# Systems Thinking in Communities:

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

This community storybook was developed by Transtria LLC.

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**Acknowledgments**

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## Introduction

*Spartanburg 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 *Spartanburg HKHC* project was to introduce systems thinking at the community level by identifying the essential parts of the Spartanburg County, South Carolina 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, elected officials, community-based organizations, academic institutions, government agencies, businesses, foundations) 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.

## Spartanburg County, South Carolina : Background and Local Participation

Spartanburg County, located in northwest South Carolina, has a population of 284,307. The county seat, Spartanburg, is the fourth largest city by population in the state. Residents of the county are 72.3% White, 20.6% Black/African American, 2% Asian, 3.1% Other, and 1.7% two or more races. The median household income is $37,579 and approximately 12.3% of the population lives below the federal poverty level. Thirty-two percent of the households in Spartanburg County have children under the age of 18. The project focused on four primary communities: Boiling Springs, Pacolet, Woodruff, and the City of Spartanburg (Northside). The four areas contain about 10% of all Spartanburg County residents and 6-41% of the population lives below the federal poverty level.

Partners for Active Living (PAL) served as the lead agency for the Spartanburg's HKHC partnership. This organization was founded in 2000 by the Mary Black Foundation in an effort to improve the health of children in Spartanburg County by advocating for a more liveable community. PAL focused primarily in three areas: childhood obesity prevention, trail development, and walking and bicycling.

Spartanburg County has a strong presence of non-profits, community coalitions, funders, and government entities that have collaborated together for over a decade. Along with PAL, the Mary Black Foundation founded the HUB City Farmers' Market (HCFM). HCFM is a non-profit organization that increases access and decreases barriers to healthy food in Spartanburg County. HCFM was responsible for implementation of the healthy eating components of the partnership's work.

In addition to PAL and HCFM, key stakeholders in the partnership included government agencies, such as the South Carolina Department of Health and Environmental Control (DHEC), the Division of Obesity Prevention and Control (DOPC), and the Departments of Parks and Recreation of both Spartanburg City and Spartanburg County. The Parks and Recreation Departments were vital to the success of the partnership's initiatives since the park locations served as the community centers and focal points for both healthy eating and active living objectives. Non-profit and community development organizations such as Upstate Forever (UF) and Spartanburg County Childhood Obesity Task Force (COT) provided the partnership with strong voices to advocate for policy changes and increase community awareness.

All partner organizations were members of the Childhood Obesity Task Force, and the meetings of this organization were extended for the purposes of the Spartanburg HKHC partnership. The non-profit members entered into the partnership with strong community support, which was important when engaging the community and developing grassroots support throughout the grant period.

### *Spartanburg HKHC's* Priorities and Strategies

The partnership and capacity building strategies of *Spartanburg HKHC* included:

- **Community Advisory Groups:** The advisory groups were formed early in the initiative to help increase community participation in planning and decision making for HKHC projects. The groups provided valuable insight during partnership activities, such as meeting with architects to discuss the Healthy Food Hub.
- **Spartanburg Childhood Obesity Task Force:** The task force supported healthy eating and active living initiatives, specifically Good for You Spartanburg. The group worked in committees to complete projects, such as collecting Body Mass Index statistics, menu labeling, and after-school healthy eating and active living training.

The healthy eating and active living strategies of *Spartanburg HKHC* included:

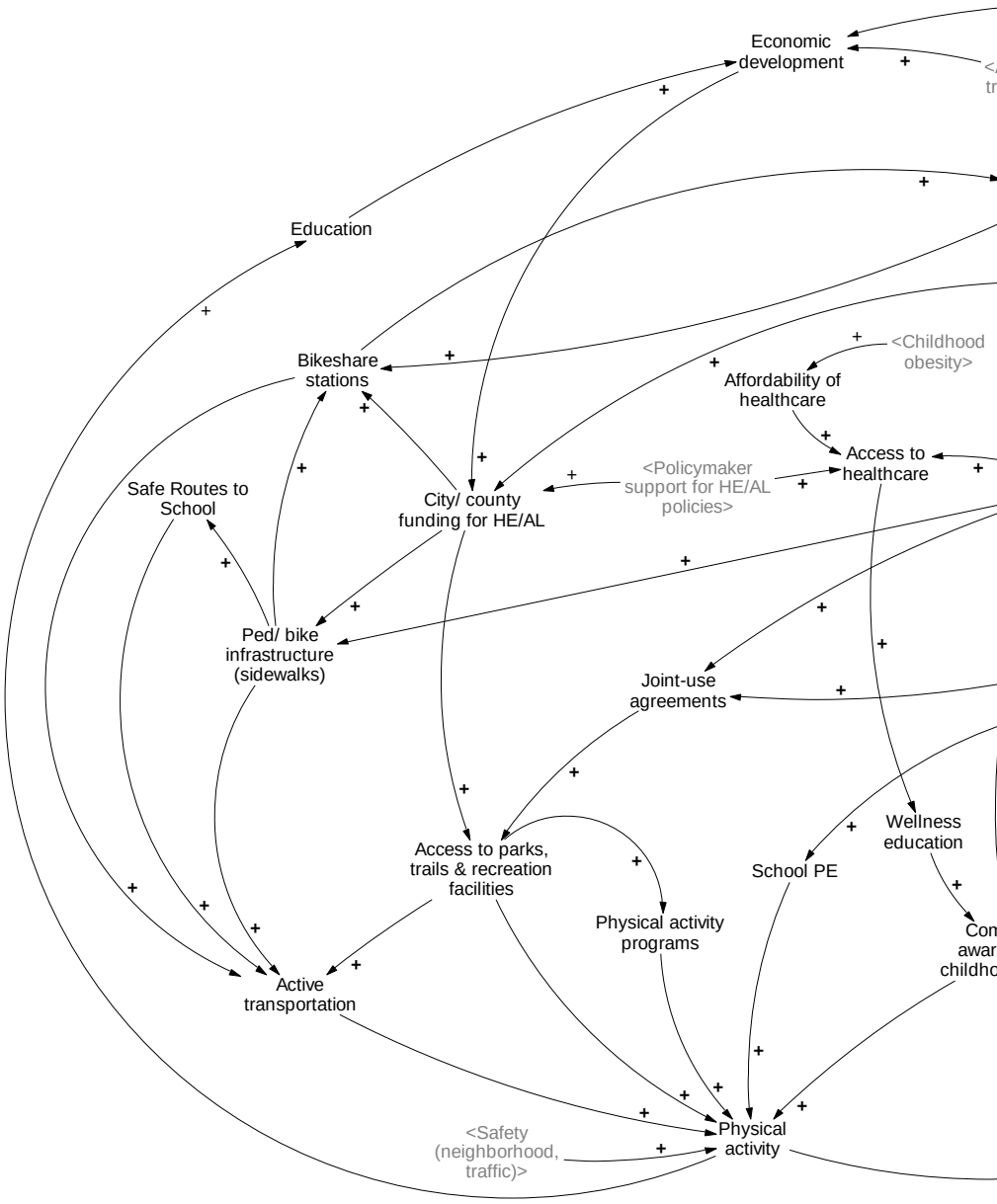
- **Farmers' Market and Mobile Markets:** The Spartanburg HKHC partnership and the Hub City Farmers' Market, with funds awarded from the Mary Black Foundation, purchased and refurbished a van that was used as a mobile market selling fresh, local produce. The Hub City Farmers' Market also increased Electronic Benefit Transfer (EBT) and Senior and Women, Infants, and Children (WIC) voucher use.
- **Active Transportation:** PAL collaborated with partners to improve active transportation infrastructure in the target communities by installing sidewalks, crossing lights, and making improvements to busy intersections.
- **Parks and Play Spaces:** The partnership improved parks, play spaces, and trails in the target communities. The Spartanburg School District 7 and the City of Spartanburg established a joint use agreement that opened school facilities to the public.

For more information on the partnership, please refer to the Spartanburg County case report (www.transtria.com/hkhc).

**Systems Thinking in Communities: Spartanburg County, 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 Spartanburg County, 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.

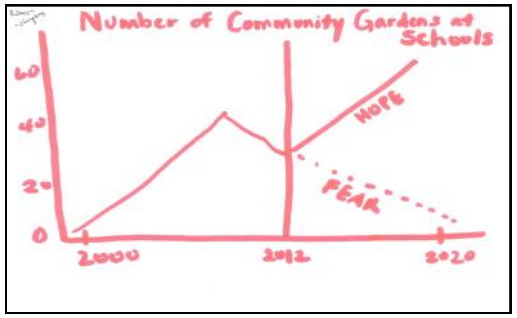
Figure 1: *Spartanburg HKHC* Causal Loop Diagram




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.

**Group Model Building**

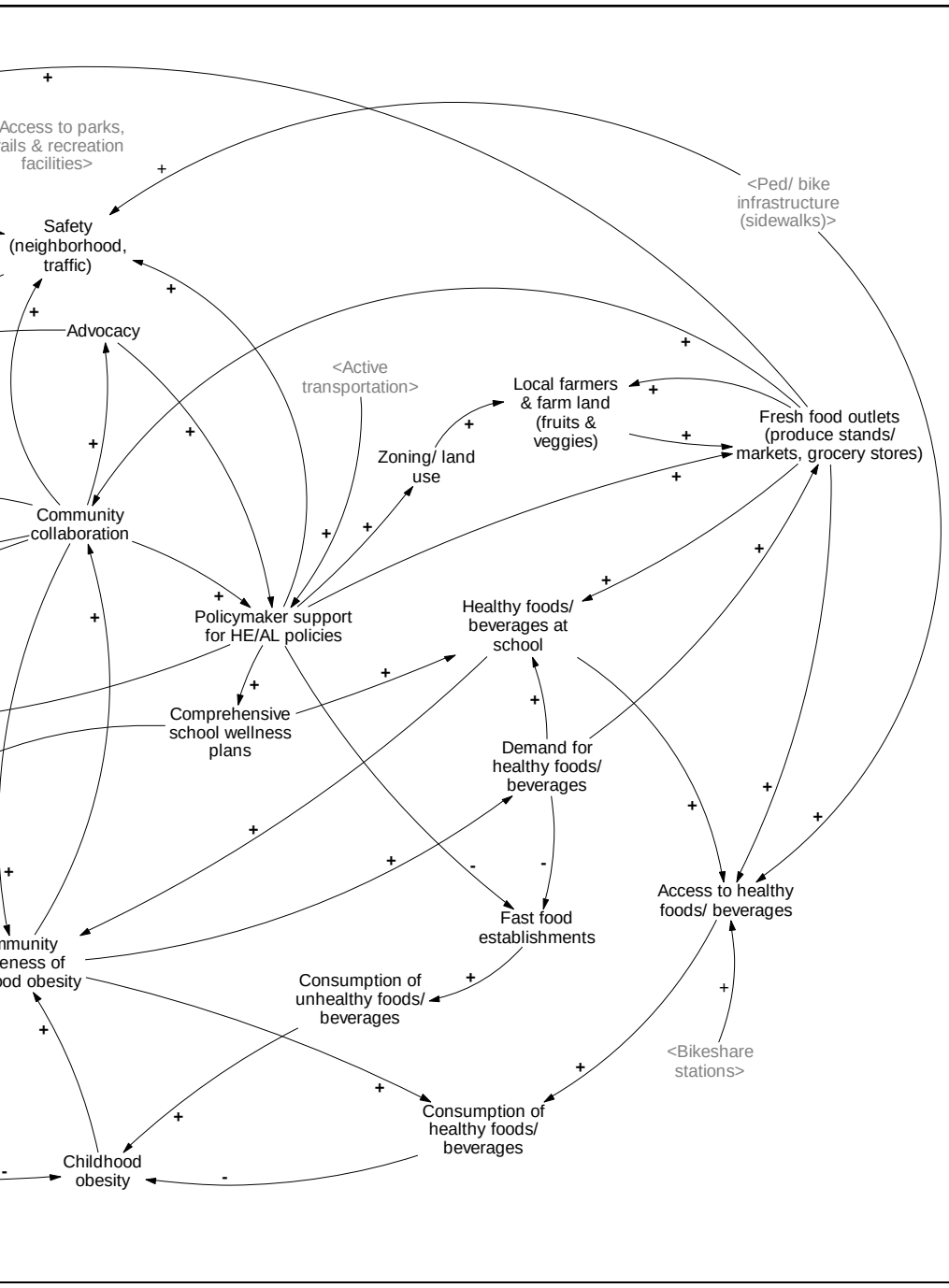
Members of the *Spartanburg HKHC* partnership participated in a group model building session in June, 2012 and generated this system. also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included residents; elected officials; and representatives from community-based organizations, academic institutions, government agencies, businesses, foundations. 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 Spartanburg County 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 community gardens at schools, the number of gardens in schools has increased since 2000 with a more recent drop off in this number, and the participant hopes that this recent decline will reverse 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.

One feedback loop is: community collaboration → access to healthcare → wellness education → community awareness of childhood obesity → community collaboration.

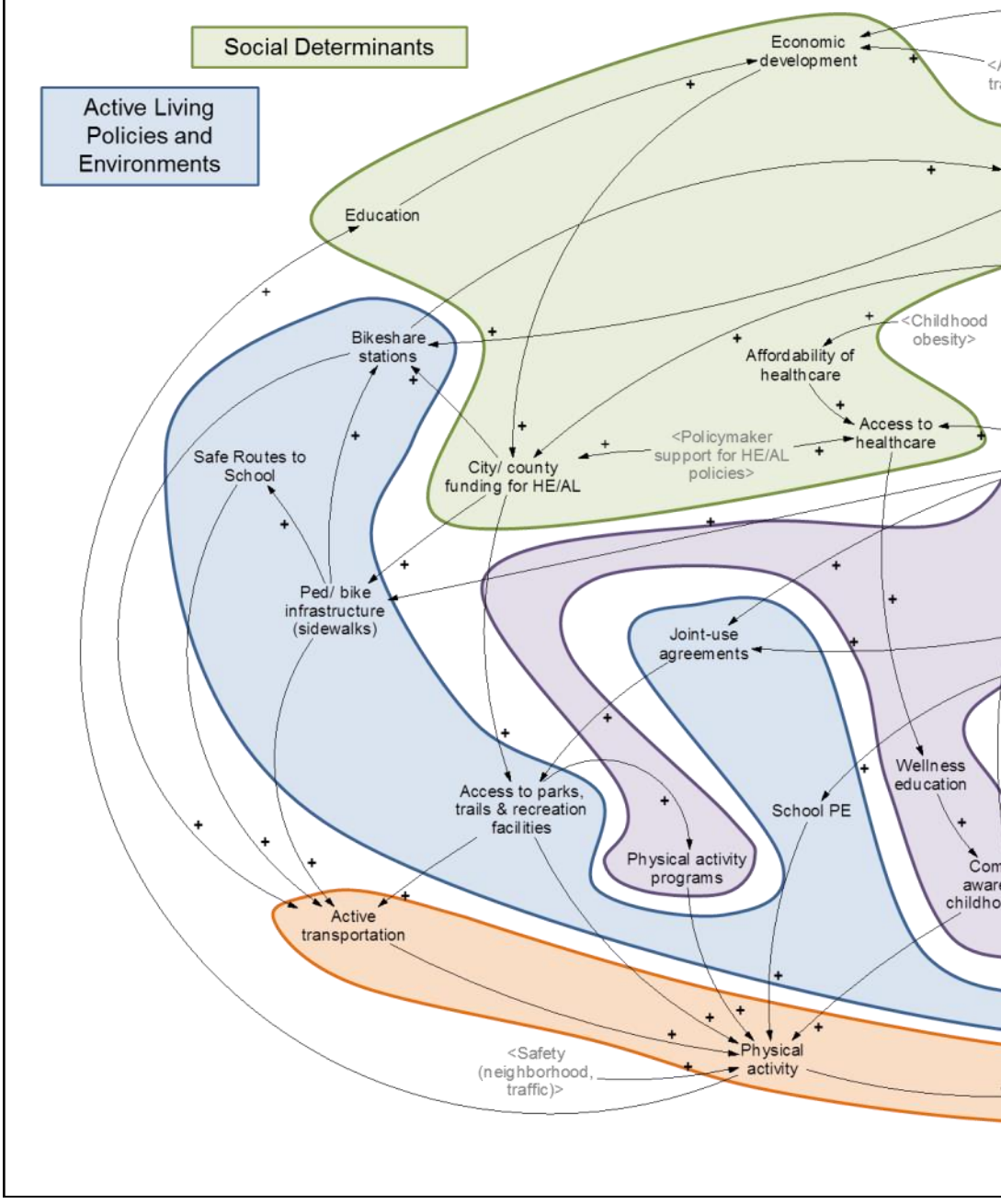
What is important to notice is that there are other feedback loops interacting simultaneously to influence or to be influenced by community collaboration. Some variables may increase community collaboration while other variables limit it. Determining the feedback loop or loops that dominate the system's 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 *Spartanburg HKHC* 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 Spartanburg County, South Carolina and to stimulate greater conversation related to Spartanburg County '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 Spartanburg County, 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).

Figure 2: Subsystems in the *Spartanburg HKHC* Causal Loop Diagram




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, food distribution and procurement, and food retail. During the behavior over time graphs exercise, the participants generated nine graphs related to policy or environmental strategies (e.g., fresh food outlets) or contexts (e.g., local farmers and farm land) that affected or were affected by the work of *Spartanburg HKHC*. 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 eleven graphs related to policy or environmental strategies (e.g., Safe Routes to School) or contexts (e.g., access to parks, trails, and recreation facilities) that affected or were affected by the partnership's work.

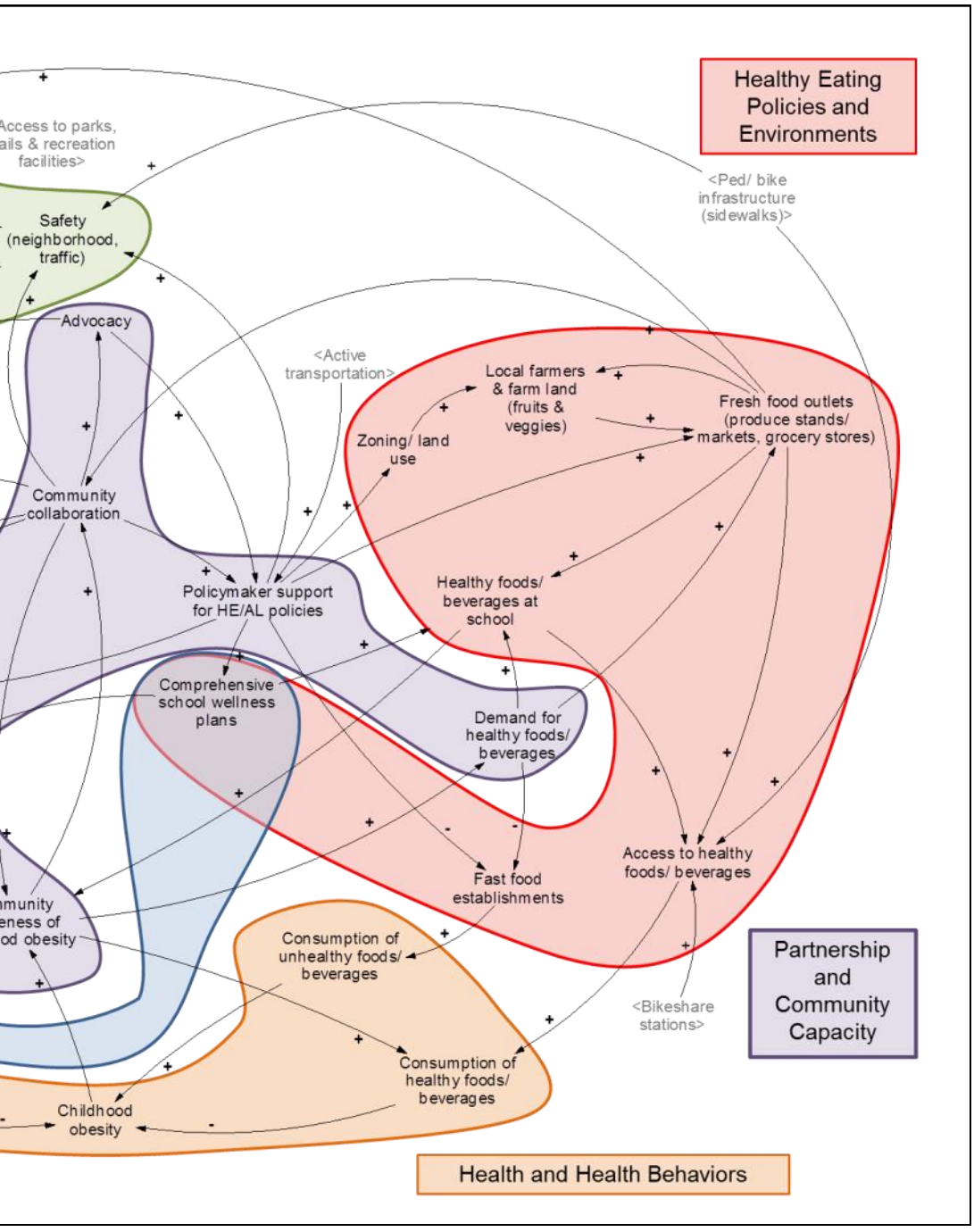
Health and Health Behaviors (Orange)

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., active transportation).

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, *Spartanburg HKHC* worked to increase community collaboration through community advisory groups. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as policy-maker support for healthy eating and active living policies.




Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., city or county funding for healthy eating and active living) and psychosocial influences (e.g., perceptions of safety) 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 *Spartanburg HKHC* partners or by other representatives in Spartanburg County, South Carolina . Using this CLD as a starting place, community conversations about different theories of change within subsystems may continue to take place.

The next sections begin to examine the feedback loops central to the work of *Spartanburg HKHC*. 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.

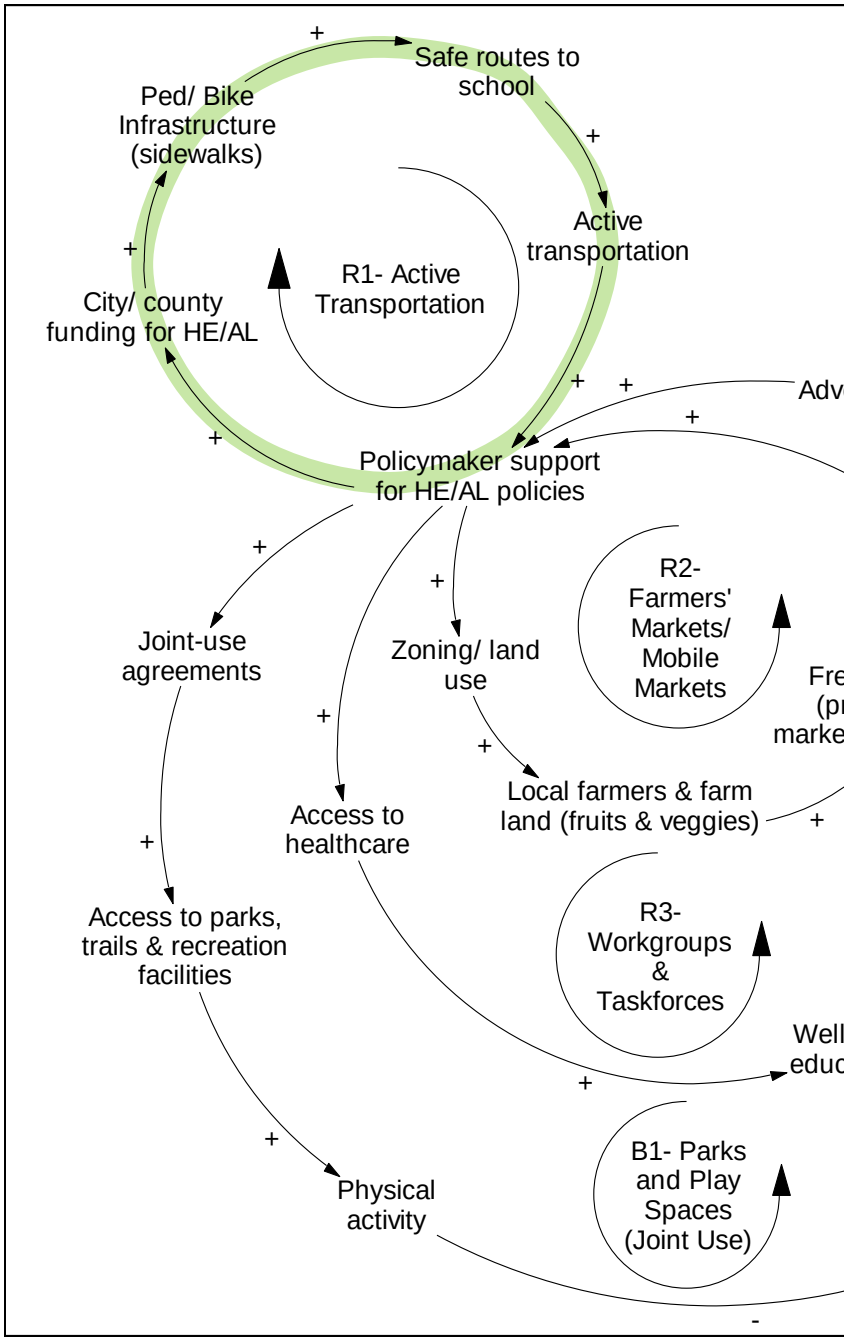
**Active Transportation Feedback Loop**

To simplify the discussion about feedback loops, several loops drawn from the Spartanburg HKHCCLD (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 Spartanburg County, 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 active transportation (green highlighted loop in Figure 3). Spartanburg County, South Carolina partners improved active transportation infrastructure in target communities by installing sidewalks and crossing lights as well as making improvements to busy intersections. Participants described how pedestrian and bike infrastructure improves the number of safe routes to school, increasing active transportation (e.g., walking, biking). In turn, more kids walking and biking to school boosts policy-maker support for active living policies that appropriate city or county funds to improve pedestrian and bike infrastructure.

*Story B*: While the preceding story reflected a positive scenario for Spartanburg County, South Carolina , the same feedback loop also tells the opposite story. Less pedestrian and bike infrastructure, or poor quality infrastructure, leads to fewer safe routes to get to school by bike or foot. Consequently, kids are less likely use active modes of transportation to school and policy-makers are not inclined to rally behind active living policies that appropriate city or county funds to active living initiatives, such as improvements to pedestrian and bike infrastructure..




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 — Active Transportation" 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.

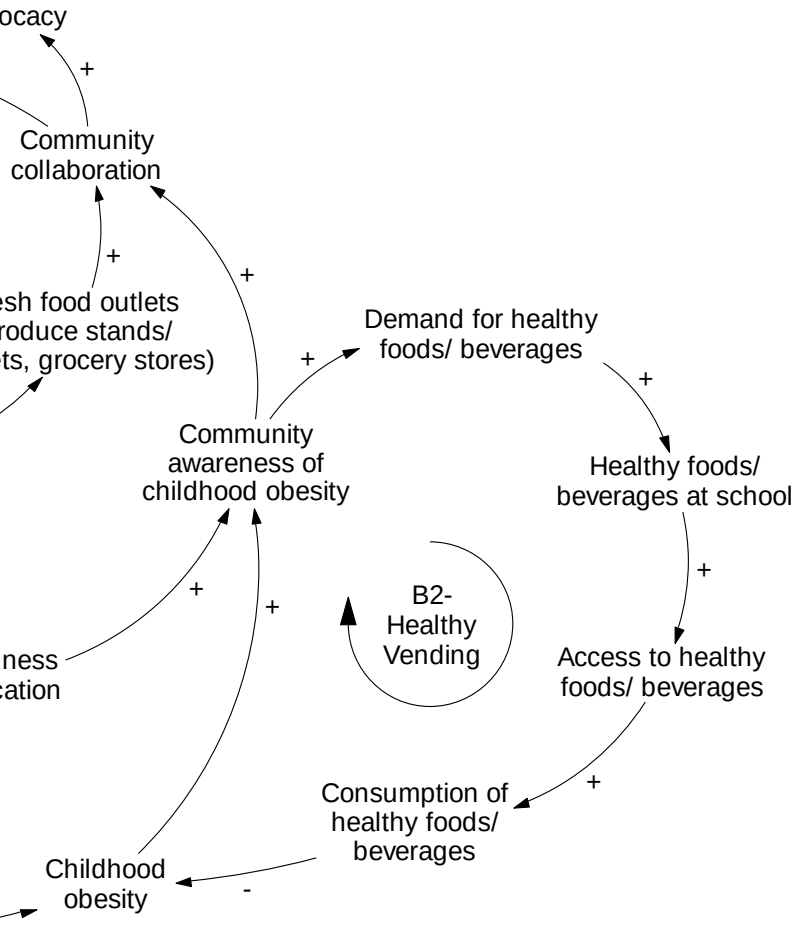
***"I think we've seen an increase in children who walk and bike to school in large part due to efforts for active living and Safe Routes to School. My hope is that it will continue to increase and kids will have more opportunities to walk and bike to school. My fear is that a traffic accident that freaks parents out, whether a kid gets hit by a car or kidnapped or whatever, [and] it all falls apart." (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.

In isolation, this reinforcing loop represents the influence of pedestrian and bike infrastructure on active modes of transportation designed to increase overall physical activity. To understand other influences on these variables, 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.

Figure 3: Active Transportation Feedback Loop

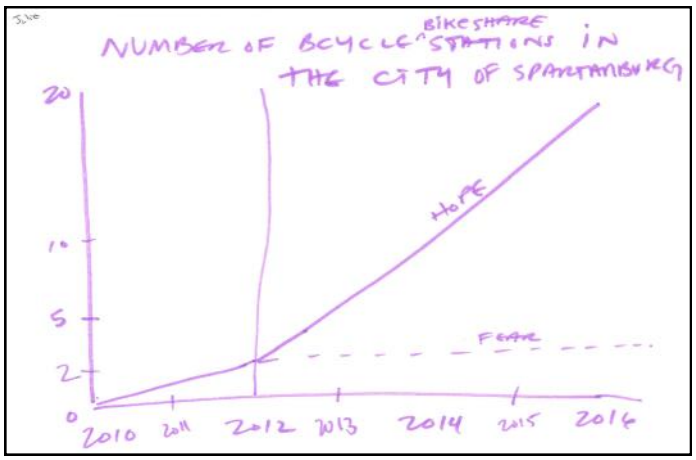



<u>System Insights for Spartanburg HKHC</u>

Participants also identified a slight increase, but very small number of bike share stations in Spartanburg County, South Carolina, limiting residents' adoption of bicycling as a mode of transportation (see behavior over time graph).

From the systems thinking exercises, several insights can inform partners' active transportation strategy. For instance, working with schools and businesses to advocate for bike share stations to increase the number of community residents, young and old, using active modes of transportation. Likewise, gaining support from local media to share success stories related to active modes of transportation, such as local Safe Routes to School programs, and to ensure that traffic accidents involving youth are reported in a competent manner discussing actual risk of these incidents instead of sensationalizing a rare occurrence (see quote on previous page).

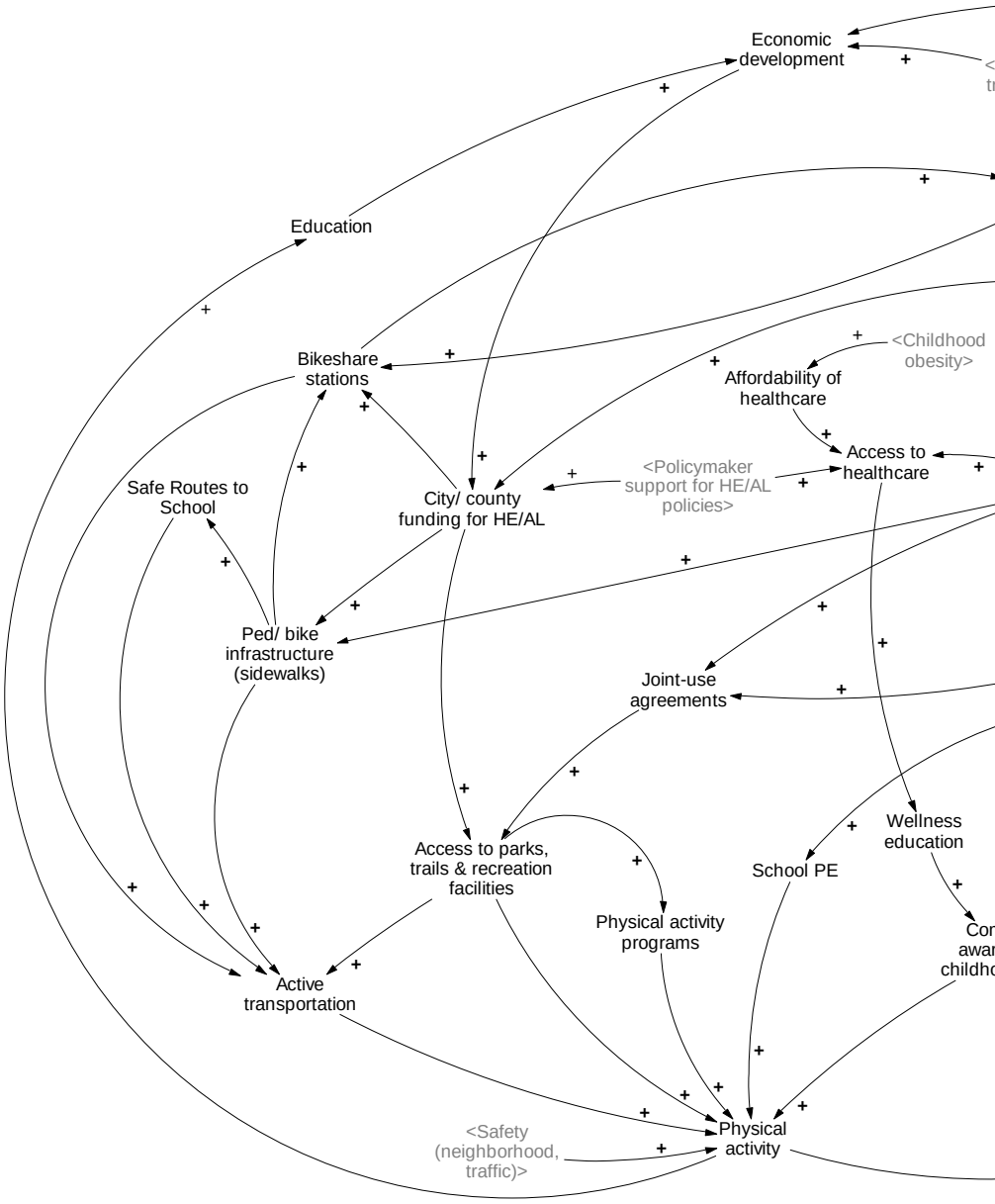
In addition to these insights, systems thinking can also help to pose key questions for assessment and evaluation, including developing measures to assess policy-maker support for active living policies and initiatives, evaluating the impact of pedestrian and bike infrastructure improvements on active transportation behaviors, and examining the return on investment from funds spent on active living initiatives.



**Opportunities for Systems Thinking in Spartanburg County, 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, causal relationships and polarities, reinforcing feedback loops, and balancing feedback loops, among others. For the *Spartanburg HKHC* partners, this storybook also summarized the healthy eating, active living, partnership and community capacity, social determinants, and health and health behaviors subsystems in the Spartanburg County causal loop diagram as well as an example feedback loop corresponding to the partnership's primary strategies.

Figure 4: *Spartanburg HKHC* 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 Spartanburg County, South Carolina to promote healthy eating and active living as well as preventing childhood overweight and obesity.

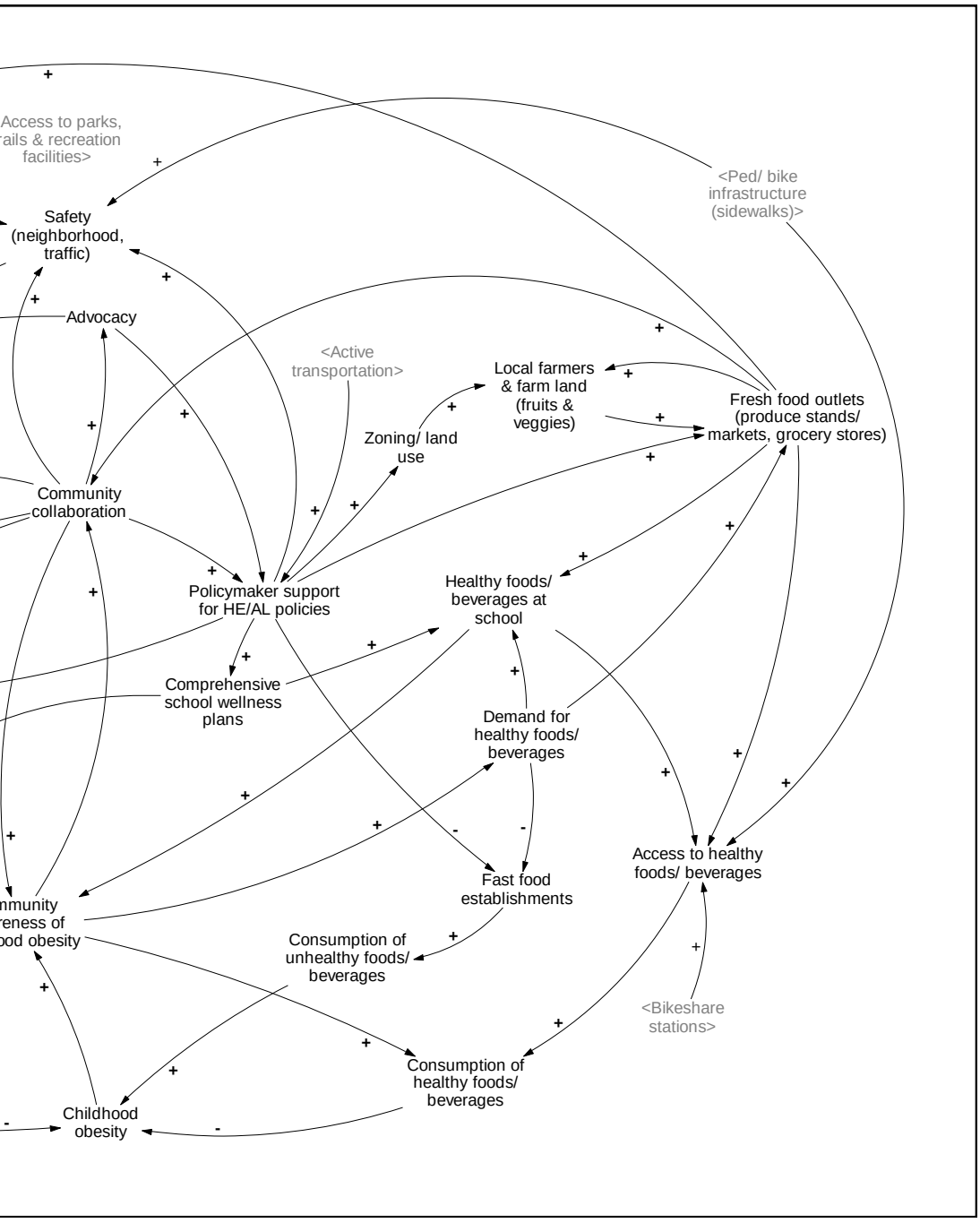
Yet, there are several limitations to this storybook, including:

- the participants represent a sample of the *Spartanburg HKHC* 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 vending/ menus at worksites, healthy options in restaurants, government nutritional assistance (SNAP), land subsidies to community corporate farms, access to public transportation, suburban sprawl, crime, community/ school gardens, media on HE/ AL, crime, affordability of healthy foods/ beverages, chronic diseases; 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 Spartanburg County 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 *Spartanburg HKHC* 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.

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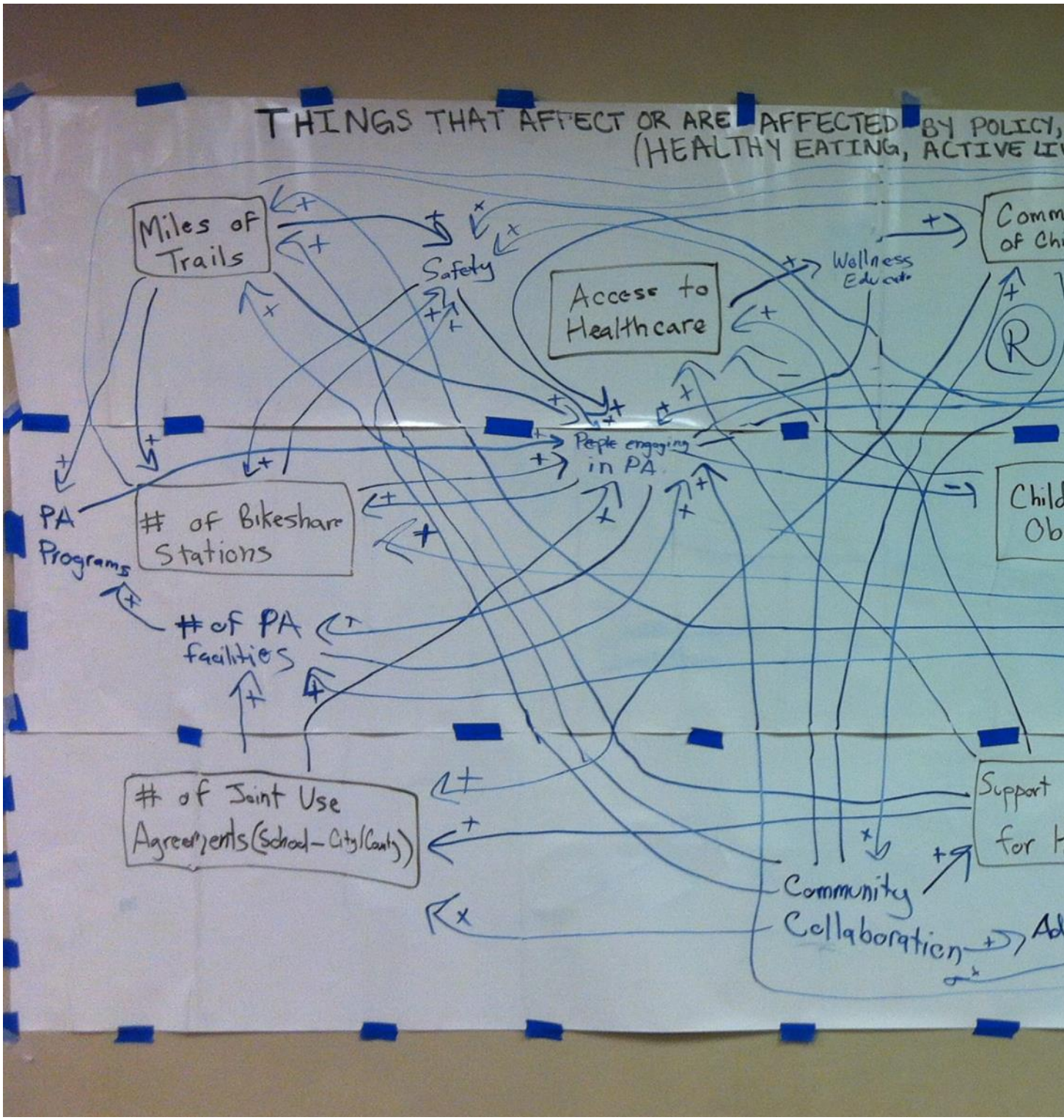
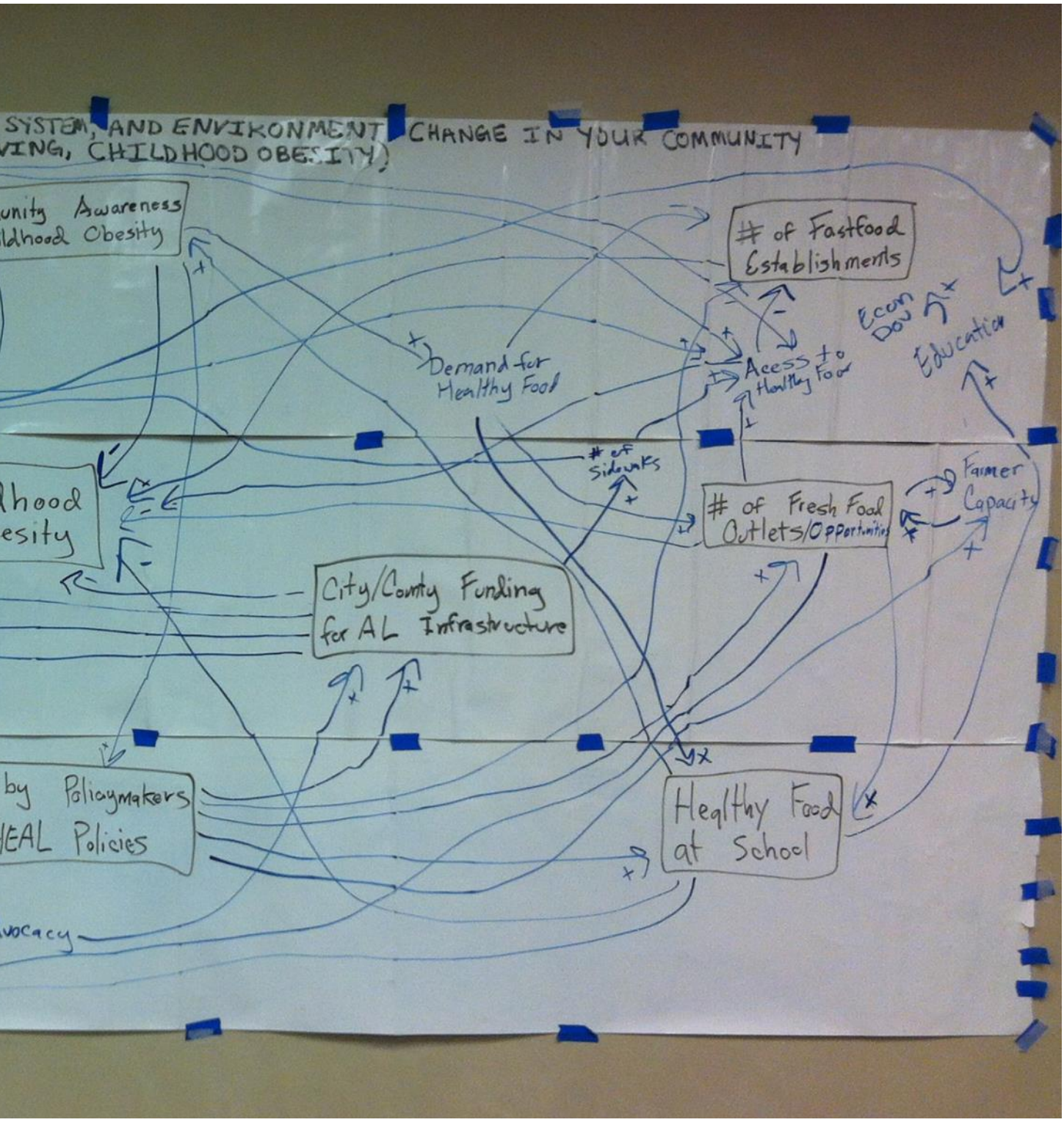
**Appendix A: Behavior Over Time Graphs Generated during Site Visit**

| **Spartanburg County, South Carolina: *Spartanburg HKHC*** | |
|---|---|
| **Categories** | **Number of Graphs** |
| Active Living Behavior | 5 |
| Active Living Environments | 6 |
| Funding | 5 |
| Healthy Eating Behavior | 2 |
| Healthy Eating Environments | 7 |
| Marketing and Media Coverage | 1 |
| Obesity and Long Term Outcomes | 2 |
| Partnership & Community Capacity | 5 |
| Policies | 3 |
| Programs & Promotions (Education and Awareness) | 1 |
| Social Determinants of Health | 4 |
| **Total Graphs** | **41** |

**Appendix B: Photograph of the Original Version of the *Spartanburg HKHC*Causal Loop Diagram**




SYSTEM, AND ENVIKONMENT CHANGE IN YOUR COMMUNITY
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unity Awareness
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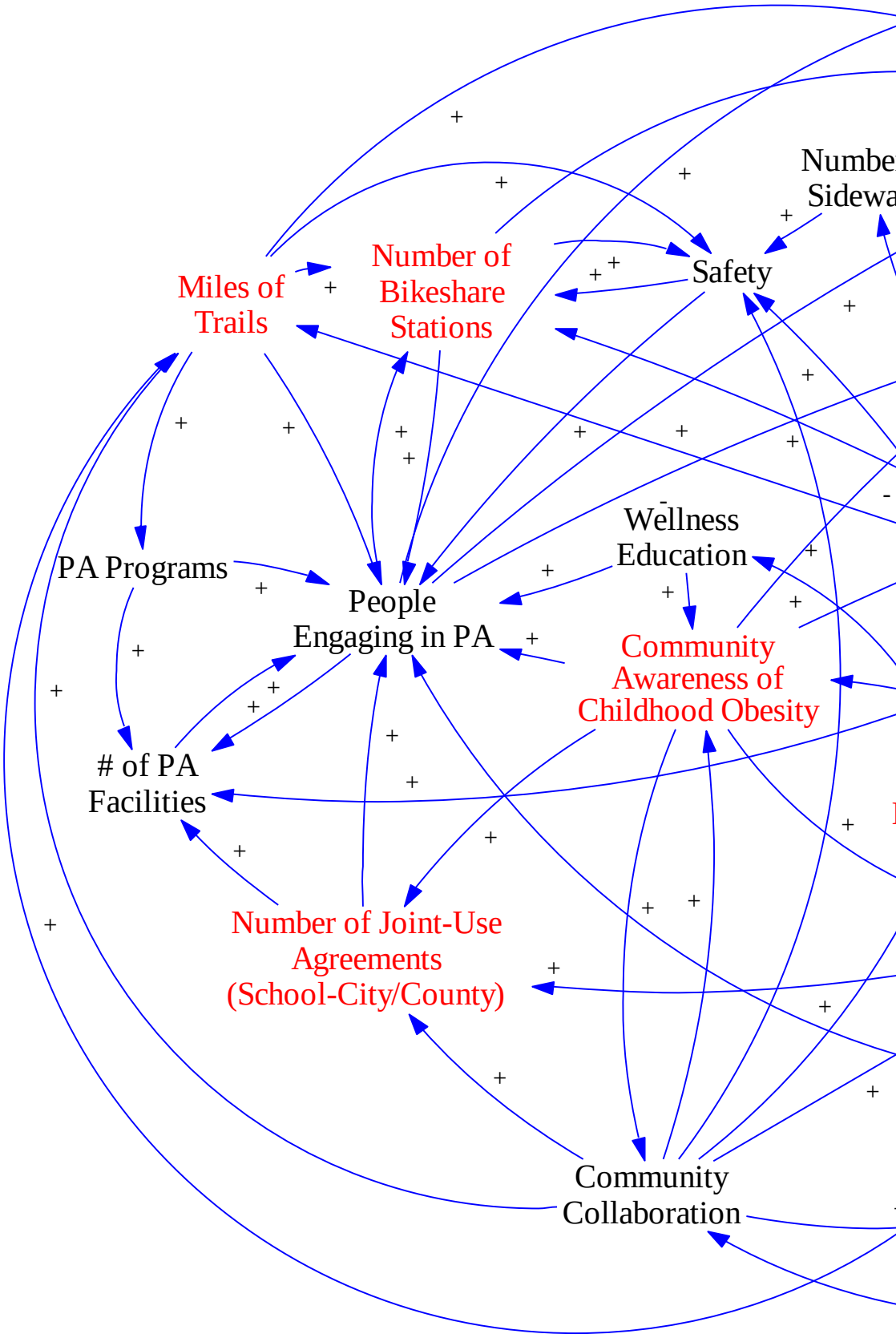
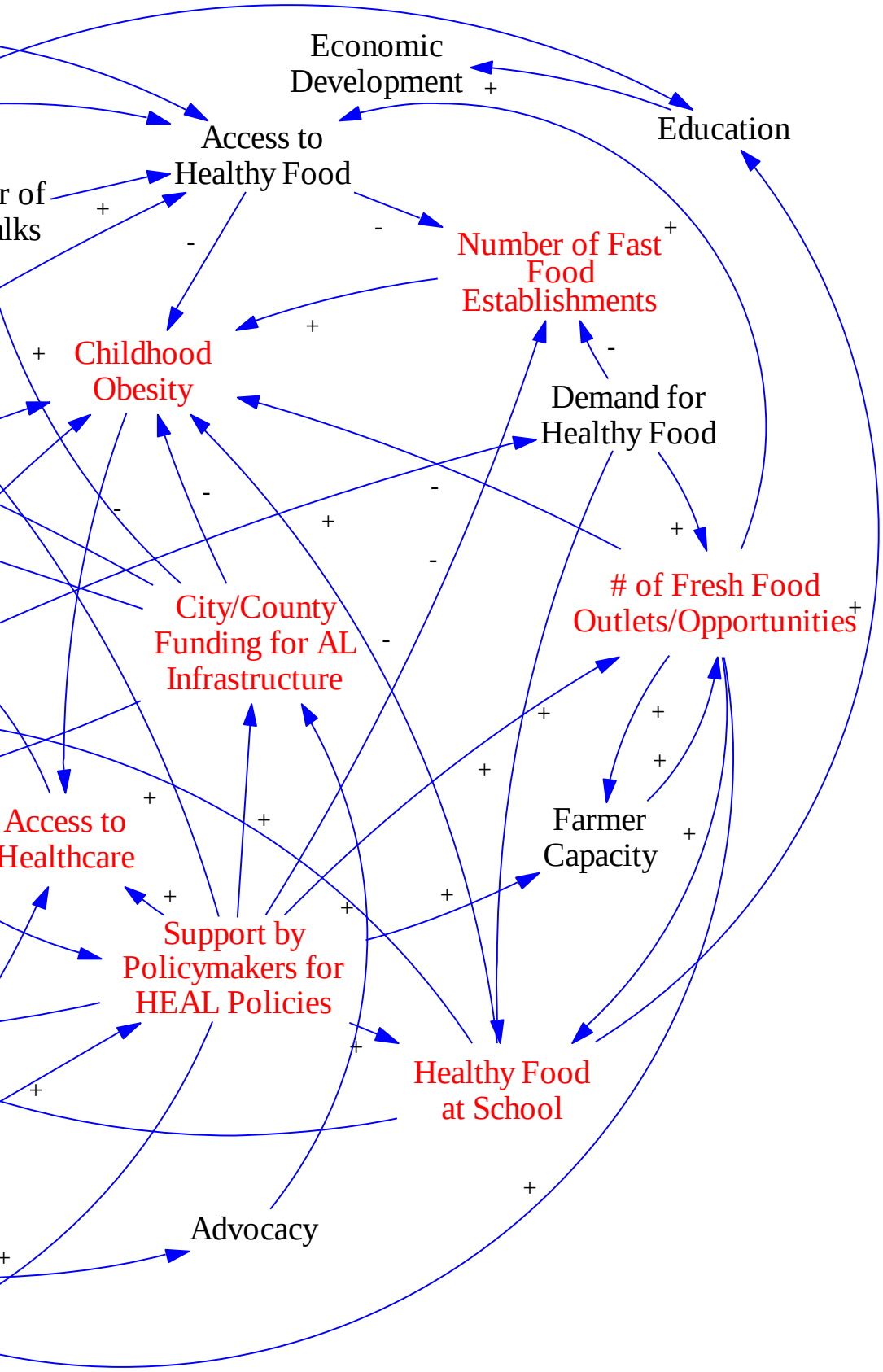
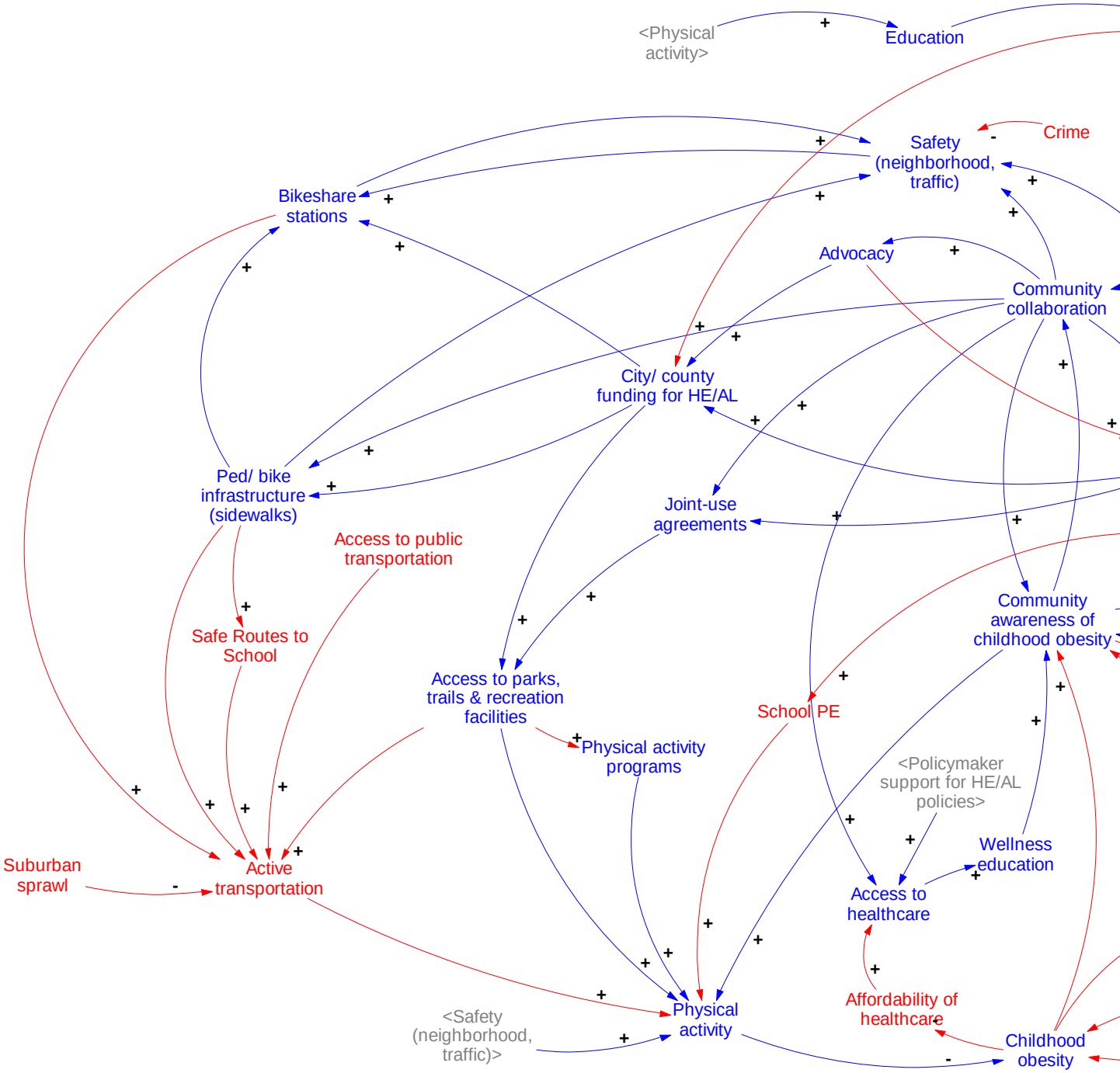
# of Fastfood Establishments
Demand for Healthy Food
Access to Healthy Food
Econ Dev
Educatio
# of Sidewalks
# of Fresh Food Outlets/Opportunities
Farmer Capacity
City/County Funding for AL Infrastructure
by Policymakers
EAL Policies
Healthy Food at School
vocacy

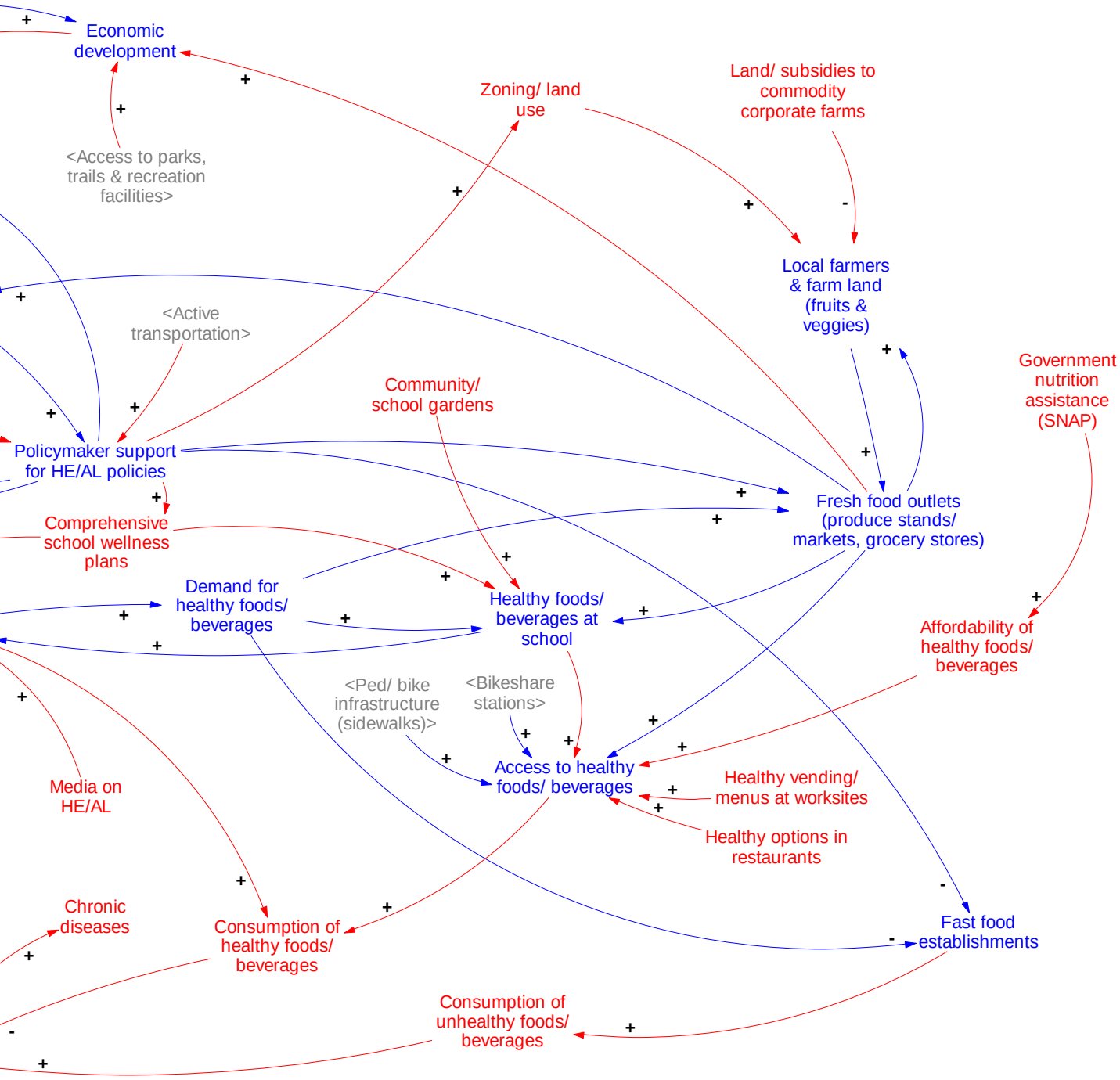
**Appendix C: Original Translation of the Causal Loop Diagram into Vensim PLE**



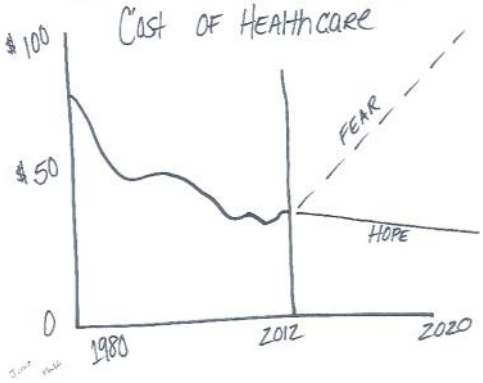

Economic Development
Education
Access to Healthy Food
r of
lks
Number of Fast Food Establishments
Childhood Obesity
Demand for Healthy Food
# of Fresh Food Outlets/Opportunities
City/County Funding for AL Infrastructure
Access to Healthcare
Farmer Capacity
Support by Policymakers for HEAL Policies
Healthy Food at School
Advocacy

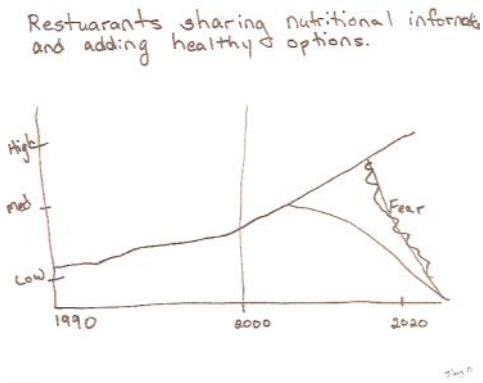
**Appendix D: Transcript Translation of the Causal Loop Diagram into Vensim PLE**

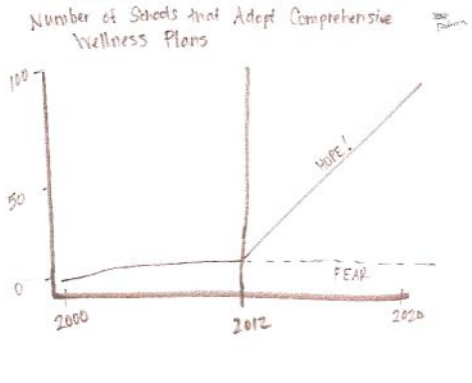


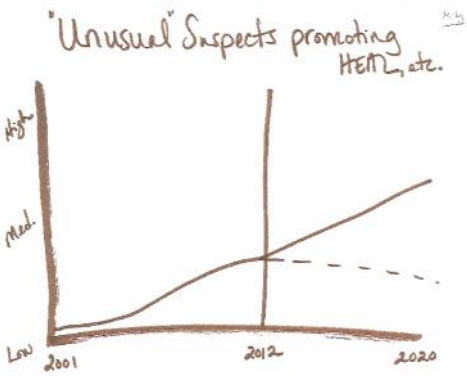

Economic development
<Access to parks, trails & recreation facilities>
Zoning/ land use
Land/ subsidies to commodity corporate farms
Local farmers & farm land (fruits & veggies)
<Active transportation>
Community/ school gardens
Government nutrition assistance (SNAP)
Policymaker support for HE/AL policies
Fresh food outlets (produce stands/ markets, grocery stores)
Comprehensive school wellness plans
Demand for healthy foods/ beverages
Healthy foods/ beverages at school
Affordability of healthy foods/ beverages
<Ped/ bike infrastructure (sidewalks)>
<Bikeshare stations>
Access to healthy foods/ beverages
Media on HE/AL
Healthy vending/ menus at worksites
Healthy options in restaurants
Chronic diseases
Consumption of healthy foods/ beverages
Fast food establishments
Consumption of unhealthy foods/ beverages

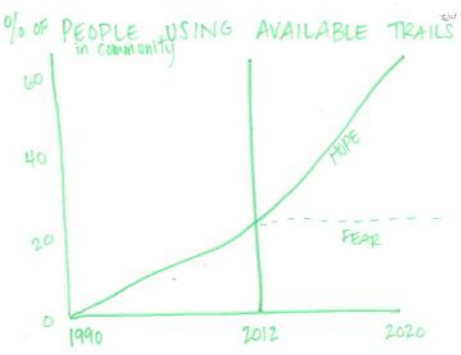
**Appendix E: Behavior Over Time Graphs not Represented in the Storybook**

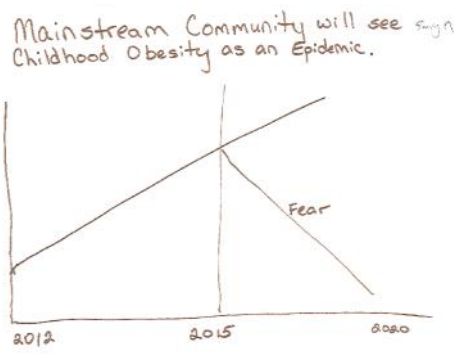


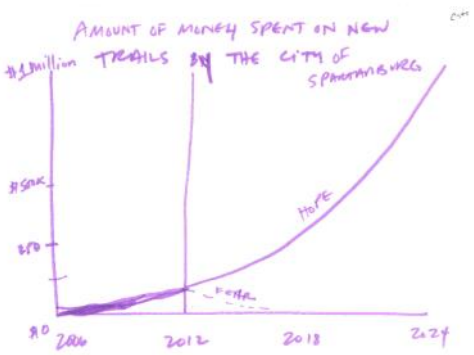



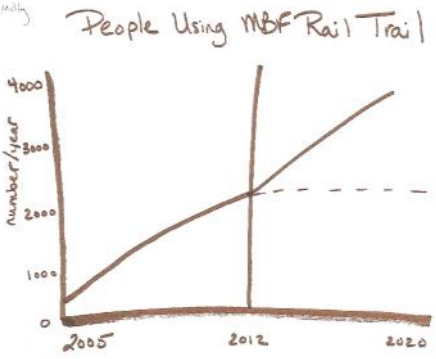



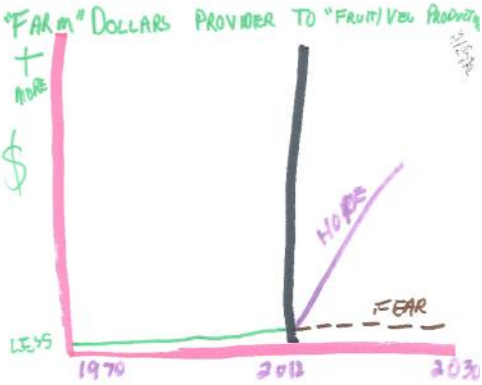



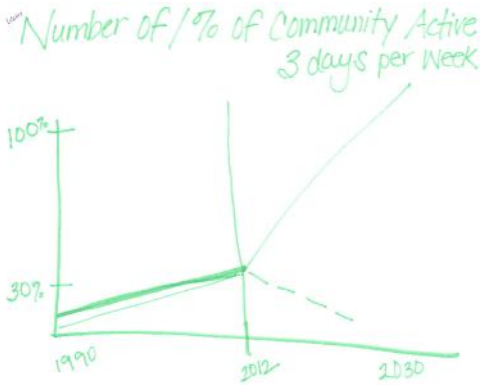



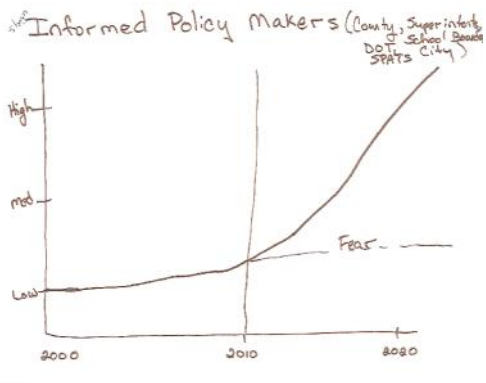



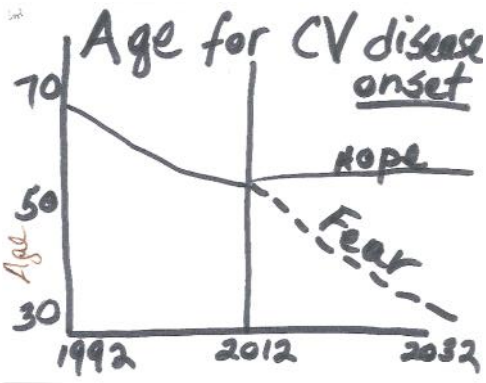



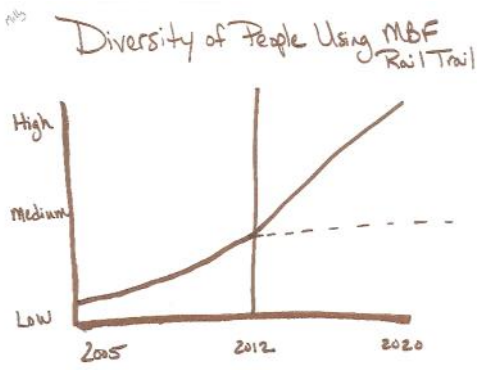



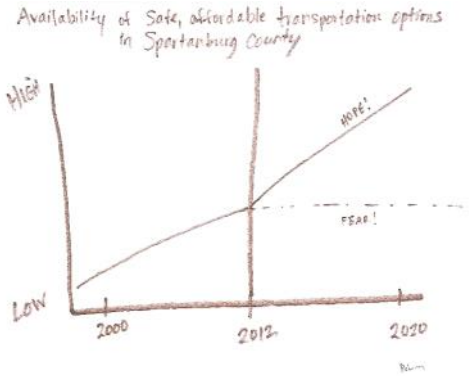



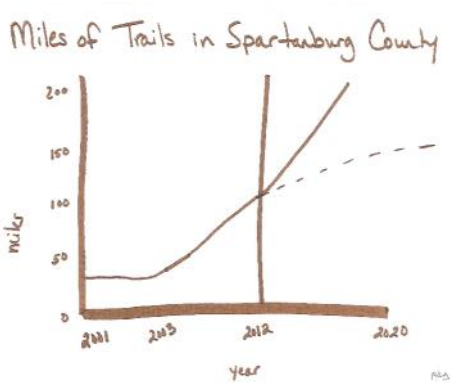



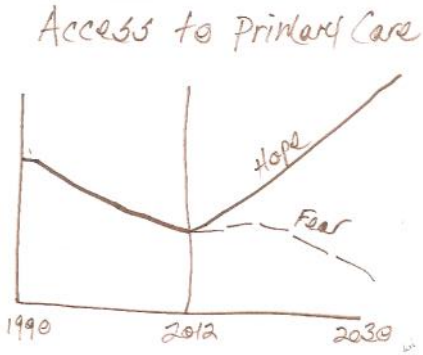

Diversity of People Using MBF Rail Trail
High
Medium
Low
2005
2012
2020

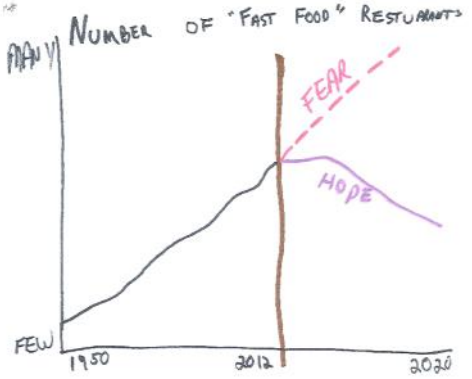

Availability of Safe, affordable transportation options in Spartanburg County
High
Low
HOPE!
FEAR!
2000
2012
2020

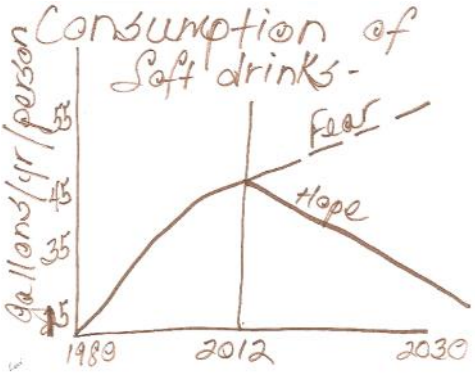

Miles of Bike Lanes in Sptbg Co.
75
50
25
0
miles
2001
2003
2012
2020

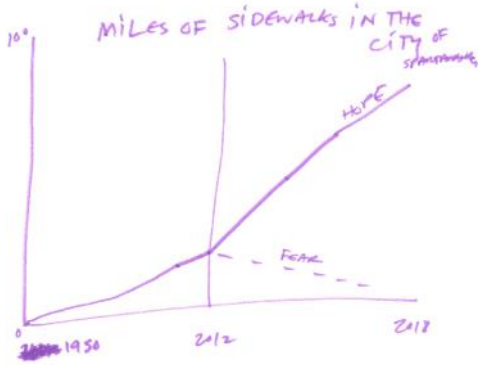

Miles of Trails in Spartanburg County
200
150
100
50
0
miles
2001
2003
2012
2020
year

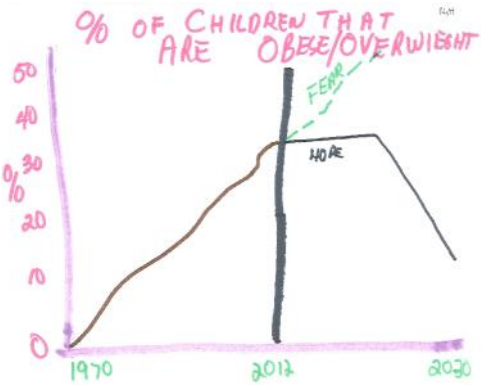

MILES OF TRAILS FOR RECREATION
HIGH
LOW
HOPE
FEAR
1990
2012
2030

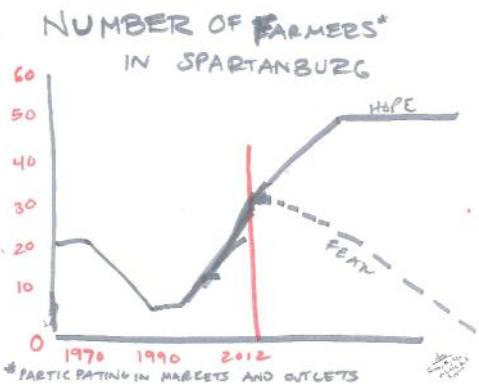

Access to Primary Care
Hope
Fear
1990
2012
2030

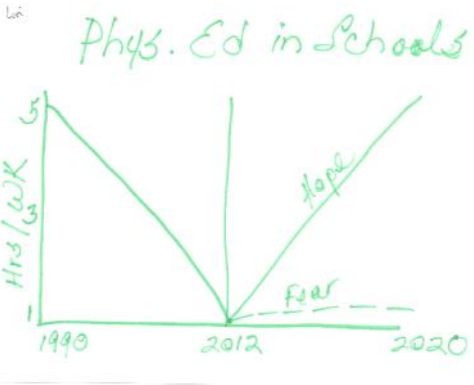

Number of "Fast Food" Restaurants
MANY
FEW
FEAR
HOPE
1950
2012
2020


Consumption of Soft drinks -
Gallons/yr/person
55
45
35
25
Fear
Hope
1989
2012
2030


MILES OF SIDEWALKS IN THE CITY OF
10
HOPE
FEAR
0
1950
2012
2018


% OF CHILDREN THAT ARE OBESE/OVERWEIGHT
50
40
%30
20
10
0
FEAR
HOPE
1970
2012
2020


NUMBER OF FARMERS* IN SPARTANBURG
60
50
40
30
20
10
0
HOPE
FEAR
1970
1990
2012
*PARTICIPATING IN MARKETS AND OUTLETS


Phys. Ed in Schools
5
1
Hrs/wk
Hope
Fear
1990
2012
2020