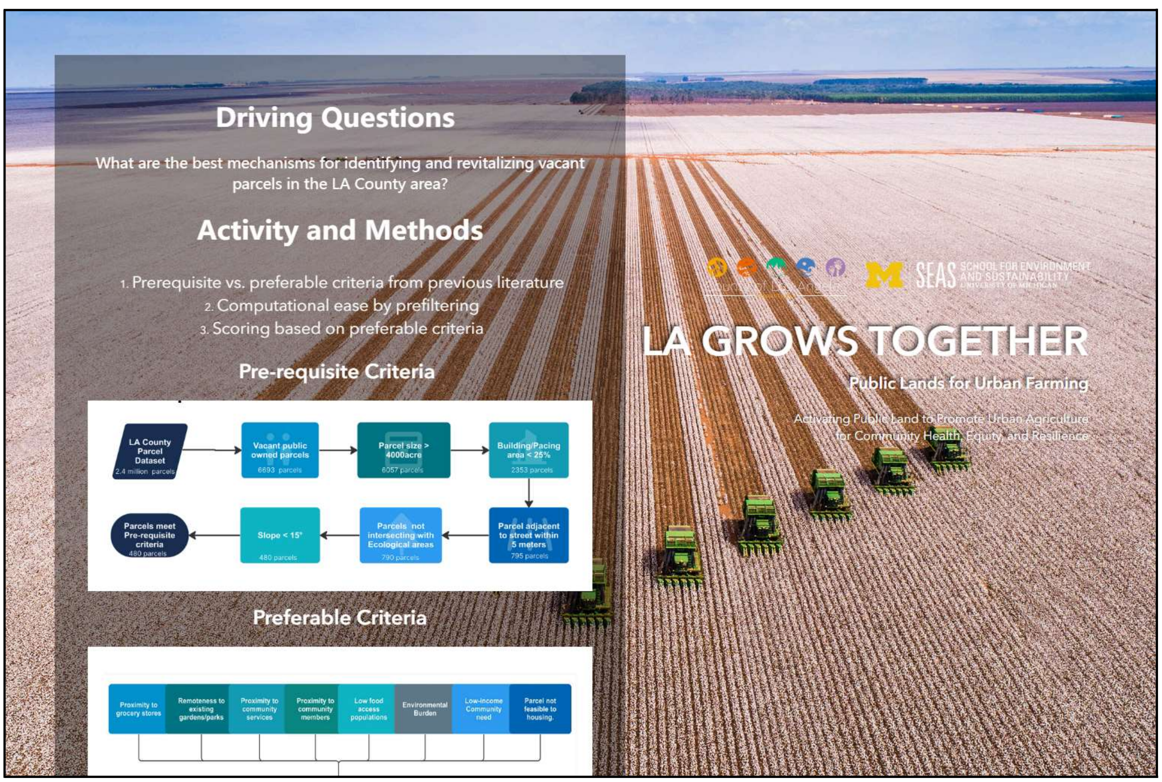
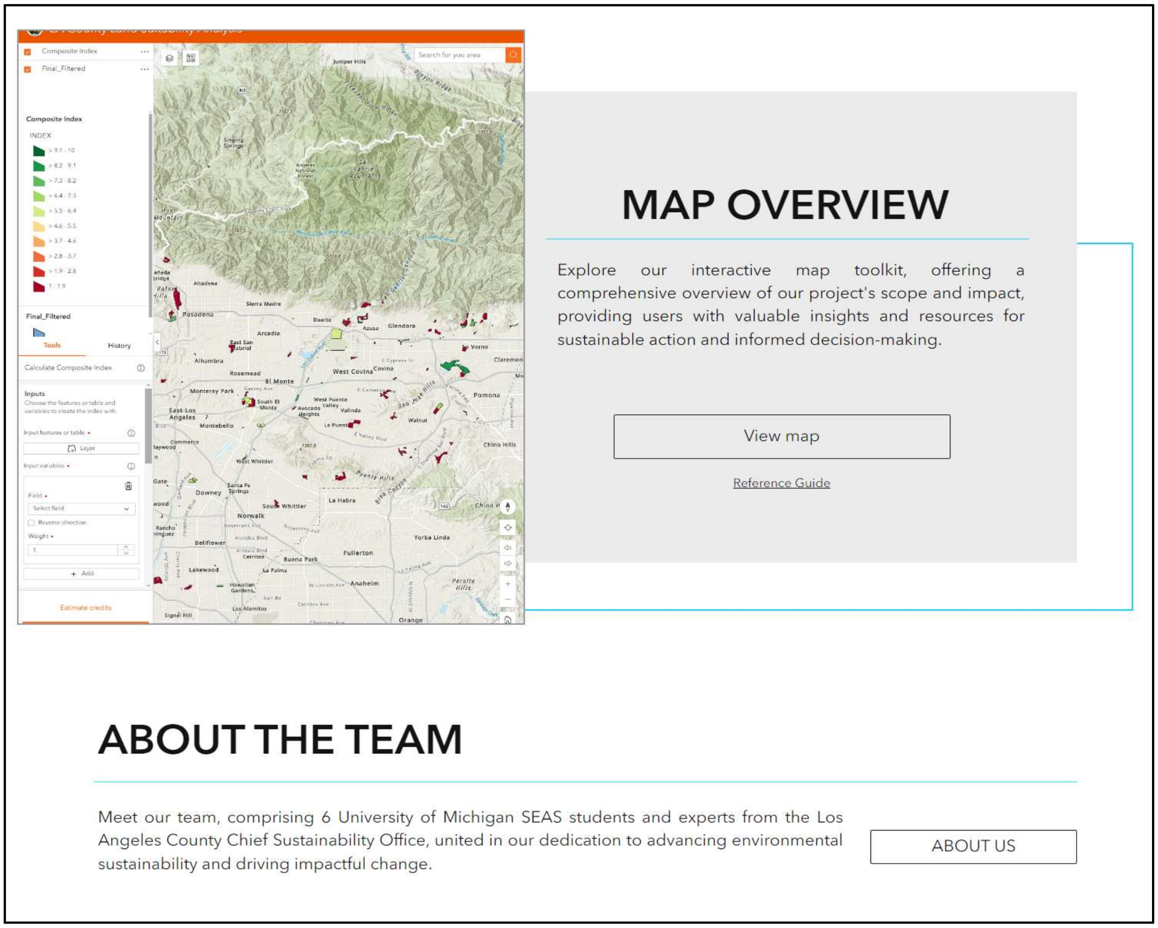
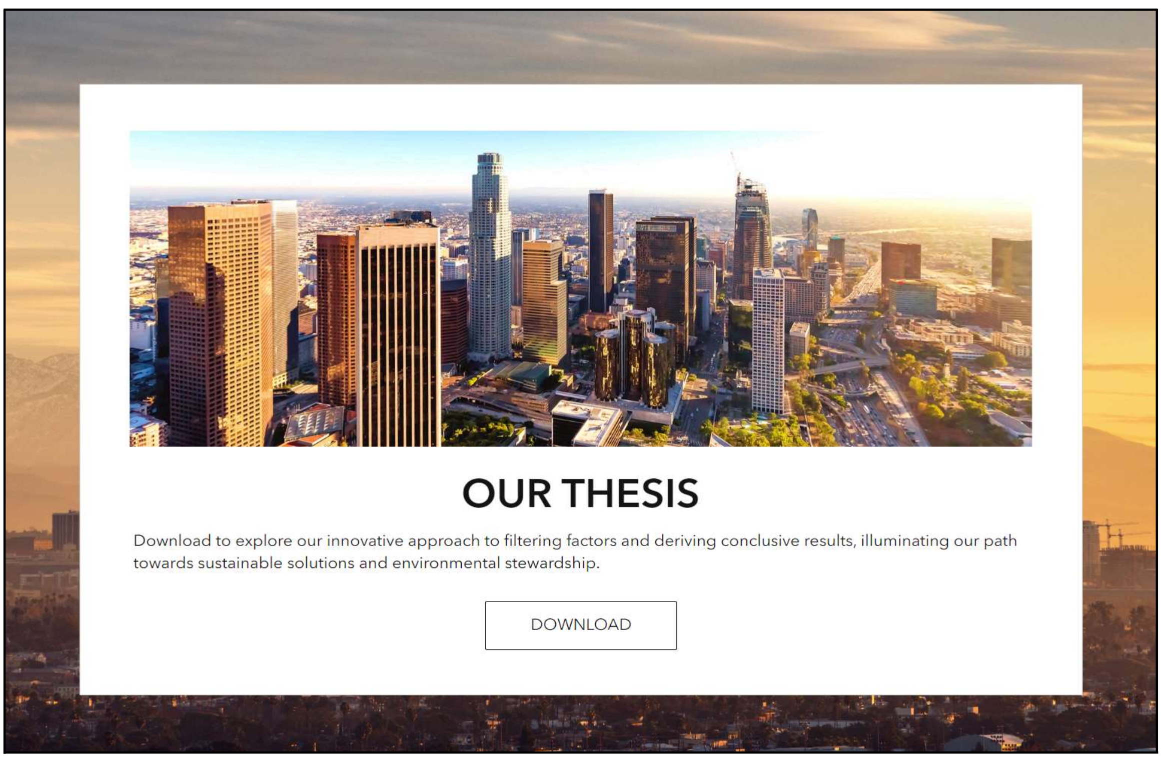





MAP OVERVIEW
Explore our interactive map toolkit, offering a comprehensive overview of our project's scope and impact, providing users with valuable insights and resources for sustainable action and informed decision-making.
View map
Reference Guide
ABOUT THE TEAM
Meet our team, comprising 6 University of Michigan SEAS students and experts from the Los Angeles County Chief Sustainability Office, united in our dedication to advancing environmental sustainability and driving impactful change.
ABOUT US


OUR THESIS
Download to explore our innovative approach to filtering factors and deriving conclusive results, illuminating our path towards sustainable solutions and environmental stewardship.
DOWNLOAD

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