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Engaging Social Capital for Decentralized Urban Stormwater Management

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Abstract:

Decentralized approaches to urban stormwater management, whereby installations of green infrastructure (e.g., rain gardens, bioswales, constructed wetlands) are dispersed throughout a management area, are cost-effective solutions with co-benefits beyond just water abatement. Instead of investing in traditional approaches for managing stormwater, such as deep tunnels and high capacity treatment facilities (i.e., gray infrastructure), municipalities that invest in green approaches (i.e., natural capital) may reap multiple benefits from increased green space, ecosystem services, increased property values, and community engagement. To maximize the provision of these benefits, water managers should account for social and other human capitals in their management plans. In this presentation, we will highlight the role of human, social, and cultural capitals in the USEPA's groundbreaking study in the Shepherd Creek

watershed (Cincinnati OH USA). The study investigated whether market-based mechanisms can be used to engage citizens to participate in voluntary stormwater management on their private property and would this lead to a sufficient number of green infrastructure installations to reduce storm flow volume. We invested in the human capital of the neighborhood in order to educate the residents on the urban stormwater problem and their potential role as private stormwater managers. Further, we quantified the role of social capital and found that as residents engaged in the program, their neighbors were significantly more likely to engage. This finding highlights the role of social networks in building trust in novel programs, especially those proposed by external agents. When a member of a social network engages in a program and shares his/her positive experience with members of his/her social network in order to get them to enroll, that initial participant appropriates social capital to influence the actions of others. As more residents of a neighborhood engage, perhaps the neighborhood will shift to a culture of private stormwater managers. If so, we expect to see increased green infrastructure on private land over time, and that may spread to other communities. Such a cultural shift would have profound implications on urban stormwater management.

Keywords: stormwater management, social capital, green infrastructure

1. Introduction

Urban streams are often afflicted with what has been deemed the *urban stream syndrome*- flashy hydrographs, altered stream channels, elevated contaminant and nutrient loads, and ecological degradation [1]. While many environmental factors contribute to the status of these streams, urban stormwater runoff has been identified as a major source of stream degradation. Green infrastructure, whereby investments in natural capital foster working landscapes that manage stormwater at the source, has been proposed as a partial remedy for urban stream syndrome by disconnecting impervious surfaces from stormwater infrastructure (i.e., municipal separate storm sewage systems). Stormwater runoff increases in proportion to the amount of impervious surface in a watershed, and in suburban areas, much of this impervious surface is residential. Therefore, to treat the urban stream syndrome, management must extend to residential properties (i.e., decentralization).

However, stormwater managers have no means of gaining access to residential properties through regulatory processes in the United States, thus residential stormwater management must be voluntary. To engage or incent citizens as stormwater managers, we must go beyond the

technical aspects of stream restoration and invest in social factors [2]. When it comes to the human factor, three forms of capital influence the success of environmental management projects: human, social, and cultural capitals. One way to differentiate the forms of capital is through the number of people involved. Another way is temporal, or how long they endure. Below, each form is described with a definition and a common example.

Human capital is the stock of skills, education, experiences, and knowledge of an individual—what you know, what you do, and who you are. You invest in your own human capital by seeking education [3]. Likewise, learning of your own constraints is a form of human capital (e.g., realizing you struggle with math or public speaking). You can also invest in the human capital of others by educating them or offering them opportunities.

Social capital is similar to human capital except that it is shared among two or more people. It is the stock of skills, knowledge, etc. that people bring to reoccurring, shared experiences [4]. Social capital is developed through social networks or social connections. Connections can create formal roles between members, such as the roles between students and teachers (e.g., teachers teach and evaluate while students learn and behave appropriately). Or, connections/networks can be informal without any specific roles, like those of neighbors (e.g., some neighbors share baked goods and watch each others' pets while other neighbors intentionally annoy each other) [5]. Social capital is expended or appropriated when used to influence the behavior of members of one's social network (e.g., you encourage your friends to join a team or volunteer for a good cause) [6]. Another way to spend social capital is to gain information that you would not otherwise have access to (e.g., a colleague gives you a tip on a potential job opening or client) [7].

Cultural capital is shared like social capital but spans a greater amount of time. Cultural capital is shared between generations. It reflects the culture of a people and place and is appropriated when that culture influences someone's behavior [8]. For example, the importance of education may be stressed throughout a family unit. Parents stress good grades to their children; those children grow up to stress academics to their children; and so on. After a few generations, the culture of the family is one of academic excellence, and poor grades are shunned (i.e., children's behavior is influenced to produce good grades) [9].

2. Methods

Through an interdisciplinary and integrated approach, this research tested a novel method that focuses municipal or local governmental resources on environmental management through stormwater management practices on suburban private land with particular emphasis on deriving

multiple benefits from green infrastructure. In the Shepherd Creek Watershed (Cincinnati, Ohio, USA) we invested in the human capital of the neighborhood by sending out brochures to eligible residents. These brochures aimed to educate the neighborhood on the issues surrounding urban stormwater and to also describe each resident's opportunity to participate in our stormwater management program, which would provide rain gardens and rain barrels to residents through a reverse auction [10]. In addition, we demonstrated the two forms of stormwater management practices available through our program—rain barrels and rain gardens—in a public park. Lastly, a promotional website was developed with additional information, and staff was on hand to answer questions or address concerns. Human capital was assessed by calculating the amount of stormwater runoff abated for each property and comparing the volume of water abated in those properties that did not require any financial incentive to install green infrastructure to those that did request financial payment to gain access to their property [10].

The role of social capital was assessed geostatistically through bootstrapping (with replacement) techniques. We compared the average distance between properties associated with successful bids to the average distance between an equal number of properties that were randomly selected from all eligible properties [2]. Because cultural capital operates along a multi-generational temporal scale, no attempt was made to quantify the effects of cultural capital.

3. Results and Discussion

One surprising result was the number of \$0 bids, indicating even a nominal induction of human capital via an education campaign was sufficient to enroll many participants (i.e., no economic incentive was necessary aside from free BMP installation and maintenance). Approximately 55% of bids were for \$0, which indicates that these homeowners would participate in the absence of an economic incentive.

Another finding revealed the role of social capital as clusters of properties tended to participate in the second round of bidding, indicating that as first round participants shared their experiences, their neighbors became more willing to trust the program and enroll. In the first year of the program, enrollment was randomly distributed. Residents from all over the neighborhood signed up to receive rain gardens and/or rain barrels on their property. For these residents, the education campaign and the promise of economic incentives was enough for them to enroll in a novel program. For many other residents of the neighborhood, it took tapping into their social networks to get them to enroll. Many of these residents enrolled the second year of the program, only after seeing rain gardens and rain barrels installed on their neighbors' properties. The residents that enrolled in the second year needed more than education to get them to enroll; they also needed to establish trust that the program would be good for them. Once they

saw the program benefitting their neighbors, they were more likely to participate. These agglomerations of participating properties may indicate a shift in the neighborhood culture regarding stormwater management and have positive implications for long term watershed health.

One key lesson from the social capital side of Shepherd Creek is the value of time in novel environmental management schemes. Had the program only run for one year, a large segment of residents that did eventually participate would have been written off as nonparticipants/not interested. When introducing new ideas or any sort of change to a community, it takes time to build trust and to get citizens to buy in and engage. Sometimes, tapping into a social network can provide a shortcut to trust building, but that takes time as well.

In the environmental management context, we hope to change the culture of stormwater management such that every citizen considers where and how rain falls and runs off. Once the citizenry knows about urban stormwater (e.g., when I fertilize my lawn before a rain, that fertilizer runs off into the stream where my kids swim), they may be more likely to reduce their own environmental impact (e.g., not fertilize before a storm, install a rain garden).

In Shepherd Creek, only time will reveal if the culture in the neighborhood shifted to emphasize environmental management. If the children of Shepherd Creek grow up knowing about stormwater and feeling as though they have a role in protecting urban streams, they may build rain gardens and spread the word to their new neighborhoods and social networks as adults, thus influencing the culture of both Shepherd Creek and beyond.

4. Conclusions

Instead of exclusively investing in physical capital, sewage and stormwater managers should couple investments with commensurate investment in human capitals for long term success. Replacing aging infrastructure with new technologies, even GI, without necessary investments in human, social, and cultural capitals are susceptible to community rejection [11]. While simple in theory, this approach poses many difficulties on the ground; stormwater utilities are not traditionally in the business of operating and maintaining green space and often work as monoliths in social isolation.

Decentralized GI installations require perpetual access to public and private land, a constraint that may find a creative solution in many urban settings. Recent work emphasizes the potential to create links between implementing green CSO solutions and other problems facing post-industrial cities, such as the foreclosure crisis and vacant land, environmental justice, and food deserts [12]. Thus, future efforts to identify and leverage other sources of social, human, and

cultural capitals to address larger-scale water resources management are set in post-industrial U.S. cities facing compounding issues of vacant land and regulatory pressures from combined sewer overflows.

Urban exodus in many rust belt cities resulted in dramatic population decline which has steeply worsened as a result of the foreclosure crisis. For example, Cleveland, OH (USA) experienced a 56.6% reduction in population from its peak in 1950 (914,808 residents) to 2010 (396,815 residents) according to the U.S. Census Bureau. These problems seem to foment a sound fit for an expeditious approach: utilize vacant land as a site for decentralized stormwater management. Using GI techniques, vacant lots may be transformed into lot-scale rain gardens or aggregated into multi-acre features such as constructed wetlands and retention ponds.

In this context, our next research efforts aim at scaling up from individuals to institutions. We aim to utilize bridging organizations, such as community development corporations, and partner with municipal utilities to address the critical issues of combined sewer overflows and vacant land. At an advanced level, our basic studies will direct the adaptation of incentives to appeal to municipal governments. Our vision is for governance to be incentivized toward restoration of infiltrative surface in urban areas with green infrastructure so as to achieve increased runoff mitigation.

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Conflict of Interest

The authors declare no conflict of interest.

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