Systems Thinking in Communities:

Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Washington DC

This community storybook was developed by Transtria LLC.

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Introduction

D.C. Healthy Kids, Healthy Communities is one of 49 community partnerships participating in the national *Healthy Kids, Healthy Communities* program of the Robert Wood Johnson Foundation (www.healthykidshealthycommunities.org). The purpose of this *D.C. Healthy Kids, Healthy Communities* project was to introduce systems thinking at the community level by identifying the essential parts of the Washington DC system and how the system influences policy and environmental changes to promote healthy eating and active living as well as to prevent childhood obesity. To accomplish this goal, community partners participated in a group model building session and discussions. The group model building exercises were designed by staff from Transtria LLC and the Social System Design Lab at Washington University in St. Louis, Missouri as part of the *Evaluation of Healthy Kids, Healthy Communities* funded by the Robert Wood Johnson Foundation. These exercises actively involved a wide range of participants in modeling complex systems and provided a way for different representatives (e.g., government agencies, community-based and civic organizations, schools, foundations, policy/advocacy organizations) to better understand the systems (i.e., dynamics and structures) in the community (see the *Healthy Kids, Healthy Communities Group Model Building Facilitation Handbook*, www.transtria.com/hkhc). Overall, the evaluation was designed to assess policy, system, and environmental changes as a result of the community partnerships' efforts to increase healthy eating and active living in order to reduce childhood obesity.

Washington DC: Background and Local Participation

Washington DC is the capital of the United States and, in 2010, had a population of 601,723, the 24th most populated city in the United States. Commuters from the surrounding Maryland and Virginia suburbs raise the city's population to more than one million during the work week. The Washington DC Metropolitan Area has a population of 5.8 million, the seventh largest metropolitan area in the country. In DC approximately 50% of the population was African American, while in the two target areas for HKHC, Ward 7 and Ward 8, the population was predominately (92-95%) African American.

Specific efforts of HKHC targeted Wards 7 and 8, which are located east of and separated from the rest of the city by the Anacostia River (see Figure 2). These areas have the lowest per capita incomes in the city and the highest rates of adult obesity or overweight, diabetes, and hypertension.

In 2008, the Summit Health Institute for Research and Evaluation, Inc. (SHIRE) brought the DC partnership together to discuss the HKHC proposal opportunity. SHIRE, a non-profit organization, was established in 1997 to promote health and wellness for all people and worked to eliminate health disparities. SHIRE served as the lead agency for the DC partnership by bringing together necessary partners and resources to accomplish healthy eating and active living policy and environmental changes. Part of its mission within the DC partnership was to establish community partnerships, conduct policy advocacy, provide training and technical assistance, and initiate demonstration projects to inform policy change.

SHIRE was primarily active at the local level, focusing efforts in Washington DC, Prince George's County, and other parts of Maryland. However, for the HKHC project, the focus areas were Wards 7 and 8 in DC.

The partnership was made up of individuals representing agencies. No political figures were included in the partnership. The partnership had relationships with Council members that represented Wards 7 and 8 as well as Council members who had a particular interest in health issues.

D.C. Healthy Kids, Healthy Communities' Priorities and Strategies

The partnership and capacity building strategies of *D.C. Healthy Kids, Healthy Communities* included:

- **Community Engagement:** Several community engagement activities and opportunities were held to ensure resident voices were being heard, particularly from those living in Wards 7 and 8 in DC.
- **Park Ambassadors:** The DC partnership worked with Groundworks Anacostia and other DC partners to design a Park Ambassador program that would employ local residents to watch over parks and playground spaces, while also providing a stable job for residents.

The healthy eating and active living strategies of D.C. Healthy Kids, Healthy Communities included:

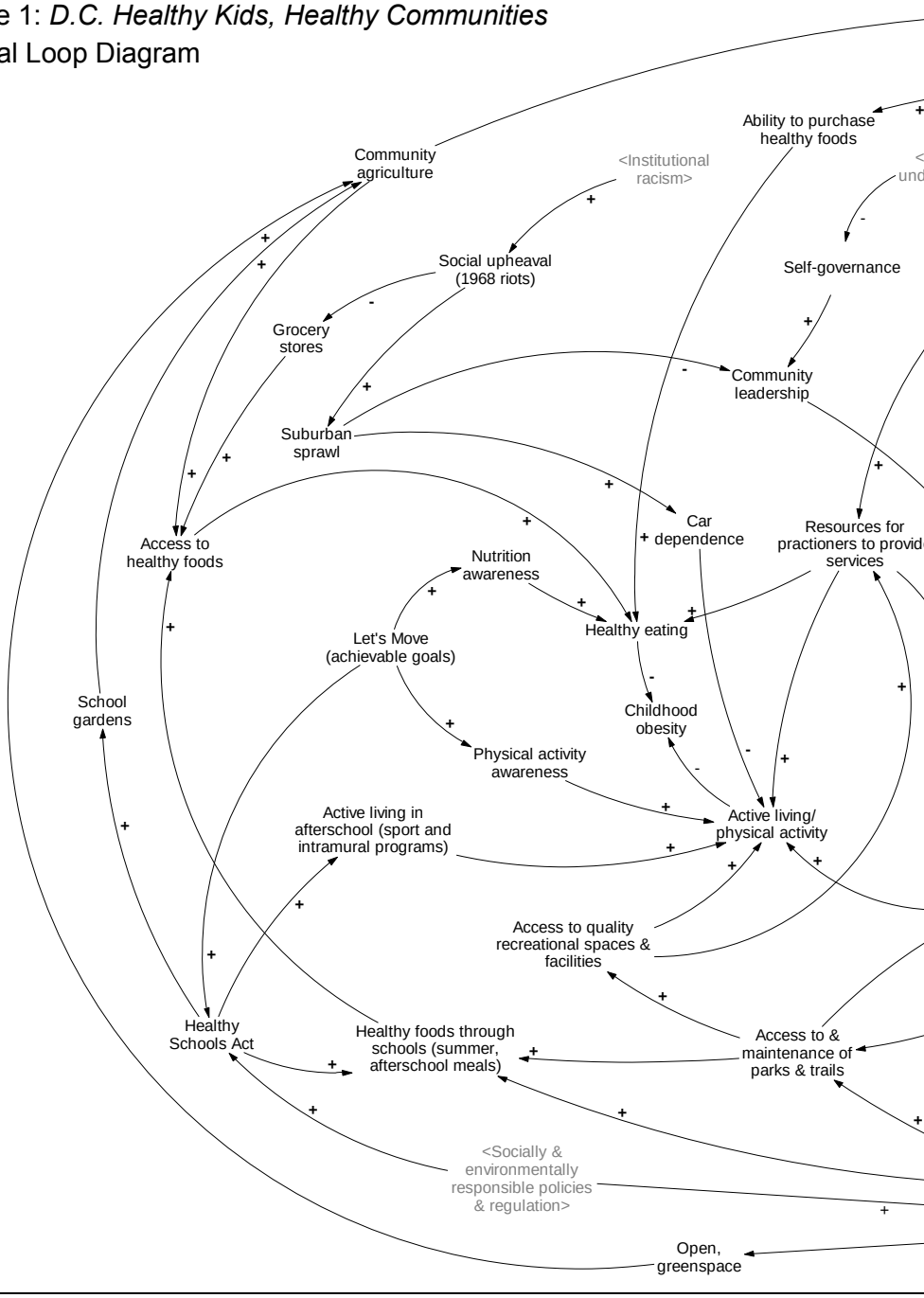
- **Nutrition Standards in After School:** A policy was adopted that instituted an After School Meal Program in DC. This program provided federal funding to qualifying educational and enrichment programs that operated during the school year to serve healthy meals and snacks to children and teens, ages 18 and under.
- **Healthy Eating Initiatives:** DC Hunger Solutions collaborated with DC Council and Councilmembers; with support from the DC partnership, to pass Food, Environmental, and Economic Development ("FEED") DC Act of 2010. This act was designed to improve access to healthy foods in lower-income neighborhoods, encourage green technology in food stores, and create good jobs in areas with very high levels of unemployment. The Department of Parks and Recreation, with support from the DC partnership, expanded the Department of Parks and Recreation Fee-based Use Permit Authority Act of 2012, which included provisions for healthy vending at park and recreation centers in DC.
- **Third Party Reimbursement:** The DC partnership collaborated with the Department of Health to create policies to reimburse community-based fitness and healthy living programs by insurers. In January 2012, billing codes were modified by the DC Department of Health Care Finance to expand codes available to providers delivering services to overweight and obese children and adults.

For more information on the partnership, please refer to the Washington DC case report (http://www.transtria.com/hkhc_case_reports.php).

Systems Thinking in Communities: Washington DC

"Systems thinking" represents a range of methods, tools, and approaches for observing the behaviors of a system (e.g., family, community, organization) and how these behaviors change over time; changes may occur in the past, present, or future. Figure 1 illustrates a system of policies, environments, local collaborations, and social determinants in Washington DC that influence healthy eating, active living, and, ultimately, childhood obesity. This system and the dynamics within the system are complicated with many different elements interacting.

Figure 1: *D.C. Healthy Kids, Healthy Communities*
Causal Loop Diagram



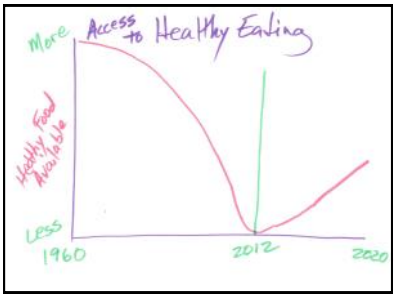
Group Model Building

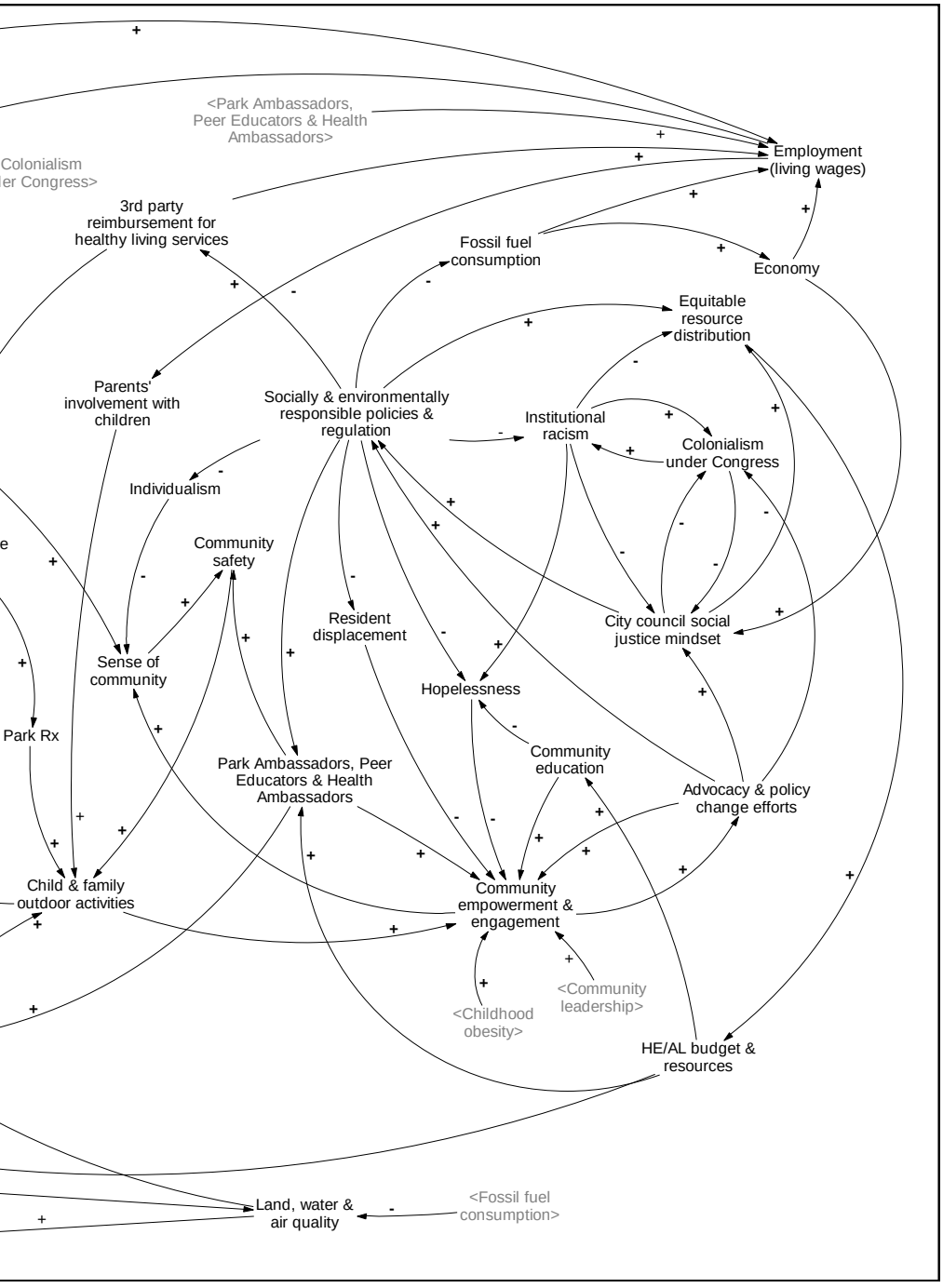
Members of the *D.C. Healthy Kids, Healthy Communities* partnership participated in a group model building session in February, 2011 and generated this system. also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included community members and representatives from civic, policy, and community-based organizations; government agencies; foundations; and businesses. The group model building session had two primary activities: 1) a Behavior Over Time Graph exercise; and 2) a Causal Loop Diagram (or structural elicitation) exercise.

<u>Behavior Over Time Graphs</u>

To identify the range of things that affect or are affected by policy, system, and environmental changes in Washington DC related to healthy eating, active living, and childhood obesity, participants designed graphs to name the influences and to illustrate how the influences have changed over time (past, present, and future). In this illustration for access to healthy eating, the amount of access to healthy eating has decreased since

1960 to 2012 and the participant hopes that this trend will change and increase into the future. Each graph is a tool to increase the use of common, specific language to describe *what* is changing in the community as well as *when*, *where*, and *how* it is changing. The graphs capture participants' perceptions of the influence, or variable, and through the graph, the participant tells their story. These perceptions are based on actual data or evidence, or they are part of the participants' lived experience.





Causal Loop Diagram

To examine the relationships among the variables from the behavior over time graphs, participants worked together and with facilitators to develop a causal loop diagram. In Figure 1, the words represent variables of quantities that can increase and decrease over time (i.e., the behavior over time graphs). These variables are influenced by other variables as indicated by the lines with arrows. The lines with arrows represent causal relationships - this is what is known about the system and how it behaves.

For instance, there are many feedback loops influencing or influenced by community empowerment and engagement in this causal loop diagram. One feedback loop is: community empowerment and engagement → advocacy and policy change efforts. A second feedback loop is: community empowerment and engagement → sense of community→ community safety → child and family outdoor activities → community empowerment and engagement.

What is important to notice in these examples is that there are two different feedback loops interacting simultaneously to influence or to be influenced by <variable>. Some variables may increase <variable> while other variables limit <variable>. Determining the feedback loop or loops that dominate the system's behavior at any given time is a more challenging problem to figure out, and ultimately, requires the use of computer simulations.

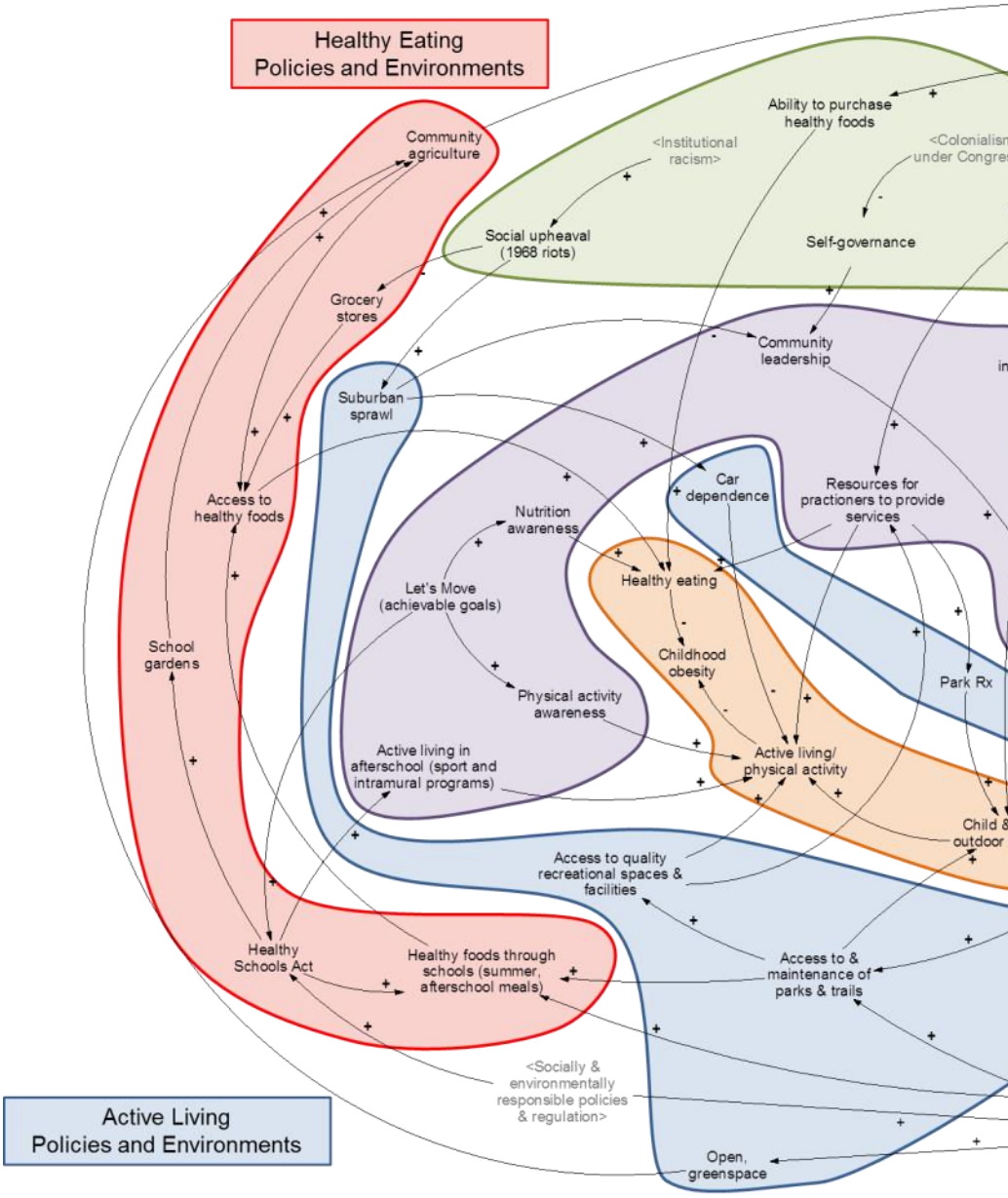
Based on this preliminary work by the *D.C. Healthy Kids, Healthy Communities* partnership, this "storybook" ties together the behavior over time graphs, the participants' stories and dialogue, and feedback loops from the causal loop diagram to understand the behavior of the system affecting health in Washington DC and to stimulate greater conversation related to Washington DC's theory of change, including places to intervene in the system and opportunities to reinforce what is working. Each section builds on the previous sections by introducing concepts and notation from systems science.

Causal Loop Diagram for the Childhood Obesity System

The causal loop diagram (CLD) represents a holistic system and several subsystems interacting in Washington DC. In order to digest the depth and complexity of the diagram, it is helpful to examine the CLD in terms of the subsystems of influence. Because of this project's focus on healthy eating, active living, and childhood obesity, this system draws attention to a number of corresponding subsystems, including: healthy eating policies and environments (red), active living policies and environments (blue), health and health behaviors (orange), partnership and community capacity (purple), and social determinants (green).

From the group model building exercises, several variables and causal relationships illustrated in Figure 2 were identified within and across subsystems. This section describes the subsystems in the CLD.

Figure 2: Subsystems in the *D.C. Healthy Kids, Healthy Communities* Causal Loop Diagram



Healthy Eating Policies and Environments (Red)

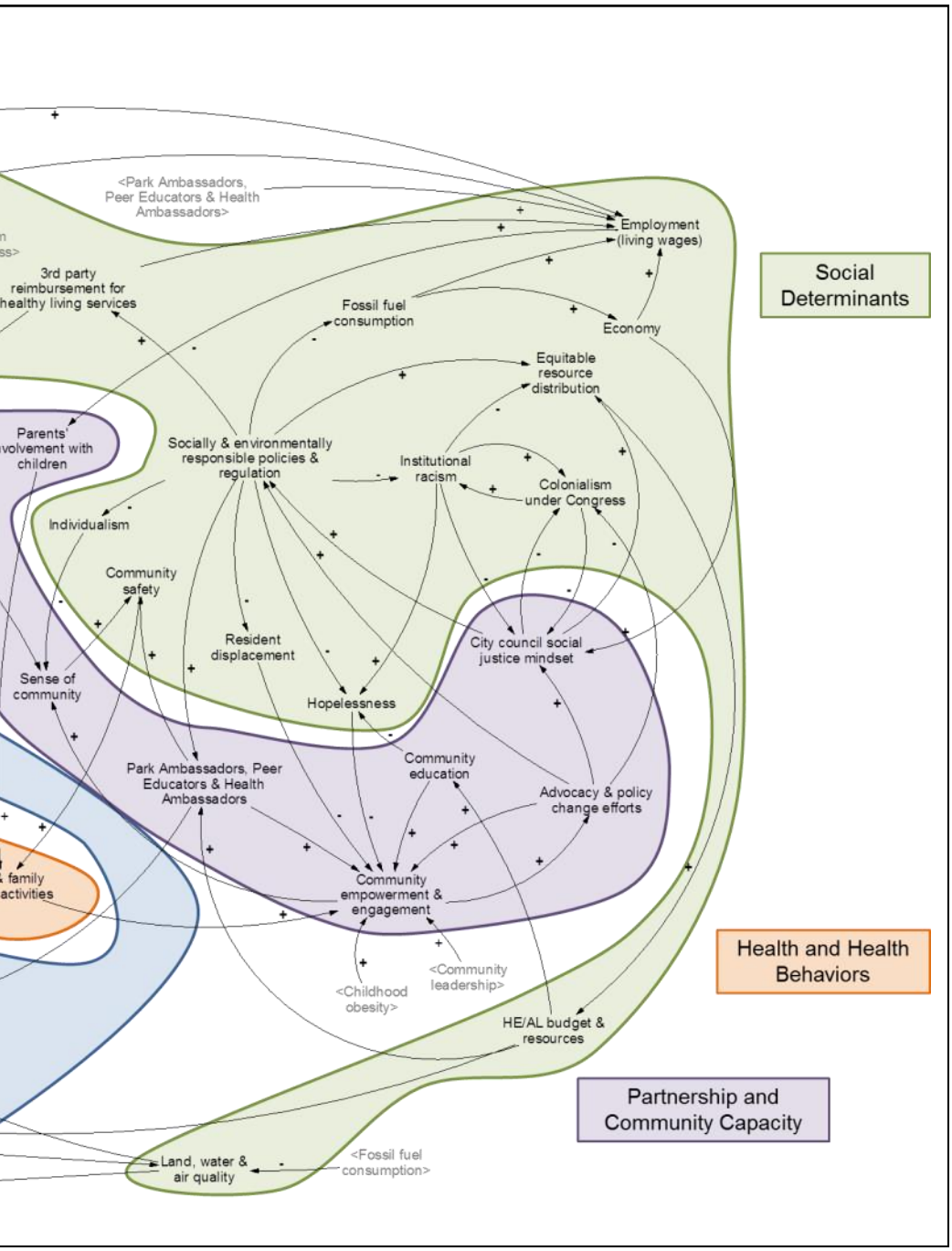
The healthy eating policy and environmental subsystem includes food production (e.g., community agriculture, school gardens), food distribution and procurement (e.g., healthy foods through schools), and food retail (e.g., access to healthy foods, grocery stores). During the behavior over time graphs exercise, the participants generated four graphs related to policy or environmental strategies (e.g., grocery stores, school gardens) or contexts that affected or were affected by the work of *D.C. Healthy Kids, Healthy Communities*. The variables represent participants' conversations from the behavior over time graph and causal loop diagram exercises.

Active Living Policies and Environments (Blue)

The active living policy and environmental subsystem includes design, planning, construction, and enforcement or maintenance related to access to opportunities for active transportation and recreation. For this topic, the group model building participants developed five graphs related to policy or environmental strategies (e.g., open green space, access to maintenance of parks and trails) or contexts (e.g., suburban sprawl) that affected or were affected by the partnership's work.

Health and Health Behaviors (Orange)

The subsystem for health and health behaviors includes health outcomes (e.g., obesity), health behaviors (e.g., healthy eating, physical activity), and behavioral proxies or context-specific behaviors (e.g., child and family outdoor activities).



Partnership and Community Capacity

The partnership and community capacity subsystem refers to the ways communities organized and rallied for changes to the healthy eating and active living subsystems. For instance, *D.C. Healthy Kids, Healthy Communities* places special emphasis on advocacy efforts to achieve policy changes. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as community education or parents involvement with children.

Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., employment, economy, fossil fuel consumption) and psychosocial influences (e.g., community safety, hopelessness) in the community that impact health beyond the healthy eating and active living subsystems. In order to achieve health equity, populations and subgroups within the community must have equitable access to these resources and services.

Each one of these subsystems has many more variables, causal relationships (arrows), and feedback loops that can be explored in greater depth by the *D.C. Healthy Kids, Healthy Communities* partners or by other representatives in Washington DC. Using this CLD as a starting place, community conversations about different theories of change within subsystems may continue to take place. For instance, these participants identified interest in understanding more about the relationships among advocacy and policy change efforts, 3rd party reimbursement, and Park Ambassadors.

The next sections begin to examine the feedback loops central to the work of *D.C. Healthy Kids, Healthy Communities.* In these sections, causal relationships and notations (i.e., arrows, “+” signs, “-” signs) from Figure 2 will be described to increase understanding about how systems thinking and modeling tools can work in communities to increase understanding of complex problems that are continuously changing over time, such as childhood obesity. At the end of this CLD storybook, references to other resources will be provided for those interested in more advanced systems science methods and analytic approaches.

Community Empowerment Feedback Loop

To simplify the discussion about feedback loops, several loops drawn from the *D.C. Healthy Kids, Healthy Communities* CLD (see Figures 1 and 2) are highlighted in Figures 3-7. While the CLD provides a theory of change for the childhood obesity prevention movement in Washington DC, each feedback loop tells a story about a more specific change process.

Causal Story for Feedback Loop

Story A: In this case , the story is about the community empowerment (green highlighted loop in Figure 3). Participants described how with less colonialism under congress, there is less institutional racism, which decreases the feeling of hopelessness. With less hopelessness, it increases community empowerment and engagement In turn, advocacy and policy change efforts are increased which decreases colonialism under congress.

Story B: While the preceding story reflected a positive scenario for Washington DC, the same feedback loop also tells the opposite story. With more colonialism under congress, there is more institutional racism, which increases the feeling of hopelessness. With more hopelessness, it decreases community empowerment and engagement In turn, advocacy and policy change efforts are decreased which increases colonialism under congress.

Reinforcing Loop and Notation

These stories represent a reinforcing loop, and the notation in the feedback loop identifies it as a reinforcing loop (see "R1 — Community Empowerment" and green highlighted loop in Figure 3). The words represent variables of quantities that increase and decrease as illustrated in the stories above. These variables change over time and are influenced by other variables as indicated by the arrows. Each arrow represents a causal relationship, and the plus and minus signs on the arrows indicate whether or not the influence of one variable on another variable (1) increases/adds to (plus or "+" sign), or (2) decreases/removes from the other variable (minus or "-" sign). These signs

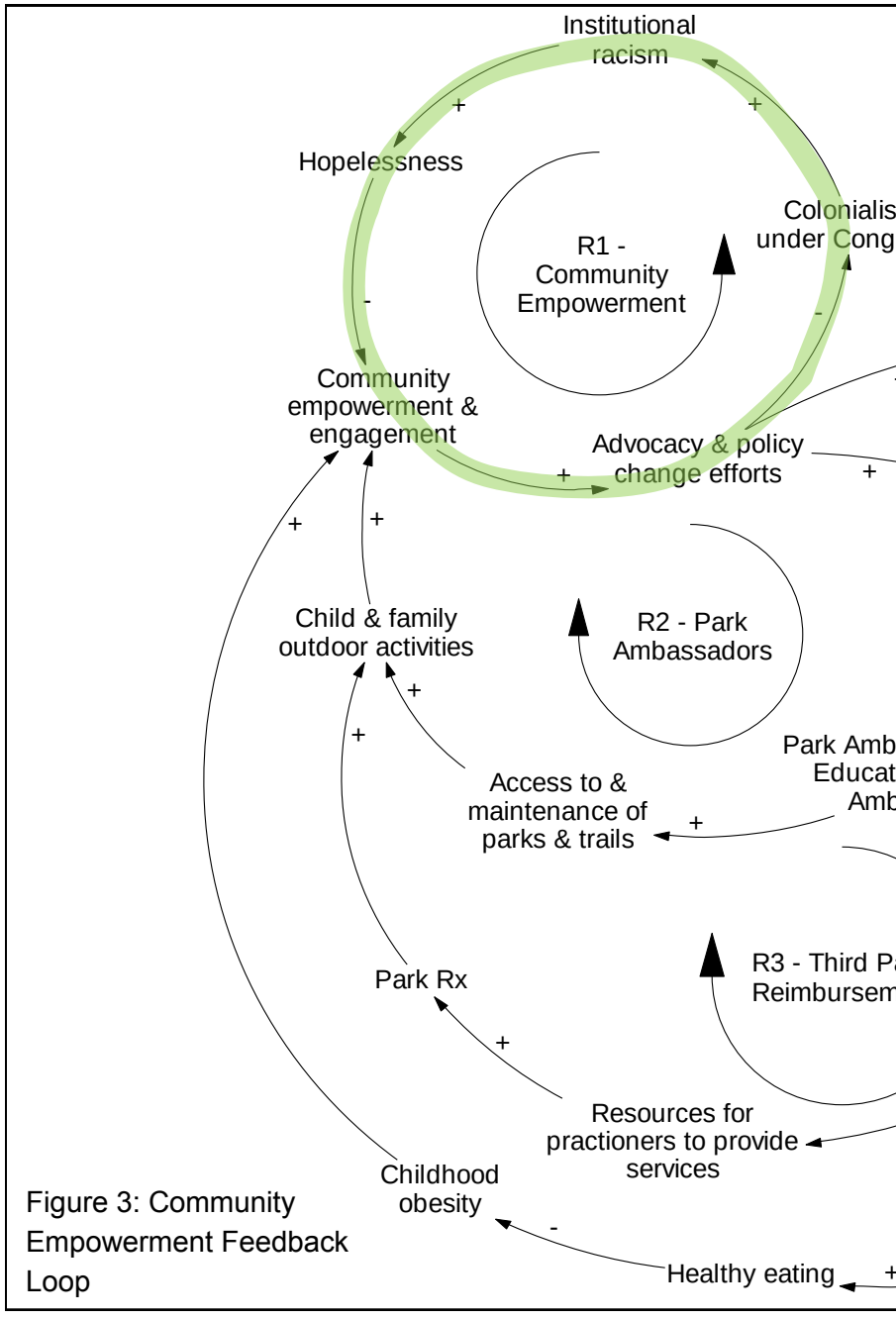


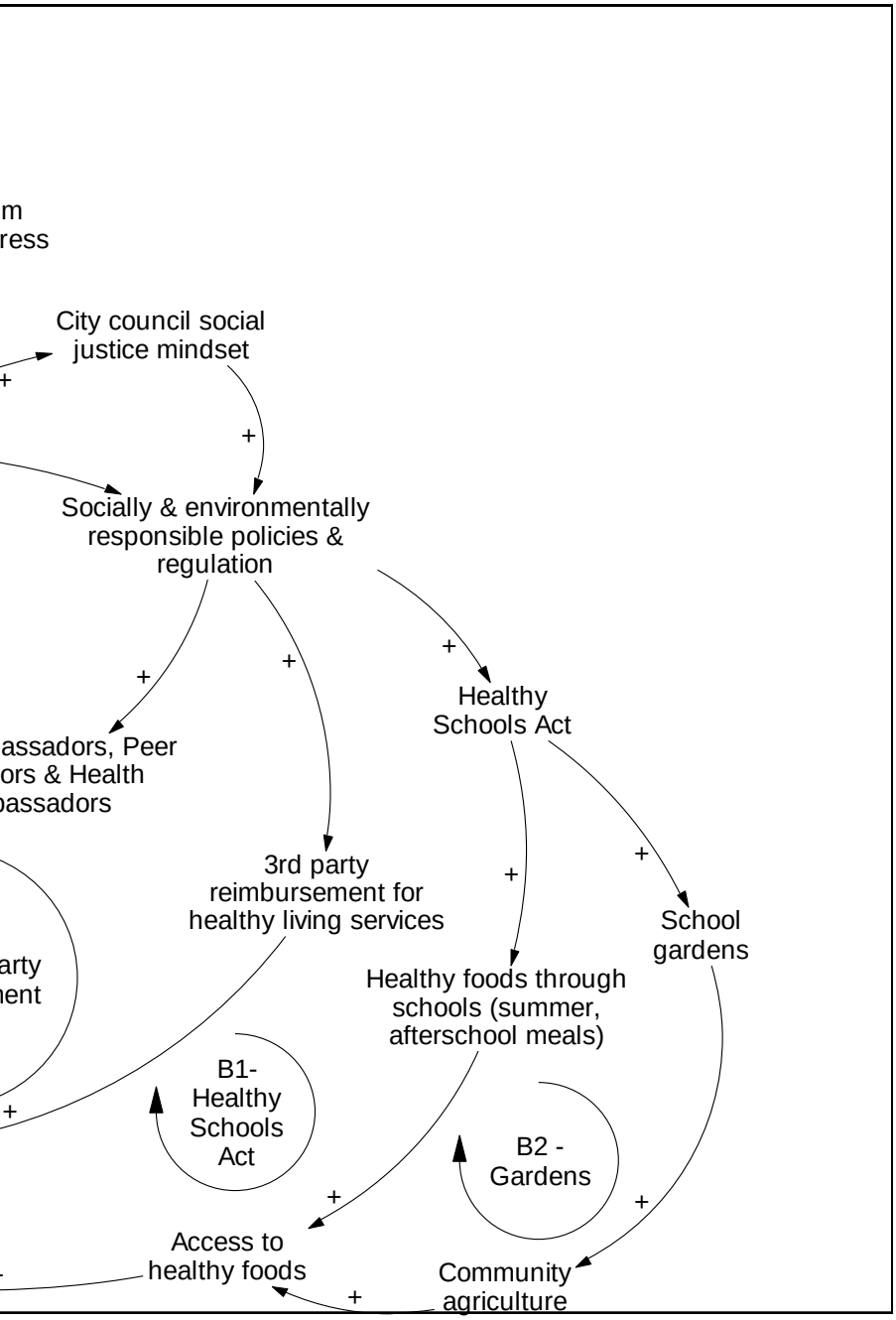
Figure 3: Community Empowerment Feedback Loop

"I really got involved in the local scene around 2006 with the early childhood obesity prevention collaborative and, from the very beginning we felt it was important to engage residents as persons who would carry the message. We also believe very strongly in paying back, so from the very beginning, we began to work with peer educators. We know that the excitement about that work is building. What's missing are the resources to build on the excitement, so we're beginning to see other opportunities for folks in the neighborhood to spread the good news about healthy living." (Participant)

are referred to as polarities. In a reinforcing loop, the effect of an increase or decrease in a variable continues through the cycle and returns an increase or decrease to the same variable, respectively.

Looking specifically at the "+" or "-" notation, a feedback loop that has zero or an even number of "-" signs, or polarities, is considered a reinforcing loop. Balancing loops, with an odd number of "-" signs in the loop, are another type of feedback loop and are referenced in the next sections.

In isolation, this reinforcing loop represents a virtuous cycle in Story A as these assets positively support one another, or a vicious cycle in Story B as these challenges perpetuate a downward spiral. Yet, the influence of community empowerment and engagement likely levels off at some point. To understand what specifically leads to the leveling off of community empowerment and engagement, it may be helpful for the partners in Washington DC to consider other variables that influence or are influenced by community empowerment and engagement. In addition, it is important to remember that this reinforcing loop is only one part of the larger CLD (see Figures 1 and 2), and the other loops and causal relationships can have an impact on the variables in this loop.



<u>System Insights for *D.C. Healthy Kids, Healthy Communities*</u>

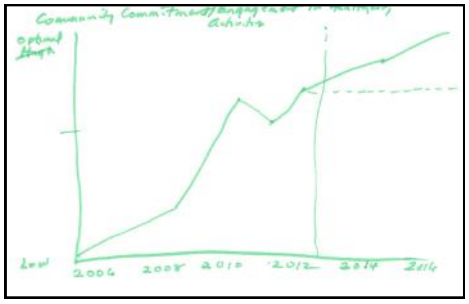
Participants identified an increase in community commitment and engagement since 2006 in Washington DC (see behavior over time graph bottom right).

From the systems thinking exercises, several insights can inform strategies to continue to improve community empowerment including:

- With deeper roots in the community (e.g., longevity, relationships), residents have more time and feel more confident voicing their concerns and opinions to civic leaders in order to improve or maintain healthy eating and active living assets in the community.
- Strategic partnerships to engage residents in advocacy initiatives stimulate support and funding from city government agencies.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- Does poverty and reliance on governmental assistance limit social engagement among residents in communities? If so, how?
- What are some ways to assess empowerment in the community generally and specifically with respect to policy and environmental changes to support healthy eating and active living?



Park Ambassadors Feedback Loop

Given the introduction to feedback loops and CLD notation in the previous section, this discussion of the feedback loop highlighted in orange in Figure 4 expands on the concepts and notation, and highlights park ambassadors.

Causal Story for Feedback Loop

Story A: In this case, the story is about Park Ambassadors. Washington DC partners had several strategies to engage residents by involving them in park advocacy and maintenance. With more Park Ambassadors, Peer Educators, and Health Ambassadors, there is an increase in access to and maintenance of parks and trails, which increases child and family outdoor activities. With more child and family outdoor activities, there is more community empowerment and engagement, which increases advocacy and policy changes efforts. An increase in advocacy and policy change efforts also increase socially and environmentally responsible policies and regulations, and in turn, increases Park Ambassadors, Peer Educators, and Health Ambassadors.

Story B: Alternatively, with less Park Ambassadors, Peer Educators, and Health Ambassadors, there is a decrease in access to and maintenance of parks and trails, which decreases child and family outdoor activities. With less child and family outdoor activities, there is less community empowerment and engagement, which decreases advocacy and policy changes efforts. A decrease in advocacy and policy change efforts also decreases socially and environmentally responsible policies and regulations, and in turn, decreases Park Ambassadors, Peer Educators, and Health Ambassadors.

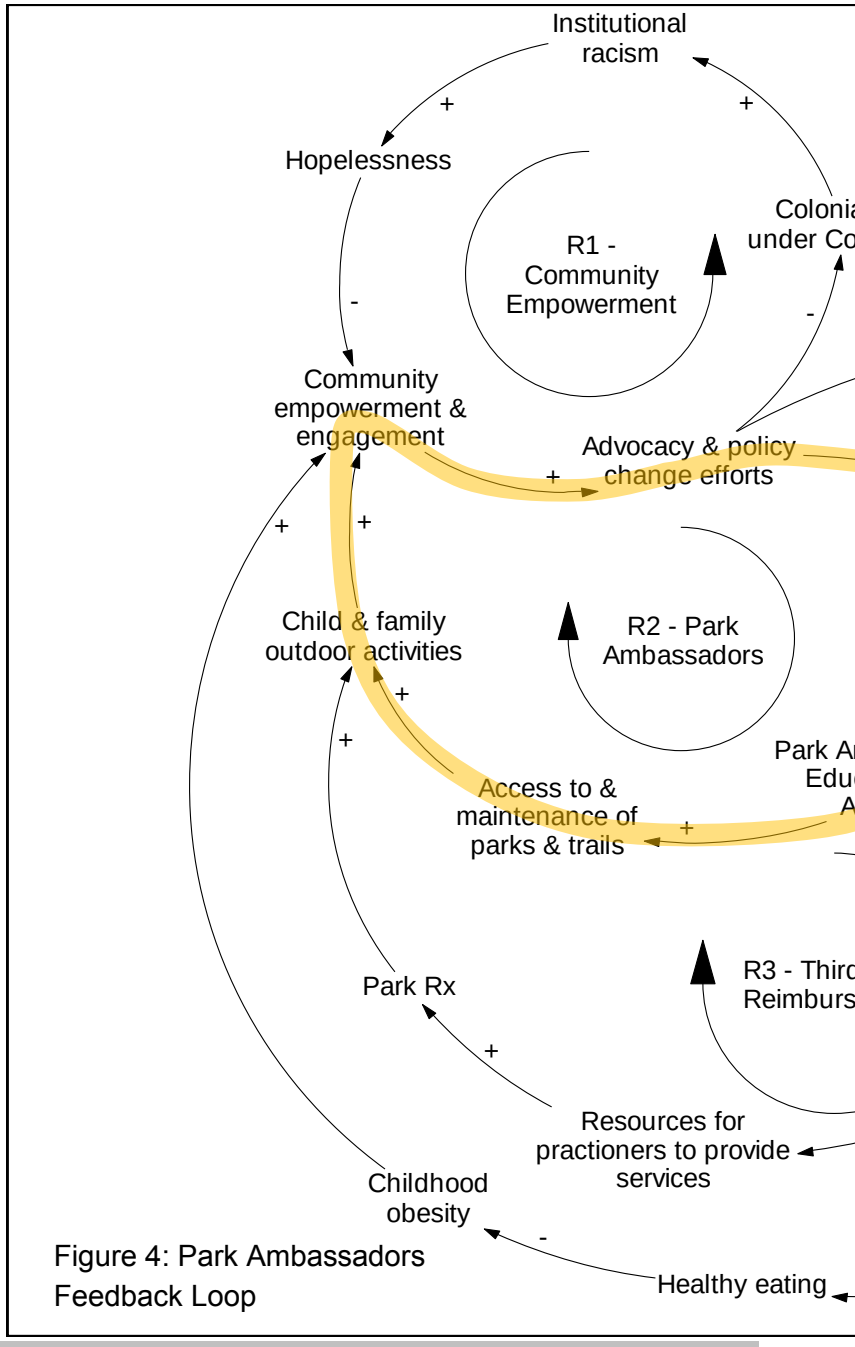


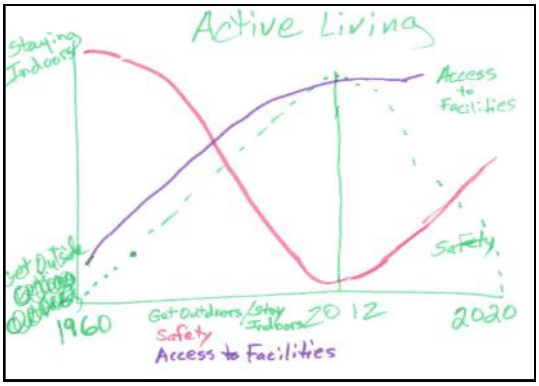
Figure 4: Park Ambassadors Feedback Loop

Reinforcing Loop and Notation

Similar to the previous loops, this one also represents a reinforcing loop (all "+" signs). In addition, it includes causal relationships representing more immediate effects (e.g., community empowerment and engagements influence on advocacy and policy change efforts), and, potentially, delayed effects (e.g., access to

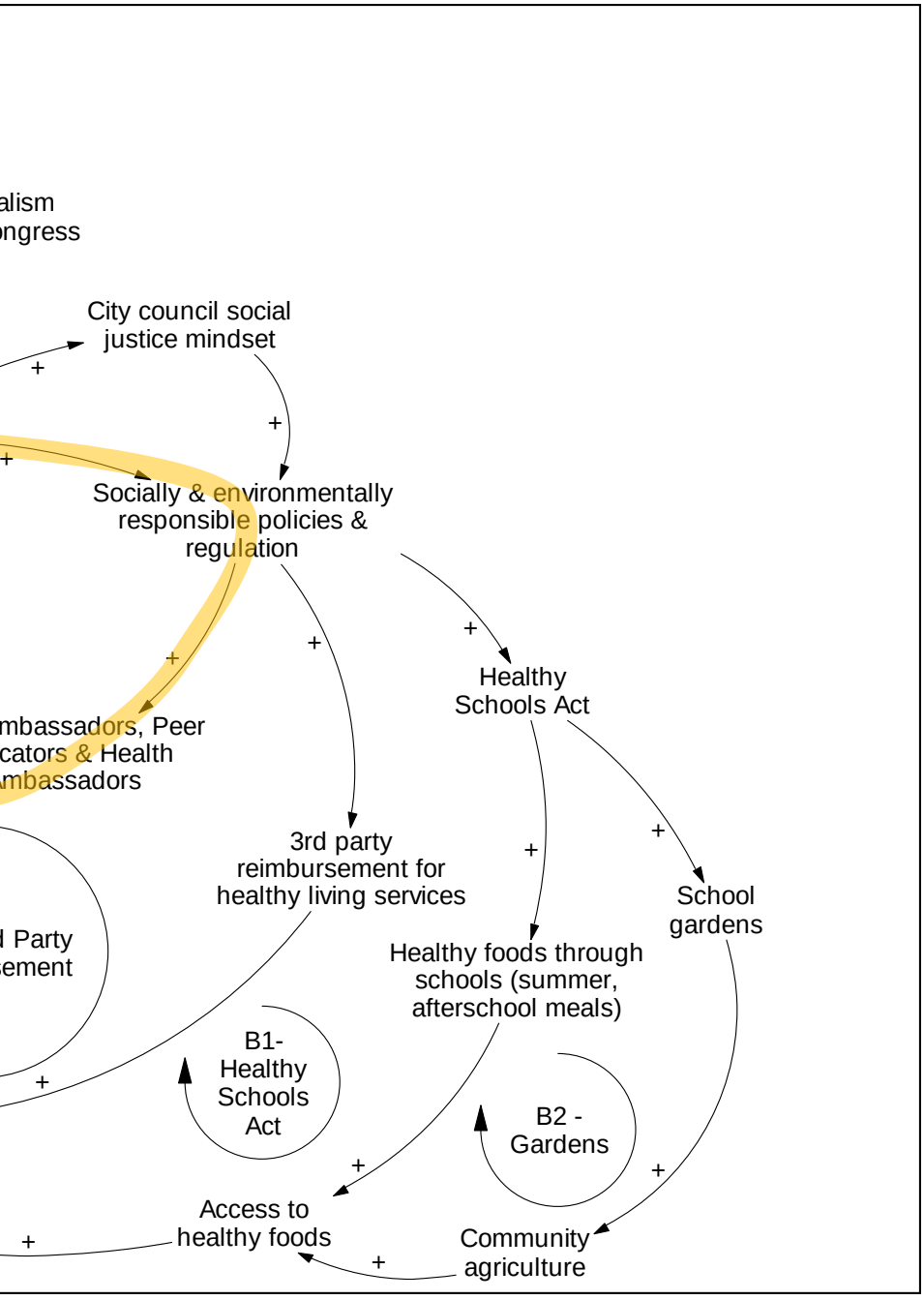
"If everyone realized the natural connection between living somewhere [with a healthy environment], that you're naturally healthier, we'd probably be a little bit better. My neighborhood changed in the 80's; it went from a place of always being outside to not being able to go outside. That was because of a lot of the policies that had an effect on how healthy our environments are, so with decreasing the regulation of waterways and green spaces and the [increase in] use of kind of natural resources, I think it kind of started off some of those things we now see with the problems of obesity and physical activity. " (Participant)

and maintenance of parks and trails influence on child and family outdoor activities). This delayed effect is noted using two hash marks through the middle of the arrow line (not included in Figure 4).



<u>System Insights for *D.C. Healthy Kids, Healthy Communities*</u>

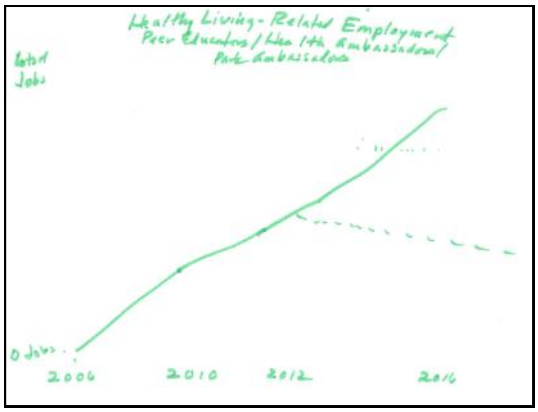
In the behavior over time graphs, participants identified access to active living facilities increasing since 1960 with a hope that it will continue to increase and level off when there are enough facilities available (see behavior over time graph on top right). Similarly, participants identified the number of healthy living employment opportunities (e.g., Peer Educators, Health Ambassadors, and Park Ambassadors) has increased since 2006 with the hope that the healthy living employment opportunities will continue to increase (see behavior over time graph bottom right).



System insights can inform the partnership's next steps with park ambassadors, including:

- Parks and play spaces that facilitate both opportunities for physical activity and resident interaction and engagement support sustainability of the quality of these spaces by increasing collaboration of local partners that can generate resources to invest in these spaces.
- Improvements to parks, trails, and recreational facilities increases residents' perceptions of safety in the community, and these perceptions strongly influence parents' decisions to allow their kids to use the facilities.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:



- What factors can increase employers' and policy-makers' attention to safe parks, trails, and outdoor facilities?
- What types of partnerships increase resident engagement and participation in advocacy related to parks and play spaces?

Third Party Reimbursement Feedback Loop

Highlighted in blue in Figure 5, the third party reimbursement feedback loop represents one of the *D.C. Healthy Kids, Healthy Communities* strategies to increase reimbursement to individuals engaging in active living and healthy eating behaviors in Washington DC.

Causal Story for Feedback Loop

Story A: With more third party reimbursement for healthy living services, there are more resources for practitioners to provide services. With more resources for practitioners to provide services it will increase the number of park prescriptions written to patients, which will increase child and family outdoor activities. With more child and family outdoor activities, there will be more community empowerment and engagement, which will increase advocacy and policy change efforts. In turn, more advocacy and policy change efforts will increase socially and environmentally responsible policies and regulations, which will increase third party reimbursements for health living services.

Story B: Alternatively, with less third party reimbursement for healthy living services, it will decrease resources for practitioners to provide services. With less resources for practitioners to provide services it will decrease the number of park prescriptions written to patients, which will decrease child and family outdoor activities. With less child and family outdoor activities, there will be less community empowerment and engagement, which will decrease advocacy and policy change efforts. In turn, less advocacy and policy change efforts will decrease socially and environmentally responsible policies and regulations, which will decrease third party reimbursements for health living services.

Reinforcing Loop and Notation

Similar to the previous loops, this one also represents a reinforcing loop (all "+" signs). In addition, it includes causal relationships representing more immediate effects (e.g., third party reimbursement for healthy living services influence on resources for practitioners to provide services) and, potentially, delayed effects.

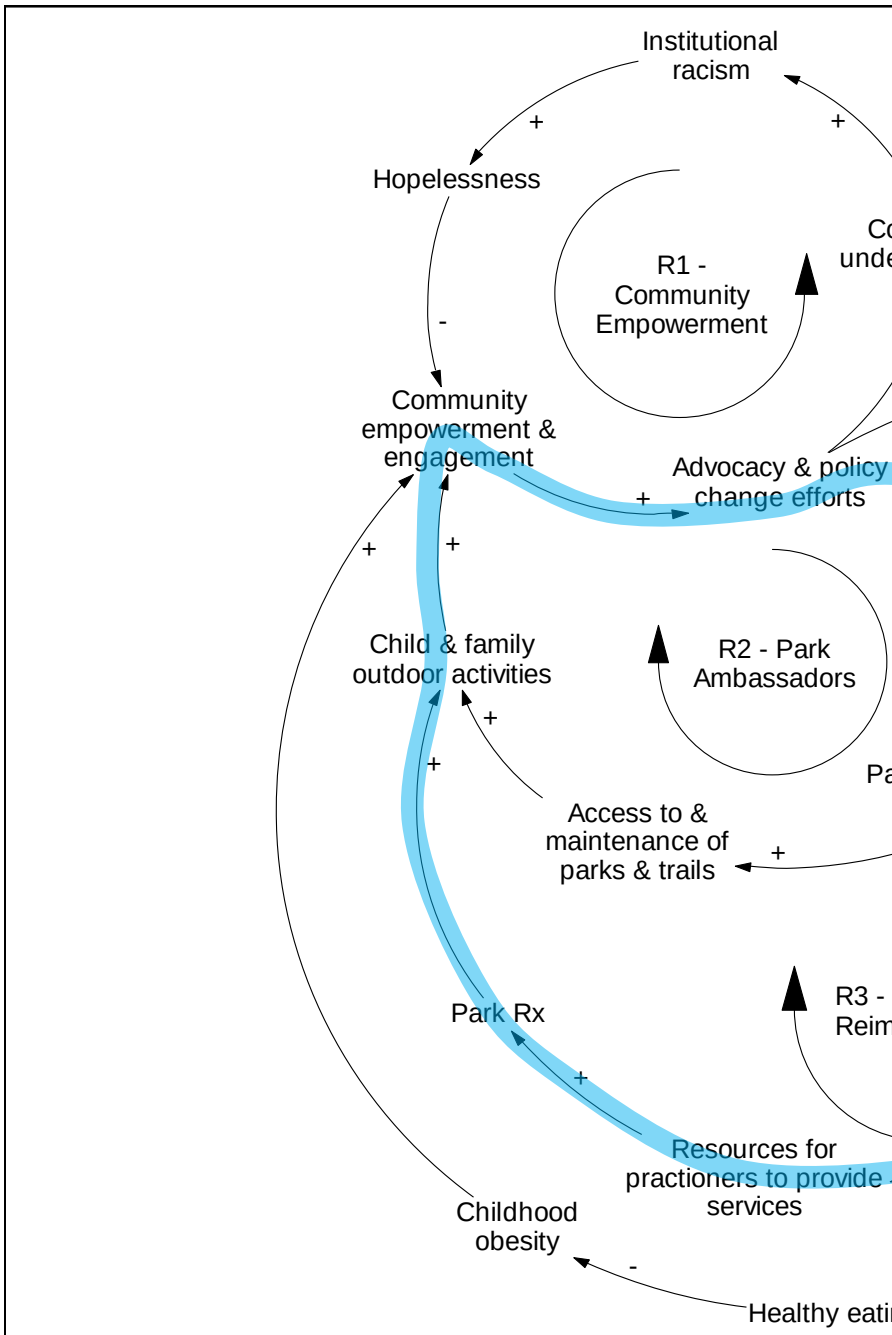
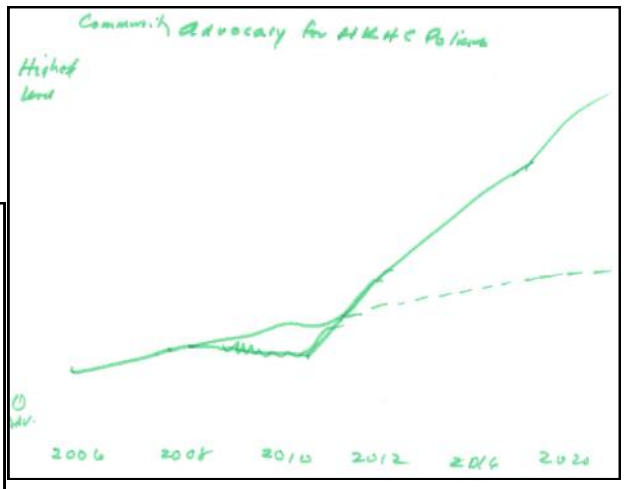


Figure 5: Third Party Reimbursement Feedback Loop

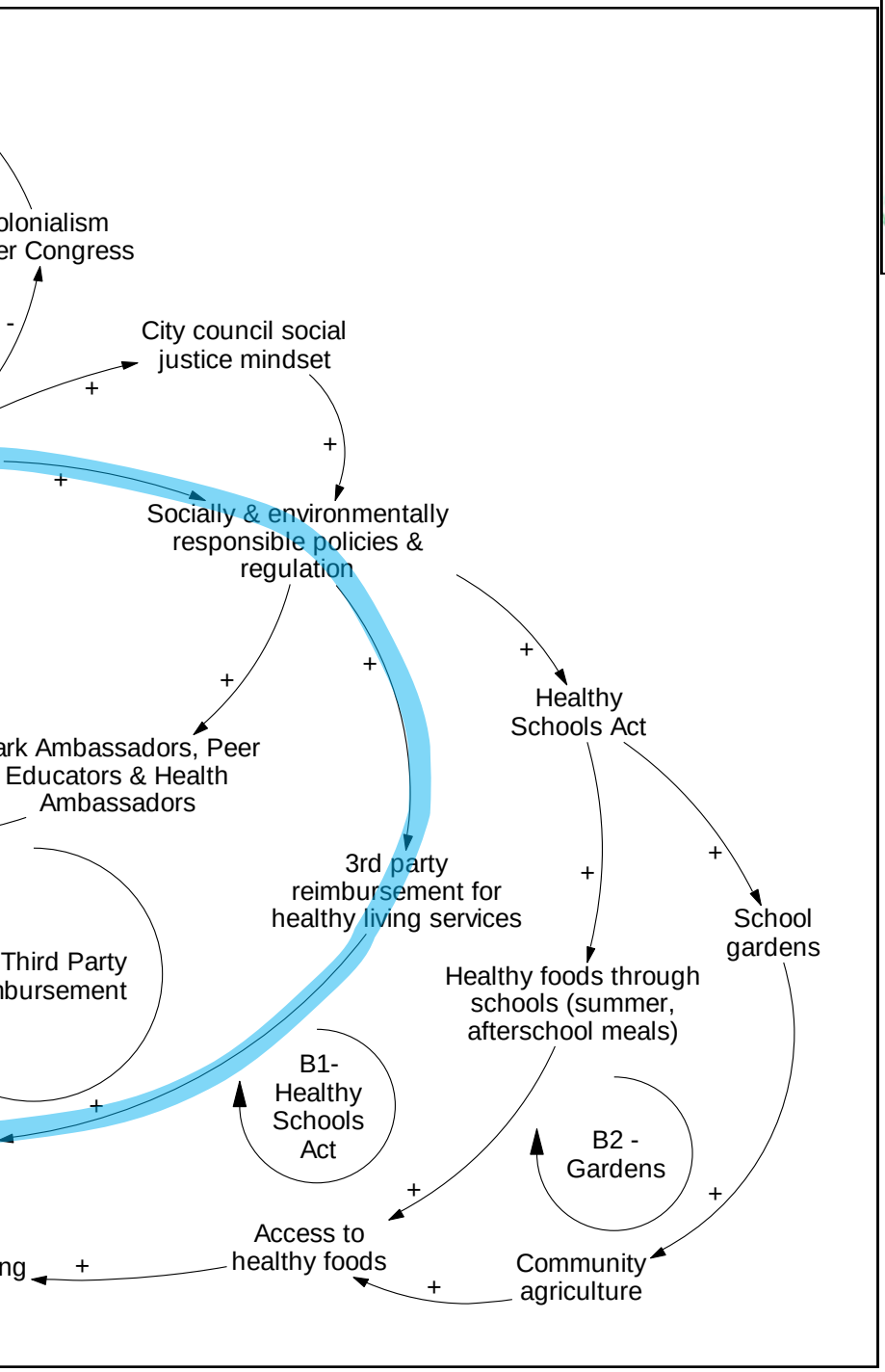
Story A provides a good illustration of the reason why it is not advantageous to separate the feedback loops from the causal loop diagram (see Figures 1-2). For instance, while the socially and environmentally responsible policies and regulations may have an influence on third party reimbursement of healthy living services, many other factors influence third party reimbursement of healthy living services. In this case, examining this loop without the context of the other variables and loops may lead to inappropriate conclusions.

System Insights for *D.C. Healthy Kids, Healthy Communities*

In the behavior over time graphs exercise, participants described an increase in community advocacy for policy changes since 2006 with the hope that community advocacy



for policy changes will continue to increase (see behavior over time graph top right).



System insights for the partnership's third party reimbursement efforts include:

- It is important to engage non-traditional partners (e.g. insurance providers) that understand the importance of health prevention and have the opportunity to influence policy strategies similar to third party reimbursement.
- Families spending more time together in physically active pursuits encourage more active lifestyles for children.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- What are some ways to assess empowerment in the community generally and specifically with respect to policy and environmental changes to support healthy eating and active living?
- What are the ways that residents can interact with civic leaders in order to influence policy and environmental change?

"There are more intentional program leaders that address physical movement of students in the afternoon, because each one of our after-school programs are supposed to have wellness and fitness components; even if it's just games outside With budget cuts, we will lose. We will lose the physical component. If there is no central office that pushes this program, it's gonna be another free for all. Teachers will be hired to give out worksheets and the kids would sit in the classroom. If we are well-funded, I think that we'll keep on growing and we'll keep on continuing bringing the physical movement more and more intentionally to really meet the Healthy School Acts." (Participant)

Healthy Schools Act Feedback Loop

Highlighted in blue in Figure 6, the healthy schools act feedback loop represents one of the *D.C. Healthy Kids, Healthy Communities* strategies to increase active living and healthy eating in Washington DC.

Causal Story for Feedback Loop

Story A: With more emphasis on a Healthy Schools Act, more healthy foods will be available through schools including summer, and after school meals. With more healthy foods available through schools, it will increase access to healthy foods, which will increase healthy eating and reduce childhood obesity. With a reduction in childhood obesity, there will be less need for community empowerment and engagement, which will decreases the need for advocacy and policy change efforts. In turn, less advocacy and policy change efforts will decrease socially and environmentally responsible policies and regulations, which will decrease the need for more Healthy Schools Act.

Story B: Alternatively, with less emphasis on a Healthy Schools Act, less healthy foods will be available through schools including summer, and after school meals. With less healthy foods available through schools, it will decrease access to healthy foods, which will decrease healthy eating and increase childhood obesity. With an increase in childhood obesity, there will be more need for community empowerment and engagement, which will increase the need for advocacy and policy change efforts. In turn, more advocacy and policy change efforts will increase socially and environmentally responsible policies and regulations, which will increase the need for more Healthy Schools Act.

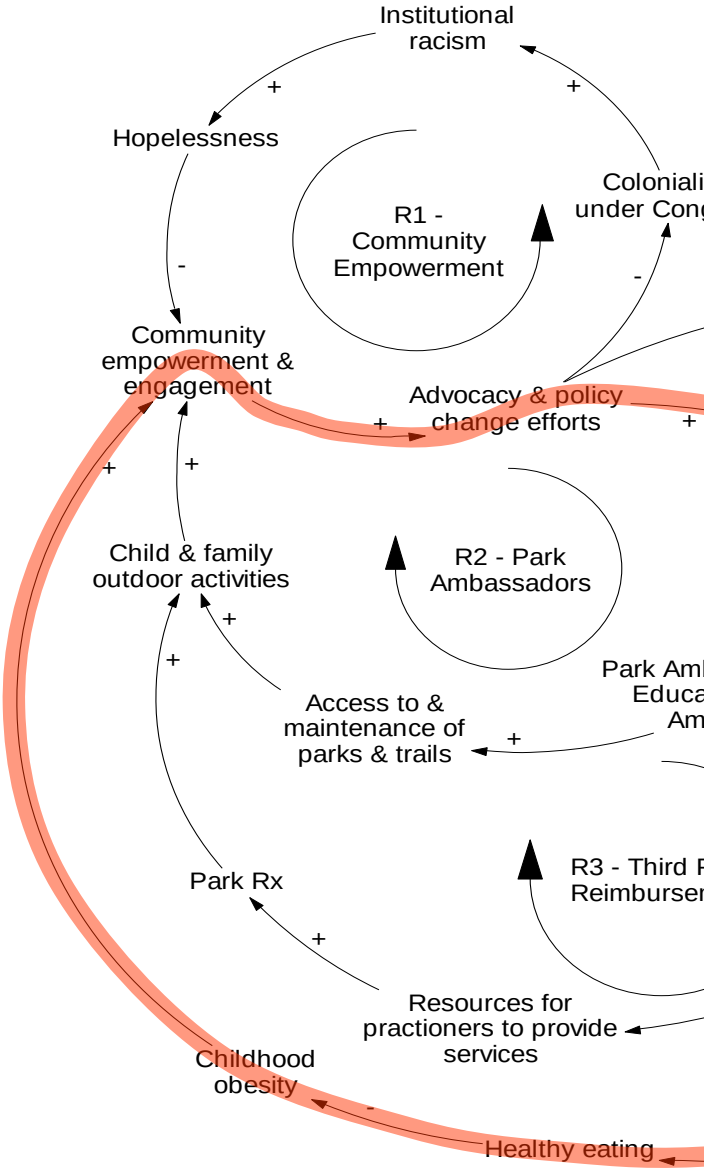


Figure 6: Healthy Schools Act

Balancing Loop and Notation

Different from the previous loops, this one represents a balancing loop (one "-" signs). In a balancing loop, the effect of the variables tend to create more of a stable trend over time, as opposed to one that is continually increasing or decreasing. This effect continues through the cycle and returns a stabilizing influence to the original variable, respectively.

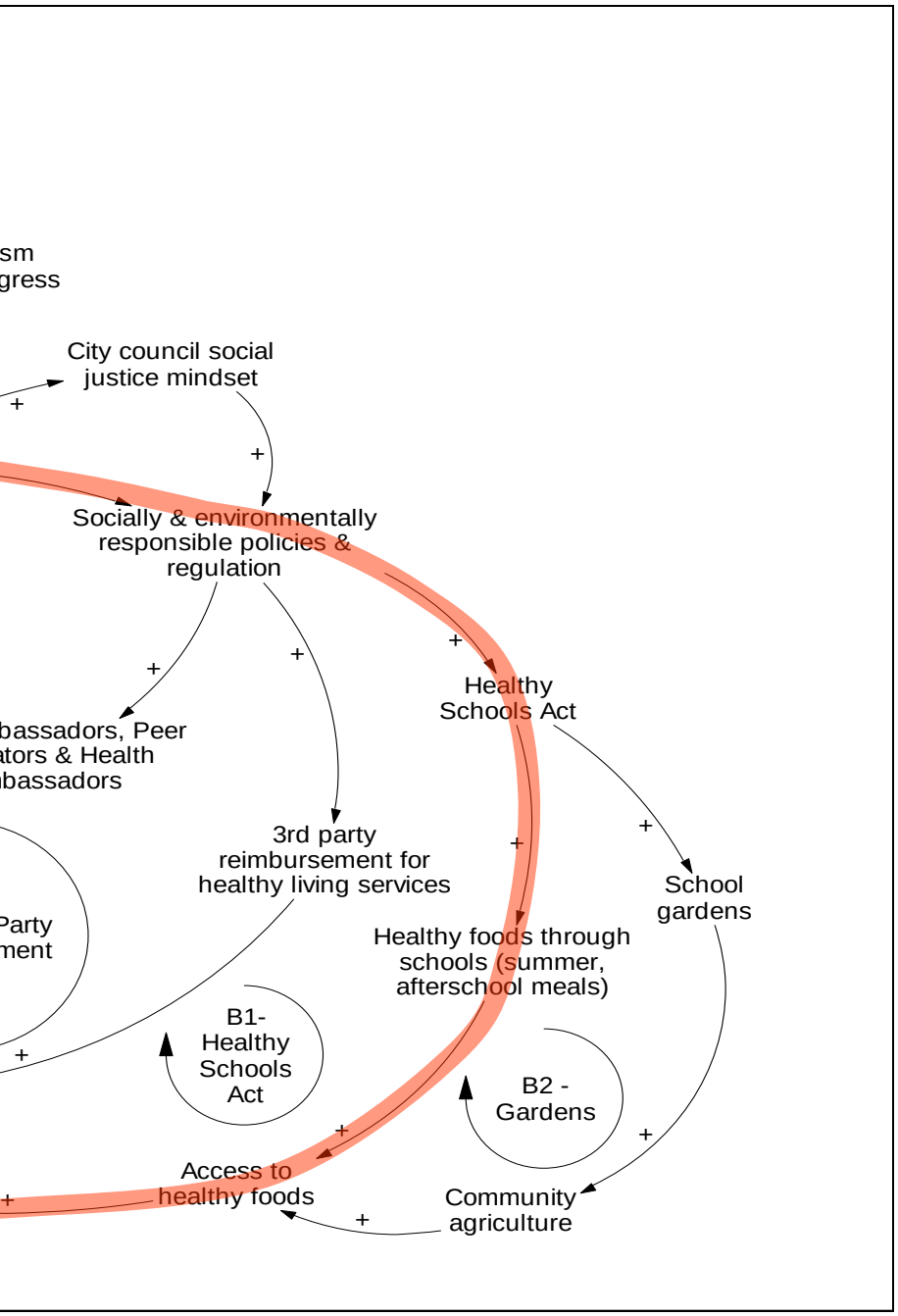
Story A provides a good illustration of the reason why it is not advantageous to separate the feedback loops from the causal loop diagram (see Figures 1-2). For instance, while the socially and environmentally responsible policies and regulation may have an influence on Healthy Schools Act , many other factors influence Healthy Schools Act. In this case, examining this loop without the

"In 1970, our school meal service was recognized as a Silver Plate award for providing more summer meals to children in the country than ever before. And that was not matched until the early 2000's when we exceeded that number, which has now been on a steady rise ever since." (Participant)

context of the other variables and loops may lead to inappropriate conclusions.

System Insights for *D.C. Healthy Kids, Healthy Communities*

In the behavior over time graphs exercise, participants described an increase in the students healthy eating in school and physical activity movement since 2007 to 2012 with the hope that the students healthy eating in school and physical activity movement will continue to increase into the future (see behavior over time graph bottom right).

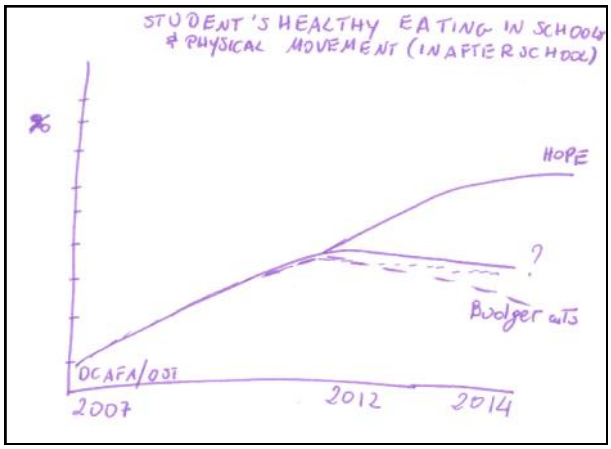


System insights for the partnership's healthy schools act efforts include:

- These environments (e.g., healthy school environments) are critical to support healthy behaviors for youth in the schools.
- Incorporation of efforts to increase community knowledge and empowerment generates more community engagement to bolster advocacy efforts (e.g., programmatic and promotional efforts to complement policy, system, and environmental changes can enhance overall advocacy).
- With deeper roots in the community (e.g., longevity, relationships), residents have more time and feel more confident voicing their concerns and opinions to civic leaders in order to improve or maintain healthy eating and active living assets in the community.

In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- How accessible are junk and fast foods and beverages compared to fresh fruits and vegetables in the schools and among vendors within a one-mile radius of the schools?
- What types of partnerships increase resident engagement and participation in advocacy?
- What factors influence partners, leaders, and residents to collaborate to improve healthy food and beverage standards?



Gardens Feedback Loop

Highlighted in red in Figure 7, the gardens feedback loop represents one of the *D.C. Healthy Kids, Healthy Communities* strategies to increase healthy eating in Washington DC.

Causal Story for Feedback Loop

Story A: With more emphasis on a Healthy Schools Act, more school gardens will be available through schools. With more school gardens, it will increase community agriculture, which will increase access to healthy foods. With more access to healthy foods, healthy eating will increase and reduce childhood obesity. With a reduction in childhood obesity, there will be less need for community empowerment and engagement, which will decreases the need for advocacy and policy change efforts. In turn, less advocacy and policy change efforts will decrease city council social justice mindset, which will decrease socially and environmentally responsible policies and regulations, which will decrease the need for more Healthy Schools Act.

Story B: Alternatively, with less emphasis on a Healthy Schools Act, less school gardens will be available through schools. With less school gardens, it will decrease community agriculture, which will decrease access to healthy foods. With less access to healthy foods, healthy eating will decrease and increase childhood obesity. With an increase in childhood obesity, there will be more need for community empowerment and engagement, which will increases the need for advocacy and policy change efforts. In turn, more advocacy and policy change efforts will increase city council social justice mindset, which will increase socially and environmentally responsible policies and regulations, which will increase the need for more Healthy Schools Act.

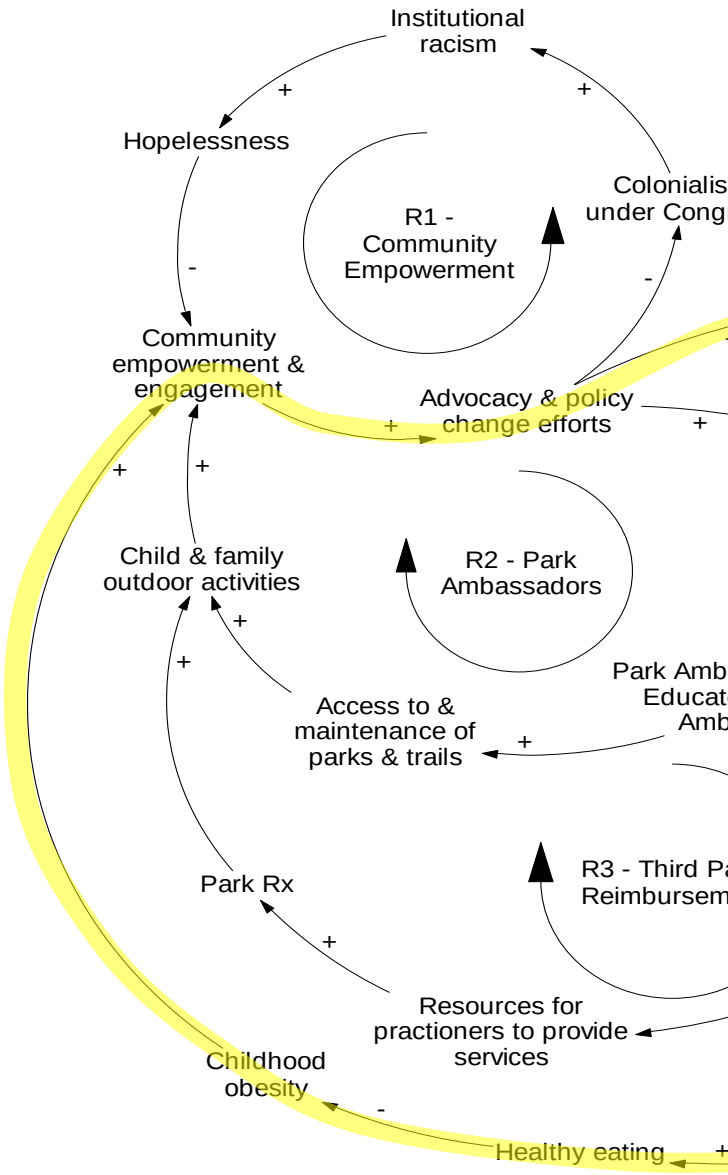


Figure 7: Gardens Feedback Loop

Balancing Loop and Notation

Similar to the previous loop (see Figure 6), this is a balancing loop (one "-" signs). In a balancing loop, the effect of the variables tend to create more of a stable trend over time, as opposed to one that is continually increasing or decreasing. This effect continues through the cycle and returns a stabilizing influence to the original variable, respectively.

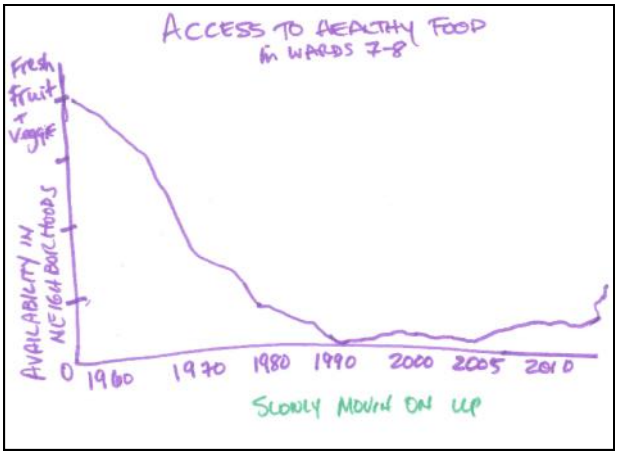
In addition, it includes causal relationships representing more immediate effects (e.g., access to healthy foods influence on healthy

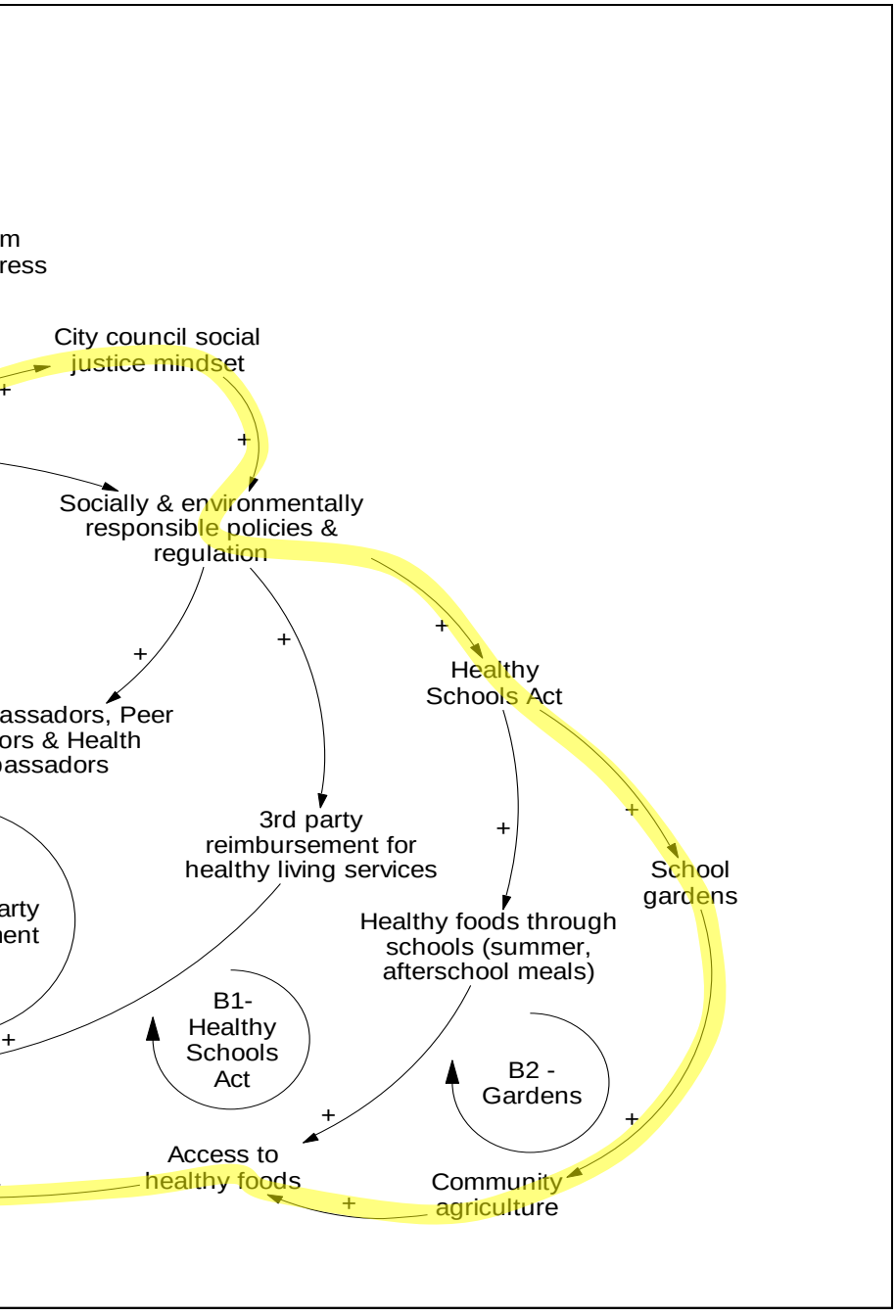
"Some of the initiatives that are underway now, along with the healthy schools initiative are led by groups like the food farm network and urban gardening and agriculture, they're beginning to rise. These "food deserts" quote unquote, as we describe them now, in these areas didn't exist. They're between a two mile radius of where we are right now; there were five grocery stores." (Participant)

eating), and, potentially, delayed effects (e.g., advocacy and policy change efforts influence on city council social justice mindset).

<u>System Insights for *D.C. Healthy Kids, Healthy Communities*</u>

In the behavior over time graphs exercise, participants described a decrease in access to healthy foods for Wards 7 and 8 (lower-income wards in Washington DC) since 1960 to 2012 with the hope that the access to healthy foods in Wards 7 and 8 will increase into the future (see illustration at the top right).





System insights for the partnership's gardens efforts include:

- Community gardens and urban agriculture designed to enhance youth and community engagement can focus on learning about native fruits and vegetables as well as agricultural practices of ancestors; this engagement also connects youth and community residents to other programs and services available in the community.
- Lower-income areas continue to face a lack of access to healthy foods and beverages, and the entire community appears to have higher costs for healthy foods and beverages.
- Incorporation of efforts to increase community knowledge and empowerment generates more community engagement to bolster advocacy efforts (e.g., programmatic and promotional efforts to complement policy, system, and environmental changes can enhance overall advocacy).

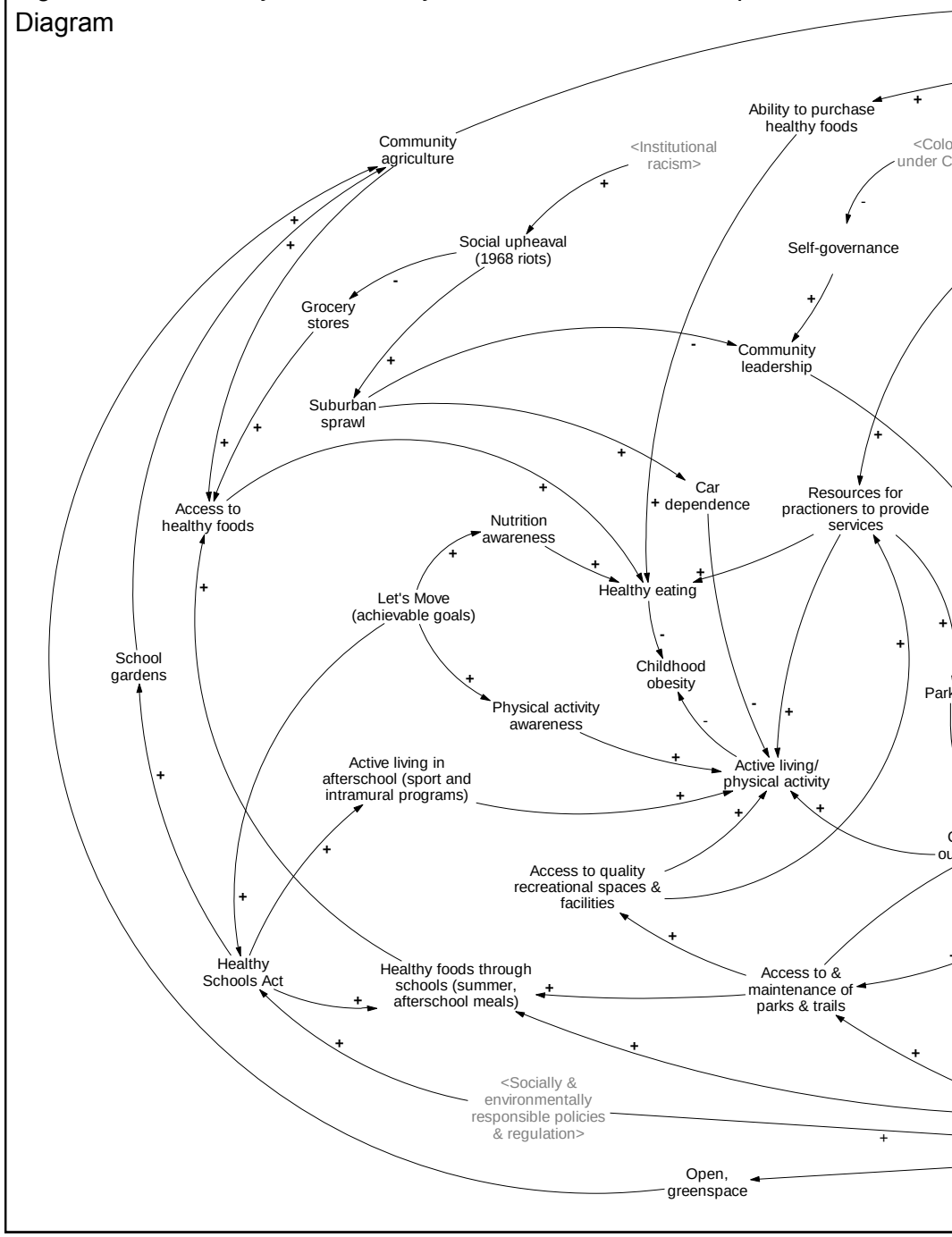
In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including:

- What are the primary drivers of the relatively high income disparities in the community? What subpopulations tend to have lower incomes and what subpopulations tend to have higher incomes? What jobs, if any, are accessible to these different populations?
- What is the optimal number of school or community gardens or farms for a neighborhood or urban area?
- What is the impact of greater consumption of unhealthy, processed foods on students' academic and testing performance?

Opportunities for Systems Thinking in Washington DC

This storybook provided an introduction to some basic concepts and methods for systems thinking at the community level, including: causal loop diagrams, variables and shadow variables, causal relationships and polarities, reinforcing feedback loops, and balancing feedback loops, among others. For the *D.C. Healthy Kids, Healthy Communities* partners, this storybook also summarized the healthy eating, active living, partnership and community capacity, social determinants, and health and health behaviors subsystems in the Washington DC causal loop diagram as well as six specific feedback loops corresponding to the partnership's primary strategies.

Figure 8: *D.C. Healthy Kids, Healthy Communities* Causal Loop Diagram



This causal loop diagram reflects a series of conversations among partners and residents from 2011 to 2013. Some discussions probed more deeply into different variables through the behavior over time graphs exercise, or causal relationships through the causal loop diagram exercise.

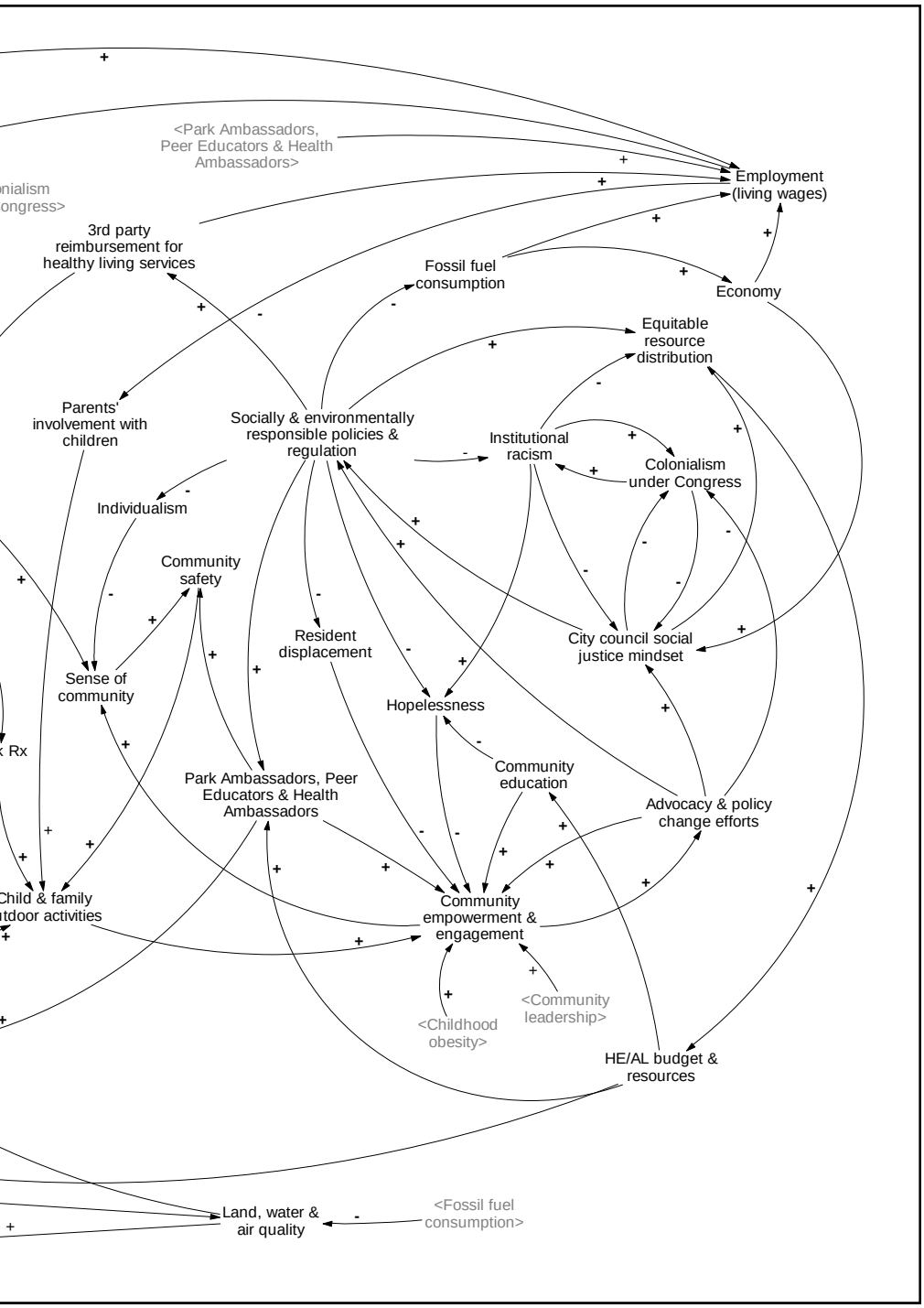
This represented a first attempt to collectively examine the range of things that affect or are affected by policy, system, and environmental changes in Washington DC to promote healthy eating and active living as well as preventing childhood overweight and obesity.

Yet, there are several limitations to this storybook, including:

- the participants represent a sample of the *D.C. Healthy Kids, Healthy Communities* partners (organizations and residents) as opposed to a representative snapshot of government agencies, community organizations, businesses, and community residents;
- the behavior over time graphs and the causal loop diagram represent perceptions of the participants in these exercises (similar to a survey or an interview representing perceptions of the respondents);
- the exercises and associated dialogue took place in brief one- to two-hour sessions, compromising the group's capacity to spend too much time on any one variable, relationship, or feedback loop; and
- the responses represent a moment in time so the underlying structure of the diagram and the types of feedback represented may reflect "hot button" issues of the time.

Much work is yet to be done to ensure that this causal loop diagram is accurate and comprehensive, for example:

- having conversations to discuss existing feedback loops to ensure that the appropriate variables and relationships are represented accurately;



- reviewing the behavior over time graphs (see also Appendix E) to confirm that the trends reflect common perceptions among residents and compare these trends to actual data;
- revisiting variables removed because they were not part of feedback loops, including healthy corner stores, farmers' market, food preparation, student academic performance and test scores, screen time, current executive leadership, school PE & recess; and
- starting new conversations about other variables (behavior over time graphs exercise) or relationships (causal loop diagram exercise) to add to this diagram.

In addition, different subgroups in Washington DC may use this causal loop diagram to delve in deeper into some of the subsectors (e.g., healthy eating, active living) or feedback loops, creating new, more focused causal loop diagrams with more specific variables and causal relationships.

Use of more advanced systems science methods and analytic approaches to create computer simulation models is another way to take this early work to the next level. The references section includes citations for resources on these methods and analytic approaches, and it is necessary to engage professional systems scientists in these activities.

Please refer to the Appendices for more information, including:

- Appendix A: Behavior over time graphs generated during site visit
- Appendix B: Photograph of the original version of the *D.C. Healthy Kids, Healthy Communities* Causal Loop Diagram
- Appendix C: Original translation of the causal loop diagram into Vensim PLE
- Appendix D: Transcript translation of the causal loop diagram into Vensim PLE
- Appendix E: Behavior over time graphs not represented in the storybook

References for Systems Thinking in Communities:

Group model building handbook:
Hovmand, P., Brennan L., & Kemner, A. (2013). Healthy Kids, Healthy Communities Group Model Building Facilitation Handbook. Retrieved from http://www.transtria.com/hkhc.

Vensim PLE software for causal loop diagram creation and modification:
Ventana Systems. (2010). Vensim Personal Learning Edition (Version 5.11A) [Software]. Available from http://vensim.com/vensim-personal-learning-edition/

System dynamics modeling resources and support:
Andersen, D. F. and G. P. Richardson (1997). "Scripts for group model building." System Dynamics Review 13(2): 107-129.

Hovmand, P. (2013). Community Based System Dynamics. New York, NY: Springer.

Hovmand, P. S., et al. (2012). "Group model building "scripts" as a collaborative tool." Systems Research and Behavioral Science 29: 179-193.

Institute of Medicine (2012). An integrated framework for assessing the value of community-based prevention. Washington, DC, The National Academies Press.

Meadows, D. (1999). Leverage points: places to intervene in a system. Retrieved from http://www.donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

Richardson, G. P. (2011). "Reflections on the foundations of system dynamics." System Dynamics Review 27 (3): 219-243.

Rouwette, E., et al. (2006). "Group model building effectiveness: A review of assessment studies." System Dynamics Review 18(1): 5-45.

Sterman, J. D. (2000). Business dynamics: Systems thinking and modeling for a complex world. New York, NY: Irwin McGraw-Hill.

System Dynamics in Education Project. (1994). Road maps: A guide to learning system dynamics. Retrieved from http://www.clexchange.org/curriculum/roadmaps/

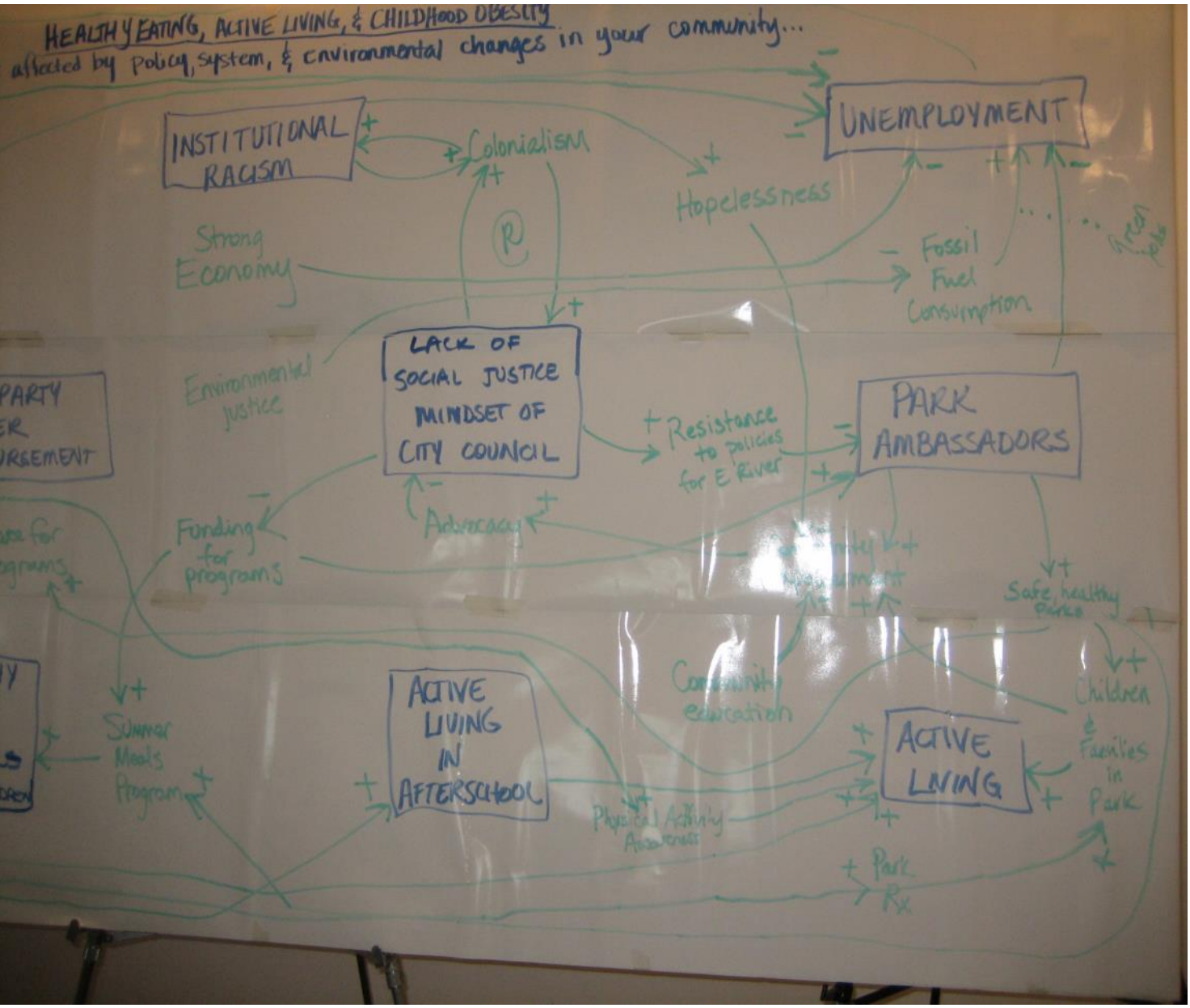
Vennix, J. (1996). Group model building. New York, John Wiley & Sons.

Zagonel, A. and J. Rohrbaugh (2008). Using group model building to inform public policy making and implementation. Complex Decision Making. H. Qudart-Ullah, J. M. Spector and P. I. Davidsen, Springer-Verlag: 113-138.

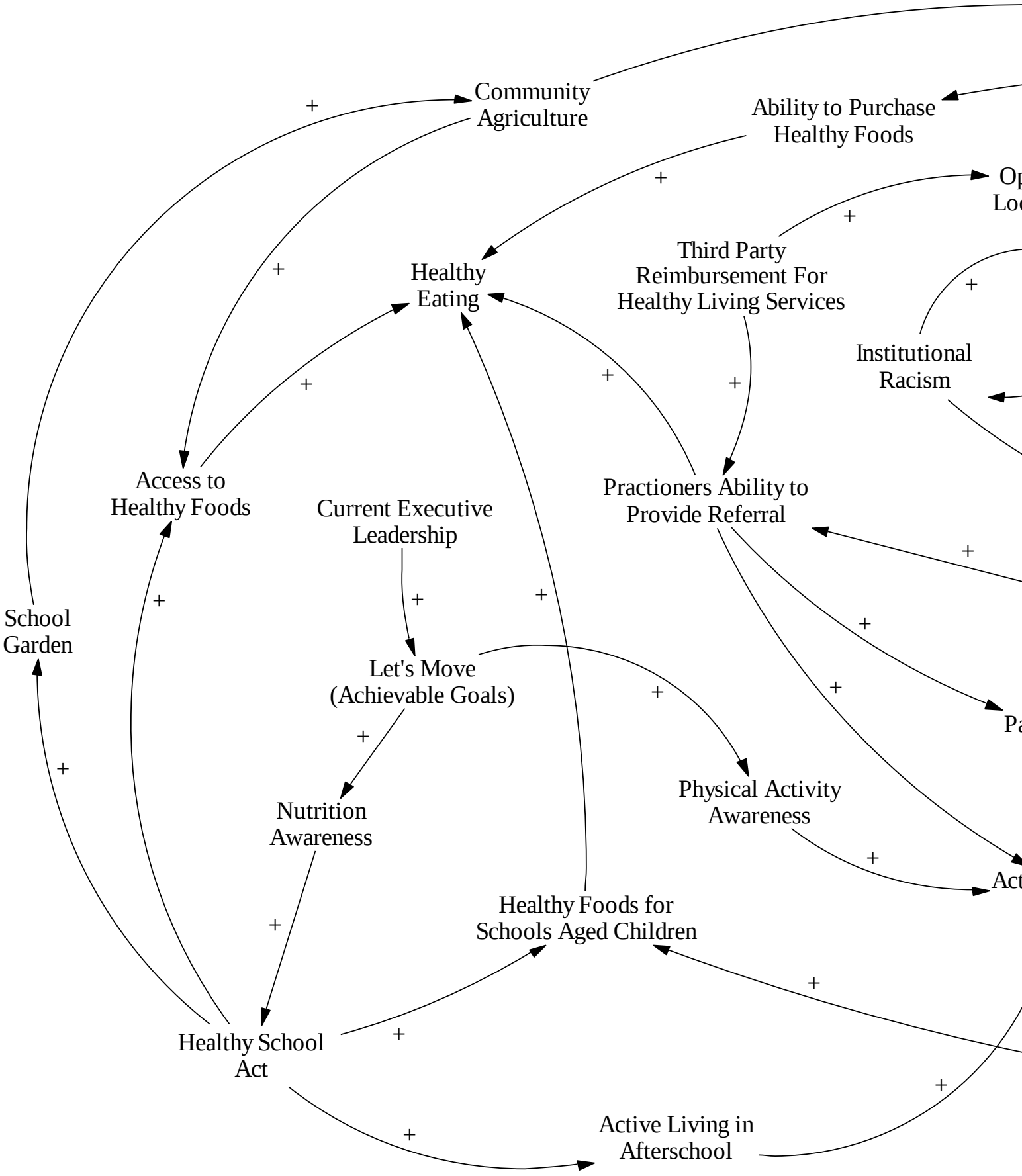
Appendix A: Behavior Over Time Graphs Generated during Site Visit

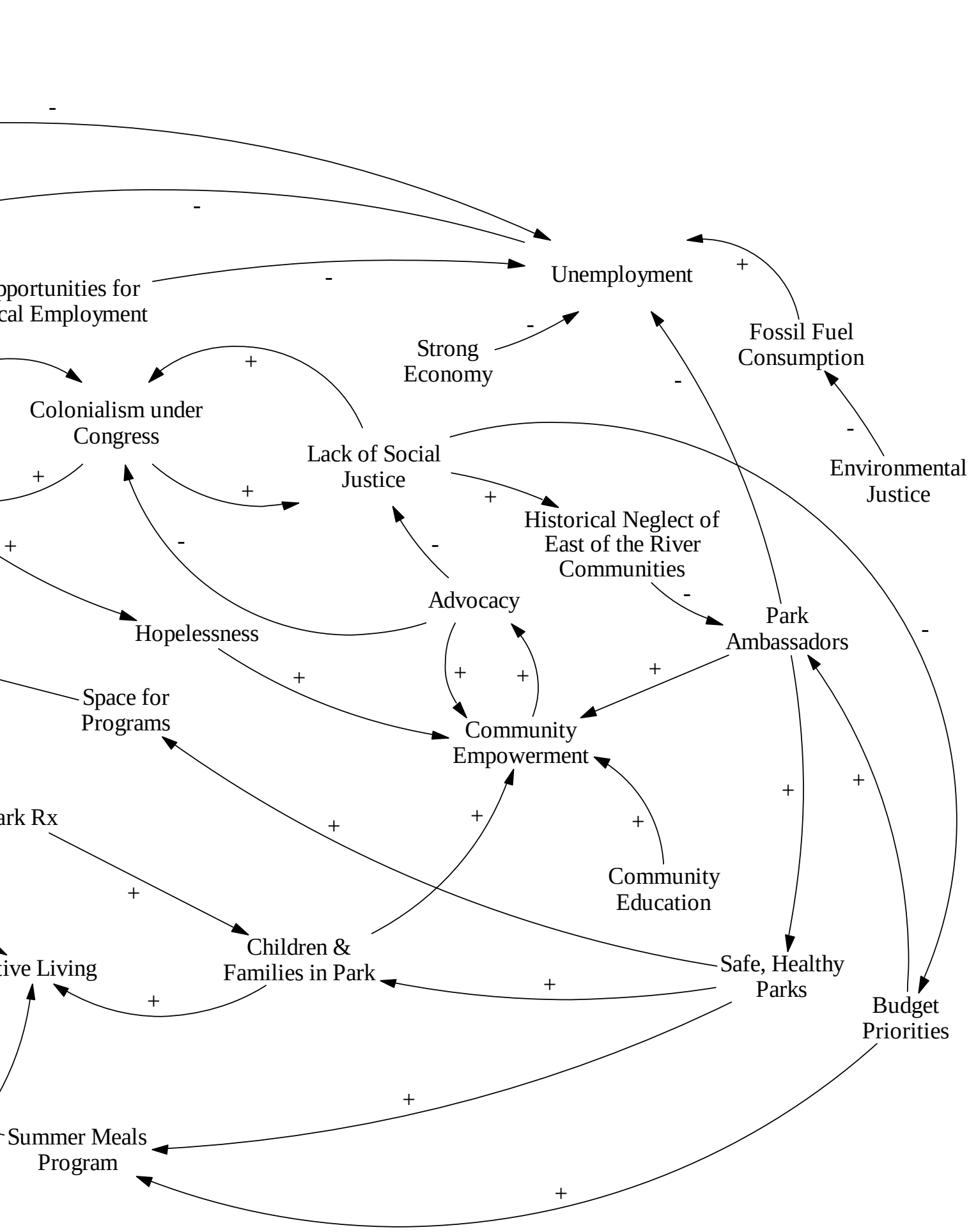
Washington DC: *D.C. Healthy Kids, Healthy Communities*	
Categories	**Number of Graphs**
Active Living Behavior	5
Active Living Environments	0
Funding	0
Healthy Eating Behavior	1
Healthy Eating Environments	3
Marketing and Media Coverage	0
Obesity and Long Term Outcomes	1
Partnership & Community Capacity	5
Policies	0
Programs & Promotions (Education and Awareness)	2
Social Determinants of Health	2
Total Graphs	**19**

Appendix B: Photograph of the Original Version of the *D.C. Healthy Kids, Healthy Communities* **Causal Loop Diagram**

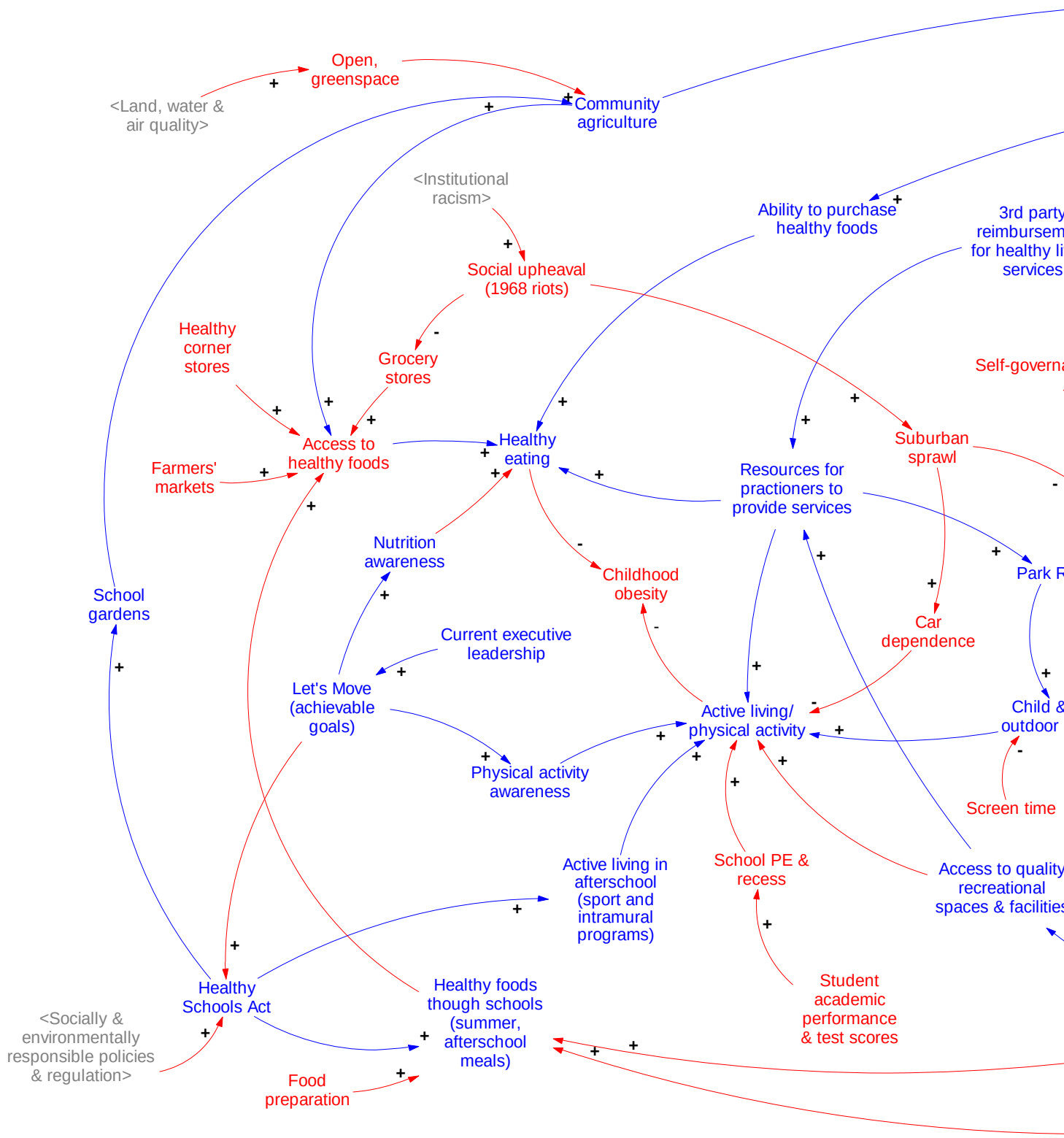

HEALTHY EATING, ACTIVE LIVING, & CHILDHOOD OBESITY
affected by Policy, System, & Environmental changes in your community...
INSTITUTIONAL RACISM
Colonialism
UNEMPLOYMENT
Hopelessness
Strong Economy
Fossil Fuel Consumption
Environmental Justice
LACK OF SOCIAL JUSTICE MINDSET OF CITY COUNCIL
Resistance to policies for E River
PARK AMBASSADORS
Funding for programs
Advocacy
Safe, healthy parks
Summer Meals Program
ACTIVE LIVING IN AFTERSCHOOL
Community education
ACTIVE LIVING
Children & Families in Park
Physical Activity Awareness
Park Rx

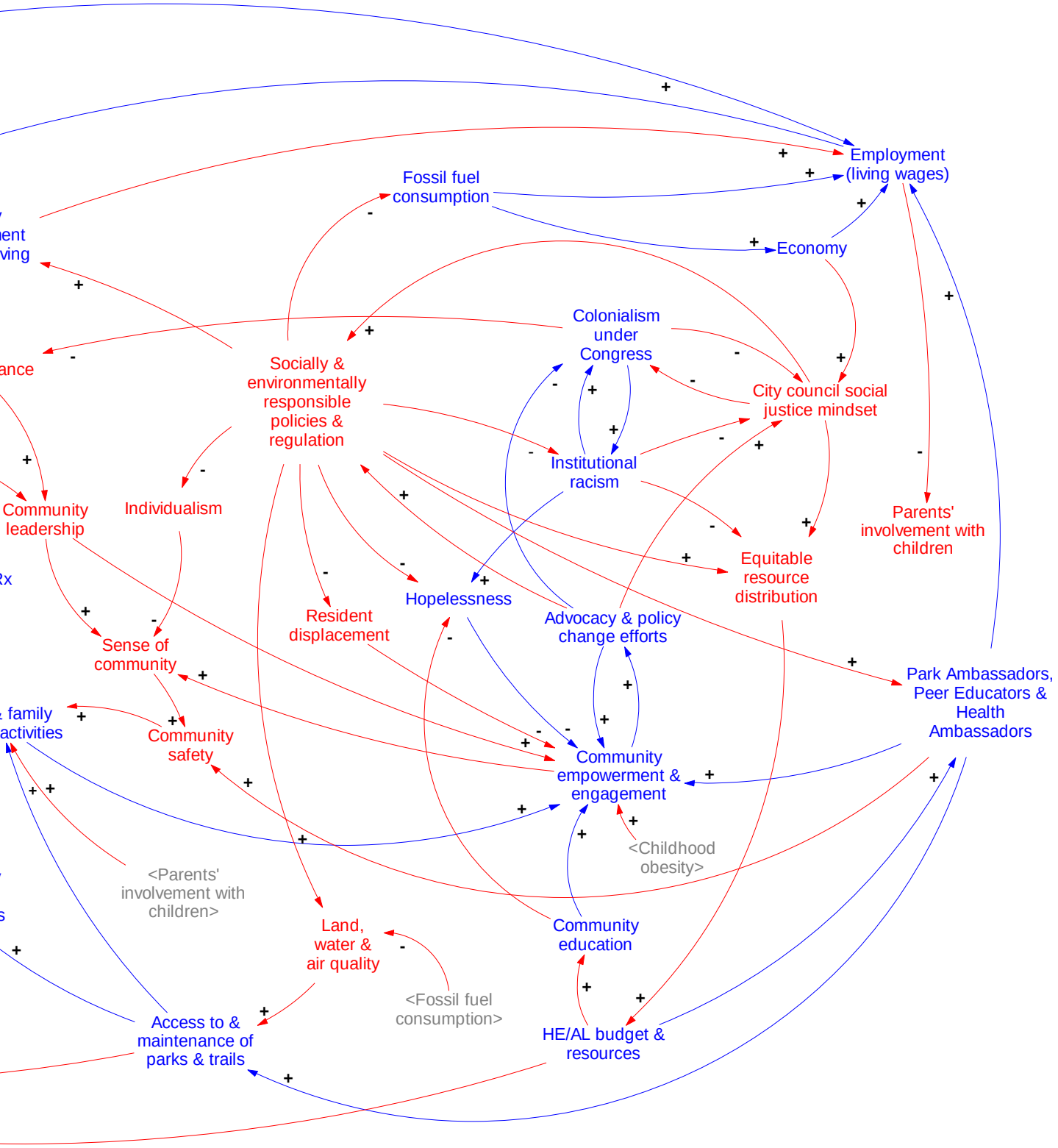
Appendix C: Original Translation of the Causal Loop Diagram into Vensim PLE




Unemployment
Strong Economy
Fossil Fuel Consumption
Colonialism under Congress
Lack of Social Justice
Environmental Justice
Historical Neglect of East of the River Communities
Advocacy
Hopelessness
Park Ambassadors
Space for Programs
Community Empowerment
Community Education
Children & Families in Park
Safe, Healthy Parks
Budget Priorities
Summer Meals Program

Appendix D: Transcript Translation of the Causal Loop Diagram into Vensim PLE




Employment (living wages)
Fossil fuel consumption
Economy
Colonialism under Congress
Socially & environmentally responsible policies & regulation
City council social justice mindset
Institutional racism
Community leadership
Individualism
Parents' involvement with children
Equitable resource distribution
Hopelessness
Resident displacement
Advocacy & policy change efforts
Sense of community
Park Ambassadors, Peer Educators & Health Ambassadors
Community safety
Community empowerment & engagement
<Childhood obesity>
<Parents' involvement with children>
Land, water & air quality
Community education
<Fossil fuel consumption>
Access to & maintenance of parks & trails
HE/AL budget & resources

Appendix E: Behavior Over Time Graphs not Represented in the Storybook 2.5x1.99