[GS-01-027] GIS&T for Equity and Social Justice

Abstract

A geographic information system (GIS) can be used effectively for activities, programs, and analyses focused on equity and social justice (ESJ). Many types of inequities exist in society, but race and space are key predictors of inequity. A key concept of social justice is that any person born into society, no matter where they were born or live, will have an equitable opportunity to achieve successful life outcomes and to thrive. Geographic information science and its technologies (GIS&T) provide powerful tools to analyze equity and social justice issues and help government agencies apply an equity lens to every aspect of their administration. Given the reliance on spatial data to represent and analyze matters of ESJ, the use of these tools is necessary, logical, and appropriate. Some types of analyses and mapping commonly used with ESJ programs require careful attention to how data are combined and represented, risking misleading or false conclusions otherwise. Such outcomes could build mistrust when trust is most needed. A GIS-supported lifecycle for ESJ is presented that includes stages of exploratory issue analysis, community feedback, pro-equity programs analysis, management monitoring and stakeholder awareness, program performance metrics, and effectiveness analysis.

Keywords: community participation, dashboard, data visualization, equity, equity impact review, equity index, ESJ, geospatial analysis, MAUP, modifiable areal unit problem, social indicators, social justice, spatial data management, zoning

Author & citation

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Explanation

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1. Definitions

Creative plan/creative design brief: a document prepared to guide the coordinated development of a portfolio of maps, dashboards, and StoryMaps. It identifies the core message that is intended and the desired actions or outcomes. It can also clarify deliverables, the creative team, timeline, and where overall approval for process elements reside.

Equality: equal access to opportunities and resources

Equity: access to opportunities and resources needed so that everyone can achieve equal outcomes

Equity and social justice lifecycle: a conceptual process for a government agency or non-profit to analyze equity issues, explore resource allocation options, decide on actions, manage programs, and analyze performance metrics.

Equity impact review: a formal process used by many jurisdictions to analyze current or new policies or resource allocations for their impact on equity and social justice goals.

Equity index: a composite numerical score that combines social determinant factors in categories such as livability, economics, education, and accessibility and that can be applied to the entire agency or sub-units of geography

Equity indicator: a numerical score for a single social determinant factors that can be applied to the entire agency or sub-units of geography

ESJ Practitioner: Non-GIS professional whose focus is on issues related to equity and social justice

GIS for ESJ Community Participation Plan (CPP): a plan to include community participation and input throughout the GIS for ESJ lifecycle to reflect community perception of space and issues.

Ground-truthing: validating data sources by a process to test the accuracy of the data via field verification process

Map abstract/use case: a statement of the purpose or focus of the map (the use case), how the map was created and key findings

Pro-equity: agency policies or program that advance equity so that all members of the community can achieve equal outcomes

Public-participation GIS: a process to help communities use GIS for their own issues and advocacy purposes

Race: race in the United States is an artificial identity imposed by the dominant white culture on groups of people based on perceived color. It is a social construct based on rules

that do not have inherent biological meaning. Racial categorization enables a dominant race to exert authority, power and privilege over subordinate groups (Barnshaw 2008).

Runbook: a compilation of the data, routines, and processes used in a geospatial analysis

Social justice: fair and just distribution of and access to public goods, institutional resources and life opportunities for all people

2. Key Issues around Equity and Social Justice

Many types of inequities exist in society, but race and space are key predictors of inequity. Where a person was born, or lives, is a key success factor for individuals and families to thrive – or not - throughout their lives. Even in an environment where equal resources are allocated to each segment of society, many unserved and underserved segments of society are so disadvantaged that **equal** resources do not provide **equitable** opportunity to thrive throughout their lives. **Equality** assumes that each individual has access to the same level of societal resources despite their individual or family need. **Equity** assumes that each individual likely requires different types and levels of resources and is provided the societal support needed to thrive throughout life.

A key concept of **social justice** is that any person born into society, no matter where they were born or live, will have an equitable opportunity to achieve successful life outcomes and to thrive. Government agency policies, practices, projects, and programs contribute to inequitable conditions in the community which impact long-term outcomes, as Figure 1 illustrates. Because of institutional racism and/or class biases, upstream policies and resource allocations have often not been focused on long-term outcomes for unserved and underserved segments of the community where the need is greatest. Focusing upstream to implement “pro-equity” policies and practices increases the likelihood for individuals, families, and communities to thrive, regardless of race or place (Office of Equity and Social Justice 2016).

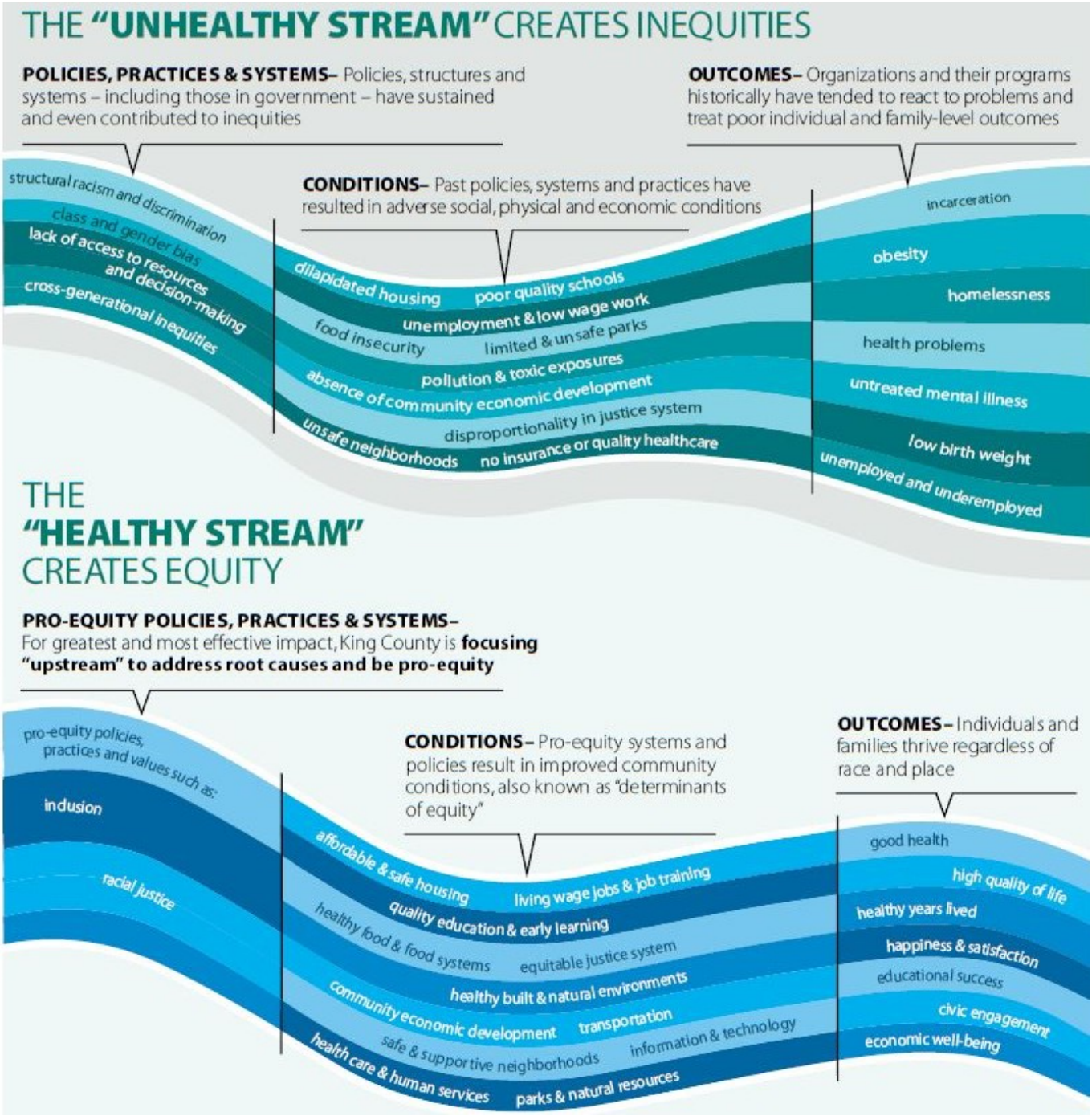

Figure 1. Government policies, practices & systems create conditions which lead to outcomes. Source: King County Equity and Social Justice Strategic Plan, 2016-2022. Reprinted with permission.

3. Making Social & Professional Connections with GIS for ESJ

The pursuit and application of effective ESJ practices is necessary across the GIS profession as a whole, as there is work being done around social-justice related analyses, and the formulation of pro-equity policies and reallocation of resources across all sectors where GIS professionals are employed: government agencies, academia, and non-profit organizations, among many other places.

GIS practitioners include professionals who are highly competent user of GIS and spatial data, regardless of whether their primary career focus is GIS or one of its domain application areas. Some GIS professionals choose to be certified by the GIS Certification Institute (gisci.org) or other certifying bodies, while others do not. Regardless, professionals and GIS users are at the forefront of defining ethical GIS for ESJ analysis and reporting. Guided by the GIS Code of Ethics, which includes specific "Obligations to Society" (URISA 2003), GIS professionals "…have a unique opportunity to contribute to sound public policies and actions that clarify, inform, promote, and ensure equity and social justice. In fact, we have…an obligation to use our skills to serve the public interest" (Salling et al. 2019).

Meanwhile, public agencies and non-profits that choose to formulate policies and resource allocation practices based on equity and social justice principles, will also have many "**ESJ-practitioners**" who may have little or no background with GIS, spatial data, and their pitfalls and uncertainties. ESJ practitioners may have backgrounds in demographics, public health, public administration, sociology, urban planning, etc., or they may also be community members, activists, or other stakeholders.

Social concerns are core to the utilization of GIS for ESJ. Too many GIS professionals and users who work with geospatial technology and geographic information for issues related to ESJ do so from the same power framework of government, academia, and industry that has used the power of maps for narrow special interests for centuries (Thatcher 2018), whether they are doing so deliberately or out of the professional work habits formed over decades. Supporting and enabling new forms of connections for ESJ-focused interdisciplinary collaboration is grounded in the concept of social constructivism and the benefits of inter-disciplinary knowledge creation (Ricker et al. 2020). This new multi-disciplinary approach is needed as a starting point for agencies, to appreciate GIS through an ESJ lifecycle.

The most important voices that exist with the GIS for ESJ relationship are community voices, but they are also the ones least likely to be integrated in any systematic way, and most often dismissed. Attempts to understand the way that communities perceive the dynamic geography of the places that they occupy requires that we move beyond academic research endeavors. To "…study America through spatially disjointed biopsies is to slice its humanity to pieces" (Bunge 1971). It has long been known "that community members could be involved in knowledge production. Instead of seeing knowledge as something to be transferred, either up the chain to the academy or down to students, they favored training people to be able to identify the roots of problems, and then solve them", as was structurally pursued in the pioneering approach of the 1971 Detroit Geographical Expedition (Knudson 2017).

Ensuring that the voice of the unserved and underserved community and its interests are included is a critical part of using GIS for ESJ. Unfortunately, from colonialism to civil rights to environmental tragedies, GIS&T provides a convenient epistemology that often shuts out the real world (Schuurman 2020). To effect change, GIS and ESJ practitioners must be aware of this systemic and systematic flaw to ensure complete and effective work flows and knowledge networks that serve the community itself.

Structured and semi-structured approaches are the place to begin with community participation plans and the ESJ lifecycle. Components may include engaging with the community to develop a consensus approach, developing an agreed community engagement protocol, interviewing the community to compile 'map biographies',

transcribing map biographies into cartographic form, entering data into a database, creating a map composite, and facilitating a community review verification process (Tobias 2000). Another structured approach to achieving community involvement is the concept of public participation GIS (PPGIS) (Schlossberg and Shuford 2004). PPGIS has been defined as an approach '...to make GIS and other spatial decision-making tools available and accessible to all those with a stake in community decision-making' (George & Ramasubramanian 2014).

4. Key Roles for GIS in ESJ

The goal of an equity and social justice-based approach to government policies, practices, and systems is to disrupt this historical and persistent pattern of injustice and inequities. What GIS does for ESJ is to enable deeper understanding of authentic and genuine relationships between the policies, practices, and systems (the upstream), the conditions (the midstream), and the outcomes (the downstream) of equitable and inequitable processes. Analyzing ESJ impacts of public agency policies, projects, and programs is an emerging practice of many government agencies. Geographic information science and technology (GIS&T) provides powerful tools to analyze social justice issues and help government agencies apply an equity lens to every aspect of their administration of public resources. Effective use of these geographically- and spatially-focused tools can help channel government policies and resources into healthy, pro-equity streams (Gambhir et al. 2009). But the usage must also reflect informed understanding about the factors that make spatial data complex to analyze with statistical validity, so that arguments are sound and solid. By using runbooks and documenting analytical workflows via Github and Jupyter Notebooks, robust and repeatable analytical practices can be more readily shared.

4.1 Working with Aggregated Data

ESJ is about the human condition and lived experiences, as well as relationships between people – individuals and groups – and the institutions that exist where they live and work. The practice of institutions, whether they are governments, cities, schools, hospitals, agencies, etc., is to use data – often in spatial form – to understand their clients, constituents, citizens, members, whatever they may be.

Data about individuals may be kept confidential to protect their privacy, as the Census Bureau and public health agencies are required to do. Instead, people are aggregated into units (neighborhoods, Census tracts, school districts, ZIP code areas, voting districts, etc.), and may be treated as a single entity. They become the areas units of polygons in the world of GIS. There are reasons why it is often statistically "safe" to assume that the individuals within that aggregated unit have some similar characteristics. People, like other living phenomena, do tend to cluster with others more like themselves than not (see Spatial Autocorrelation, and consider Tobler's First Law of Geography).

However, there are also complex and important statistical matters that must be managed when working with these data in these areal units. One of the most critical for GIS practitioners to consistently remember is that making comparisons and assessing relationships across those aggregated units will only be valid under certain conditions (see Problems with Scale and Zoning and Aggregation of Spatial Entities and Legislative Redistricting, for example). Something like the Modifiable Areal Unit Problem (MAUP) is the

type of factor that ESJ practitioners are unlikely to know and avoid, but analyses undertaken without care and mitigation for matters like these are likely to be erroneous and invalid, not to mention unhelpful. Fallacies and faulty generalizations will result, and outcomes like those are exactly what ESJ practitioners do not want, as they undermine credibility, derail programs and policies, and generate mistrust. Fortunately, some GIS practitioners and researchers are beginning to model how such relationships can be studied in robust, transparent, and statistically-valid ways, such as an analysis of access to community bicycles (Biehl et al. 2018), or evaluating income inequalities across a city (Prouse et al. 2014).

A related GIS issue is the analysis of "point" data – such as the location of a particular school, facility, clinic, etc., that is analyzed with respect to the multiple areas (Census tracts, school districts, hospital service areas, ZIP Code Tabulation areas, etc.) within which it is located. Efforts to understand the spatial relationship between points and polygons must also be undertaken in ways that do not compromise the integrity of the analysis, particularly by prematurely assuming a cause-and-effect relationship. This is critical in matters when the GIS "points" are sources of a pollutant, or crimes, or other events or processes that are factors in analyzing racial and social inequities. Fisher et al's 2006 models a robust example of how air toxins in West Oakland, California, were analyzed in a robust and valid manner. As the authors note, critics of environmental justice are quick to point out flaws in the methodologies or analytical approaches, factors that that might mean a court-case is thrown out, or a policy would go unchanged. Spatial analytical missteps on the part of GIS and ESJ practitioners jeopardize the efforts that must be made to make forward progress.

GIS and ESJ practitioners alike will benefit when analytical knowledge like this is shared in ways that make it accessible and easier to follow across a wider set of community situations, rather than academic research articles, which is one purpose of this entry.

4.2 Deriving Quantitative Measures of Equity

An "Index" is a composite statistic, commonly created by combining quantitative values from multiple sources or indicators. Their utility is having a single value, often numerical, that reflects the summative contributions of the sources. The values have been standardized and reconciled in a manner that mitigates having combined data of different types (nominal, ordinal, interval, or ratio). The result is a useful composite value that allows comparisons across times and places. Sometimes, the individual variables themselves, or sub-groups or categories of them, may also be deployed to characterize dimensions or facets of the overall situation.

An **equity index** is a numerical score that combines individual social determinant factors (indicators) from categories such as livability, economics, education, and accessibility. The composite index can be determined by a jurisdiction and applied to sub-units of geography. Once it has been calculated, the equity index serves as a baseline metric for a community, town, or other area. Such indicators are intended to answer the question: how is equity to be defined and assessed on a geographic and temporal basis? An equity indicator is similar in concept to environmental indicators – science-based aggregates of data to support analysis, track progress, and inform the public (OECD Secretariat 2008).

For example, the City of Tacoma, Washington, includes the following factors in its citywide

equity index (Table 1).

Table 1. Components of the Equity Index used in Tacoma, Washington

Category	Factors
Livability Social Determinant	• Nuisance / neighborhood quality • Crime • Median home value for owner-occupied units • Housing cost burden • Life expectancy • Urban tree canopy (%)
Economic Social Determinant	• Employment index • Unemployment rate • Poverty ratio • Median household income
Education Social Determinant	• Student mobility rate • 3rd grade reading proficiency • 7th grade math proficiency • Highest educational attainment
Accessibility Social Determinant	• Parks & open space • Healthy food index • Transportation access • Voter participation • Road condition • Household internet access

The Tacoma example combines individual social determinant scores to create an index score for sub-units of geography (Figure 2). As a final step, scores for the overall equity index and for categories of social determinants are ordered into simple categories for rapid assessment of conditions: very high, high, moderate, low, or very low. Such final classifications can be done in subjective or objective manner, but in any case, the rationales for the grouping should be made transparent.

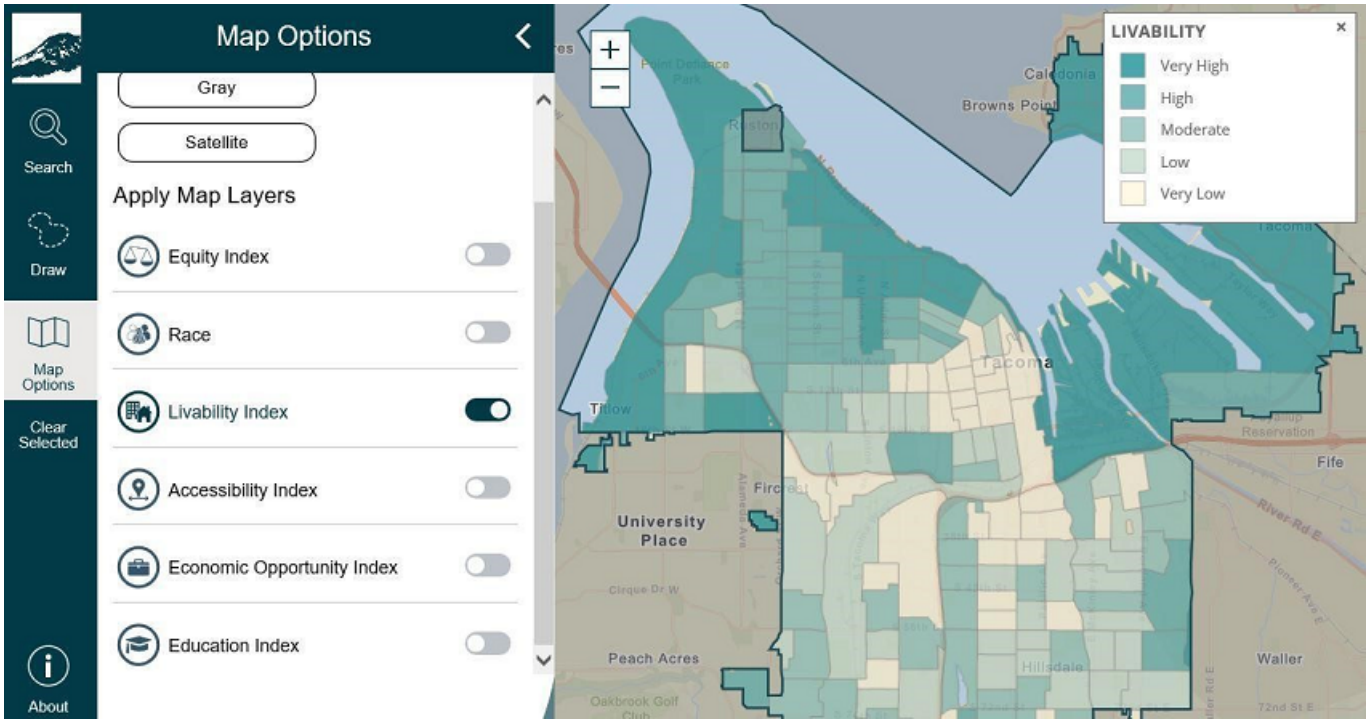

Figure 2. An example of a web-based map displaying GIS-derived a range of equity-related indexes for Tacoma, Washington. Source: author.

As another example, King County in Washington state utilizes 39 individual determinants of equity. If a composite index is used, the individual elements that make up the composite should have significance on their own. These should align with the key business lines and services that are significant for the agency.

Whether a composite equity index or individual determinants of equity are used, the basis for the decisions should be well documented. The selection and weighting of the equity index or determinants of equity should be informed by community input, as outlined in the CPP. Documentation should focus on defining the determinant(s) for the community and why they are significant. The individual elements of an equity index or stand-alone elements should be metrics whose change is meaningful and that support a clear diagnosis or assessment of the conditions to be able to accurately measure and demonstrate how conditions are improving, declining, or remain unchanged over time.

Over time, any equity index will need to be re-examined, re-calibrated, and re-published as the underlying demographic data changes. With each publication of new demographic data (such as the decennial census and editions of the American Community Survey data in the U.S.) the indexes should be re-assessed. The methodological assumptions for the indexes should be clear and transparent and applied consistently over time.

GIS is used to derive a composite equity index itself, and it can also be used to display the composite equity index as well its contributing categories. All individual factors that go into an index, or are themselves indicators, are values that are measured for – or aggregated over - a geographic space, and all of these data are either readily available for use within a GIS or can be produced for such implementation. Calculating an index without using a GIS would not only be laborious and non-sensical, but would likely to be excessively

computationally complicated, and beyond the means of community groups or ESJ practitioners working on their own. In this way, GIS is essential for the production of and assessment with equity indexes.

4.3 The Power of Mapping and Data Visualization

A third area where GIS contributes heavily to ESJ work is through its production of maps and other data visualization techniques to display data. Throughout human history, maps have been used for power relationships and suppression, but they can also be used for revealing and measuring inequities. They are powerful tools in everyone's hands. For appropriate and defensible mapping in support of ESJ, an understanding of the basic conceptual theory of the map and its limitations is important. Because of the criticality of geographic analysis and cartography for ESJ, intuitive and defined practices should be utilized for consistent and trusted interpretation and understanding across multiple dimensions. These dimensions include consistency within the organization and to compare with other agencies, consistency across types of issues, and consistency over time.

One particularly helpful cartographic element that is helpful for maps produced for ESJ purposes is the inclusion of a brief summary or abstract statement, similar to scientific publications. The map abstract should include a statement of the purpose or focus of the map (the use case), the problem or issue that the map is intended to address, the data and methodology used to create the map, the degree to which the map development process was informed by the CPP, key findings displayed in the map, and conclusions or recommendations that the map is intended to support. For traditional static map publications, the map document space available for the map abstract is severely limited. However, for web maps and story maps, an extensive abstract can be easily provided. For web map and story maps, another useful option is a graphical abstract, to help the reader quickly comprehend the focus of the map and the processes and resources utilized in its creation.

One area that is notoriously problematic with maps displaying the types of aggregated data, very common with ESJ work, is the way in which the values of variables or indicators are depicted. The use of choropleth maps, ones in which each unit area is shaded with colors to represent their values, is common for ESJ programs. By cartographic convention, lighter shades of the same color are interpreted to represent lower values or concentrations of whatever data attribute is being mapped, and darker colors are most often interpreted to represent higher values or higher concentrations. As an example, Figure 1 above has the areas with a "Livability Index" of "Very High" depicted with a darker color shade of blue, and the "Very Low" is a lighter, more pale color. But colors on a map depicting race or ethnicities can also be interpreted variably (Johnson 2001).

Being aware of and sensitive to conventions for cartographic display is important for ESJ work, but the map maker is not beholden to those. Geospatial attribute data can be classified, analyzed, and displayed via a variety of techniques for specific purposes. Options that a mapmaker chooses can have significant impacts on how the data patterns are perceived and interpreted. In addition to color choices, ESJ-focused map makers are urged to familiarize themselves with the various options for classifying the values of a data attribute's numerical range. Simple manipulations of the "breaks" for how the numerical intervals are defined can produce dramatically different looking maps, deliberately or unintentionally. This type of statistical mapping is very powerful in its capacity to change

the meaning of data-driven maps.

In addition to taking care with data classification, a particular challenge for ESJ maps involves depicting two or more variables at the same time. For example, one will wish to display the multiple racial, economic, or educational indicators that contribute to an index. Multivariate mapping is difficult to do well, though compelling to try. One visualization approach involves the use of numerous color dots. Developed by the Demographics Research Group of the University of Virginia's Weldon Cooper Center for Public Service, each dot represents one person with the color correlated with the person's race (as reported on the US Census). The Racial Dot Map (https://demographics.coopercenter.org/racial-dot-map) allows navigation from the national level to the census block level; at these smaller geographies, locations of individuals are randomized to preserve privacy. The entire code used to create the map is available in Github (Racial Dot Map 2013).

Follow up any type of bivariate or multivariate mapping – especially when done for display purposes alone - with appropriate statistical or analytical assessments of the patterns you think you see. Spatial correlation does not equal causation. Anyone involved with designing, sharing, and publishing maps made via GIS are strongly encouraged to review information about the topics mentioned above and other in the GIS&T Body of Knowledge's Cartography and Visualization section.

5. The GIS for ESJ Conceptual Lifestyle

The goal of pro-equity policies is a future community environment where race or place of birth are no longer predictors of the ability to thrive throughout life. These are long-term investments in ESJ, as the ultimate effectiveness and success of the policies and approaches will be measured not in months or years but in lifetimes or even in multiple generations.

Gauging the effectiveness of ESJ-related GIS work is aided by understanding the **lifecycle** of a typical equity and social justice process that a government agency or non-profit organization may initiate. A lifecycle approach provides context for understanding how and where in the value-stream GIS provides benefit to the organization and the community it serves, in spite of the degree to which the specific processes related to equity and social justice in their own contexts will vary.

As mentioned earlier, the community is the ultimate stakeholder in the ESJ process. At each phase of the lifecycle there should be no ambiguity about where and how the community stakeholders are involved. This means knowing about the specifics of a proposed policy, project, or program, and providing input into the decision-making process and feedback as the agreed action is implemented and evaluated.

We have previously proposed a five-step ESJ lifecycle and indicated its connections with geospatial technology and data at each step (Figure 3). This lifecycle was created for the URISA-Certified GIS for ESJ Workshop (Babinski & Franklin 2019). It is intended to provide clarity for both GIS and ESJ practitioners regarding how ESJ related issues, program concepts, relate to each other and the role of GIS&T to inform and support each stage. To interpret this as a "cycle", the user should begin within the **Issues Analysis** step, and work

in a clockwise manner. Fully completing the cycle for ESJ matters is a long-term commitment, as it may take dozens of years to be able to measure progress on systemic inequities and injustices.

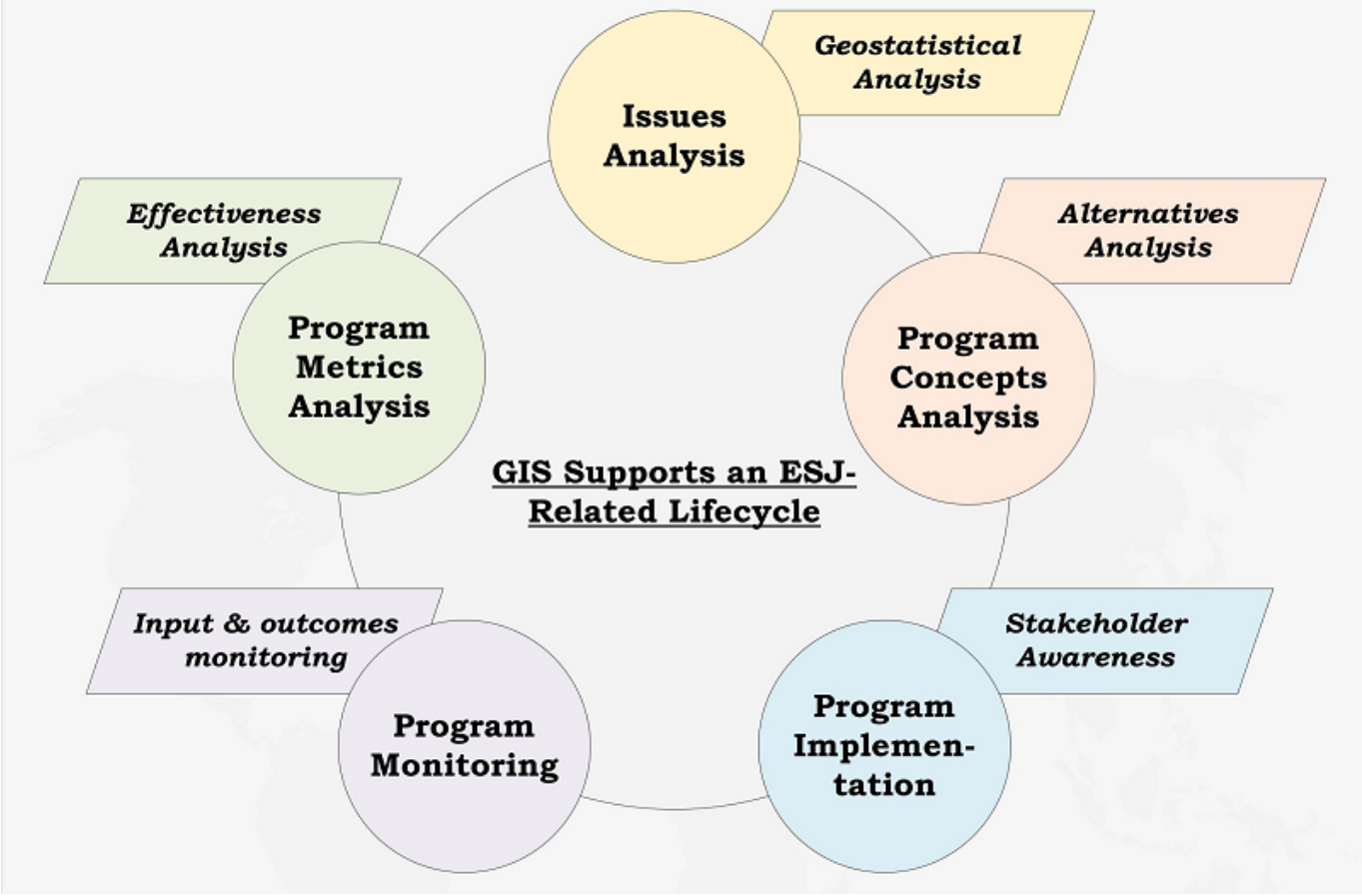

Figure 3. The GIS for ESJ Lifecyle. Source: author.

5.1 Analysis of Issues

The **Issues Analysis** stage of the ESJ lifecycle focuses on conditions in the current community. This exploratory phase helps identify segments of the community where conditions lag behind the community as a whole. During this process, locations are identified where resource needs are greatest and, based on those, potential channels for shifting resource investments upstream are explored. Its focus within the equity policies/conditions/ outcomes stream (see Figure 1) is on undesirable outcomes within segments of the community.

As an exploratory and data collections' phase, baseline or other metrics used in forming the determinants of equity are produced. Geospatial analytics are involved, and equity indexes or multiple individual determinants of equity, as described above in Section 4.2, may be calculated or derived.

The analytical work done during this phase is extremely important for ESJ matters at it sets the stage for subsequent assessments and decisions. Community contributions as data

sources, and for data validation, are key. See the discussion in **Spatial Data Management** section in **GIS&T Operations and Infrastructure** for additional suggestions.

5.2 Analysis of Program Concepts

The **Program Concepts' Analysis** portion of the ESJ lifecycle reviews the findings and data from the preceding Issues Analyses process while it turns to focus on future outcomes. It seeks actionable information to guide equitable policies, programs, and resource allocations that are needed in response to the identified issues. Based on the nature of issues identified previously and the related policies or programs that may have contributed to those, additional alternative analyses may be enacted.

For example, an equity impact review (EIR) is a formal process used by many jurisdictions to analyze new policies or future resource allocations for their impact on equity and social justice goals. An EIR can also be used on a comprehensive basis within an agency to assess existing policies, programs, and projects, to determine if they have negative impacts on equity-related outcomes. GIS is used throughout this process to manage data, perform analysis of scenarios related to desired future outcomes, and to document and display the analysis with good cartographic and visualization practices.

A typical equity impact process, such as that conducted by the City of Seattle in their Race and Social Justice Initiative (2012) includes:

- Setting outcomes – what are the priority outcomes that are the target for change
- Involving stakeholders including the community and analyze data
- Determining the potential benefits or burdens of a policy or program on desired equity outcomes
- Using the analysis to devise strategies to create positive impacts

These are part of the Program Concepts phase because the community participation plan is in its formative stage, suitable for identifying the appropriate community input and incorporating it into a data format that can be utilized within the GIS.

5.3 Program Implementation

The **Program Implementation** stage of the ESJ lifecycle is driven by communication with stakeholders, such as two-way exchanges, both within the agency and across the community. Stakeholder awareness can be achieved by providing access to program-specific data summaries or statistics, such as those provided by data dashboards (Figure 4), for example. These provide open and transparent data related to the policies or conditions that are being implemented or changed. Stakeholders should have access to appropriate data and tools to assess themselves the effectiveness of the program or policy in achieving the intended positive impacts.

During this phase, which may be lengthy, a goal is to monitor progress on the program implementation, which means how well it is doing at achieving its intentions. The dashboards assist in evaluating and raising awareness of progress, and reporting back to the community.

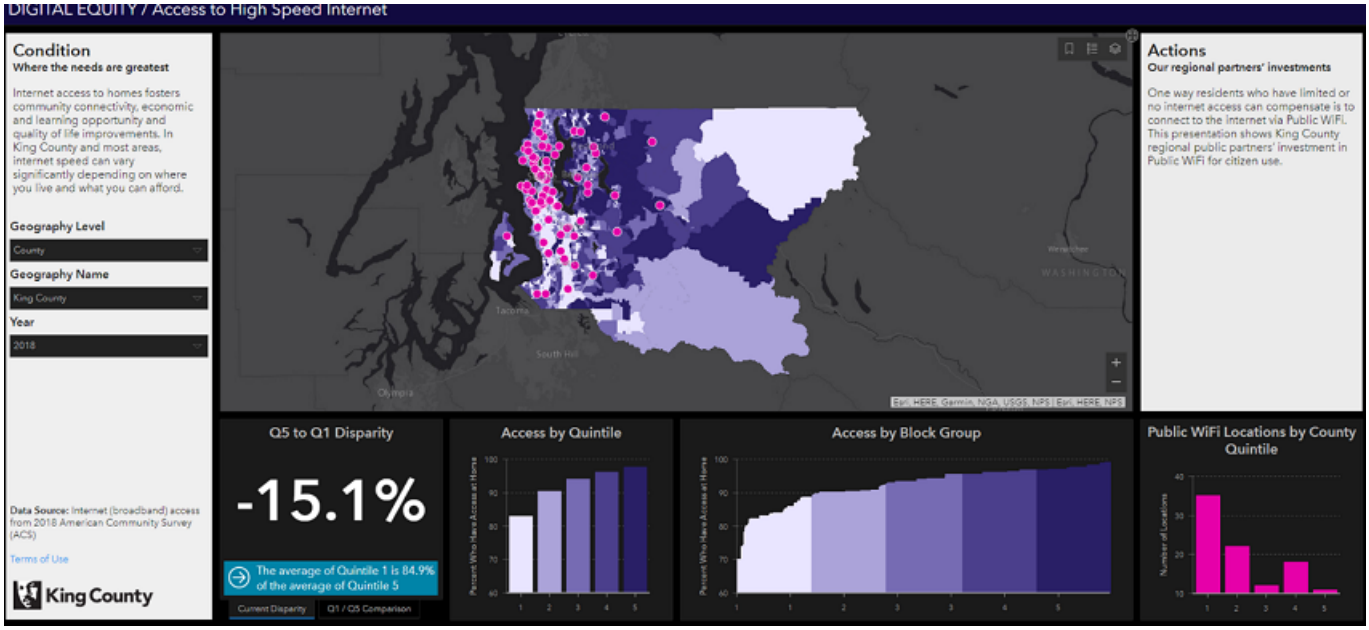

Figure 4. Example of a GIS-based dashboard displaying data for an ESJ program. Source: author.

5.4 Program monitoring: performance metrics (including ground-truthing via community input)

The **Program Monitoring** stage of the ESJ lifecycle focuses on monitoring, understanding, and reporting outcomes. Its purpose is to continually compile the data required to assess the impact on the community of the policies or conditions that are being implemented or changed. This phase of the GIS for ESJ lifecycle is also potentially long. During this time, the GIS for ESJ community participation plan should include periodic ground-truthing of data with the community. Supporting and training the community to design, create, and use GIS-enabled management dashboards (Figure 4) is helpful during this phase.

5.5 Program metrics

During the **Program Metrics** stage, the agency, program owners, and/or community stakeholders evaluate the implemented program for its effectiveness and decide about future continuation. Data that can be pulled from the dashboard, along with any additional ad hoc GIS analyses, are used to assess and determine if the original outcome-focused goals were achieved. Understanding effectiveness should include input from the community itself, via the GIS for ESJ community participation plan.

Since a considerable amount of time (i.e., years) may have passed since the initial Issues Analysis stage, care must be taken to capture any relevant new data. Have the underlying demographics of the community changed over time via voluntary or involuntary population movement? What are the impacts of socio-economic factors that have occurred at the national, state, or regional level? What other public agency or non-profit policies or programs might have impacted the single specific agency program being analyzed?

Now is also an opportunity to compare program effectiveness on outcomes over time, with similar conditions in other locations or with other geographies, or against other programs

that target the same desired outcomes.

6. Recommendations for Best Practices for the Use of GIS&T for ESJ Outcomes

Best practices for GIS and ESJ involves the systematic use of the ESJ lifecycle, which is fueled by building steady and continual connections with community stakeholders. This article has identified numerous ones, and additional suggestions for effective practices include these, below.

6.1 Dedicate Human Resources

A best practice for agencies is to designate an authority with oversight over the application of the domains of GIS for ESJ within an agency. For a small agency or non-profit organization, this might be a part-time responsibility. For a larger entity, this function could be given to an individual and/or a GIS for ESJ standards oversight committee. In any case, the organization should conduct periodic audits of its practices for alignment with the domains of GIS for ESJ outlined in this document.

6.2 Integrate ESJ Activities into New or Existing Workflows

Focusing on equity and social justice may be a new application area within an existing enterprise GIS. A key geospatial management responsibility is to ensure that existing GIS infrastructure and operations are configured to support specific enterprise business needs. Recommended practices for managing GIS&T operations and infrastructure are detailed in Babinski (2021), including understanding needs assessments and matters of spatial data (its management, sources, types of uncertainties, approaches to validation, etc.).

6.3 Enable Frequent and Transparent Sharing of Activities, Data, and Efforts

Central elements of the ESJ lifecycle are identifying issues and deciding on actions. Tools and platforms such as GIS-based and data-driven dashboards have proven to be effective at sharing conditions and issues in the community. Note, for example, the role that the Johns Hopkins University dashboard has played in sharing COVID-19 related data since the pandemic began. When designed effectively and updated consistently, dashboards can track progress of policies, programs, and/or resource allocations intended to change the problematic conditions. A dashboard that combines data about the issue and related actions is a type of progress report. Its interactive nature makes it a useful management tool and means of communicating key performance indicators to the community. GIS based dashboards for ESJ provide functionality to management and stakeholders to explore data and metrics in statistical, spatial, and temporal form.

Components of a GIS-based dashboard will include a web-based data exploration portal based on an end-user focused multi-function architecture that links inter-related data presentation strategies. Dynamically linked views allow the user to explore the data across time and space (Jern et.al 2020).

If the application of GIS for issues related to equity and social justice is to have a meaningful and positive long-term impact, GIS based ESJ dashboards are a key tool. They encapsulate the multi-disciplinary work of the ESJ team within an agency, including GIS tool

users, tool makers, and GIS scientists. They connect the multi-disciplinary scientific GIS for ESJ approach with community stakeholders. Informed by the community participation plan, the foundation of GIS based ESJ dashboards is grounded in solid spatial data sources and data management practices, in transparent, trusted, and repeatable geospatial analysis, and in clear and consistent geovisualization practices. GIS based ESJ dashboards will prove for the future the progress towards achieving today's vision of achieving racial equity and social justice.

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