Triple-Bottom Line Assessment of Green Infrastructure (GI) Implementation in New Orleans

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Abstract

A number of challenges and hazards caused by stormwater runoff impact today's-built environment. The inundation of stormwater impacts the normal use of facilities, floods our environment, carries unwanted pollutants to nearby watersheds, and affects the purity of our water system. In New Orleans, stormwater runoff impacts are felt every time there is a heavy rain. There is a vital need to implement a more sustainable drainage system for effective stormwater management. Green infrastructure (GI) mimics the dynamics of the natural ecosystem by managing stormwater runoff through a regenerative process. This research assessed the environmental, social, and economic impacts of the implementation of green infrastructure in New Orleans, looking at the strategies employed, and challenges faced by city government, non-governmental organizations and neighborhoods. The researchers conducted a qualitative study through participant observation and survey to garner a holistic view on the efforts of various organizations and interviewed practitioners and residents who have adopted the GI system for stormwater management.

Keywords: Green Infrastructure; Urban Sustainability; Stormwater management

1. Introduction

There has been a gradual but steady change in global climatic conditions. These changes have been linked to the impact of human activities on the environment, from greenhouse gas emissions to deforestation of natural forests to the architectural designs of the built environment (Anderson et.al. 2014). Developments in urban areas have disrupted the natural environment and its ecosystems; real estate developments, asphalt road infrastructures, concrete pavements, and the artificially constructed drainage systems have changed the dynamics of the interaction of nature (Young 2011). Heavy rainfalls for instance have caused monumental damages to communities, destroying households and amenities, causing loss of life and property. This is a result of stormwater that would naturally seep in through the ground or flow naturally to other water bodies or streams. Urban regions are the highest contributors to climate change because of the built environment, emissions from motorists and industrial pollution (Barthel 2013). Therefore, there is the need for the integration of green infrastructure planning into a widespread city plan in urban centers like New Orleans to help mitigate climate change (Kithia and Lyth 2011).

Climate scientists have associated human activities to rising sea levels due to irregular weather, global warming, and resultant consequences. These sets of events are threatening coastal cities because of their unique geographical nature and distinct geographical locations. Pertinently, Bettencourt et. al. (2008) established that over half of the global population now lives in cities. This high population stresses the already overburdened urban ecosystems and leads to the shortage of natural resources as a result of over exploitation. Liu et. al. (2014) argue that water runoff overburdens the city wastewater treatment facilities and carries unwanted materials and pollutants into the urban streams, there by contaminating the water body.

Stormwater has also caused excessive flooding in coastal cities, resulting in enormous economic and social losses to residents. Many cities in the United States and around the globe have adopted different forms of successful green infrastructure to mitigate flooding and, in extension, climate change.

New Orleans

New Orleans has suffered innumerable floods. The latest major flood in 2017 left hundreds of homes and businesses flooded. The city has struggled with century old pumps that are constantly failing and worsened by faulty drainage facilities that are often clogged. With most of the city below sea level, the topography does not allow for the natural law of gravity to channel water to nearby lakes, so water must be pumped out mechanically. And the current condition of the pumps makes it impossible to drain stormwater effectively. Former New Orleans Mayor Mitch Landrieu emphasized that the city needed over $9 billion to restore its outdated pumping system. This is a cost the city is unable to fund, making it necessary for the city to integrate other economically viable alternatives to stormwater management strategies. Green infrastructure implementation is a cost effective, environmentally friendly, and effective method for stormwater management, which can significantly reduce the impacts of flooding. Green infrastructure applies the basic principles of the natural environment by using on-site facilities to manage stormwater runoff which is the chief source of urban flooding (Graham et. al.). Mell (2009) describes GI as an economically and environmentally viable approach for developing sustainable and resilient communities. Because GI facilities mimic the natural process involved

in stormwater drainage systems by allowing stormwater to sink into the ground, evaporate, runoff or be stored in a water capture facility, it helps restore the natural features of the environment (Ferguson 2016). Depending on the nature of the area, its geography, rain volumes or size, various forms of GI or an integrated GI system can be implemented for efficiency in stormwater management or protecting the environment (Mentens et. al 2006fi).

This study evaluates the social, environmental and economic impact of green infrastructure implementation in New Orleans, examines the actions and strategies of the city government, non-governmental organizations and community residents in promoting the use of green infrastructure, and identifies some common challenges faced in green infrastructure implementation in the city.

Section one is an introduction to the subject matter; section two presents the strategies used in the implementation of an integrated GI system in the city; section three discusses the triple-bottom line impacts of GI in New Orleans; section four enumerates the challenges and recommendations to overcome them, and section five is a summary and conclusion of the study.

Methodology

This study applies the triple bottom line approach of implementing green infrastructure in New Orleans to formulate theories of the social, environmental, and economic impacts of green infrastructure development in the city (Sulbaran et. al. 2013). Primary qualitative data was collected through participant observation, where researchers worked along with communities in the implementation of green infrastructure. Survey was also conducted through semi-structured interviews with green infrastructure professionals on the field within New Orleans. Interview questions were designed to determine how GI is implemented by the city administration, non-

governmental organizations, communities, and individual homes; how green infrastructure implementation impacts communities in New Orleans; challenges of GI implementation, and recommendations to resolve these issues.

In the second phase of data collection, census data was analyzed to determine the construct of the city demographics, the researchers then matched the data with existing literature from around the world to strengthen their findings.

2. Strategies for the Implementation of GI in New Orleans

Multi-actor partnerships and the delivery of multi-functional benefits are crucial components of green infrastructure implementation; therefore, a holistic approach is needed in order to have full benefits of green infrastructure in the city (Cheshmehzangi and Griffith 2014). While the city government creates policies directed at weaving GI into the masterplan, a multilateral system of implementation is required to insure an efficient stormwater management system for the city. Other stakeholders include non-governmental organizations, community neighborhoods, and households.

Figure 1. Multi-actor partnership

City Level

To improve stormwater management, New Orleans city government embedded GI into its masterplan by enacting the Comprehensive Zoning Ordinance policy, Article 23: Landscape, Stormwater Management, & Screening. This policy enforces the installation of stormwater

infrastructure on any property 4500 square meters and above. The ordinance states that “No building permit or certificate of occupancy may be issued for any lot or use subject to the requirements of this Article unless all the requirements of this Article have been met. Failure to implement the landscape and/or stormwater management plan, or to maintain the lot or use in conformance with the landscape and/or stormwater management plan, is cause for revocation of the certificate of occupancy and/or the application of fines and penalties, as established in this Ordinance. In addition, all landscape is subject to periodic inspection….”

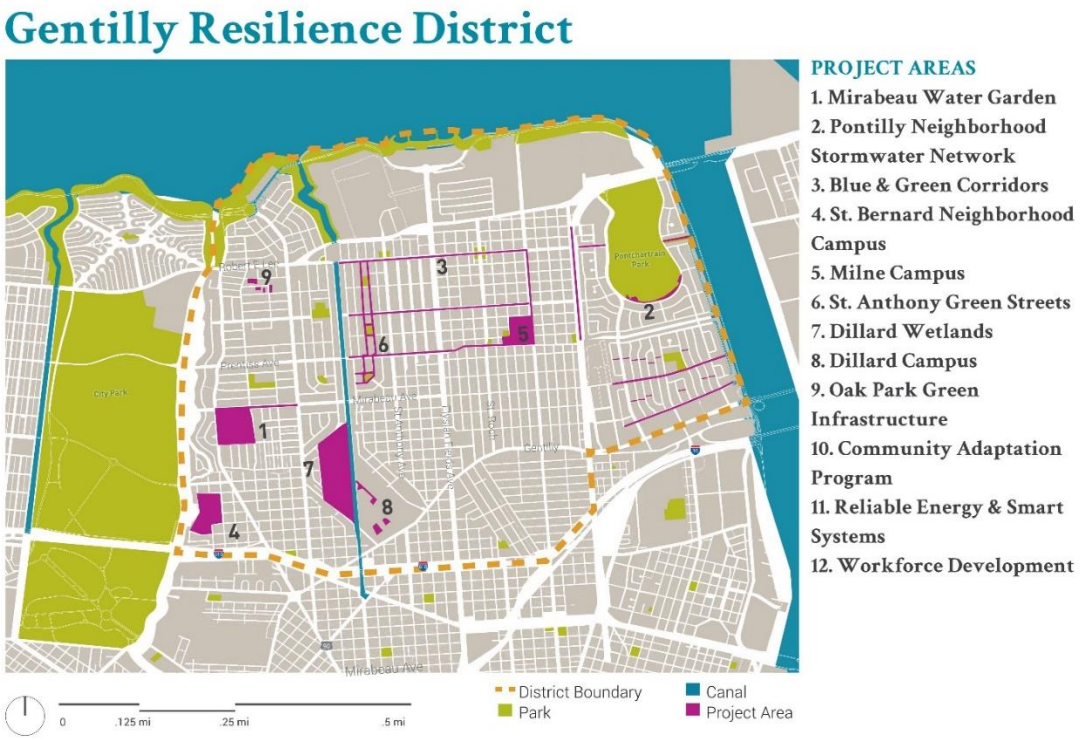
TJ Truxillo of True Grid Inc., a pervious component manufacturing and installation company, has emphasized how much the city’s GI policy has helped alleviate the impact of nature on built facilities around the city. He argues that New Orleans has a unique blend of planning enforcements that makes it stand out in comparison to other similar cities around the U.S.; while, in cities like Amsterdam, the implementation of GI is more of a national planning policy than a city or a neighborhood effort. Amsterdam like New Orleans is below sea level but is much more proactive in issues of city sustainability; it is a matter of “life or death.” (Marce and Driesen 2007)

In another effort to improve stormwater management, New Orleans has created six resilience districts based on geographic areas of shared risks and opportunities (The City of New Orleans 2015). The city proposes to tailor unique interventions for each district according to its features and needs. New Orleans is presently investing $141.3 million from the U.S. Housing and Urban Development (HUD) National Disaster Relief funds in 2016 to develop a robust GI system in the Gentilly Resilient District, which will serve as a prototype for the five other districts. Lessons learned from the

pilot district's project will aid officials in formulating a resilience-building design for further implementation in the other five districts that will survive and thrive.

Non-Governmental Organizations (NGOs), Communities, and Households

Another important strategy for effective implementation of GI in New Orleans is the NGOs' participatory engagement of communities and households. GI literature emphasizes that sustainable communities can be achieved through adequate knowledge of the needs of the communities, inclusive engagement, and by reinforcing the roles that social and environmental justice play in developing a better and more livable environment. Therefore, a deliberate push for an inclusive, safe, well designed and environmentally sound landscapes is necessary (DCLG 2006). Well-designed community engagement strategies are championing the implementation of GI in New Orleans.



Source : Batture LLC http://www.batture-eng.com/project/st-anthony-green-streets/

Many non-governmental organizations are actively engaged in propagating the importance of GI through volunteering, providing training for communities, and offering incentives to residents for GI implementation. They have also conducted community engagement workshops, community and city-wide campaigns, community visioning, and planning charrettes to ensure extensive engagement. Tara Lambeth of the University of New Orleans Center for Hazards Assessment, Response & Technology (CHART) argues that through participatory engagements, planners can minimize displacement and gentrification in communities. For example, in the Tremé neighborhood of New Orleans, Water Wise NOLA collaborates with the Greater Tremé Consortium to identify, install and manage GI facilities in their community.

The Front Yard Initiative (FYI), a New Orleans based advocacy group, provides residents with hands-on experiences in GI development, ultimately creating workforce opportunities in the green investment sector as it grows. The Front Yard Initiative also pays eligible residents to replace paving with greenery; participants are paid $2.50 per square foot of paving removed, up to 500 square feet.

The Greater New Orleans Foundation (GNOF) launched the Urban Water Series program to help promote GI implementation in New Orleans. The Urban Water Series program has been implemented in phases;

1. Phase one: (2013) GNOF hosted a series of five workshops in which national GI and stormwater management experts from five vanguard cities shared their knowledge and strategies with over 400 New Orleans practitioners.
2. Phase two: (2014) GNOF brought a diverse group of 26 city government staff, NGOs and community leaders to study firsthand the implementation of GI in Austin, Philadelphia and Milwaukee.
3. Phase 3: (2015) GNOF worked to build a movement called “living with water” in partnership with other NGOs and the public sector through educating the public on importance of GI, supporting community based organizations that represent vulnerable neighborhoods and “helping build the capacity of the Sewerage & Water Board of New

4. Orleans and the city of New Orleans to effectively implement GI infrastructure and stormwater strategies" (GNOF).

3. Triple-Bottom Line Impacts of GI Implementation in New Orleans

The successful incorporation of green infrastructure in New Orleans will have a triple-bottom line impact; social, economic, and environmental.

Social Impacts

Green infrastructure promotes environmental justice and social inclusion, which requires equal access to resilient community assets based on walking distance to parks and other amenities. The multi-actor partnerships and the multi-functional benefits in GI design support the provision of economic, recreational and social amenities for diverse demographic groups. New Orleans faces social stresses from high levels of poverty, unemployment, and violence. Although the city experienced a post-Katrina economic boom, only some of the population benefited. The median income of $25,102 for African American households is less than half of that of Caucasian households in New Orleans. According to the five-year estimates of the American Community Survey 2013-2017, 27% of New Orleans residents are living in poverty (a figure that exceeds 40% for children and 53% for single mothers). These challenges are exacerbated by environmental hazards (a typical case of environmental injustice) disproportionately affect low-income households and people of color.

Green infrastructure enhances the existing infrastructures through an integrative design, a balancing of environmental and ecological functions and an overall enhancement of the physical and social infrastructure (DCLG 2006). The successful incorporation of green infrastructure in New Orleans improves equity in the city promoting communal inclusion. Weatherby (2005) contends that designing landscapes that does not provide several beneficial functions for target

populations hinder patronage and leads to the development of exclusionary spaces. Landscape functionality is, therefore, an essential component of development. Green infrastructure achieves this goal by providing several simultaneous functions including health, recreation, and general wellbeing to promote social inclusion. Mell (2008) contends that there is the potential to increase awareness, use and subsequent ownership of spaces and develop long-term sustainable use via a systematic approach to green infrastructure development. This promotes several principal features of an urban renaissance by increasing public use of green spaces, allowing people to feel part of a space's wellbeing, and making spaces safer and more attractive to others (Ryding 1998). Further, improving equity also requires that the city ensure it will not retrofit socially inclusive landscape spaces without appropriate public consultation to determine community wants and needs (Mell 2008). The inclusionary nature of the green infrastructure concept provides opportunities to engage people and bring together diverse knowledge, experience, and information in order to develop best-practice techniques for development. The city's Gentilly Resilience District project is designed with these factors in mind and focuses on some of the most vulnerable parts of the city. In general, it improves resilience, inclusiveness, wellbeing, and equity for the communities by providing social amenities near the people.

Economic Impacts

As mentioned earlier, New Orleans' overburdened and often failing drainage system requires at least a $9 billion investment to restore/upgrade the pumps so they can adequately and efficiently manage stormwater in order to address citywide flood risk, a cost the city is unable to fund. A well-integrated GI system will help eliminate flooding damage and thus invariably reduces road maintenance costs that may arise as a result of subsidence. A 50-year conservative estimate of the cost attributable to repairs to housing, amenities, not including major

infrastructure, as a result of subsidence in New Orleans is a staggering $2.1 billion (City of New Orleans 2015). These resources could be channeled to other uses if the city had an efficient stormwater management system. New Orleans also experiences extended power outages caused by strong floods; the city estimates losses in tax revenue of about $3 million because of the inability of businesses to open and operate during these outages (City of New Orleans 2015).

Additionally, green infrastructure reduces domestic energy and water usage. Veronica Blette of Watersense, a GI advocacy organization, is a proponent for water efficiency systems to save water outdoors and improve sustainability of the water system through all seasons. She argues that reducing water run-off helps mitigate water shortages and improves efficiency by saving energy and lowering utility bills. As well, stormwater caught in barrels can be used for watering lawns; this smart water management process is practiced in the Tremé community. Another GI professional, Dana Lunn of Front Yard Initiative (FYI) argues that GI projects in communities tend to increase their housing values as well as real estate values for properties near interventions. In addition to effectively managing stormwater and placemaking, increases demand for housing in these communities. GI also generates over $200,000 worth of green investments and creates new potential job opportunities.

Environmental

GI promotes a healthy ecosystem which thereby stimulates the individual health of citizens and improves their quality of life. Issues like climate change have dominated global discourse due to its devastating impact such as flooding, rising sea levels, global warming etc. Similarly, the need for preservation of renewable resources (like water) has become critical to sustainability and urban regeneration (Mell 2008). It is estimated that the Louisiana coast loses more than an acre of coastal wetlands every hour and remains one of the most vulnerable areas in

the United States to climate change, experiencing the world's greatest relative sea level rise, 4.3 feet anticipated by 2100 according to NOAA climate change projections (City of New Orleans 2015).

The New Orleans' built environment is also compromised by chronic subsidence issues partly due to the piping and pumping system used to mechanically drain stormwater out of the city and into the lakes. GI helps recharge groundwater from retention, reducing subsidence due to excessive water drainage in the city.

Another essential impact of GI is the reduction of the heat island effect, a situation where the average temperature of an area is higher than nearby rural areas. This is most often caused by materials in urban areas, like concrete and asphalt, which absorb a lot of sunlight and store it in large thermal masses. The implementation of GI facilities throughout the New Orleans area would help reduce this effect, especially during its hot summers. Cameron et. al. (2012) argue that "gardens can play a strong role in improving the environmental impact of the domestic curtilage, e.g. by insulating houses against temperature extremes they can reduce domestic energy use. Gardens also improve localized air cooling; help mitigate flooding and provide a haven for wildlife." Communities and residences with GI facilities within the city have improved city aesthetics and placemaking which positively affects the quality of life of citizens.

New Orleans plays host annually to millions of visitors from around the globe who come to enjoy its many cultural sites, celebrations, and festivals. The festivals produce high amounts of waste materials that clog the drainage system and are carried by stormwater along with poisonous chemicals (e.g. pesticides, herbicides) and drained into the major water supply. GI facilities filter stormwater before it reaches the lakes and the rivers ensuring improved water quality. GI systems also encourage the recycling of plastics. TJ Truxillo of True Grid

emphasizes that most of the materials used in producing grids for pervious pavement are recycled plastics. With the huge turnover of plastic waste in the city, especially during festivals like Mardi Gras, recycling would positively impact the environment.

4. Challenges & Recommendations of GI Implementation in New Orleans

One of the major challenges impeding the implementation of GI in New Orleans is the lack of funding. Although the city was able to secure some grant funding from the HUD National Disaster Relief Fund, it is not enough for city-wide implementation. There is a need to seek alternative funding streams that are sustainable. Danielle Duhe, a landscape architect in New Orleans, contends that it is essential to follow up city planning with the necessary public funding appropriations. There are also HUD and FEMA funds available for communal GI projects. Additionally, Public Private Partnerships can bring additional funding and expertise from the private sector to match politically approved funding.

A change in the leadership of New Orleans in 2018 also created another challenge in the implementation of GI policy. The new mayor fully supports GI implementation and continues working on the Gentilly Resilient District Project, albeit with some delay. There is a need for an integrative policy making mechanism to ensure coverage, consistency and continuity of the city master plan that incorporates GI implementation. Doing so will enable city officials, in collaboration with relevant agencies (research institutions, NGO's etc.) and the host communities to determine complimentary varieties of green infrastructure strategies that can be imbedded in city planning policy (Mathews and Byrne 2015). GI plans and policies should also be coordinated with other departments, such as housing, health, transportation, etc., to develop consistent GI city codes and regulations. By doing so, New Orleans leadership, businesses,

industries and its citizens would have a legal obligation to integrate green infrastructure principles within urban renewal projects.

A final barrier to GI implementation is the definitional ambiguity which contributes to inaction on climate change adaptation. This lack of uniformity muddies existing programs and initiatives that deal with green space (Mell 2008). This is exacerbated by the lack of adequate community awareness programs to improve GI knowledge and the potential impact of a holistic integrated GI system in the city. Although there are many NGO's involved in GI advocacy, they are not enough to ensure success. GI is a new frontier for environmental management and, therefore, needs adequate community engagement and orientation on the system and its impacts to encourage the needed participation of the residents.

5. Summary and Conclusion

As Mell (2009) writes, GI is an economically viable approach for developing sustainable and resilient communities, adapting to climate change and for promoting smart growth. Although it is a new frontier in environmental management and the improvement of urban ecosystems, it is receiving much attention around the globe. Cities in the United States, Europe and Asia have implemented GI projects to improve the livability of their communities. There is also groundbreaking research in green infrastructure on how best to assess project valuation and project implementation in different localities. Gomez and Barton (2012) argue that because the study of urban ecosystems is still in its infancy, the subject matter has not received adequate attention in city policy making debates, as compared to issues in ecosystems like wetlands and forests. Whereas economic valuation of urban ecosystems has broadly been studied, not much has been done in other non-economic areas which are vital to the understanding of the impacts of

ecosystems' services. Therefore, there is a need for more research addressing how the many barriers to GI implementation can be overcome.

Communities in New Orleans are beginning to promote and integrate GI in their communal plan; and the mayor continues her support of the venture according to Dana Lunn of Front Yard Initiative. Also, communities are continuously learning the importance of GI as a tool for improving the urban ecosystem and are embracing the subject matter. Although there are some barriers to implementing and sustaining GI projects, funding, technical know-how, and infrastructure ownership and management, this could be alleviated with a city-wide GI comprehensive plan in place. The good news for GI is that it is receiving national attention and there is hope that more will be done to support GI development nationally.

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