

## **Systems Thinking in Communities:**

### **Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Greenville, South Carolina**



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## Introduction

*LiveWell Greenville* is one of 49 community partnerships participating in the national *Healthy Kids, Healthy Communities* program of the Robert Wood Johnson Foundation ([www.healthykidshealthycommunities.org](http://www.healthykidshealthycommunities.org)). The purpose of this *LiveWell Greenville* project was to introduce systems thinking at the community level by identifying the essential parts of the LiveWell Greenville 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 and residents 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., residents, businesses, universities, community-based organizations, advocates) 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](http://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.

## Greenville, South Carolina: Background and Local Participation

Greenville County, located in the northwest corner of South Carolina, has a population of 451,225, making it the most populated county in the state (see Figure 2). The county is 73.8% White, 18.1% Black, and 8.1 Other. The median household income is \$48,518 and approximately 15% of the population lives below the federal poverty level. The project focused on three primary communities: Berea, Nicholtown, and Sterling. Berea, the largest of the target communities, has a population of 14,295. Residents in Berea are mainly White (60.6%) and approximately 30% of the population lives below the poverty level. A large proportion (25.2%) of Hispanics live in the community. Nicholtown is located about 1.5 miles from downtown, in the heart of Greenville. The community consists of 2,708 residents who are mainly African American. In 2002, about 60% of the population had a median household income less than \$25,000. The Sterling community has a population of 10,483. Residents are mainly Black, and the median household income is \$28,101.

YMCA of Greenville was the lead agency for the LiveWell Greenville (LWG) partnership. The YMCA is one of the nation's leading nonprofit organizations focused on strengthening communities through youth development, healthy living, and social responsibility. The YMCA of Greenville is an autonomous metropolitan association governed by a Board of Directors made up of local citizens who are responsible for the policies and practices of the 11-site association.<sup>9</sup>

A coalition of community residents and organizations interested in addressing obesity rates in their community formed in 2008 and continued under several different names (e.g., Childhood Obesity Coalition, Activate Greenville) to engage a broad group of community stakeholders and organizations. In March 2010, partners were invited to attend a community forum to develop a strategic framework addressing obesity and adopted the name Healthy Kids, Healthy Greenville. During the first year of the HKHC project, the coalition engaged in a formal rebranding process. The resulting brand, LiveWell Greenville, was officially launched in 2011, as a local coalition that focused on a macro-level approaches to decreasing childhood obesity. The coalition utilized community assets to coordinate and align existing and developing community efforts toward making Greenville County a healthier place to live, work, and play by creating policies, systems, and environments.

During the rebranding process, a leadership team organized a retreat for more than 80 key public and private stakeholders and community members throughout three communities (i.e., Berea, Nicholtown, Sterling) and the surrounding Greenville County to develop a strategic community action plan addressing childhood obesity and fostering broad-scale community ownership. During this retreat, leadership team commitment and focus area assignments were coordinated for LWG coalition workgroups. A leadership team member (or, alternatively, an expert in the field with a specific workgroup) was asked to serve as the lead facilitator within each workgroup during individual monthly workgroup meetings. Routine monthly meetings were held throughout the HKHC initiative to ensure strategic movement on HKHC action plans. The leadership team provided technical assistance to the eight individual workgroups that were developed:

- **Active and Public Transit Workgroup:** Increase access to and connection between sidewalks and bike paths, improve directional signage on trails and in neighborhoods, and increase access through active public transit services to supermarkets and other healthy food retail establishments.
- **Physical Activity and Recreation Workgroup:** Increase awareness of existing parks and recreation facilities through collaborative mapping and promotions advocating parks and facilities within communities.
- **Access to Healthy Foods Workgroup (Food Policy Subcommittee):** Coordinate a network of community gardens, build new gardens, and establish mobile farmers' markets.
- **After School/Child Care Workgroup:** Implement a 'gold standard' system in centers to provide healthy activities and snacks, through provider training on healthy policy and curriculum promotion and technical assistance for sourcing, preparing, and storing nutritious snack options.
- **School Workgroup:** Assist schools in Safe Routes to School efforts and establishing healthier food fundraising, procurement practices for vendors of locally-grown foods, and inclusion in school menus.
- **Worksite Workgroup:** Implement wellness policies and environment changes to create conditions for employees to make healthy choices.
- **Healthcare Workgroup:** Implement pediatric care provider training in motivational interviewing and a referral protocol to prevent and treat overweight and obesity in primary care.
- **Faith-based Workgroup:** Cultivate faith-based environments that promote healthy choices.

### **LiveWell Greenville's Priorities and Strategies**

The partnership and capacity building strategies of *LiveWell Greenville (LWG)* included:

- **Formal Retreats and Training:** Over 80 community members and stakeholders (e.g., after school providers, child care providers, hospital representatives, school board trustees and staff, PTA, health department, health care providers, philanthropists, elected leaders, city and county government representatives, public and active transit planners, recreation providers, media representatives) attended strategic retreats to develop focus areas and form workgroups with strategic action plans to achieve policy and environmental changes. LWG provided financial support for and assisted with leadership development training for facilitators to lead workgroups on how to guide planning and implementation.
- **Community Change Agents:** LWG identified the Sterling Land Trust Board, the Nicholtown Neighborhood Association, and Russell Community Church as leaders in the target communities who could serve as change agents and assisted with capacity building for the newly formed Board.
- **Community Advisory Committees:** LWG coordinated adult and youth planning committees to guide engagement, assessment, and implementation processes aimed at strategy-specific targets.

The healthy eating and active living strategies of *LiveWell Greenville* included:

- **Active Transportation:** The partnership implemented active transportation improvements aimed at increasing bicycle and pedestrian access, including physical changes to streets, construction of trails, installation of way-finding signage, and development of bike storage stations.
- **Access to Healthy Food:** The partnership increased access to affordable and nutritious produce through implementation of a farmers' market and mobile market in communities with limited access to fresh produce.
- **Nutrition and Physical Activity Standards in After School Setting (Out of School Time):** The partnership increased policy and environment standards for healthy eating and active living in out of school time centers through gold standard policies that exceeded the requirement for licensure.

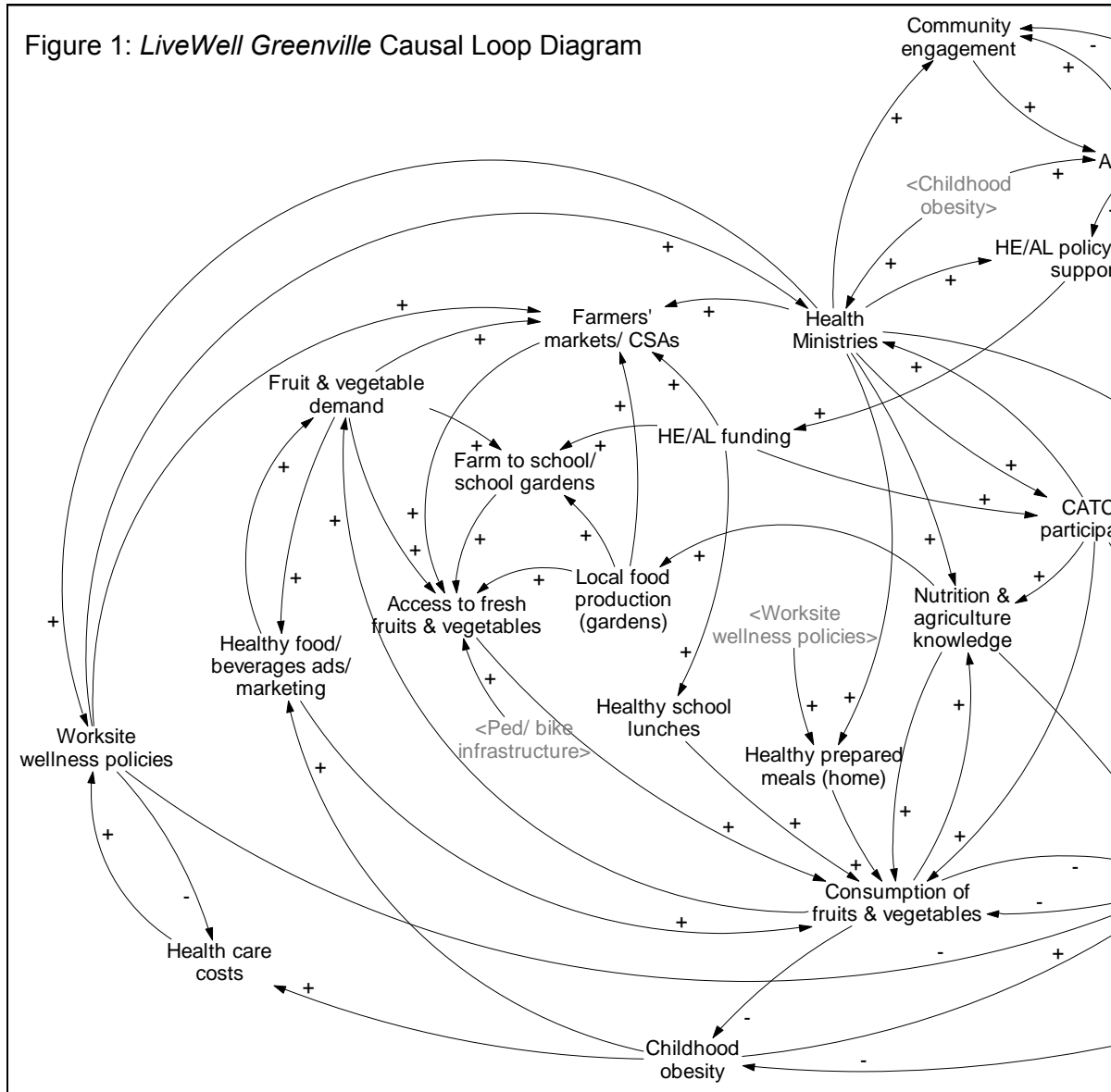
For more information on the partnership, please refer to the Greenville case report ([http://www.transtria.com/hkhc\\_case\\_reports.php](http://www.transtria.com/hkhc_case_reports.php)).

## Systems Thinking in Communities: Greenville, South Carolina

“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 Greenville, South Carolina 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.

Models, such as Figure 1, provide a way to visualize all the elements of the system and their interactions, with a focus on causal relationships as opposed to associations. Through the model, specific types of causal relationships, or feedback loops, underlying the behavior of the dynamic system, can be identified to provide insights into what is working or not working in the system to support the intended outcomes (in this case, increases in healthy eating and active living, and decreases in childhood overweight and obesity). In system dynamics, the goal is to identify and understand the system feedback loops, or the cause-effect relationships that form a circuit where the effects “feed back” to influence the causes.

Figure 1: *LiveWell Greenville* Causal Loop Diagram



### Group Model Building

Members of the *LiveWell Greenville* partnership participated in a group model building session in July, 2012 and generated this system, also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included residents; representatives from businesses, universities, community-based organizations; and advocates. 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.

#### Behavior Over Time Graphs

To identify the range of things that affect or are affected by policy, system, and environmental changes in Greenville related to healthy eating, active living, and childhood obesity, participants designed graphs to name the influences



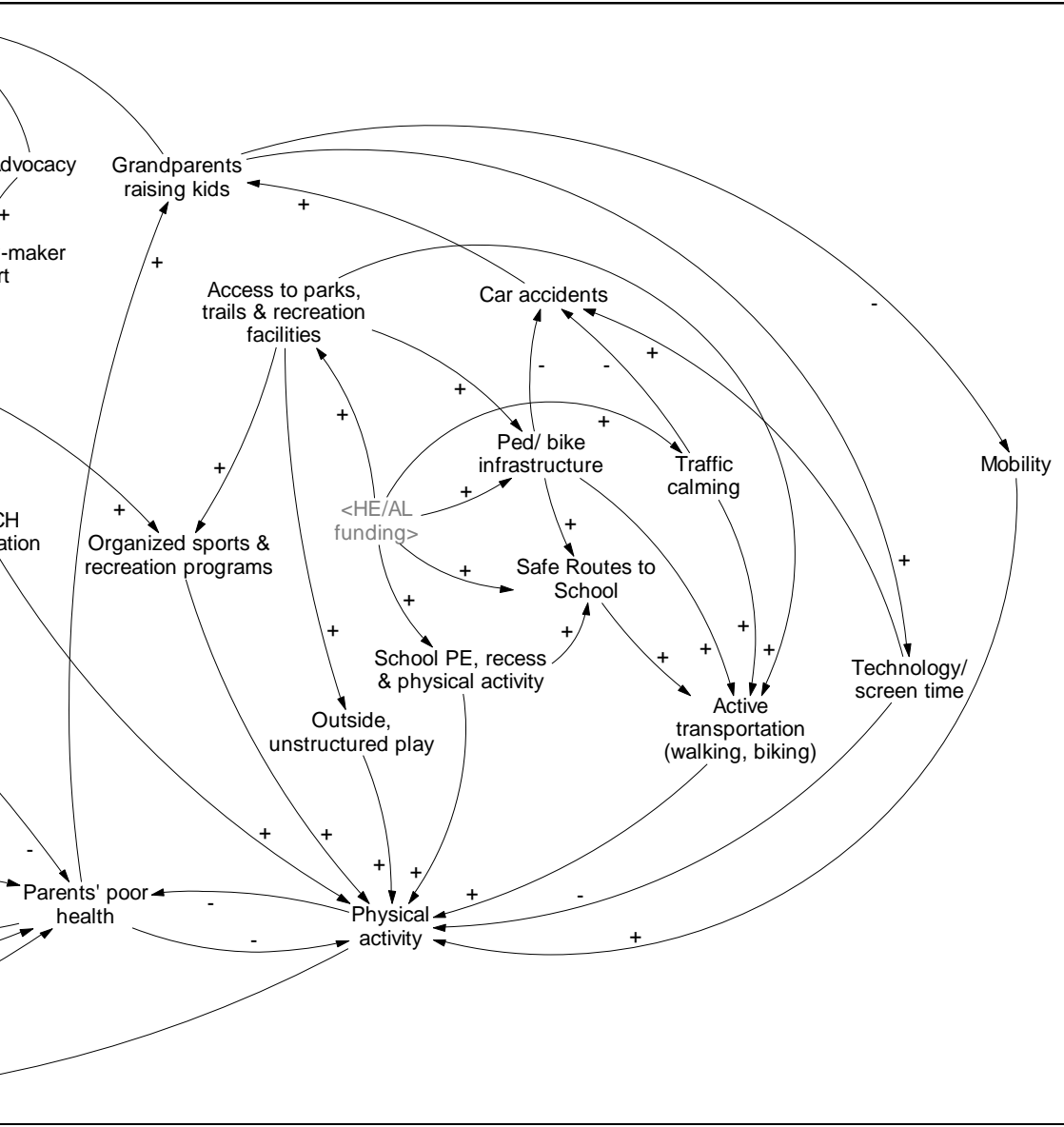
and to illustrate how the influences have changed over time (past, present, and future). In this illustration, the number of physician offices and practices hiring wellness professionals has increased over time from 2000 to 2012 with the hope that more wellness professional will be hired at physician practices into the future (see behavior over time graph previous page bottom right).

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 engagement in this causal loop diagram. One feedback



loop is: community engagement → advocacy → community engagement. A second feedback loop is: community engagement → advocacy → healthy eating and active living policymaker support → healthy eating and active living funding → CATCH participation → Health ministries → community 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 community engagement. Some variables may increase community engagement while other variables limit community engagement. 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 *LiveWell Greenville* 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 Greenville, South Carolina and to stimulate greater conversation related to Greenville'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 Greenville, South Carolina. 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.

### Healthy Eating Policies and Environments (Red)

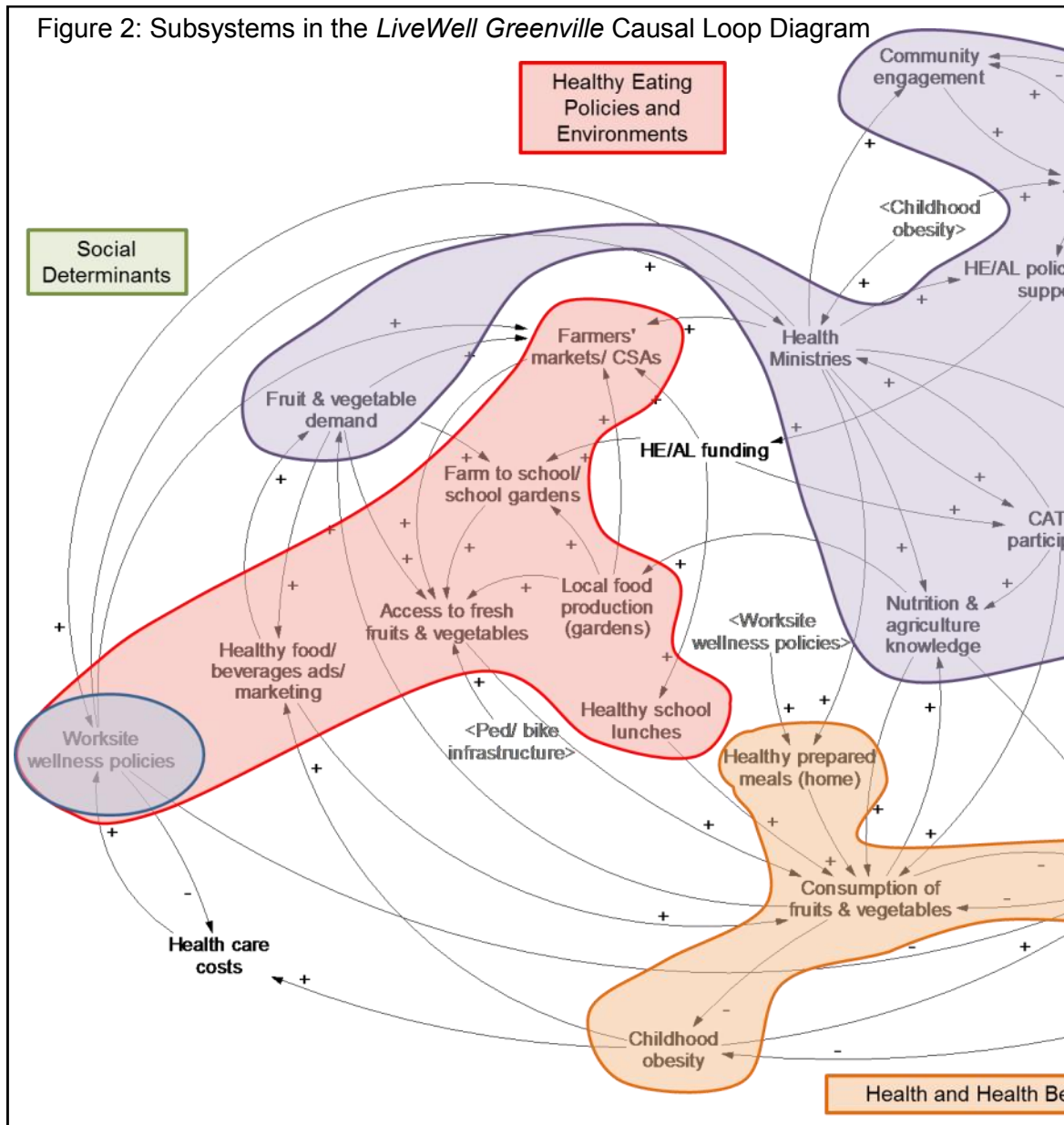
The healthy eating policy and environmental subsystem includes food production (e.g., local food production including gardens), food distribution and procurement (e.g., farm to school gardens), and food retail (e.g., farmers' markets and CSAs). During the behavior over time graphs exercise, the participants generated eleven graphs related to policy or environmental strategies (e.g., worksite wellness policies) or contexts (e.g., access to fresh fruits and vegetables) that affected or were

affected by the work of *LiveWell Greenville*. 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 twelve graphs related to policy or environmental strategies (e.g., pedestrian and bike infrastructure, traffic calming) or contexts (e.g., car accidents) that affected or were affected by the partnership's work.

### Health and Health Behaviors (Orange)

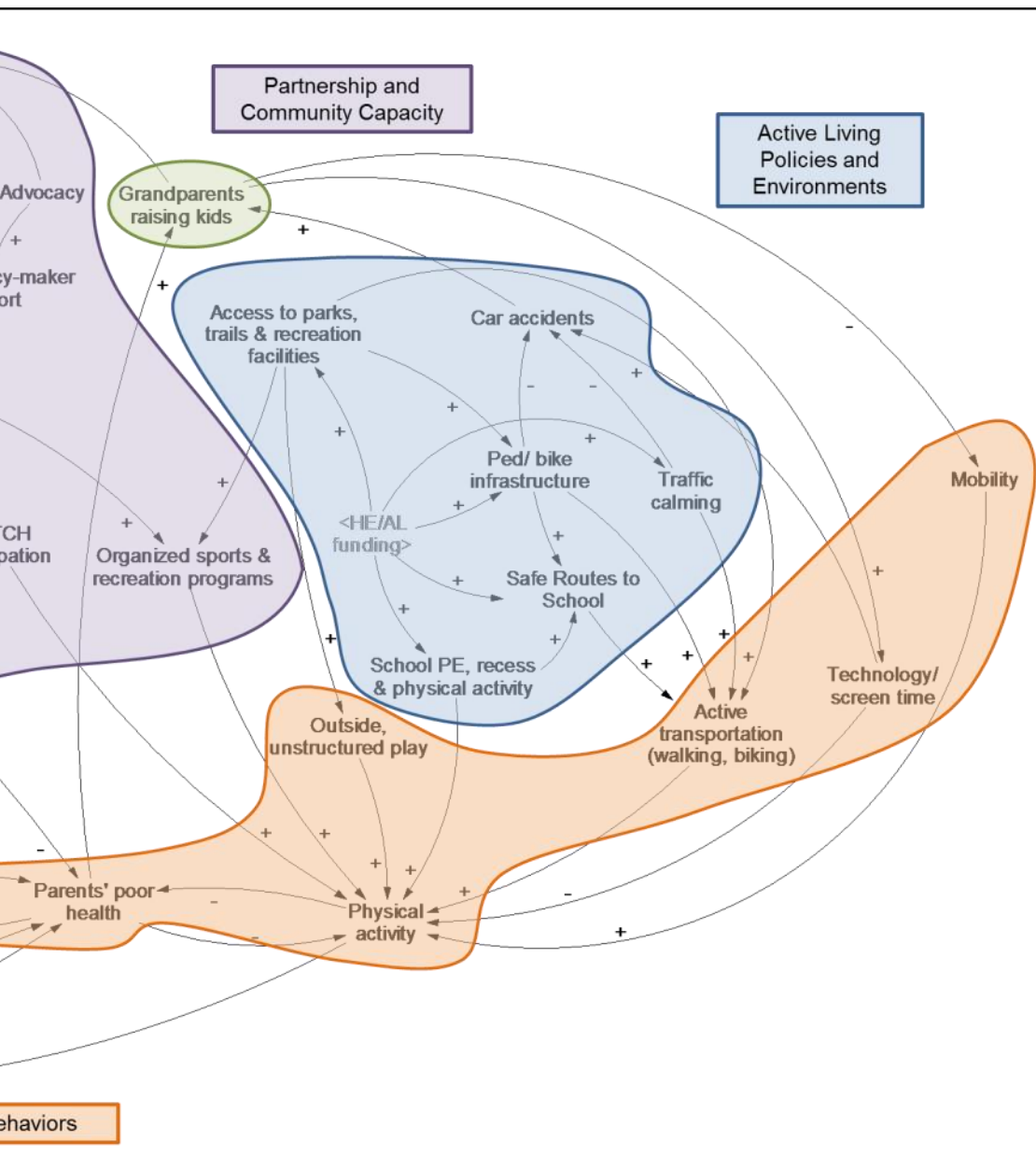




The subsystem for health and health behaviors includes health outcomes (e.g., obesity), health behaviors (e.g., healthy eating, physical activity), and behavioral proxies or context-specific behaviors (e.g., healthy prepared meals at home, parent's poor health).

### 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, *LiveWell Greenville* formed



advisory committees to inform engagement of specific strategies for healthy eating and active living changes. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as healthy eating and active living policy-maker support or Health Ministries.

### Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., healthy eating and active living funding, health care costs) and psychosocial influences (e.g., grandparents raising kids) 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 *LiveWell Greenville* partners or by other representatives in Greenville, South Carolina. 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 access to fresh fruits and vegetables, community engagement, and advocacy.

The next sections begin to examine the feedback loops central to the work of *LiveWell Greenville*. 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 Outreach Feedback Loop

To simplify the discussion about feedback loops, several loops drawn from the LiveWell Greenville 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 Greenville, South Carolina, each feedback loop tells a story about a more specific change process.

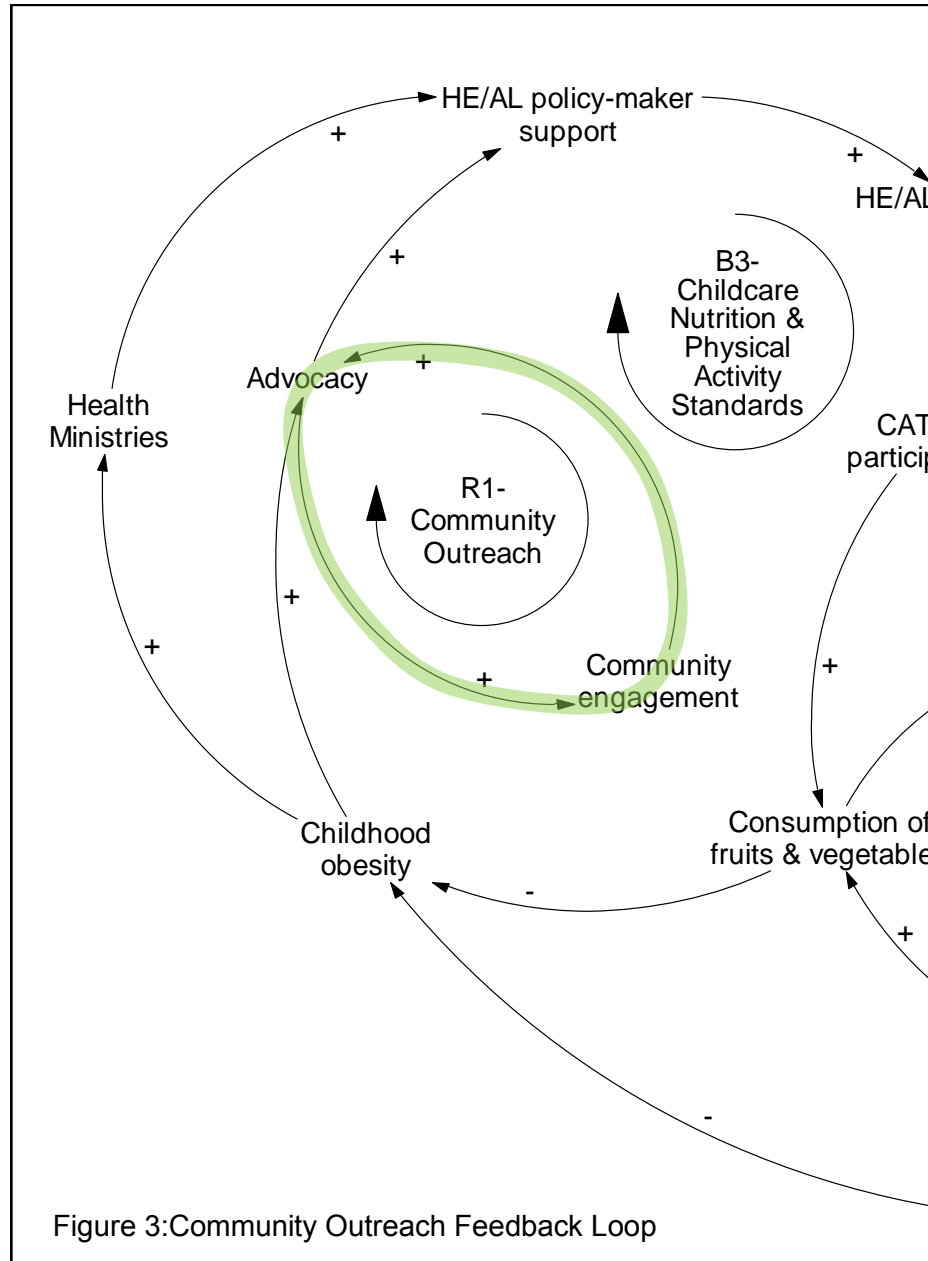
### Causal Story for Feedback Loop

*Story A:* In this case, the story is about the Community Outreach (green highlighted loop in Figure 3). Participants described how through their efforts to create advisory committees to inform future work, they were able to focus on increasing community engagement, which increases in healthy eating and active living advocacy efforts. In turn, with more advocacy there is more community engagement.

*Story B:* While the preceding story reflected a positive scenario for Greenville, South Carolina, the same feedback loop also tells the opposite story. With less community engagement, there is a decrease in healthy eating and active living advocacy efforts. In turn, with more advocacy there is more community engagement.

### Reinforcing Loop and Notation

These stories represent a reinforcing loop, and the notation in the feedback loop identifies it as a reinforcing/balancing loop (see “R1— Community Outreach” 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 are referred to as polarities.

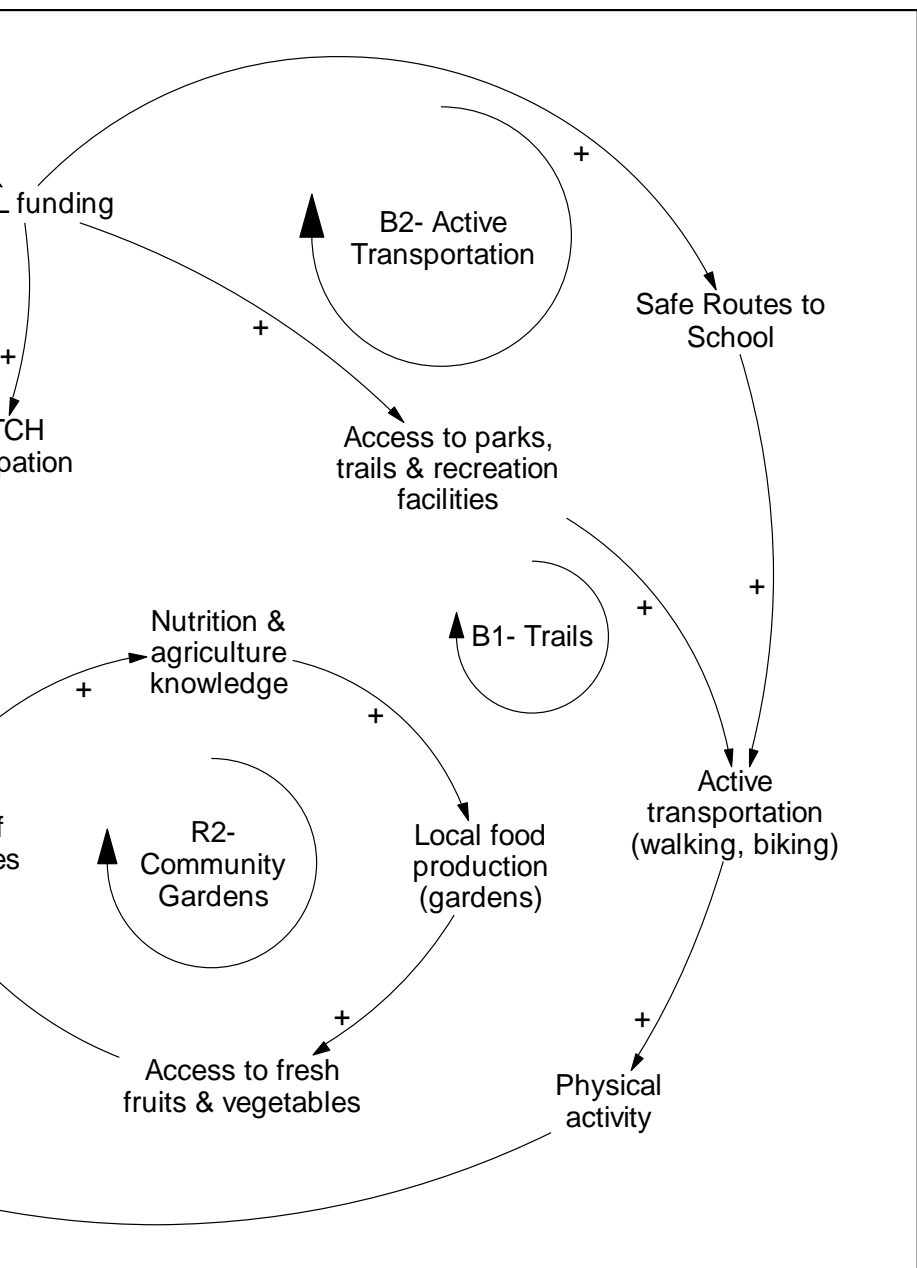


***“The idea is, that could be sidewalks, road diets, mixed development, suburban retrofits, new developments, walkable communities, where people choose to live, how decisions are made for how schools are sited, all those ideas. And so the more people who are either purchasing houses in certain types of communities, creating demand for it, voting for people who support that, all [of] that will—if you increase the number of people, the importance of the issue—have its effect; even the number of kids walking to school.” (Participant)***

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 engagement likely levels off at some point. To understand what specifically leads to the leveling off of community engagement, it may be helpful for the partners in Greenville, South Carolina to consider other variables that influence or are influenced by community 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.

### System Insights for LiveWell Greenville

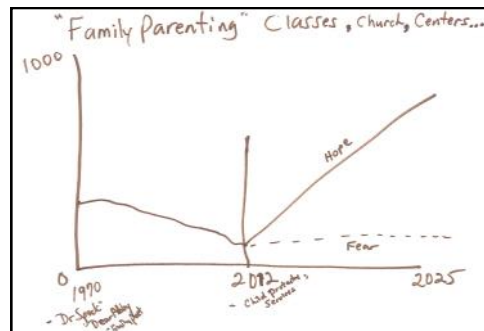
Participants identified a decrease in the number of family parenting classes, churches, and centers since 1970 to 2012 with the hope that more family parenting classes will be available into the future (see behavior over time graph bottom right).

From the systems thinking exercises, several insights can inform the community outreach strategy, including:

- Strategic partnerships to engage residents in advocacy initiatives stimulate support and funding from city government agencies.
- Parent knowledge and awareness is key to their engagement in efforts to increase healthy eating and active living and reduce childhood obesity; this knowledge and awareness increases their skills to interact with their children through cooking meals at home or engaging in physical activity.
- 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).

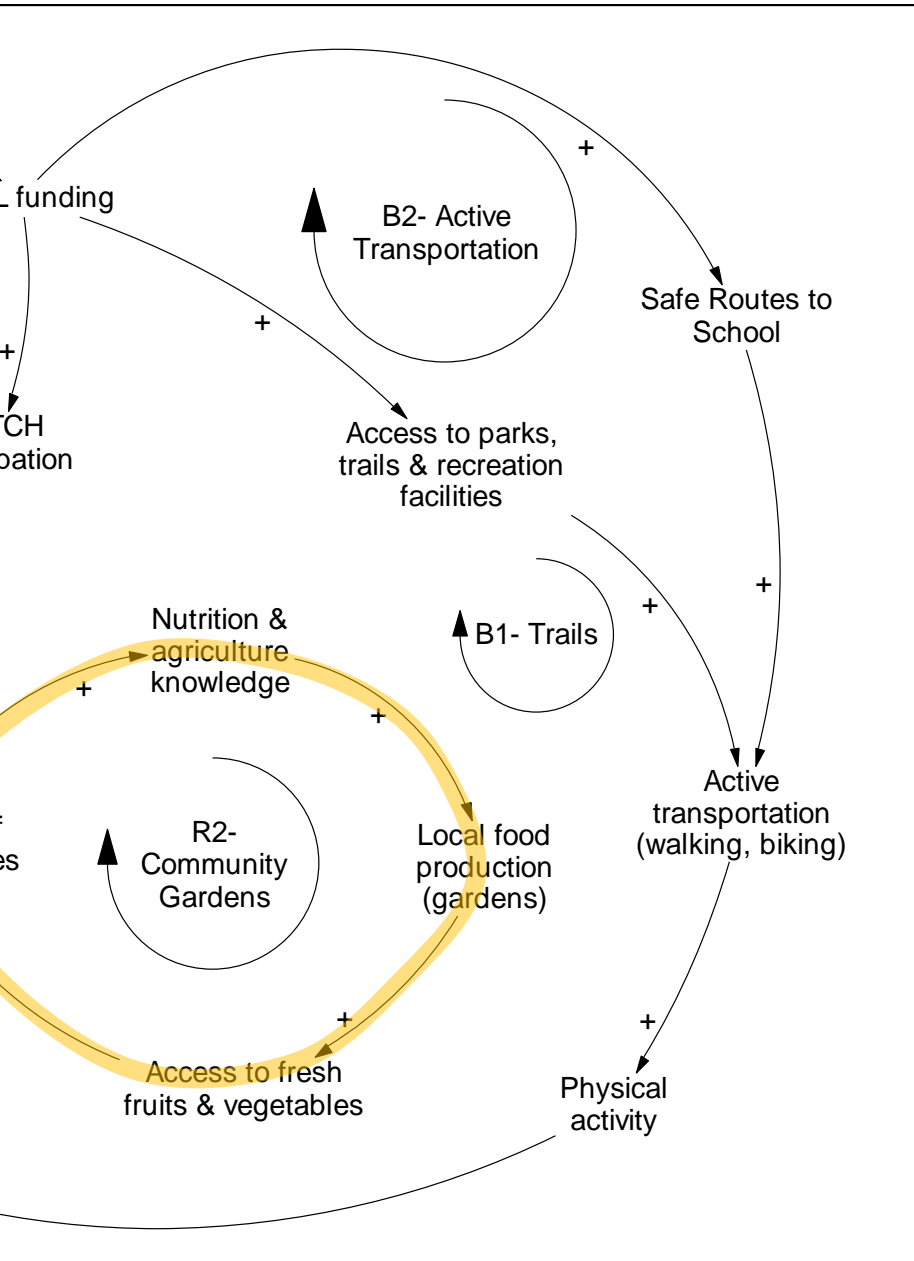
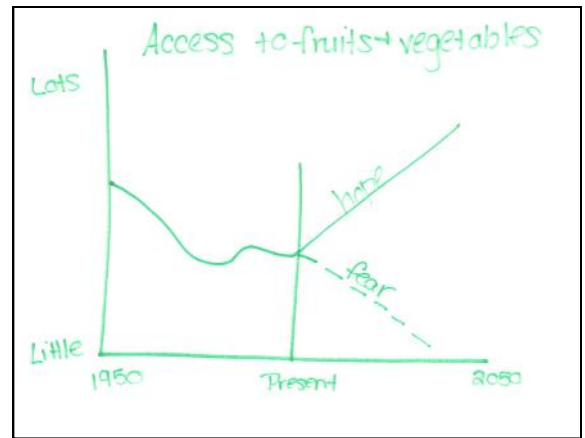
- Non-traditional partners with expertise in community engagement and organizing enhance more traditional advocacy approaches targeting policy– and decision-makers.





## System Insights for *LiveWell Greenville*

In the behavior over time graphs exercise, participants described a decrease in access to fruits and vegetables in the community since 1950 to 2012 with the hope that access to fruits and vegetables will change and increase into the future (see behavior over time graph top right). Similarly, the number of people growing their own food in the Greenville has decreased since 1950 to 2012 with the hope that the number of people growing



their own food will change and increase into the future (see behavior over time graph bottom right).

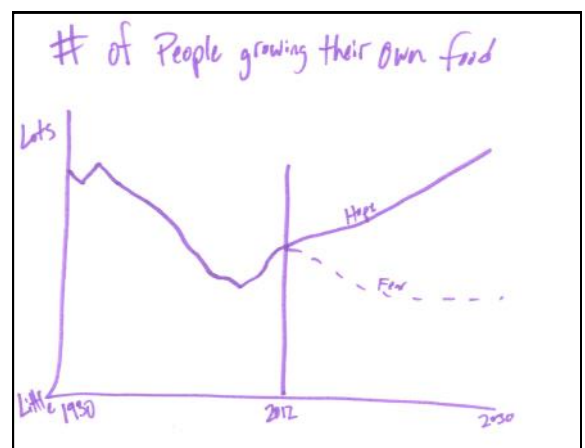
System insights for the partnership's trails efforts include:

- 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.
- Because increasing access to non-processed foods requires greater food preparation, partners must also build residents' skills and confidence in preparing healthy meals.

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

- What is the optimal number of school or community gardens or farms for a neighborhood or urban area?
- What is the potential for local food

production given the vacant urban lots available for agriculture? What development patterns will sustain the ability to meet these food production requirements into the future?







## Active Transportation Feedback Loop

Highlighted in red in Figure 6, the active transportation feedback loop represents one of the *LiveWell Greenville* strategies to increase active living in Greenville, South Carolina.

### Causal Story for Feedback Loop

**Story A:** With more Safe Routes to School programs and routes available for youth in the community, there are more residents participating in active transportation including walking and biking, which increases overall physical activity. As more people are engaging in physical activity, there is a reduction in childhood obesity, which decreases the need for health ministries in the community. With less health ministries in the community, there is less healthy eating and active living policy-maker support, which reduces healthy eating and active living funding. In turn, less healthy eating and active living funding also reduces the safe routes to school programs and routes that are available.

**Story B:** Alternatively, with less Safe Routes to School programs and routes available for youth in the community, there are less residents participating in active transportation including walking and biking, which decreases overall physical activity. As less people are engaging in physical activity, there is an increase in childhood obesity, which increases the need for health ministries in the community. With more health ministries in the community, there is more healthy eating and active living policy-maker support, which increases healthy eating and active living funding. In turn, more healthy eating and active living funding also increases the safe routes to school programs and routes that are available.

### Balancing Loop and Notation

Similar to the previous loop (see Figure 5), this is a balancing loop (one “-” sign). In addition, it includes causal relationships representing more immediate effects (e.g., safe routes to school influence on active transportation), and, potentially, delayed effects (e.g., physical activity influence on childhood obesity).

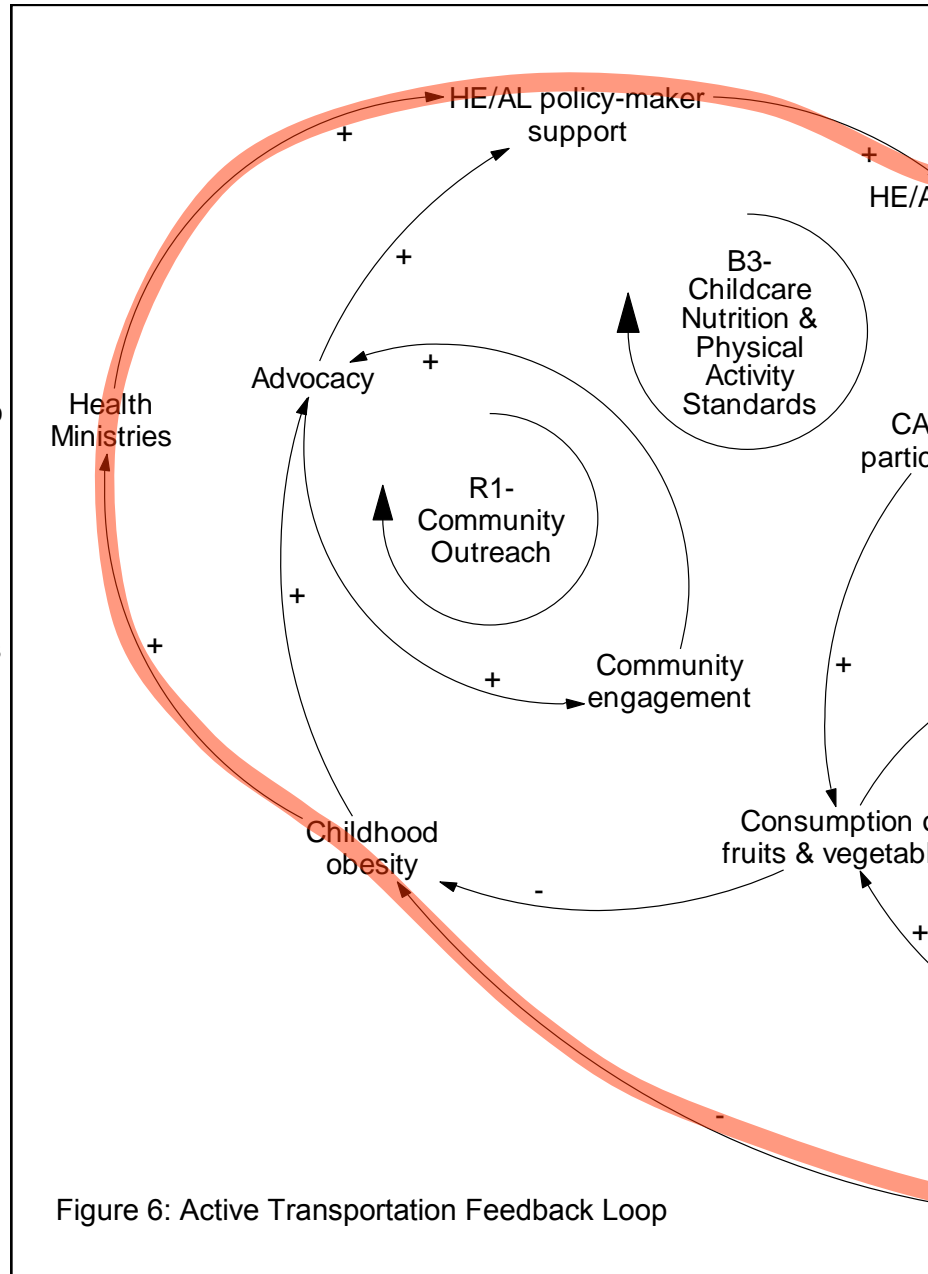


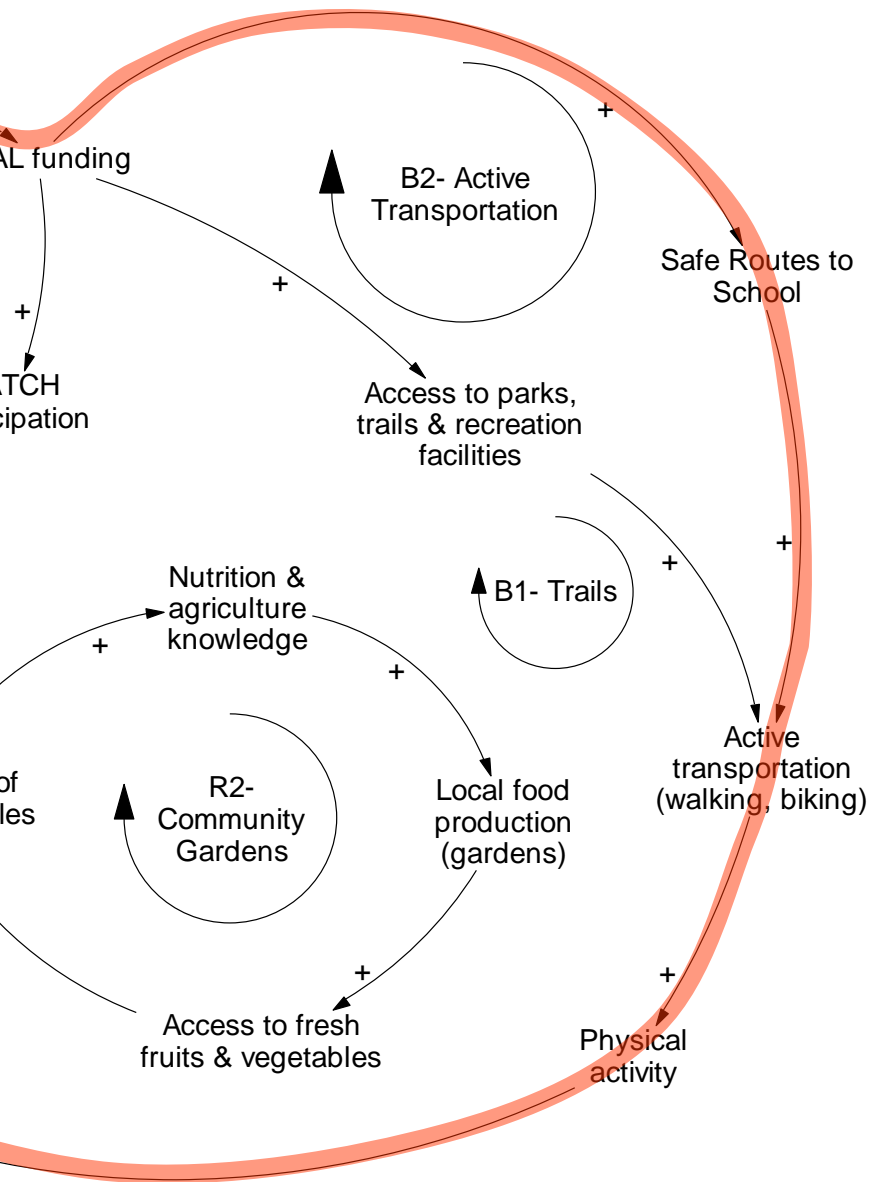
Figure 6: Active Transportation Feedback Loop

***“The number of bikes sold is going to depend on policies and systems of safe places for people to ride the bikes. Also it involves the continued effort of getting people to be concerned about their health and getting exercise, and I think the number of bikes sold, my hope is that it will increase, that families will use them as a mechanism to bring families together, to do things together, because bikes come in all sizes.” (Participant)***



## System Insights for *LiveWell Greenville*

In the behavior over time graphs exercise, participants described a decrease in the number of walkable and bikeable streets in Greenville County since 1970 to 2012 with the hope that more streets will become walkable and bikeable into the future (see behavior over time graph top right). Participants also described a slight increase in the number of people who consider “walkable growth” or walkability to be an issue in the community since



1990 to 2012 with the hope that walkability will continue to increase into the future and become a priority for the community (see behavior over time graph bottom right).

System insights for the partnership’s active transportation efforts include:

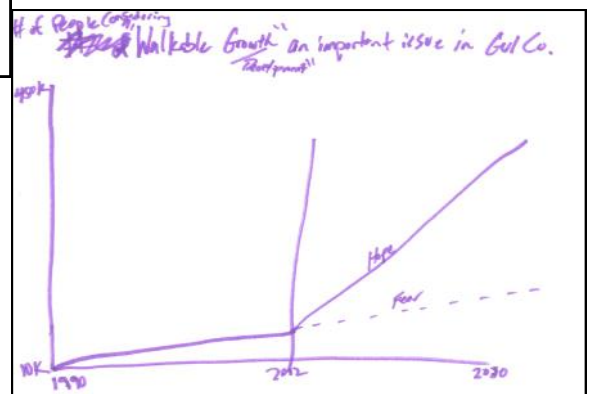
- Infrastructure for pedestrians and bicyclists increases the number of families being active together, sidewalks and bike lanes — along with traffic calming and other safety measures — create opportunities for families to choose active rather than sedentary transportation modes.
- Non-traditional partners (e.g., health ministries) with expertise in community engagement and organizing enhance more traditional advocacy approaches targeting policy- and decision-makers.

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

- What streets have accommodations for pedestrians, bicyclists, and drivers? Are they safe for all users? What is still needed (e.g., traffic calming measures, more

sidewalks and bike lanes)?

- What types of trips are made by car, bike, and foot in the communities? Who is using the current active transportation infrastructure and who is not (e.g., adults, children)?



## Child Care Nutrition and Physical Activity Standards Feedback Loop

Highlighted in yellow in Figure 7, the child care nutrition and physical activity standards feedback loop represents one of the *LiveWell Greenville* strategies to increase healthy eating and active living in Greenville, South Carolina.

### Causal Story for Feedback Loop

*Story A:* With more child care facilities participating in CATCH a program that incorporates nutrition and physical activity standards, there is an increase in the consumption of fruits and vegetables in the child care facilities. With greater consumption of fruits and vegetables, there is a reduction in childhood obesity, which decreases advocacy efforts for healthy eating and active living. With less advocacy, there is less healthy eating and active living policy-maker support, which decreases healthy eating and active living funding. In turn, as less healthy eating and active living funding is available, there is less participation in programs like CATCH by the child care facilities.

*Story B:* Alternatively, with less child care facilities participating in CATCH a program that incorporates nutrition and physical activity standards, there is a decrease in the consumption of fruits and vegetables in the child care facilities. With less consumption of fruits and vegetables, there is an increase in childhood obesity, which increases advocacy efforts for healthy eating and active living. With more advocacy, there is more healthy eating and active living policy-maker support, which increases healthy eating and active living funding. In turn, as more healthy eating and active living funding is available, there is greater participation in programs like CATCH by the child care facilities.

### Balancing Loop and Notation

Similar to the previous loops (see Figure 5 & 6), this is a balancing loop (one “-” sign). In addition, it includes causal relationships representing more immediate effects (e.g., CATCH participation influence on consumption of fruits and vegetables), and, potentially, delayed effects (e.g., consumption of fruits and vegetables influence on childhood obesity).

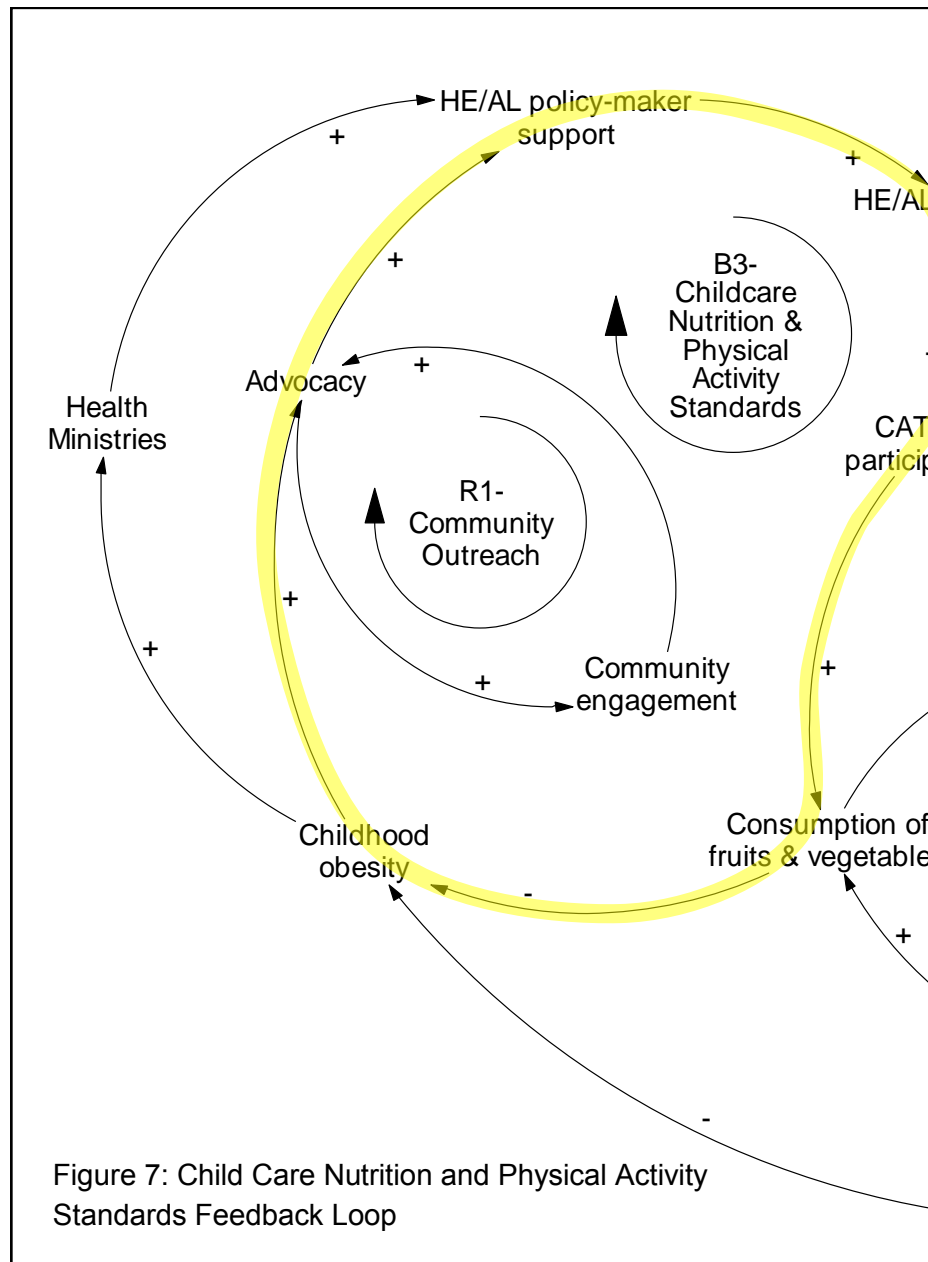
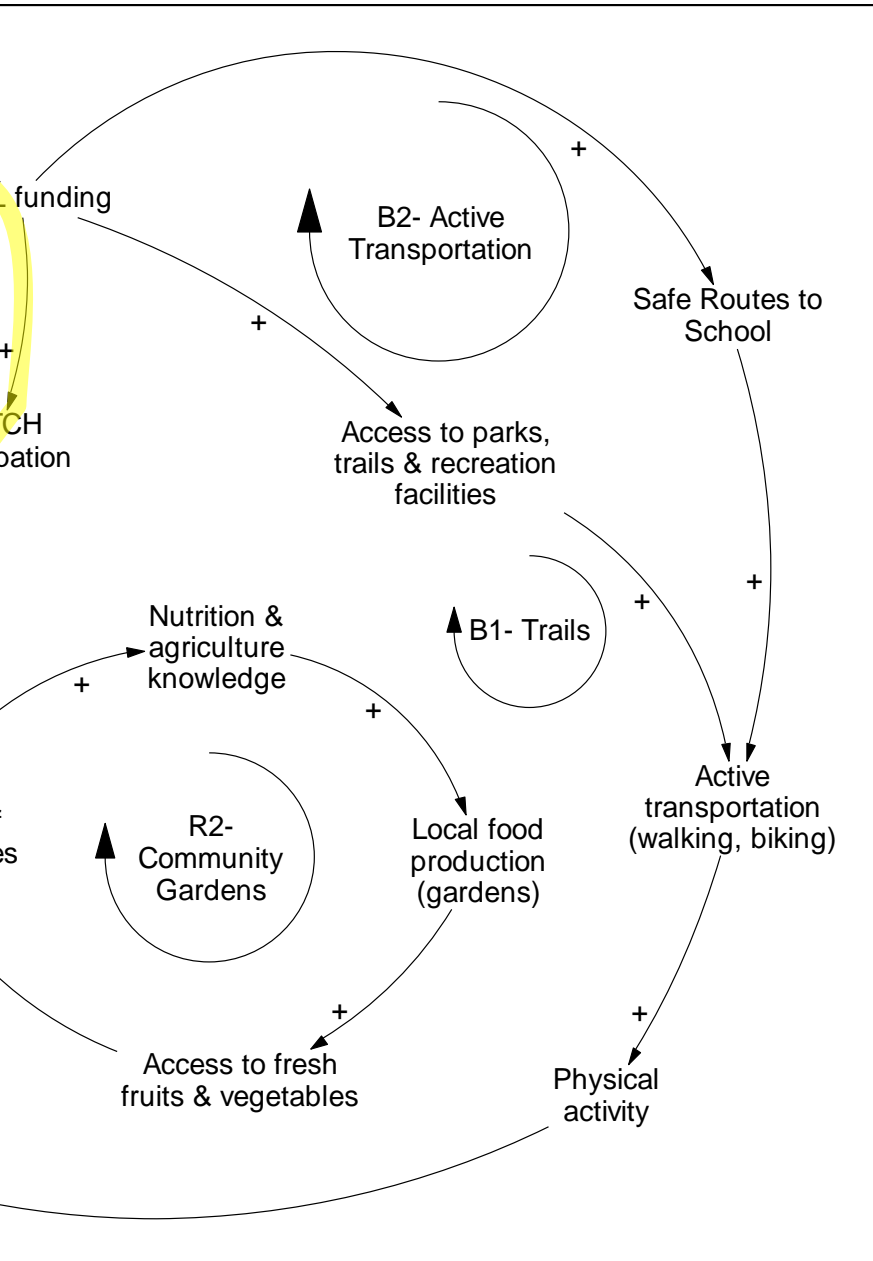
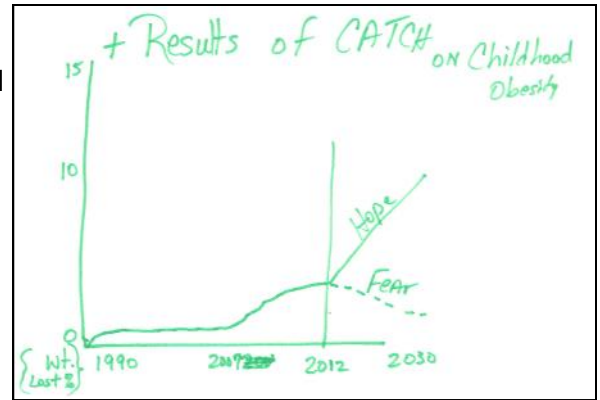


Figure 7: Child Care Nutrition and Physical Activity Standards Feedback Loop

***“We just finished the Grow Healthy Toolkit after a few years of working on it, but [it’s] a very good product; it’s beautiful with a lot of great resources. It’s going to be a very valuable resource to the daycares and with technical assistance they’ll be getting. And we’re working on some things right now to try to get that jump started; I’m trying to find stipends and other things that we can help sort of off-set the costs and pay for some of those toolkits getting out to the daycares. My fear is that they’ll cut off the money.” (Participant)***

System Insights for LiveWell Greenville

In the behavior over time graphs exercise, participants described an increase in the positive results of CATCH on childhood obesity in child care facilities since 1990 to 2012 with the hope that CATCH participation will continue to increase and positive results related to childhood obesity will continue into the future (see behavior over time graph top right). Similarly, participants also described a slight increase in the number of daycares (or



child cares) receiving “Grow Healthy” Toolkits designed to help providers implement nutrition and physical activity standards. Participants hope the number of daycares receiving the “Grow Healthy” Toolkit will drastically increase into the future (see behavior over time graph bottom right).

System insights for the partnership’s child care nutrition and physical activity standards efforts include:

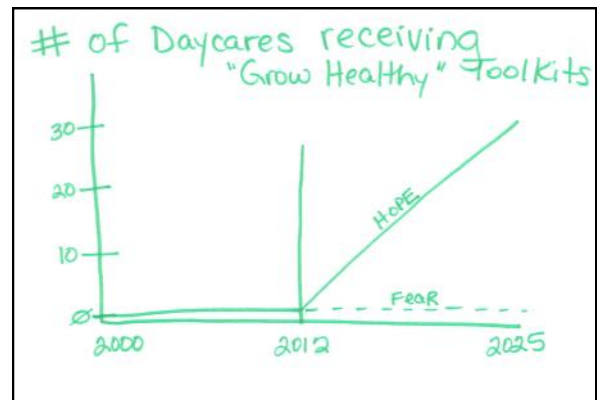
- Because increasing access to non-processed foods requires greater food preparation, partners must also build residents’ skills and confidence in preparing healthy meals through the development and dissemination of education and training materials — similar to the “Grow Healthy” Toolkit.
- Teaching youth to prepare meals and snacks with fresh fruits and vegetables gives them opportunities to inform and educate their families and friends about the benefits of healthy eating in order to generate greater collaboration and support in the community.

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

- How do schools and child care agencies make decisions about curricula dedicated to physical education, active recess, and other non-

academic pursuits?

- What is the quantity and quality of food vendors within a one-mile radius of child care center and after school programs (e.g., access to fruits and vegetables, access to junk foods)?
- What is the quantity and quality of public recreation facilities within a one-mile radius of child care center and after school programs?

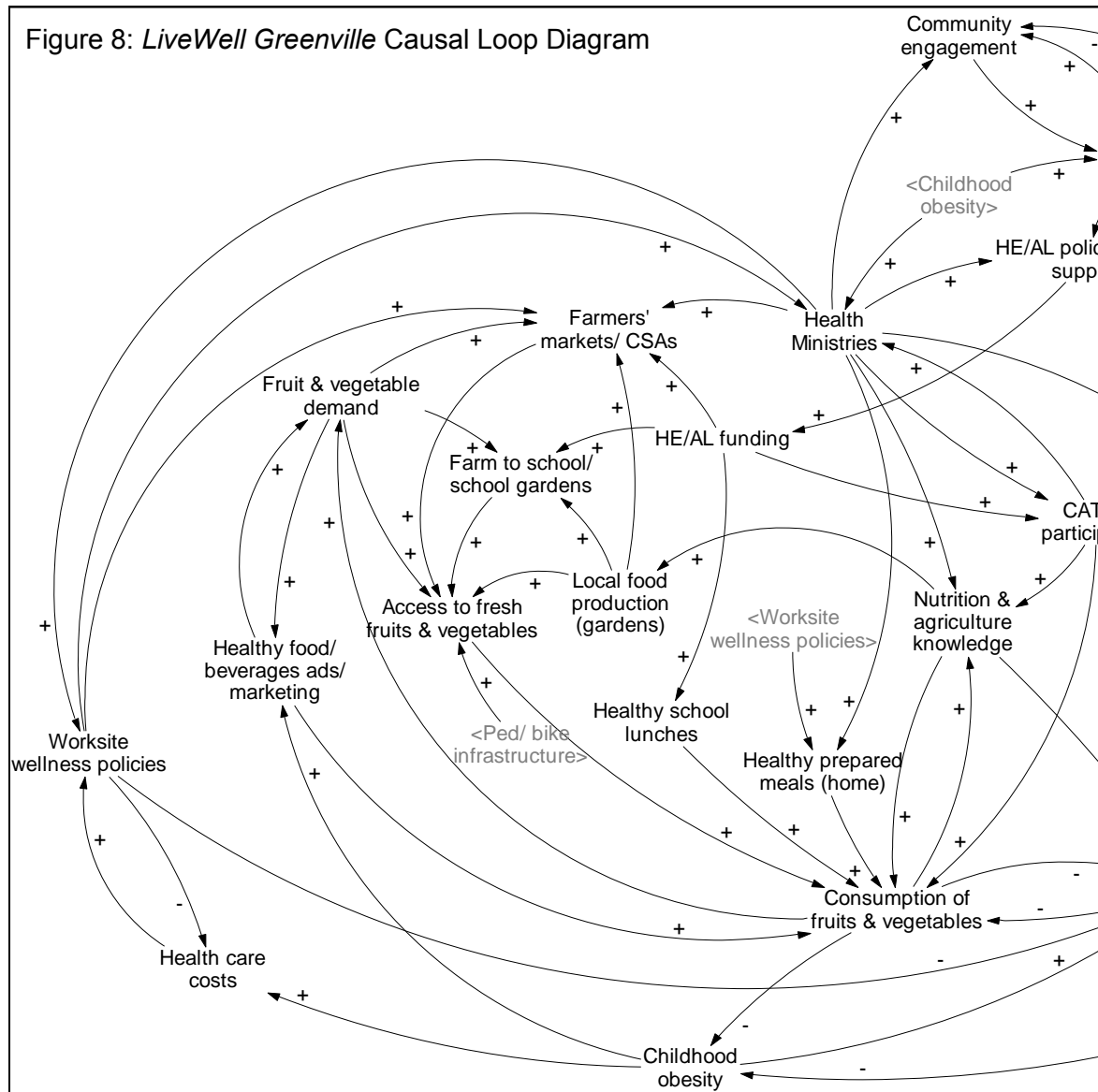


## Opportunities for Systems Thinking in Greenville, South Carolina

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 *LiveWell Greenville* partners, this storybook also summarized the healthy eating, active living, partnership and community capacity, social determinants, and health and health behaviors subsystems in the Greenville causal loop diagram as well as six specific feedback loops corresponding to the partnership's primary strategies.

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 Greenville, South Carolina 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 *LiveWell Greenville* 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



## 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.

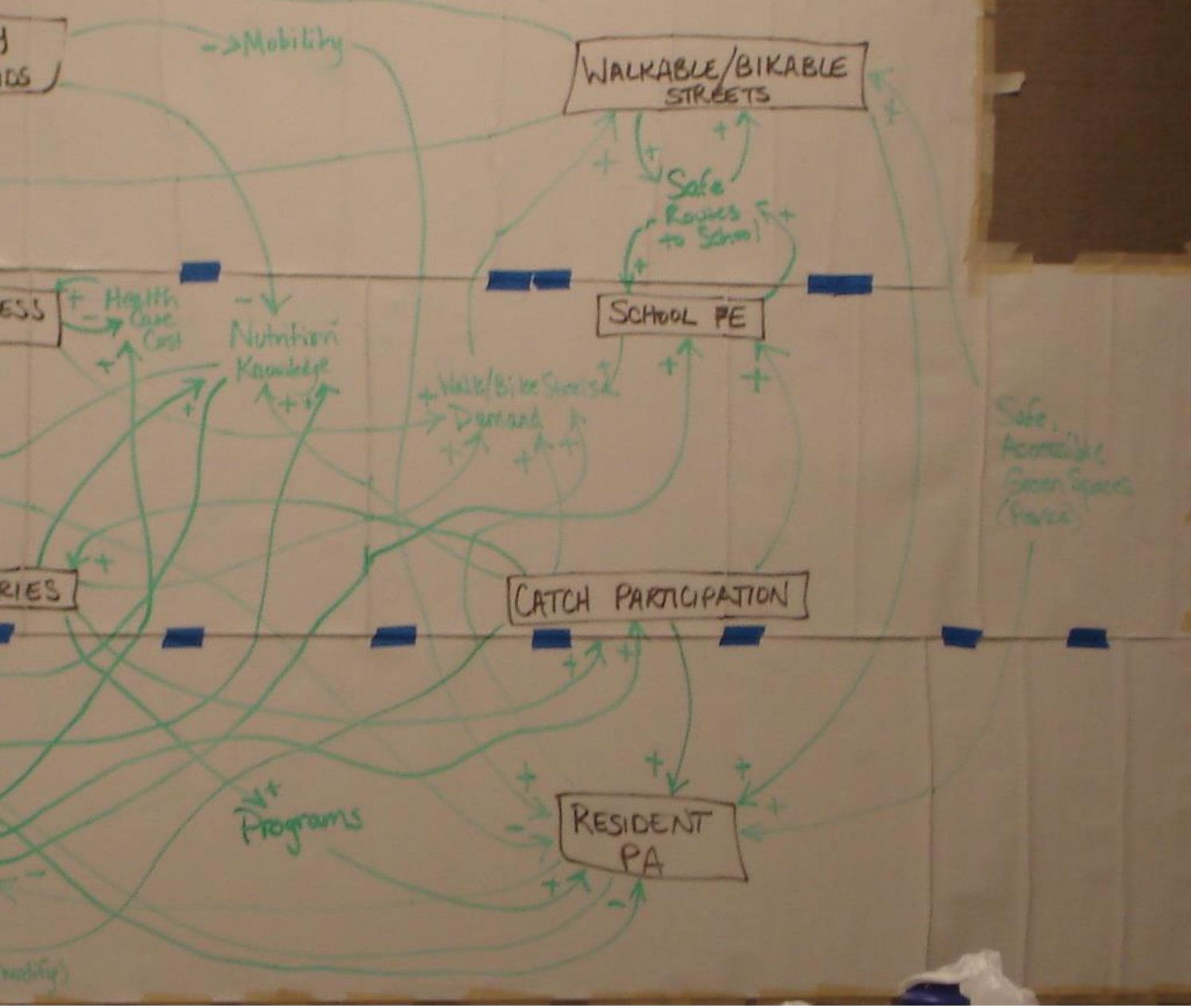
**Appendix A: Behavior Over Time Graphs Generated during Site Visit**

<b>Greenville, South Carolina: <i>LiveWell Greenville</i></b>	
<b>Categories</b>	<b>Number of Graphs</b>
Active Living Behavior	8
Active Living Environments	4
Funding	0
Healthy Eating Behavior	5
Healthy Eating Environments	6
Marketing and Media Coverage	1
Obesity and Long Term Outcomes	3
Partnership & Community Capacity	1
Policies	1
Programs & Promotions (Education and Awareness)	7
Social Determinants of Health	2
<b>Total Graphs</b>	<b>38</b>

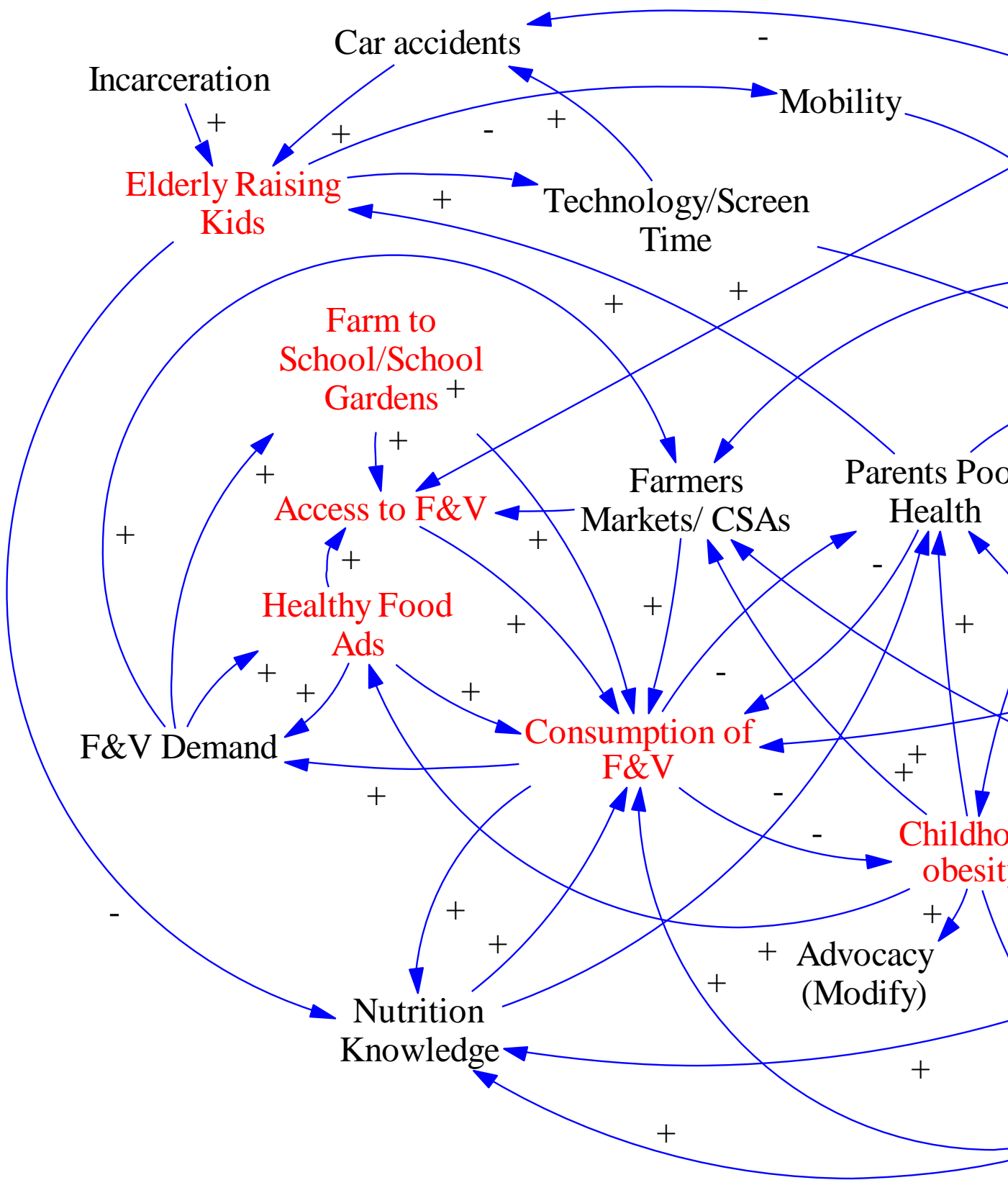


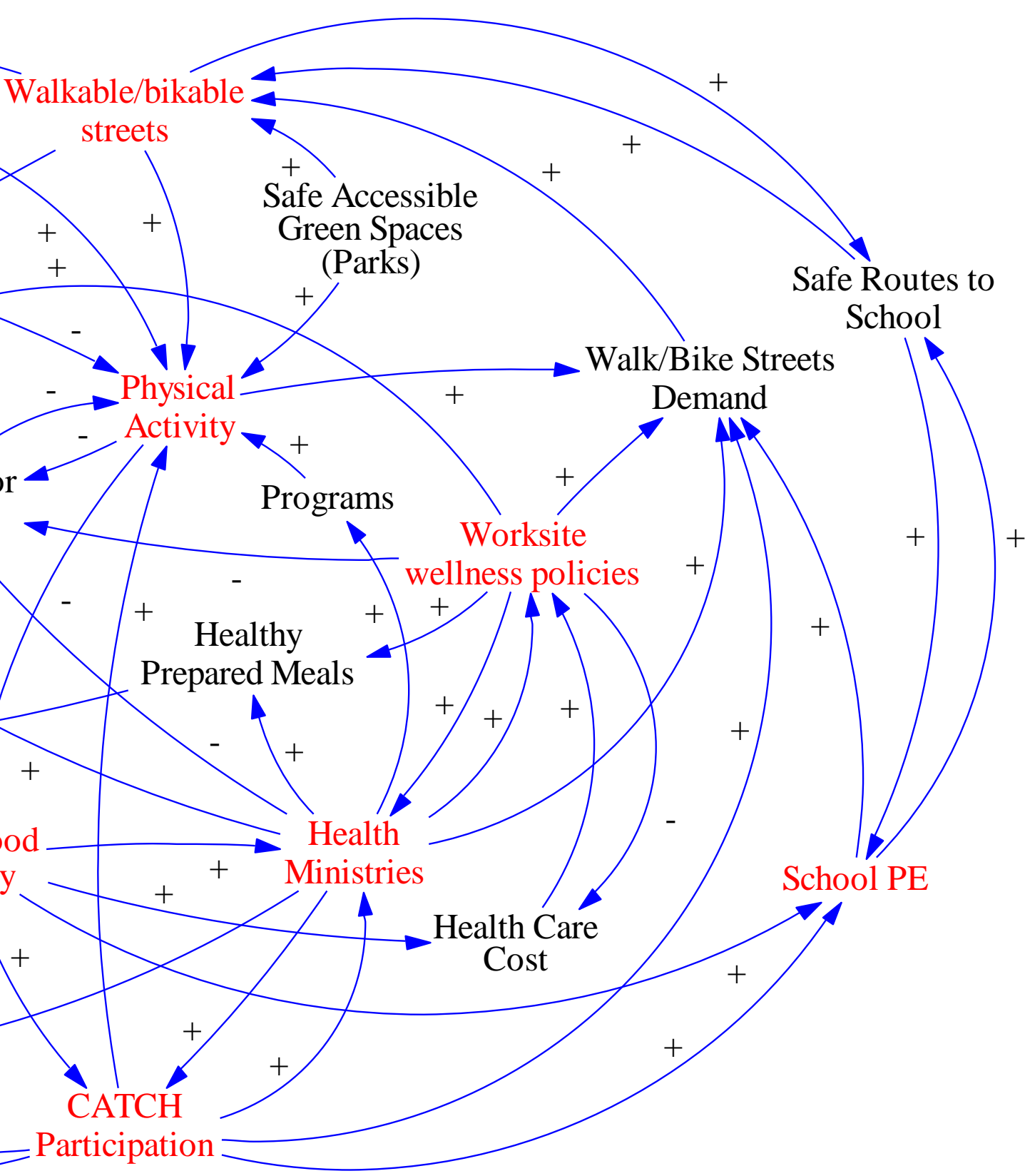


ING, & CHILDHOOD OBESITY  
Environmental changes in your community...

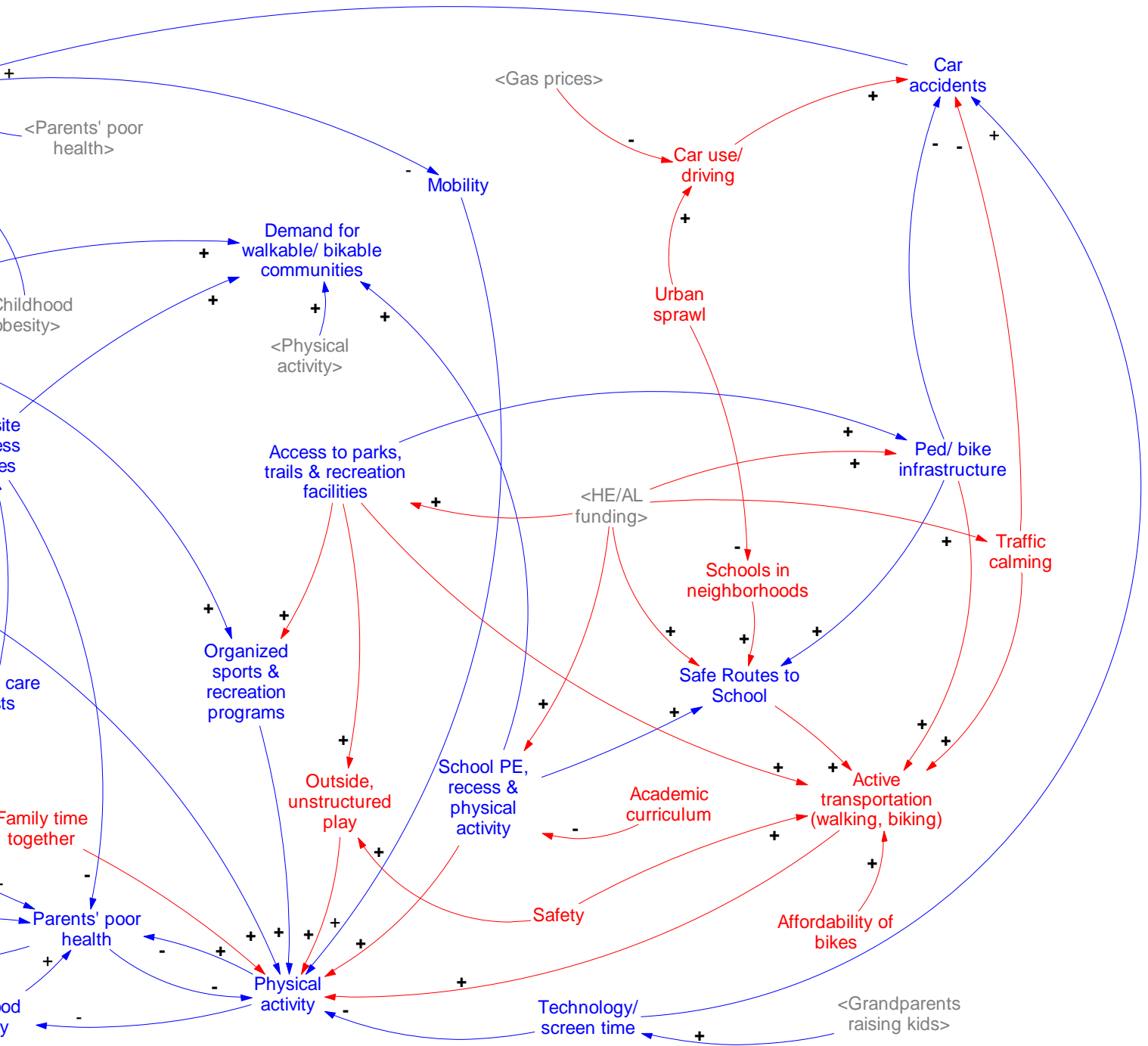


Appendix C: Original Translation of the Causal Loop Diagram into Vensim PLE

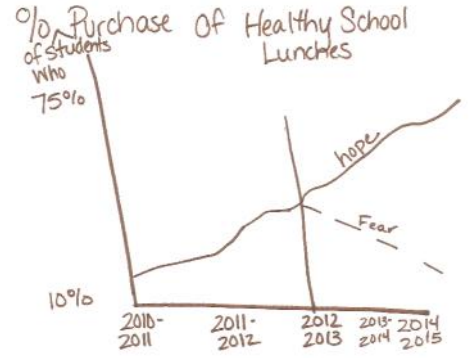
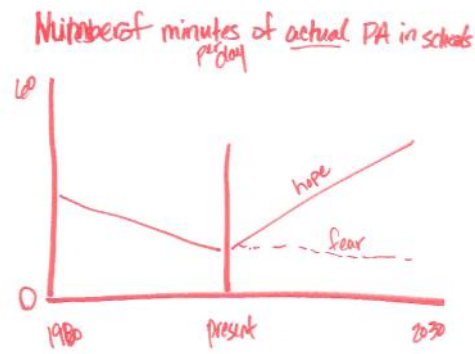
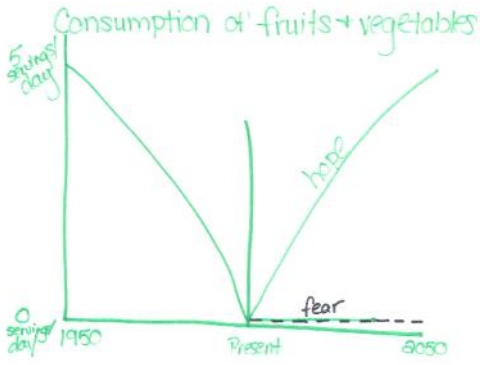




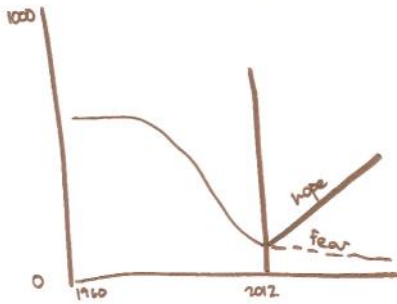




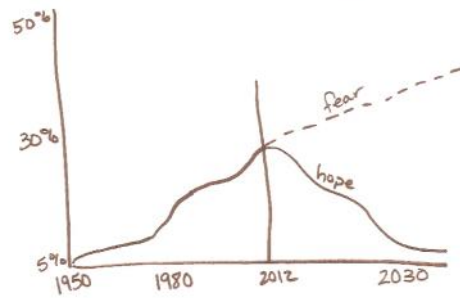
Appendix E: Behavior Over Time Graphs not Represented in the Storybook



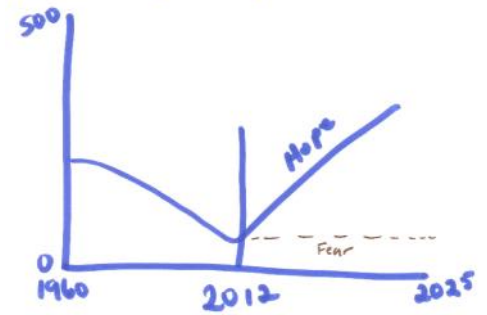
# Kids who bring lunch to school



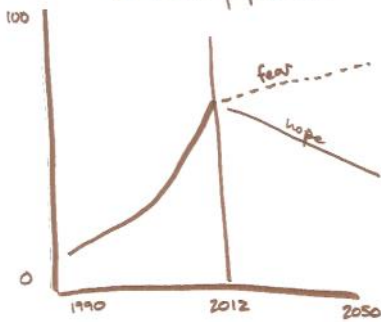
Rate of Childhood Obesity in Grille Co.



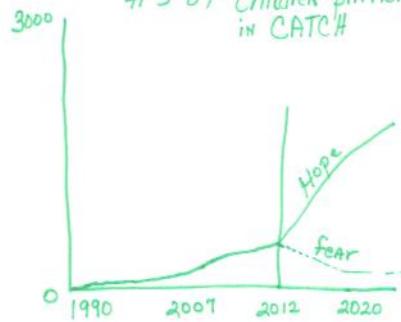
Number of "Family Classes" in school



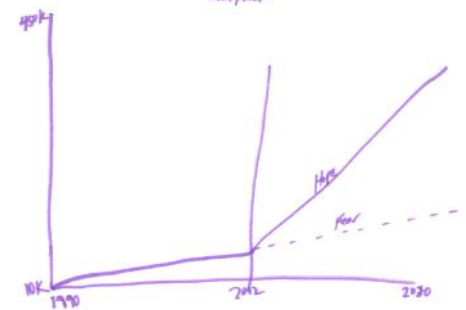
% obese population



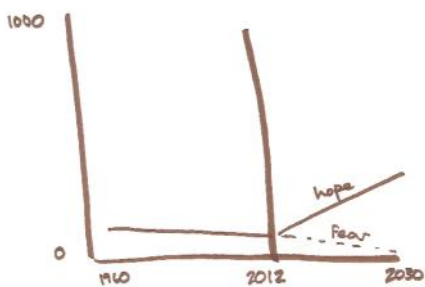
#'s of children participating in CATCH



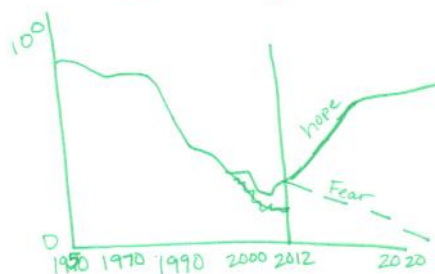
# of People completing Walkable Growth an important issue in Cal Co. (continued)



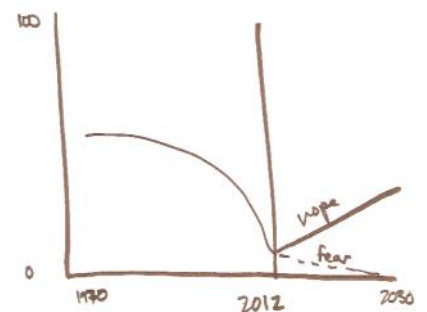
# healthy food retailers



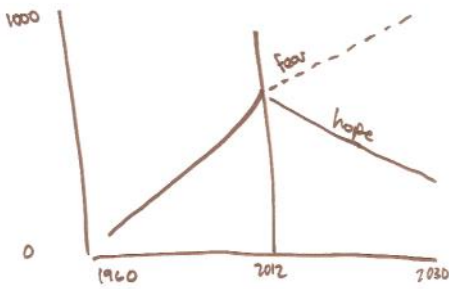
% of Student who walk/bike to school weekly



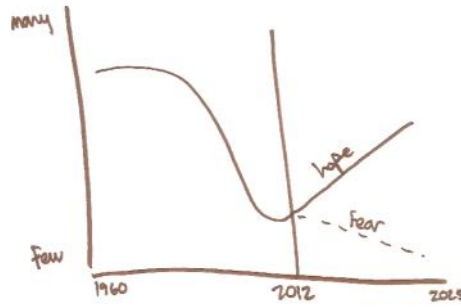
% schools w/ Ag. programs



# sales of Frozen dinners



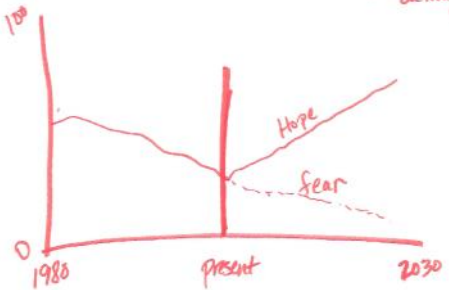
# home gardens



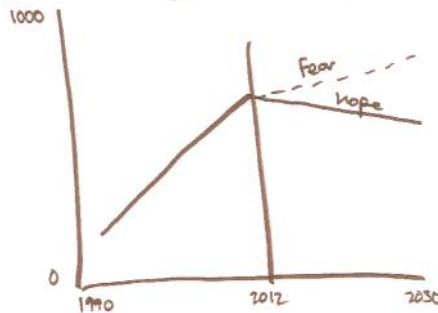
# of schools establishing School Gardens/Rishps (Farm To School)



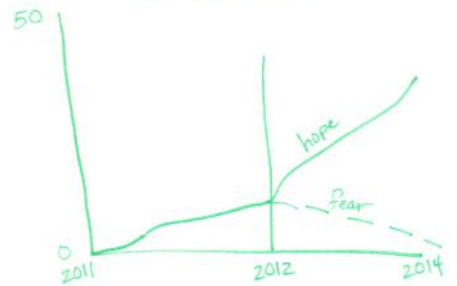
Percent of residents getting daily physical activity



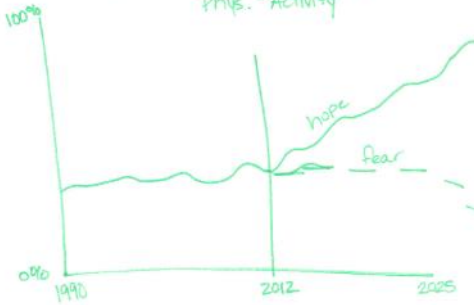
# gym memberships



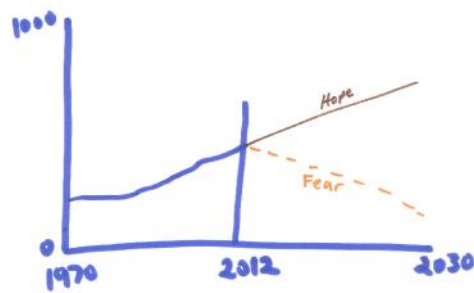
# of LiveWell Worksites (PSE in ea. area: HE/AL/Tob. Free)



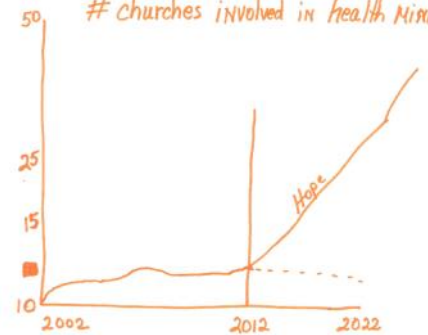
% of Gen. adults meeting stds for Phys. Activity



Number of bikes sold



# Churches involved in health ministries



# of Kids playing tennis



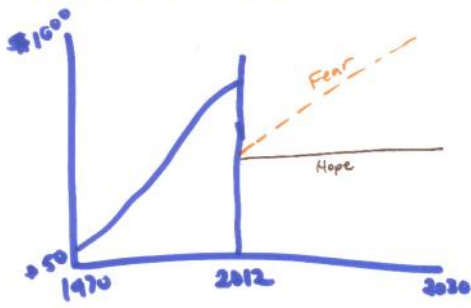
# of Backyard Gardens



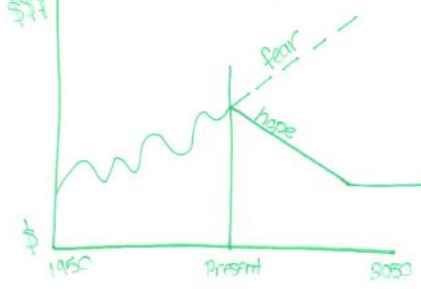
# of Worksites implementing Family NW programs



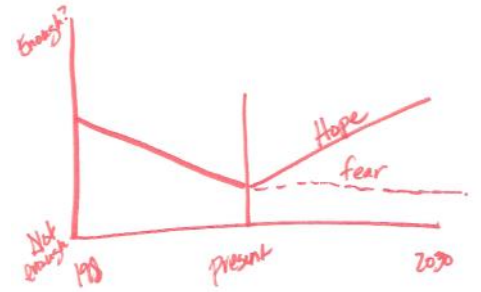
### Cost of Bikes



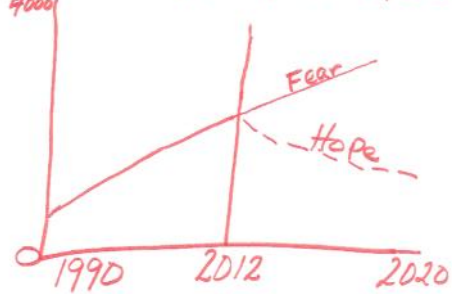
### Cost of fruits + vegetables



### Percent of school budget spent on PE



### Number of Grandparents Raising G Kids



### % of ads focused on healthy food

