Systems Thinking in Communities:

Understanding the Causes of Inactivity, Poor Diet/Nutrition, and Childhood Obesity in Cuba, New Mexico

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Acknowledgments

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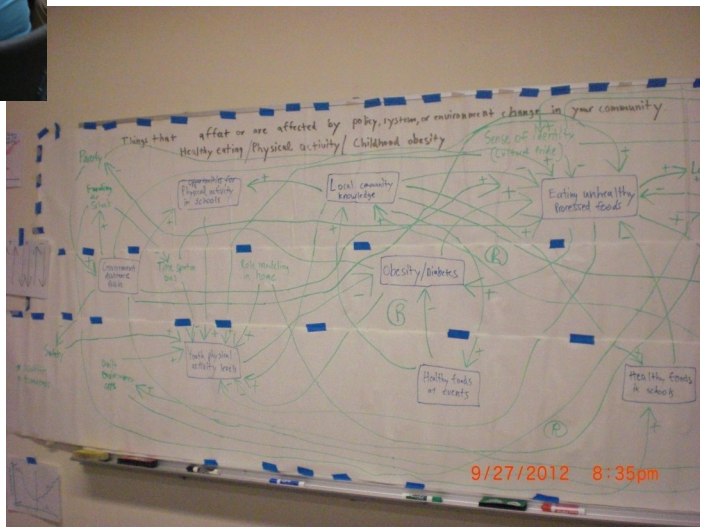
Things that affect or are affected by policy, system, or environment change in your community
Healthy eating / Physical activity / Childhood obesity
9/27/2012 7:14pm


Things that affect or are affected by policy, system, or environment change in your community
Healthy eating / Physical activity / Childhood obesity
Poverty
Local community knowledge
Eating unhealthy processed foods
Obesity/Diabetes
Healthy foods at events
9/27/2012 8:35pm

Introduction

Healthy Kids, Healthy Cuba 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 *Healthy Kids, Healthy Cuba* project was to introduce systems thinking at the community level by identifying the essential parts of the Cuba, New Mexico 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, government agencies, community-based organizations, businesses) 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.

Cuba, New Mexico: Background and Local Participation

Cuba, New Mexico is a rural hub with an approximate radius of 60 miles located in Sandoval County. The Village of Cuba has about 800 residents. The area to the north includes small villages (e.g., Gina), counties (e.g., Rio Arriba County, Gallina), and extends into the three most eastern sections of the Navajo Indian Reservation which includes the poorest of the poor among the Native American population. The population seems to be getting older, with many of younger residents leaving due to the lack of economic opportunities, with the timber mines closing and the logging industry completely shutting down. About 8,800 people live within a 35-mile radius of the village of Cuba.

According to U.S. Census data, the median household income for Cuba residents was $21,538 in 2000 with 41% of the population living below the poverty level. The unemployment rate was 17.5% (much higher than the unemployment rates in Sandoval County and NM, 6.6% and 7.3% respectively). Census data also revealed for the Village of Cuba and the outlying areas 36.3% of the population is Hispanic, 36.3% are American Indian and 26.0% are Anglo; about 33.9% of the population (close to 3,000) is under 20 years old.

The Prevention Research Center (PRC) in the Health Sciences Center at the University of New Mexico was established in 1995 and serves as the lead agency for *Healthy Kids, Healthy Cuba.* The PRC has projects across the state within single communities and multiple communities (i.e., up to 16), depending on the project.

Momentum for active living and healthy eating prevention efforts in Cuba have been occurring since 1980 when a resident of Cuba, also serving as family physician, directed and founded a non-profit organization, Nacimiento Community Foundation (NCF). He also formed the Step Into Cuba Alliance in 2009 to promote healthy lifestyles and prevent chronic disease by providing walkways, trails and social support for walking and hiking in Cuba. This Alliance, in collaboration with the Prevention Research Center, served as the primary partners for *Healthy Kids, Healthy Cuba*.

Healthy Kids, Healthy Cuba was a complement to the existing active living efforts of the Prevention Research Center and Step Into Cuba Alliance, in that it extended the target population to children and broadened the focus to incorporate nutrition standards and healthy food access.

Cuba, New Mexico is a high-need and resource poor area in which researchers, practitioners, and community leaders realize the importance of not duplicating resources in order to broaden the support for the entire community. Therefore, coordination and communication around different project goals has been key across *Healthy Kids, Healthy Cuba partnership*, Step Into Cuba Alliance, Nacimentio Community Foundation, and Prevention Research Center.

Healthy Kids, Healthy Cuba's Priorities and Strategies

The partnership and capacity building strategies of *Healthy Kids, Healthy Cuba* included:

- **Community Champions:** In rural Cuba, there are many community champions that served as the change agents to create policy, system, and environmental change approaches, as well as programs to support these efforts. One champion, a physician in the community, invested time on prevention efforts through the NCF and the Step Into Cuba Alliance, and was honored at the White House for extraordinary work to improve physical activity opportunities in Cuba.
- **Youth Engagement:** *Healthy Kids, Healthy Cuba* made it a goal to focus on engaging youth to create changes in the community. To this end, they have found opportunities through schools and local organizations to engage youth. One particularly local organization, AMI Kids, serves as a local alternative school that provides troubled youth with the opportunity to develop confidence and competencies in vital life skills and educational areas to assist them in making better choices. The youth have been actively involved with clean-up days at the garden and trails, selling water at the Sandoval County Fair, working at the farmers' market, and more.

The healthy eating and active living strategies of *Healthy Kids, Healthy Cuba* included:

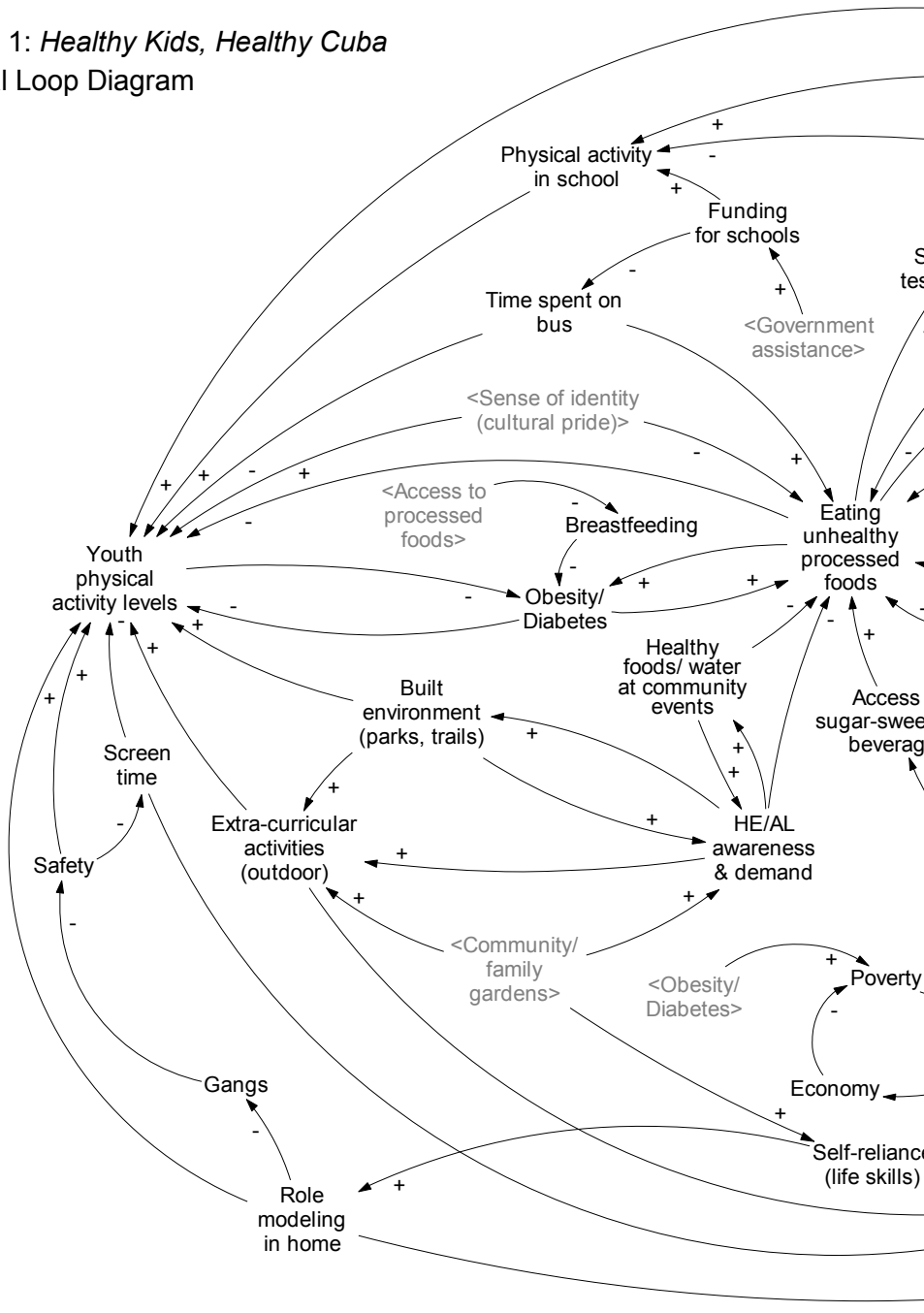
- **Parks and Recreation:** Wilderness trails and walking paths were created in the Village of Cuba and within St. Francis of Assisi Park. The Cuba Department of Parks and Recreation received a $10,000 grant from Sandoval County to pay for exercise equipment and televisions in the local fitness center. Fitness center usage fees of ten dollars per month were used to pay for utilities. Residents who paid the fee have 24-hour access to the fitness center through use of an entry code lock system which also tracks usage of the facility. *Healthy Kids, Healthy Cuba* is currently trying to get funding to update the St. Francis of Assisi Park, and many assessment activities have occurred to create a design for the park.
- **Active Transportation**: U.S. 550 is a primary route connecting Albuquerque to northwestern New Mexico and Colorado, and it runs through the Village of Cuba, serving as a commercial center for the area. Residents within Cuba and from surrounding areas visit the village to access food, mail, and other health services. The Village of Cuba along with the Step Into Cuba Alliance worked with the Department of Transportation to take a lead role on pedestrian improvements on U.S. 550. Specifically, sidewalks have been added to both side of the street through town.
- **Farmers' Markets**: In 2009, a farmers' market was started in Cuba on Saturdays and it has grown to approximately six vendors. During the market, the Village of Cuba provided electricity and access to park amenities, including a park building and restrooms. The market had an EBT machine and approximately 75% of the vendors accepted Women, Infant, and Children (WIC) coupons and Supplemental Nutrition Assistance Program (SNAP) payments.
- **Community Gardens**: In 2009, a community garden was expanded (originally built in 2007). Garden practices were put into place including the use of organic gardening methods and an informal agreement with the American Legion Home for use of its land and building. Efforts were made to accommodate community garden members who relied on wheelchairs to get around, including assignment to raised-bed gardens and clearing the ground of rocks. The Village of Cuba donated the water for the Cuba Community Garden.
- **Healthy Vending:** The Sandoval County Fair held every year from Wednesday to Sunday contains four food and beverage vendors. The Sandoval County Fair Board agreed to require vendors to sell water for less than soda, but the amount to charge was left up to each vendor.
- **After School Activity Bus:** Through advocacy efforts and support from a former school superintendent, an activity bus was created to provide children with access to fresh, healthy food and opportunities to engage in physical activity, such as working in the community garden. Because the superintendent left in 2013 and the activity bus was removed, *Healthy Kids, Healthy Cuba* partners have been trying to restore the activity bus.

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

Systems Thinking in Communities: Cuba, New Mexico

"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 Cuba 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.

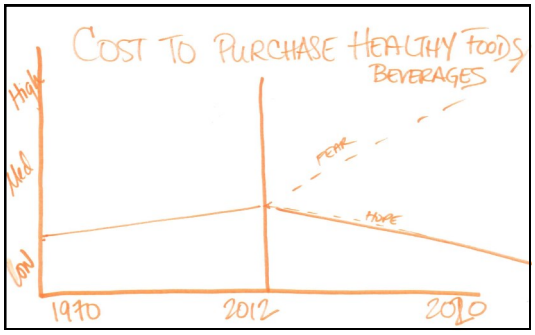
Figure 1: *Healthy Kids, Healthy Cuba*
Causal Loop Diagram



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

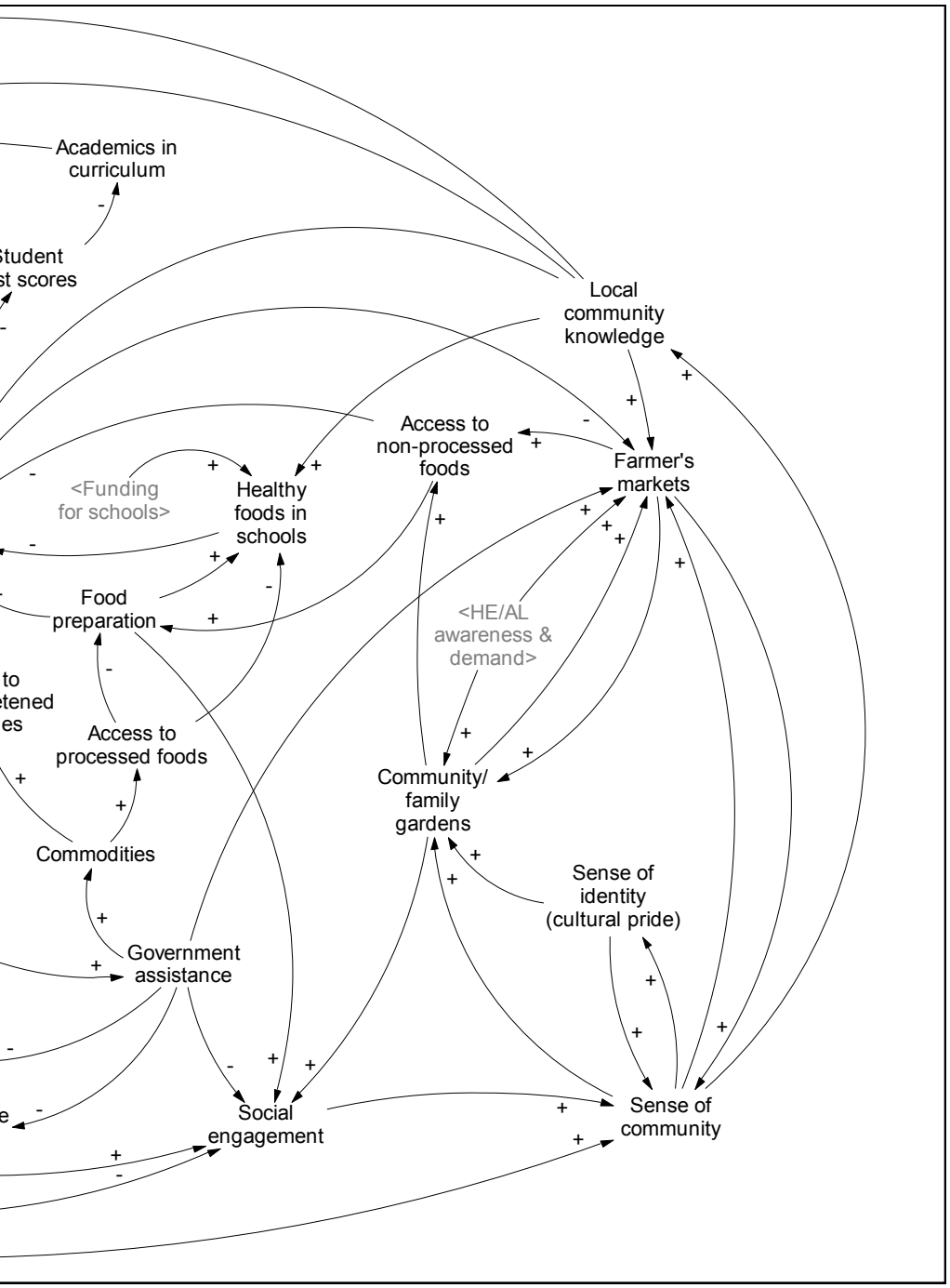
Members of the *Healthy Kids, Healthy Cuba* partnership participated in a group model building session in September, 2012 and generated this system, also referred to as a causal loop diagram (Figure 1). Participants in the group model building session included residents as well as representatives of non-profit agencies, academic institutions, health care providers, 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 Cuba 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 cost to purchase healthy foods and beverages, the cost has increased steadily since 1990, and the participant hopes that this increase 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.

For instance, there are many feedback loops influencing or influenced by eating unhealthy processed foods in this causal loop diagram. One feedback loop is: eating unhealthy processed foods → farmers' markets → sense of community → local community knowledge → eating unhealthy processed foods. A second feedback loop is: eating unhealthy processed foods → youth physical activity levels → obesity/ diabetes → eating unhealthy processed foods.

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 eating unhealthy processed foods. Some variables may increase eating unhealthy processed foods while other variables limit eating unhealthy processed foods. 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.

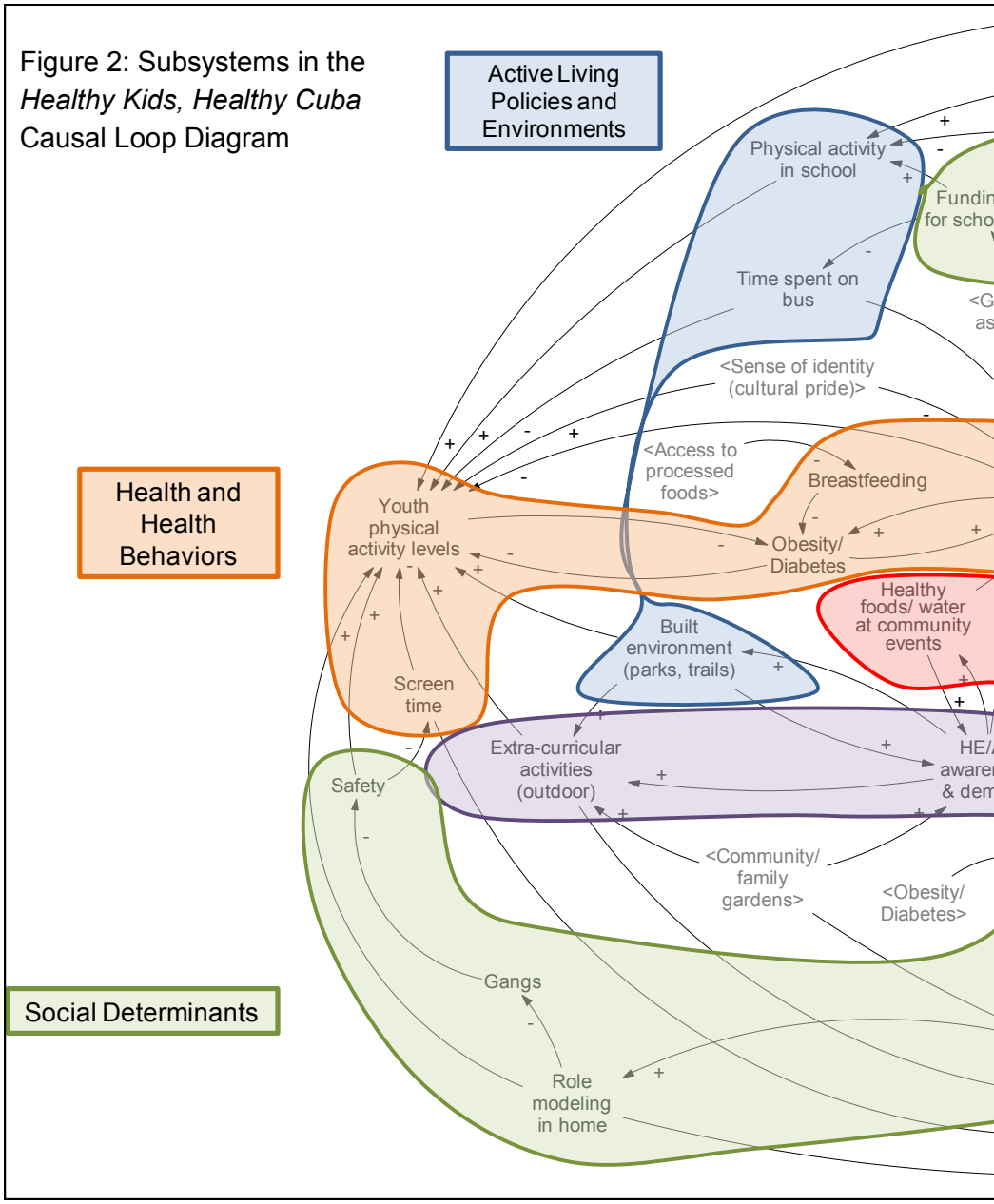
Based on this preliminary work by the *Healthy Kids, Healthy Cuba* partnership, this "storybook" ties together the behavior over time graphs, the participants' stories and dialogue, and feedback loops from the causal loop diagram to understand the behavior of the system affecting health in Cuba and to stimulate greater conversation related to Cuba'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 Cuba. 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 *Healthy Kids, Healthy Cuba* Causal Loop Diagram



Healthy Eating Policies and Environments (Red)

The healthy eating policy and environmental subsystem includes food production (e.g., commodities), food distribution and procurement (e.g., access to processed foods), and food retail (e.g., farmers' markets). During the behavior over time graphs exercise, the participants generated 13 graphs related to policy or environmental strategies (e.g., cost of healthy foods) or contexts (e.g., healthy foods are not available in schools) that affected or were affected by the work of *Healthy Kids, Healthy Cuba*. The variables represent participants' conversations from the behavior over time graph and causal loop diagram exercises.

Active Living Policies and Environments (Blue)

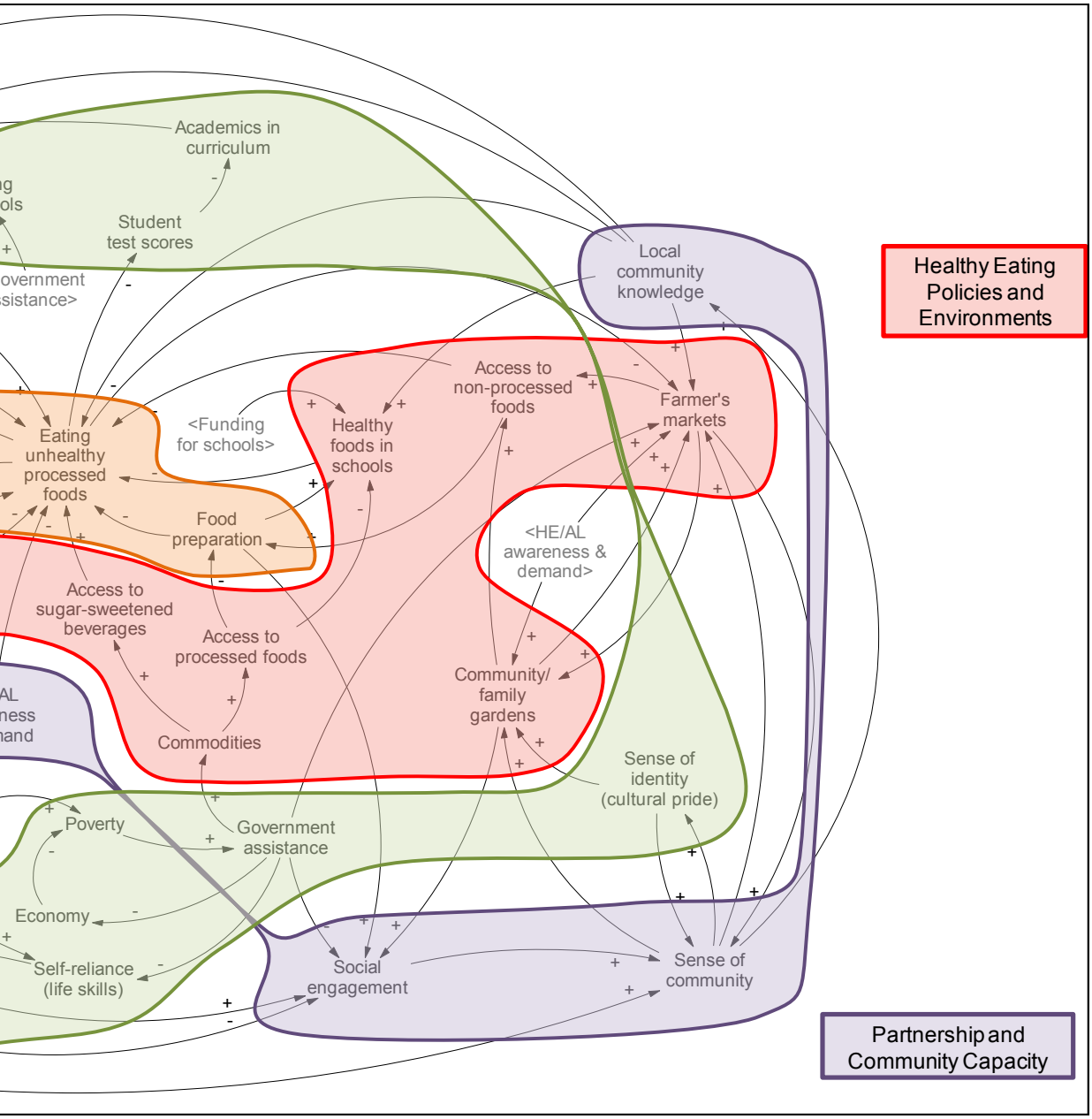
The active living policy and environmental subsystem includes design, planning, construction, and enforcement or maintenance related to access to opportunities for active transportation and recreation. For this topic, the group model building participants developed 8 graphs related to policy or environmental strategies (e.g., taxes earmarked for extra-curricular activities in schools) or contexts (e.g., time spent on bus) 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., food preparation, breastfeeding, screen time).

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, *Healthy Kids, Healthy Cuba* had community champions working toward social engagement of community residents in the change process. This subsystem also includes community factors outside the partnership that may influence or be influenced by their efforts, such as outdoor extra-curricular activities for kids or demand for healthy eating and active living.



Social Determinants

Finally, the social determinants subsystem denotes societal conditions (e.g., poverty, gangs, funding for schools) and psychosocial influences (e.g., sense of identity, self-reliance) 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 *Healthy Kids, Healthy Cuba* partners or by other representatives in Cuba. 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 gangs, safety, and outdoor physical activity.

The next sections begin to examine the feedback loops central to the work of *Healthy Kids, Healthy Cuba*. 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.

Farmers' Markets Feedback Loop

To simplify the discussion about feedback loops, several loops drawn from the *Healthy Kids, Healthy Cuba* 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 Cuba, New Mexico, each feedback loop tells a story about a more specific change process.

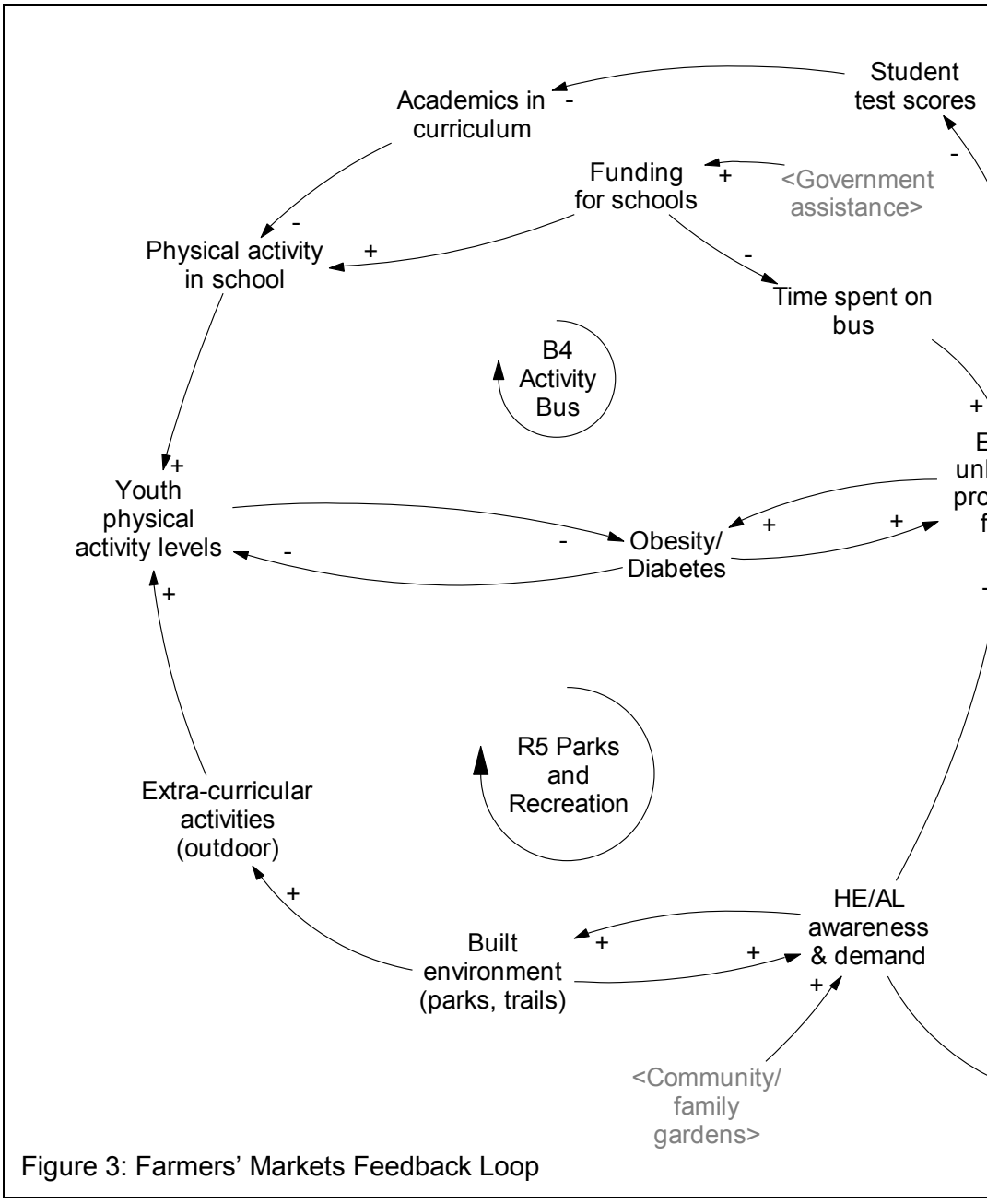


Figure 3: Farmers' Markets Feedback Loop

Causal Story for Feedback Loop

Story A: In this case, the story is about farmers' markets (green highlighted loop in Figure 3). Cuba partners set up a market with support from the village and they have increased the size up to six vendors. Participants described how the farmers' market increased residents' access to non-processed foods. In turn, residents had to spend more time preparing their meals. As a result, residents consumed less unhealthy, processed foods. And, this led back to an increase in use of the farmers' market.

Story B: While the preceding story reflected a positive scenario for Cuba, the same feedback loop also tells the opposite story. Without the farmers' market, there is less access to non-processed foods, less residents' time invested in food preparation, and greater consumption of unhealthy, processed foods.

Reinforcing Loop and Notation

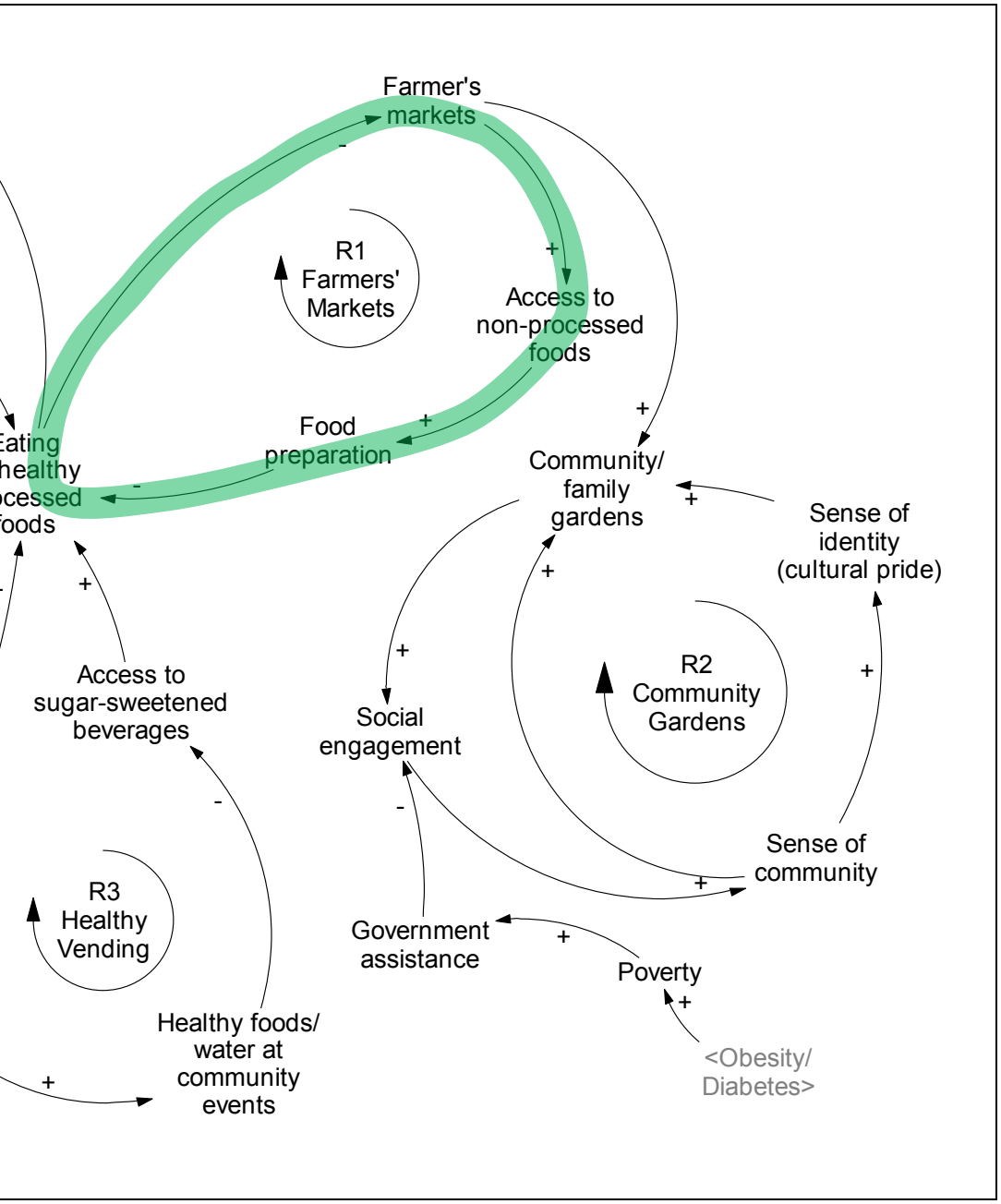
These stories — pro and con — represent a reinforcing loop, and the notation in the feedback loop identifies it as a reinforcing loop (see "R1 — Farmers' Markets" and green highlighted loop in Figure 3). The words represent variables of quantities that increase and decrease as illustrated in the stories 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.

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

"Sense of community is actualized through community events and that's one of the biggest [benefits] of the farmers' market" (Participant)

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 size or number of farmers' markets likely levels off at some point when the community residents all have access to non-processed foods. To understand what specifically leads to the leveling off of farmers' markets, it may be helpful for the partners in Cuba to consider other variables that influence or are influenced by farmers' markets. 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 have an impact on the variables in this loop.

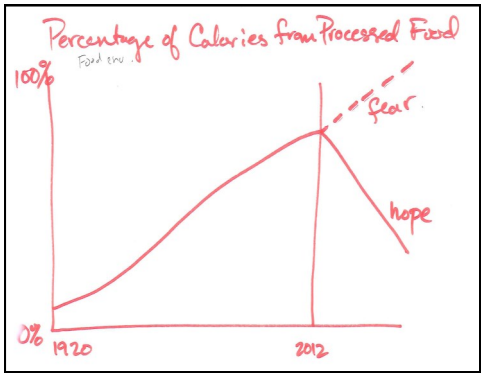


<u>System Insights for *Healthy Kids, Healthy Cuba*</u>

Participants identified an increase in the number of vendors for the farmers' market in Cuba.

From the systems thinking exercises, several insights can inform next steps with the farmers' market, including:

- Because increased access to non-processed foods requires greater food preparation, partners may work to build residents' skills and confidence in preparing healthy meals.
- With the percentage of calories from processed foods steadily increasing to close to 100% in Cuba over time, the farmers' market represents an opportunity to reduce residents' consumption of unhealthy foods and replace these calories with those from healthier foods (see behavior over time graph below).
- As residents eat less processed foods, they will be more likely to go to the farmers' market to purchase healthy, nutritious foods, which will support and potentially increase the vendors at the market.
- Finally, as suggested in the quote on the previous page, the farmers market has the added benefit of increasing the sense of community in Cuba (not shown in Figure 3).



Community Gardens (and Youth Engagement) 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 community gardens as well as youth and community engagement.

Causal Story for Feedback Loop

Story A: Participants described how community gardens increase youth and community engagement by interacting with others to learn gardening skills and share in the crops produced in the garden. Increasing engagement from youth and adults helps to increase a sense of community in Cuba which contributes to a shared sense of identity and history, increasing cultural pride of the residents. As residents identify with the gardening and agricultural roots of their ancestors, they increase their participation in the community garden.

Story B: Alternatively, an absence of community gardens contributes to fewer opportunities for youth and community engagement. As residents are less involved in activities with others, there is a decline in the overall sense of community, and, as a consequence, less exposure to historical traditions and common ties that lead to a less developed sense of identity and cultural pride.

Reinforcing Loop and Notation

Unlike the farmers' market loop in Figure 3, this loop has no "-" signs or polarities; therefore, it is still a reinforcing loop (see "R2—Community Gardens" in Figure 4).

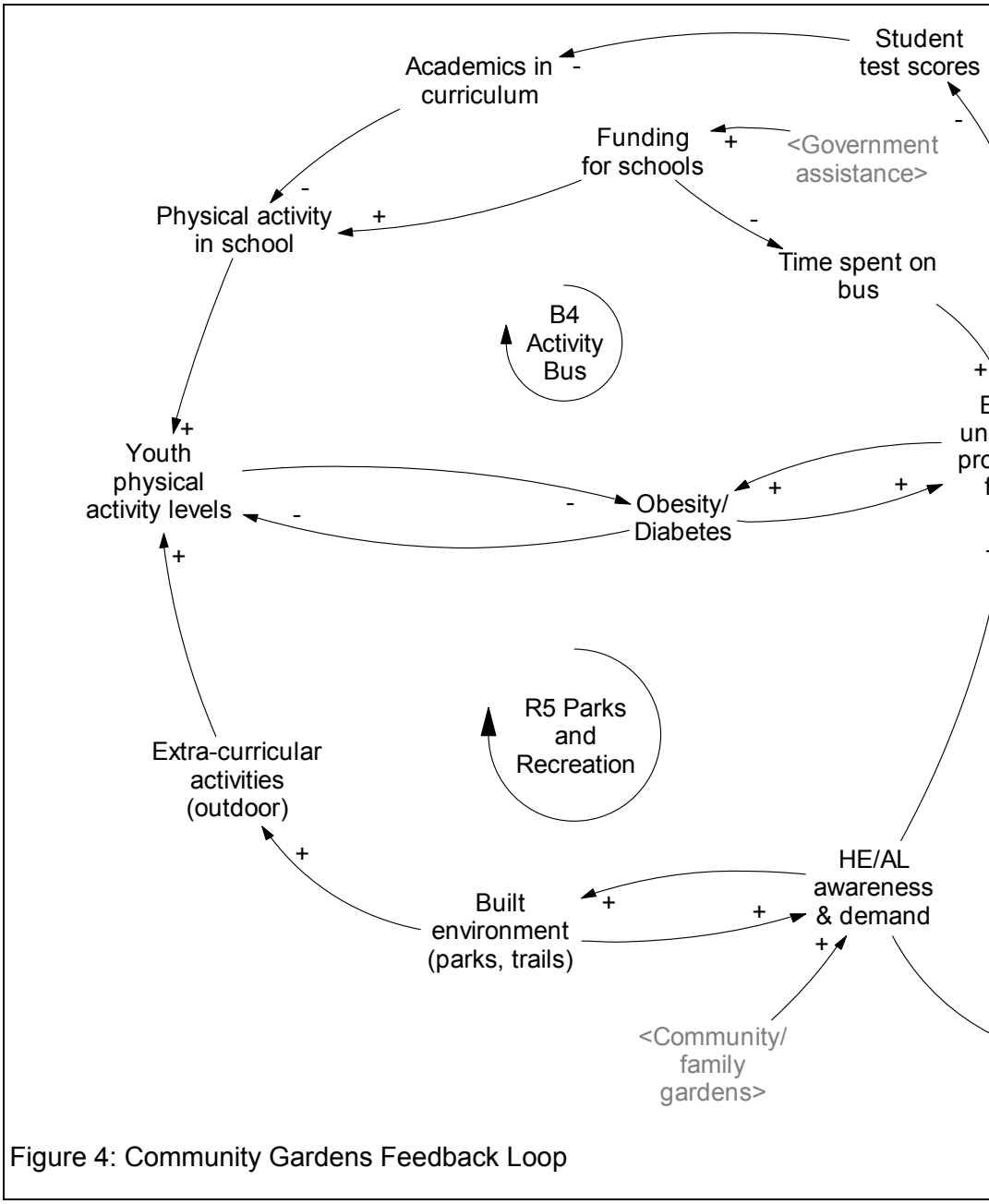


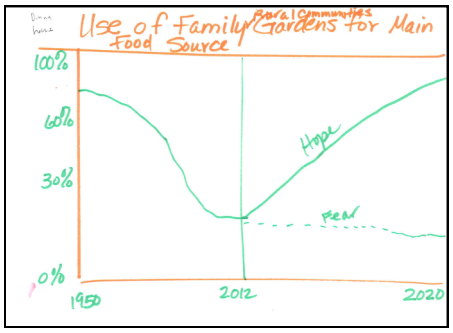
Figure 4: Community Gardens Feedback Loop

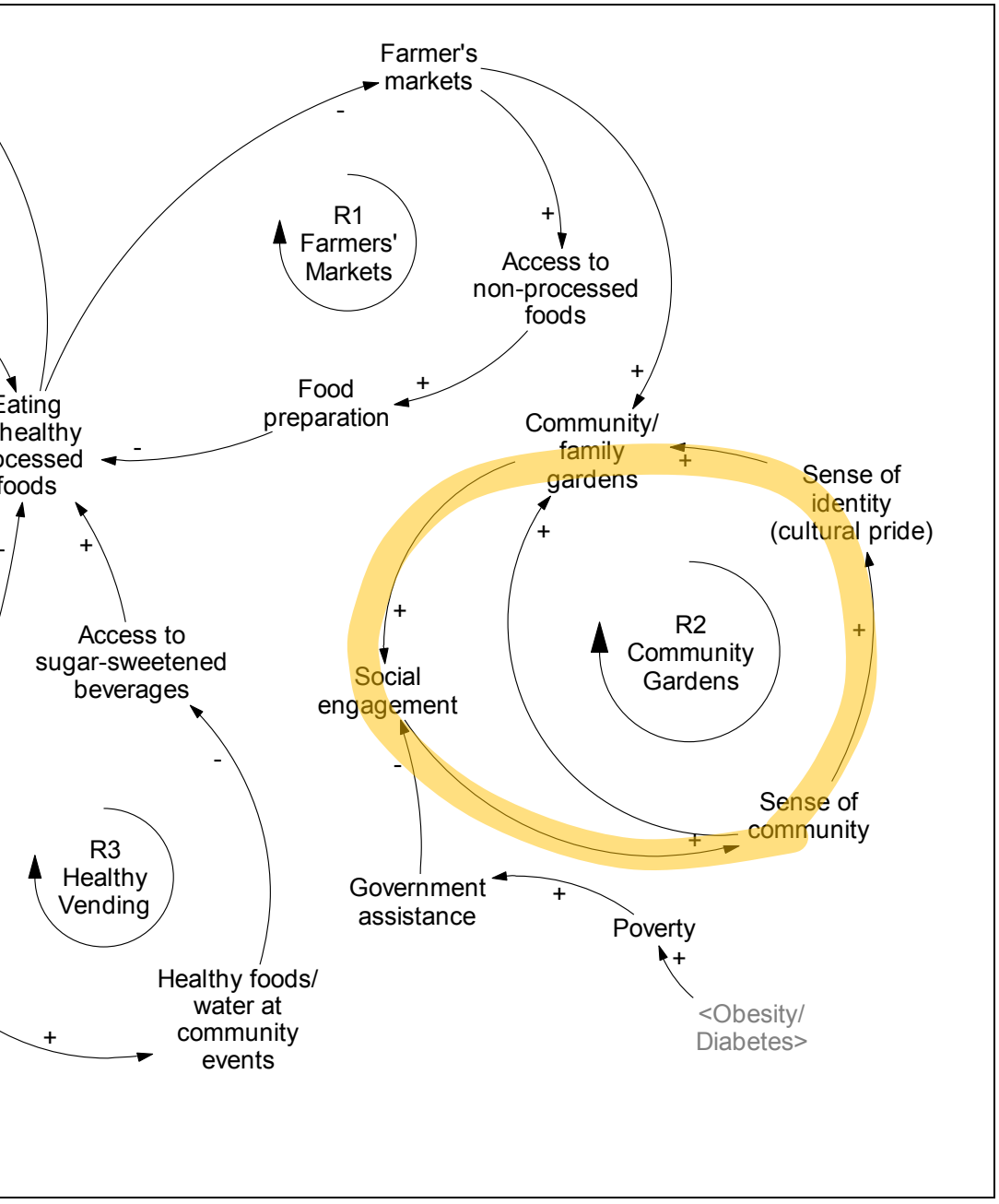
Some of these causal relationships may have more immediate effects (e.g., involvement in the community garden directly increases interactions and engagement with others in the community) and other relationships may have delayed effects (e.g., it may take some time to build trust and shared beliefs and values important to a strong sense of community). For future reference, this delayed effect is noted using two hash marks through the middle of the arrow line (not included in Figure 4).

"One of the things that I think we miss so much when we talk about a community garden is that we are not growing food in the community garden. We're growing people. We're growing community." (Participant)

System Insights for *Healthy Kids, Healthy Cuba*

In the behavior over time graph (top right), participants identified that the use of family or community gardens for the main source of food has declined dramatically over the last 60+ years from about 80% of Cuba residents to about 20% of residents. In the behavior over time graph (bottom right), participants described how the community garden was increasingly serving as a source of socialization and community building in Cuba.



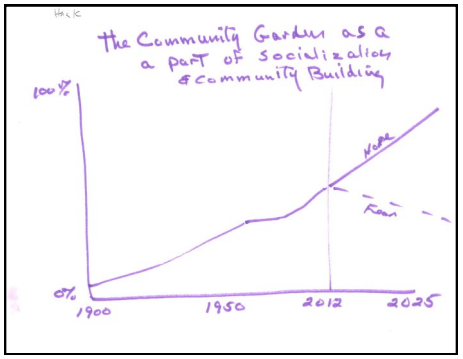


System insights can inform the partnership's next steps with community gardens, including:

- Expansion of the community garden or installation of new community gardens and farms to serve as a primary food source for Cuba once again.
- Consideration of opportunities in and around the garden that are specifically designed to enhance youth and community engagement (e.g., learning to grow native fruits and vegetables, learning about the agricultural practices of their ancestors).
- Identification of ways to connect youth and community residents to other programs and services in Cuba through their participation in the garden.

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

- What quantity of produce is necessary to grow in the garden(s) and local farms in order to provide for all Cuba residents?
- How and why are community gardens successful at increasing youth and community engagement? What are the types and numbers of new engagement opportunities?
- How does social engagement increase sense of community, and, in turn, sense of identify? What are the key ingredients to a successful approach?



Healthy Vending Feedback Loop

In blue in Figure 5, the healthy vending feedback loop represents another one of the strategies to increase healthy eating in Cuba, New Mexico. This loop is a little more complex than some of the preceding loops and it doesn't even look like a loop.

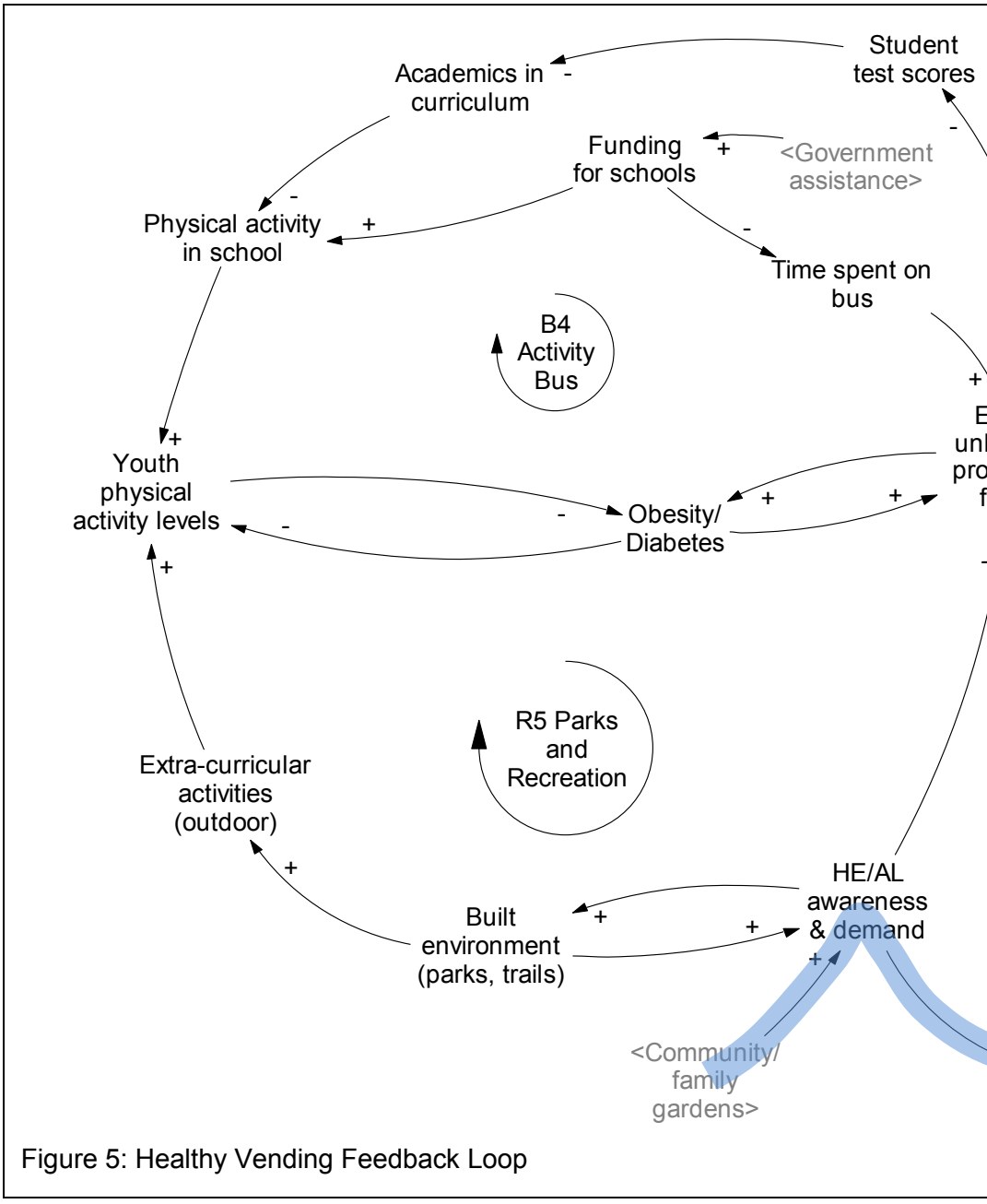


Figure 5: Healthy Vending Feedback Loop

Causal Story for Feedback Loop

Story A: Vendors providing healthy foods and water at community events (e.g., Sandoval County Fair) can help to limit access to sugar-sweetened beverages. With fewer attendees purchasing these beverages, there is less consumption of unhealthy, processed beverages. As noted in Figure 3, less consumption of these processed choices can increase use of the farmers' market. Greater use of the farmers' market can increase demand for locally grown foods from the community garden. Participation in the community garden leads to a greater awareness and demand for healthy foods and beverages that can increase healthier alternatives sold by vendors at community events.

Story B: In contrast, vendors that do not provide healthy foods and water at community events increases access to sugar-sweetened beverages, which leads to an increase in consumption of unhealthy, processed beverages. With greater consumption of processed foods and beverages, there is less demand for the farmers' market or the produce from the community garden. Less involvement with community gardens leads to less awareness and demand of healthy foods, which reinforces vendors' sales of the unhealthy alternatives.

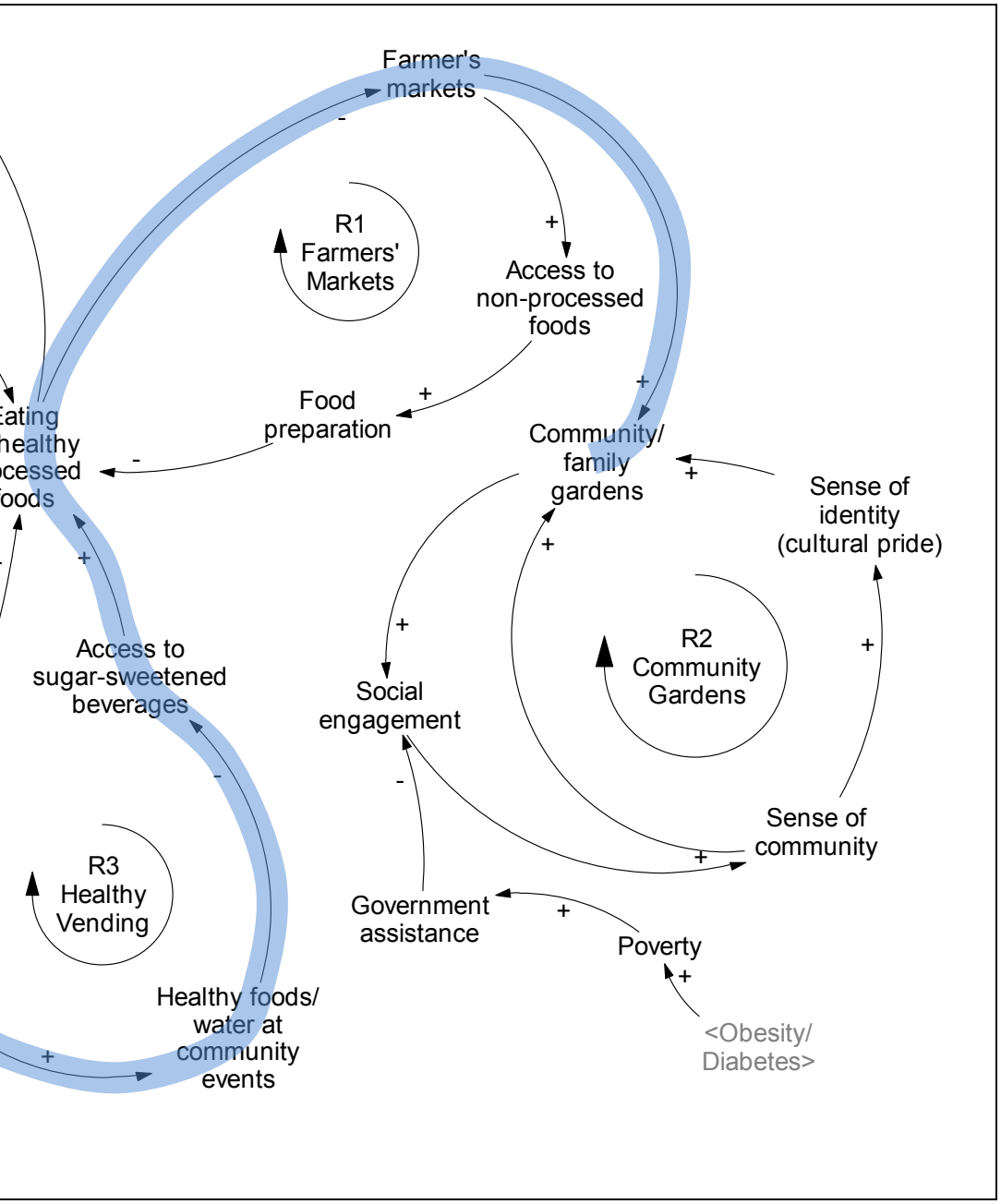
Reinforcing Loop and Notation

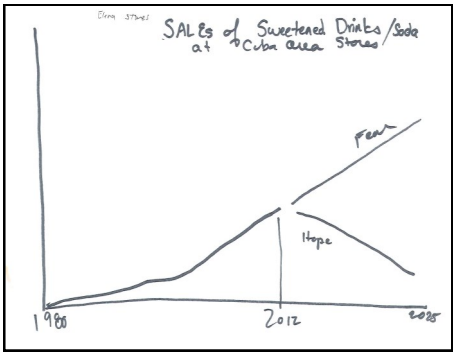
Like the farmers' market loop in Figure 3, this loop has two "-" signs or polarities; because this is an even number, it is still a reinforcing loop (see R3—Healthy Vending in Figure 5). Yet, this loop, unlike the previous loops, is disconnected. Because this loop crosses over several of the other loops, it uses a shadow variable to keep the image from getting too messy with lots of overlapping loops. The shadow variable for community and family gardens is presented in gray text with brackets on either side to show that it "shadows," or

"We asked our vendors to price the water the same price as the soda [in the concession stand]; people bought water. They said that they had soda leftover." (Participant)

duplicates, the original variable.

Some of these causal relationships may have more immediate effects (e.g., vendors providing water instead of sugar-sweetened beverages limits access to these beverages) and other relationships may have delayed





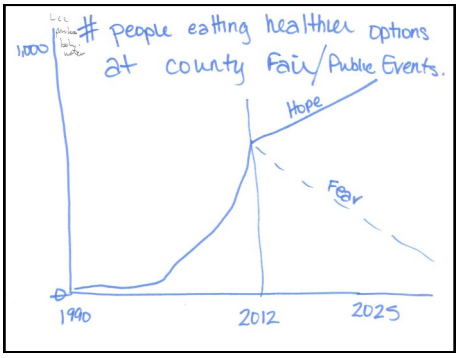
effects (e.g., awareness and demand for healthy eating may take some time to change what is sold by vendors). Again, this type of delayed effect is noted using two hash marks through the middle of the arrow line (not included in Figure 5).

<u>System Insights for *Healthy Kids, Healthy Cuba*</u>

In the behavior over time graph (top right), participants identified an increase in the sales of sweetened drinks and sodas since 1980 at Cuba area stores in general. However, in the behavior over time graph (bottom right), participants identified a more recent increase in the number of people eating healthier at the county fair and other events.

System insights can inform the partnership's next steps with healthy vending, including:

- Encouraging all local vendors to increase healthier options for foods and beverages to give people better choices.
- Working to create linkages between the farmers' market, community garden, and the county fair or other community events.
- Celebrating local vendors' success in selling healthy foods and water to increase awareness and demand.



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

- How has demand for healthy foods and beverages in Cuba changed over time? What is its influence on related products sold by vendors at events or in local stores?
- Has consumption of unhealthy, processed foods declined as a result of these changes in products sold by vendors?

After School Activity Bus (and Active Transportation) Feedback Loop

The loop highlighted in purple in Figure 6 represents two of the strategies that go hand-in-hand to increase active living in Columbia, Missouri, the after school activity bus and active transportation.

Causal Story for Feedback Loop

Story A: Participants described how children from the reservation ride the bus for about three hours every day back-and-forth to school; this time is inactive and it often entails eating unhealthy, processed foods during the ride. Eating these foods loaded with fats and sugars made it difficult for the students to focus, reducing their test scores. With lower test scores, the schools placed greater emphasis on academics in the curriculum at the expense of time for physical activity (physical education, active recess). Because children spend a great deal of time in school, their overall physical activity levels also declined, contributing to greater percentages of overweight or obese children at risk for diabetes.

Story B: With support from a former school superintendent, partners supported an activity bus that offered these children healthy food and beverage options and physically active opportunities. The bus helped to limit consumption of processed foods, and, over time, partners suggested this reduced consumption will improve student test scores allowing for a more diverse curriculum in schools that blends academics with opportunities for physical activity. This should improve youth rates of physical activity and decrease rates of overweight, obesity, and diabetes.

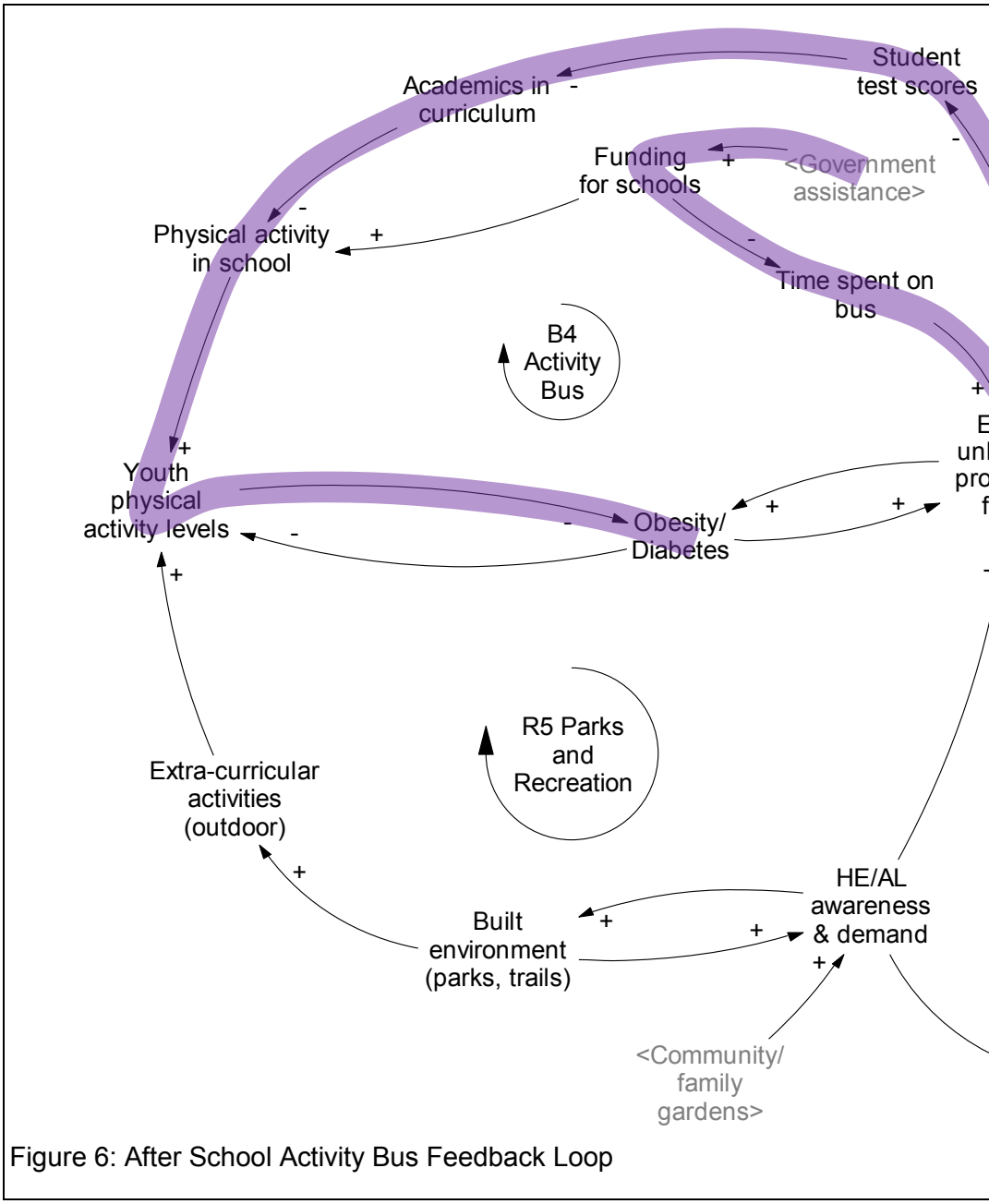


Figure 6: After School Activity Bus Feedback Loop

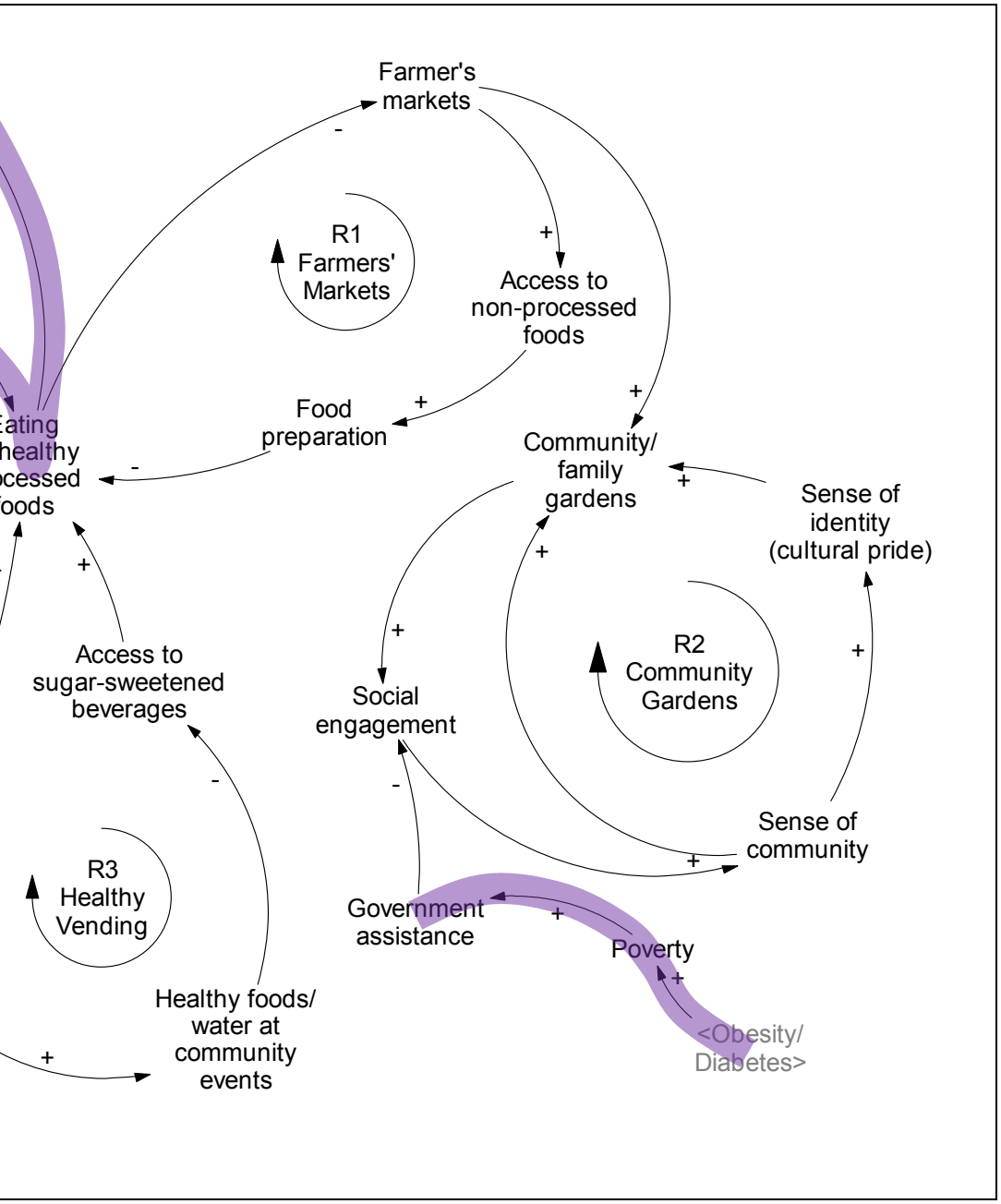
Reinforcing Loop and Notation

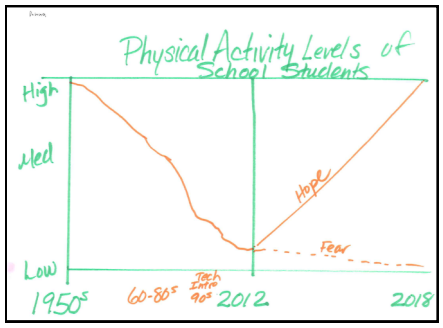
Unlike previous loops, this loop has five "-" signs or polarities; because this is an odd number, it is a balancing loop (see B2—Activity Bus in Figure 6). While reinforcing loops tend to identify patterns of increase or decrease, balancing loops identify more stabilizing trends.

Similar to previous loops, some of these causal relationships may have more immediate effects (e.g., the

"Students on the reservation... many of them are riding a bus [to get to school]. That's a three hour bus ride. I mean they're tired… They've been sitting all day. And we're not giving them physical activity in the schools, so we're contributing to the same thing." (Participant)

activity bus replaces unhealthy foods and beverages with healthier options) and other relationships may have delayed effects (e.g., the effect of increases in physical activity levels on reductions in overweight, obesity, and diabetes).



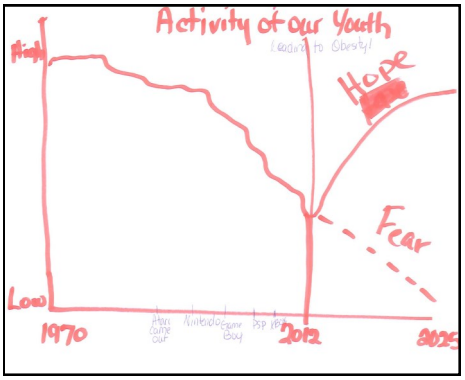


System Insights for *Healthy Kids, Healthy Cuba*

In both behavior over time graphs (top and bottom), participants identified a substantial decline in physical activity among students and youth over the last several decades.

System insights can inform the partnership's next steps with the activity bus and active transportation, including:

- Locating schools in or in closer proximity to the reservation to minimize students' time on the bus or to increase active transportation. This also entails increased funding support for schools.
- Using a health in all policies approach, schools can place greater emphasis on time for physical activity during the school day in order to increase physical activity and reduce rates of overweight, obesity, and diabetes in the community.
- Increasing rates of overweight, obesity, and diabetes reduces health and quality of life, including the ability to work and maintain a steady income. Thus, addressing these health problems can help to minimize unemployment, poverty, and reliance on government assistance.



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

- What is the impact of greater consumption of unhealthy, processed foods on students' academic and testing performance?
- How do schools make decisions about curricula dedicated to academics as compared to physical education, active recess, or other non-academic pursuits?

Parks and Recreation Feedback Loop

Highlighted in red in Figure 7, the parks and recreation feedback loop represents one of the *Healthy Kids, Healthy Cuba* strategies to increase active living in Cuba.

Causal Story for Feedback Loop

Story A: As the built environment includes more parks and recreation facilities, these places create more opportunities for outdoor extra-curricular activities. With more places and activities, youth are more likely to increase their physical activity by using these resources. As youth physical activity levels increase, their rates of overweight, obesity, and diabetes decline. With a healthier population, there is less unemployment, poverty, and reliance on governmental assistance. As people become less dependent on external support, they increase their engagement and sense of community. In turn, participation in community gardens and other community activities increases. This participation increases awareness and demand for healthy eating and active living that, in turn, supports new or improved built environments for physical activity.

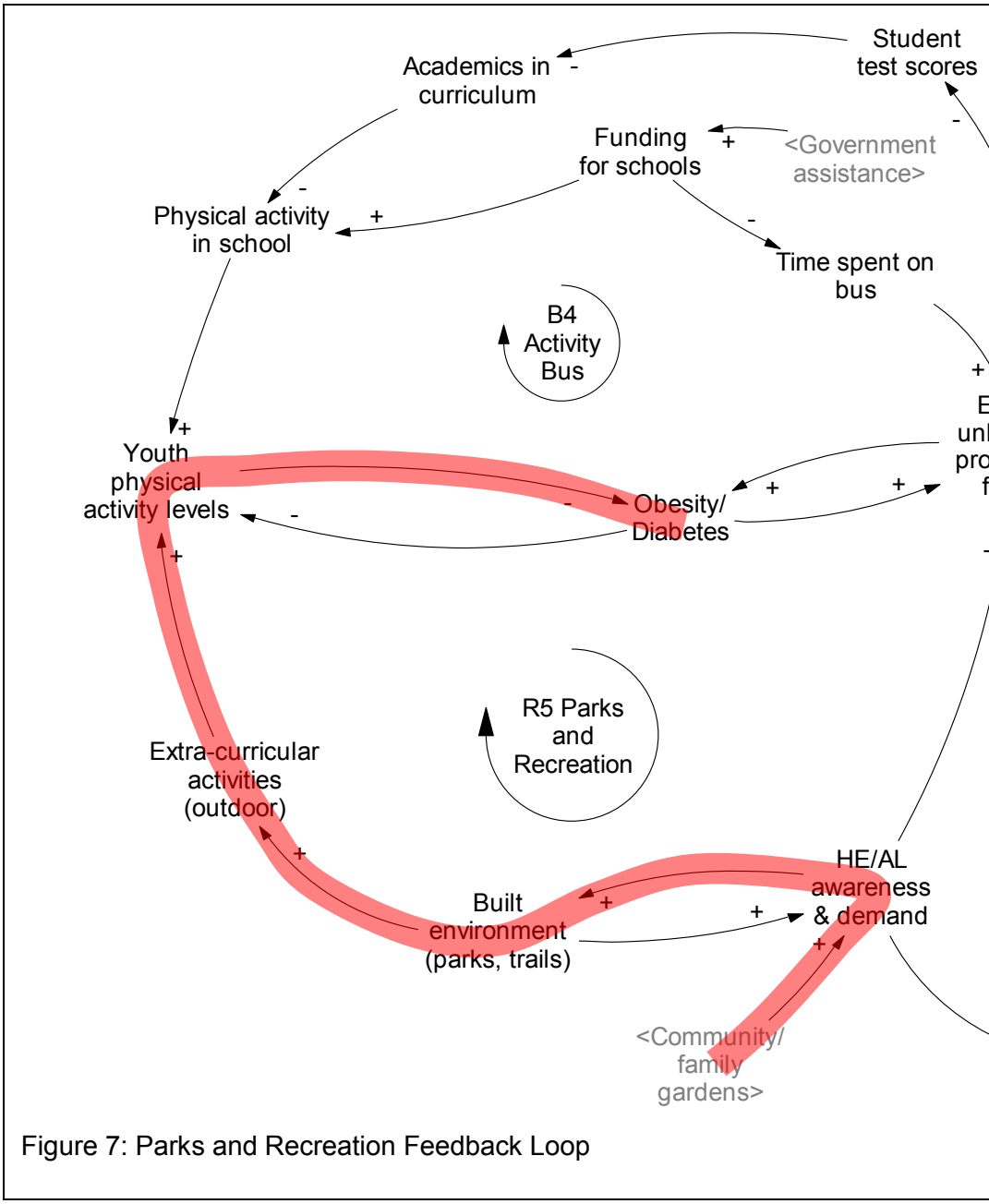


Figure 7: Parks and Recreation Feedback Loop

Story B: Alternatively, the absence of parks and recreation facilities leads to less outdoor extra-curricular activities followed by less overall youth physical activity. Less activity increases rates of overweight, obesity, and diabetes, and poor health can increase rates of unemployment and poverty, creating greater dependence on government assistance. People relying on government assistance may feel less engagement or ownership of the community. Consequently, there may be less participation in the community gardens resulting in less awareness and demand for healthy eating and active living, and, ultimately, less support for new or improved parks and recreation facilities.

Reinforcing Loop and Notation

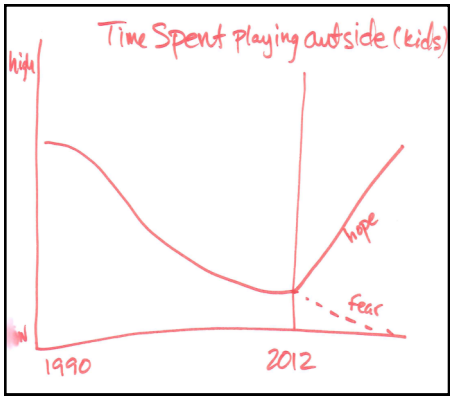
Similar to many of the previous loops, this one also represents a reinforcing loop (two "-" signs). In addition, it includes causal relationships representing more immediate effects (e.g., new parks create opportunities for

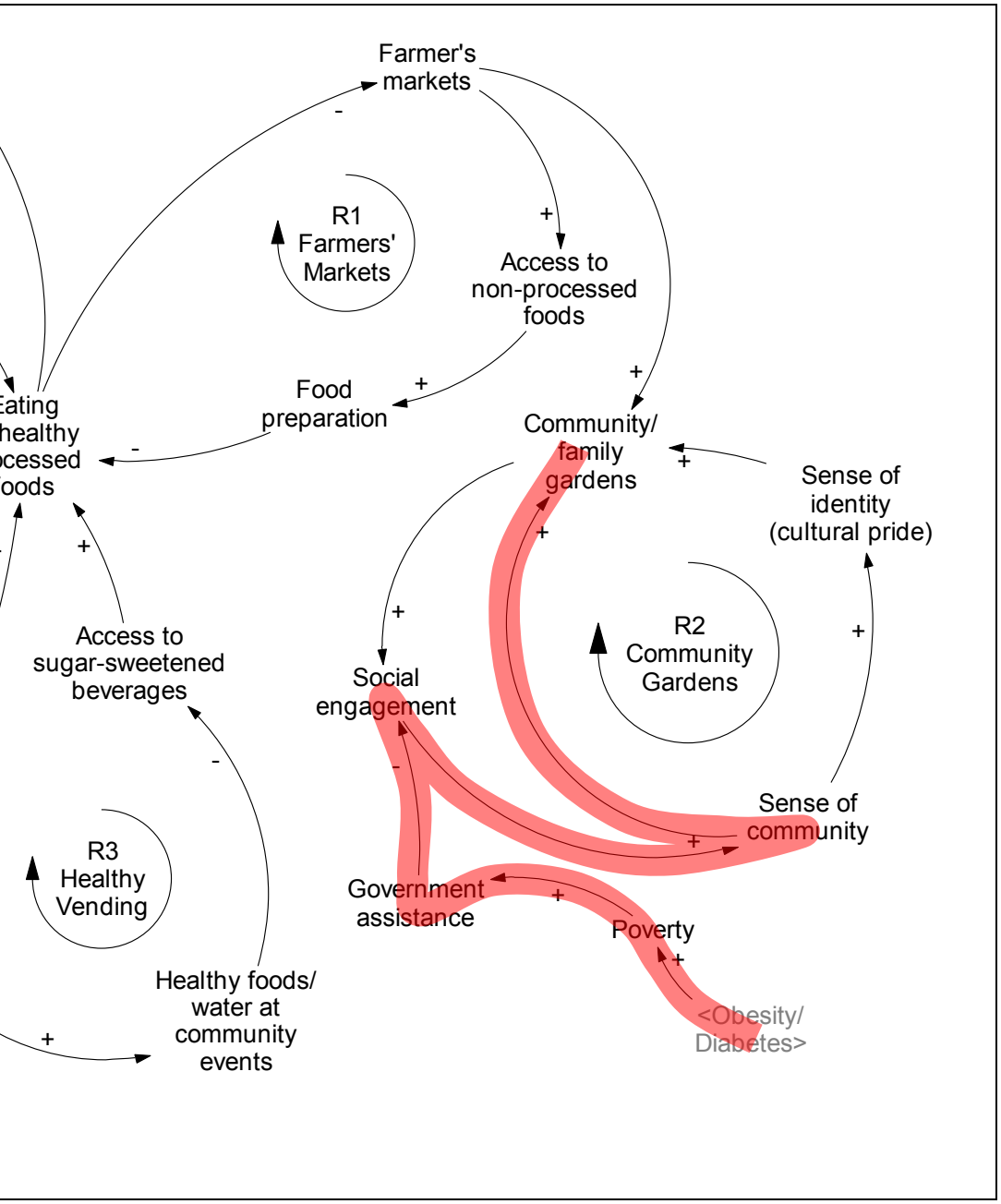
"The environment has made a difference. I mean we've got trails that people are actually accessing which is why we did it. And so those two together will decrease diabetes and obesity." (Participant)

outdoor extra-curricular activities), and, potentially, delayed effects (e.g., the affect of poor health — obesity and diabetes — on rates of poverty).

<u>System Insights for *Healthy Kids, Healthy Cuba*</u>

In the behavior over time graphs exercise, participants described a declining trend in the number of kids playing outside since 1990 (top right) as well as a decline in the number of youth participating in outdoor extra-curricular activities (bottom right).



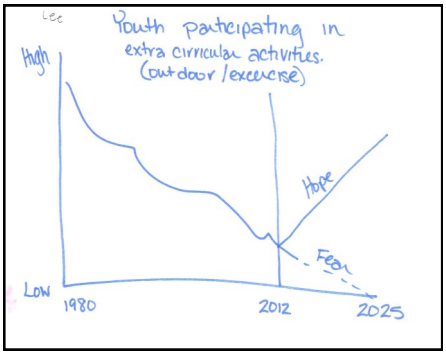


System insights for the partnership's parks and recreation efforts include:

- Drawing connections between the community garden and parks and recreation facilities in order to increase awareness and demand for healthy eating and active living throughout Cuba.
- Considering how parks, trails, and other recreation facilities can be designed to support and encourage outdoor extra-curricular activities for youth.
- Examining ways to expand the reach of outdoor extra-curricular activities to youth from poorer families to help break the cycle of poverty.
- Looking at other influences limiting outdoor activity among youth, such as gangs and violence, and how these parks, recreation facilities, and extra-curricular programs can be designed to increase community safety.

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

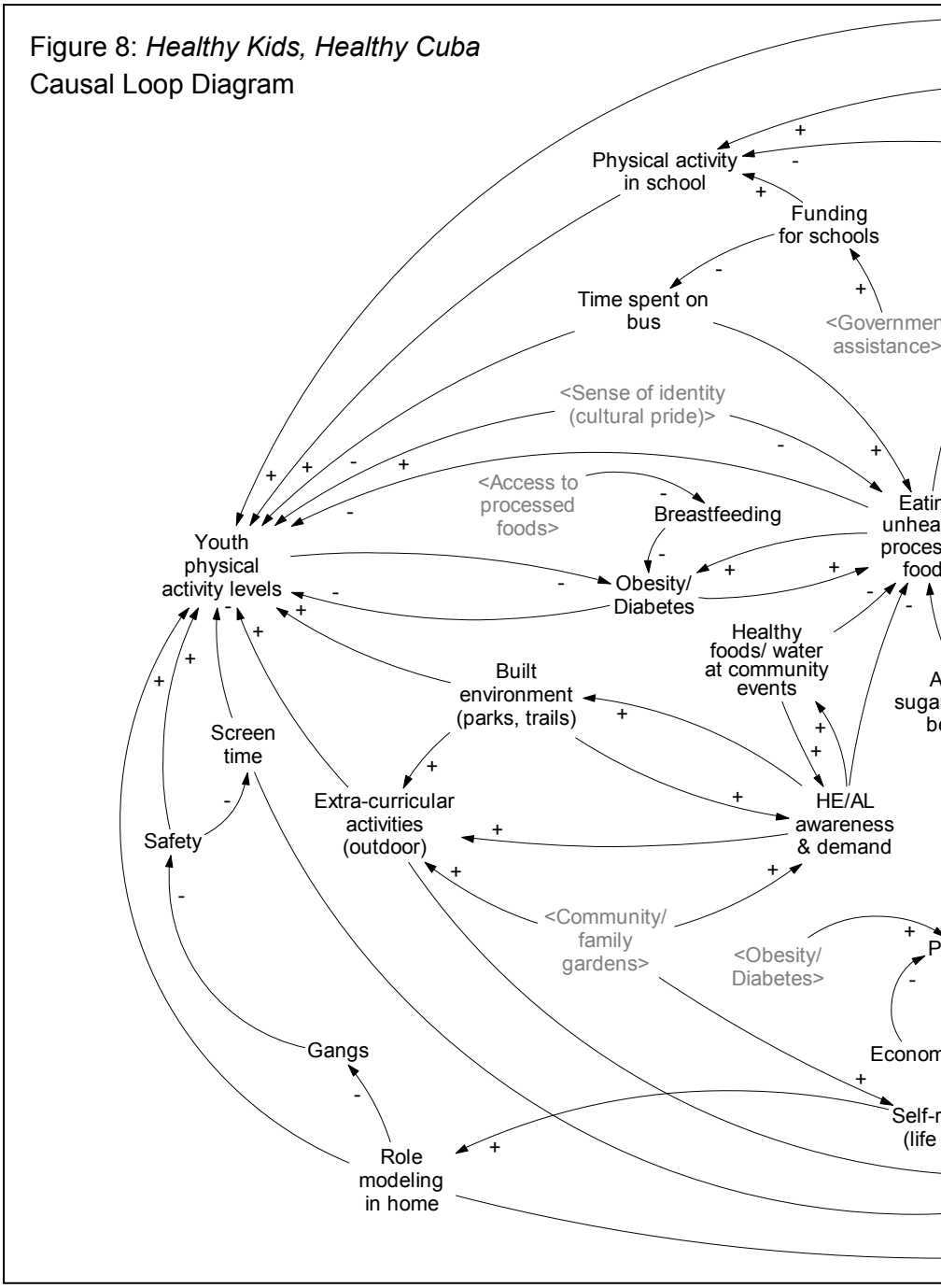
- What are the appropriate types and numbers of parks, recreation facilities, community gardens, and extra-curricular programs to support increased outdoor activity among children and adolescents?
- How and why does poverty and reliance on governmental assistance limit social engagement among residents in Cuba?



Opportunities for Systems Thinking in Cuba

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

Figure 8: *Healthy Kids, Healthy Cuba* 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 Cuba, New Mexico to promote healthy eating and active living as well as preventing childhood overweight and obesity.

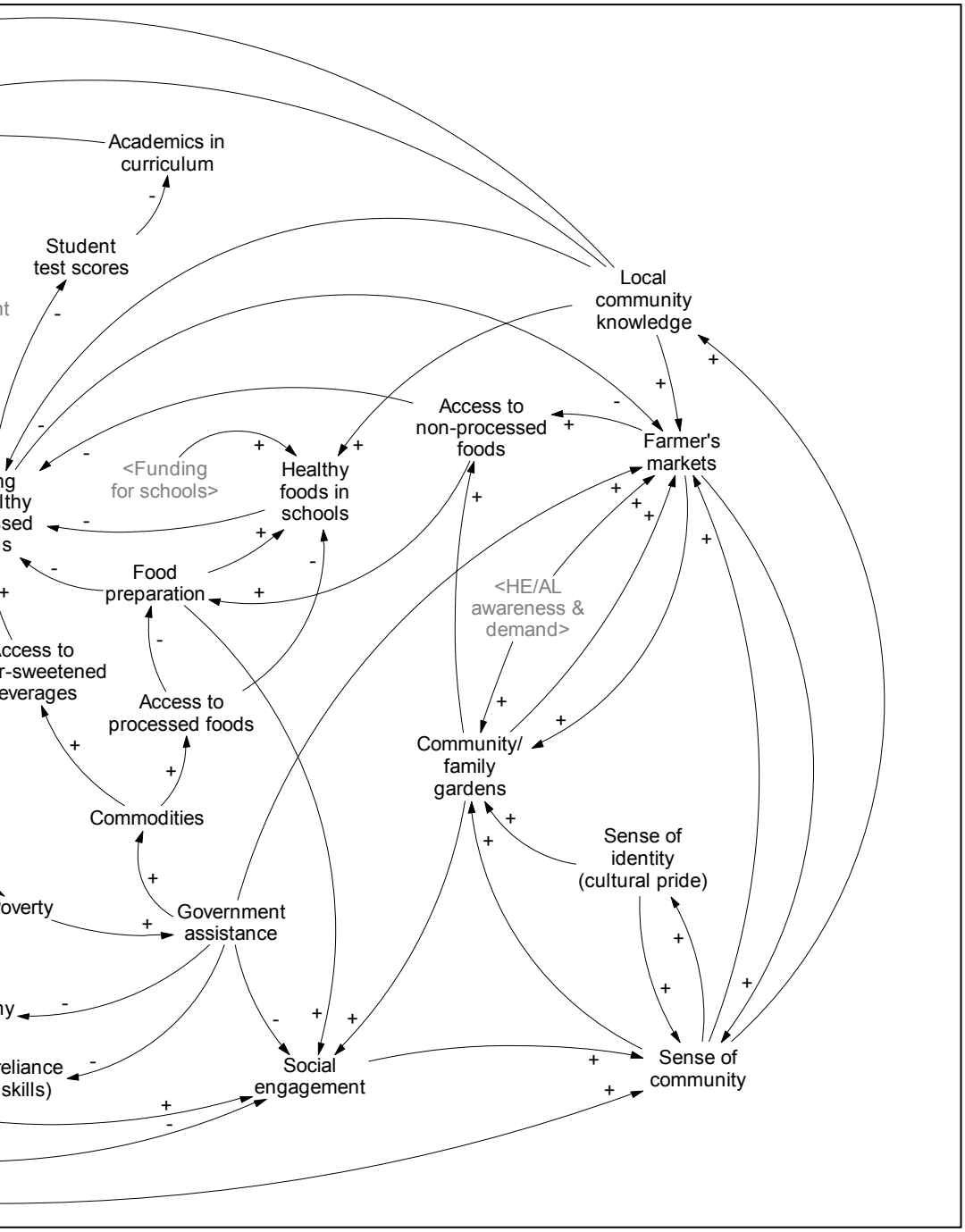
Yet, there are several limitations to this storybook, including:

- the participants represent a sample of the *Healthy Kids, Healthy Cuba* 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; and



- revisiting variables removed because they were not part of feedback loops, including food desert, positive self image, food advertising, cost of healthy food/ beverages; 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 Cuba 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 *Healthy Kids, Healthy Cuba* 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/

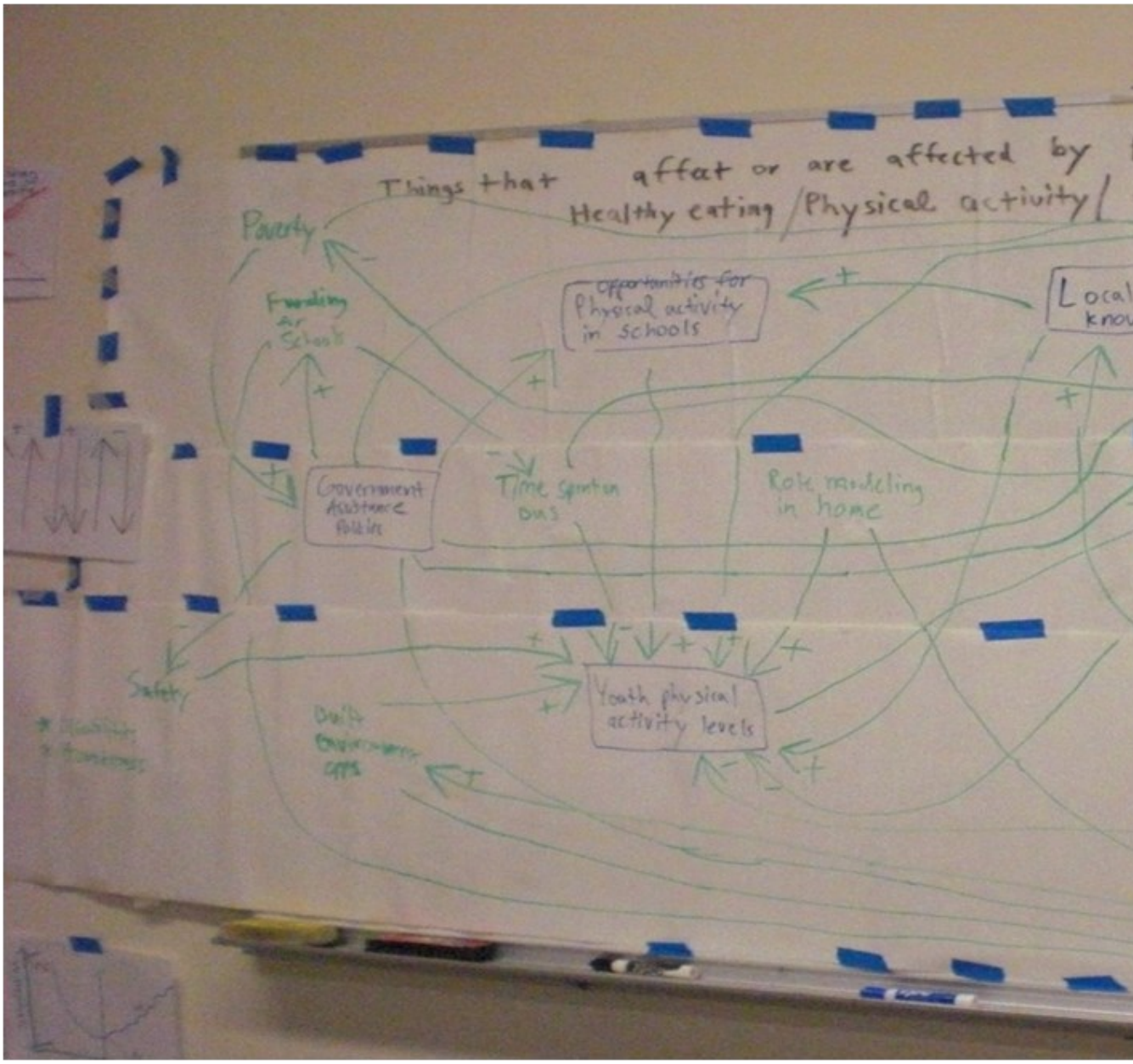
Vennix, J. (1996). Group model building. New York, John Wiley & Sons.

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

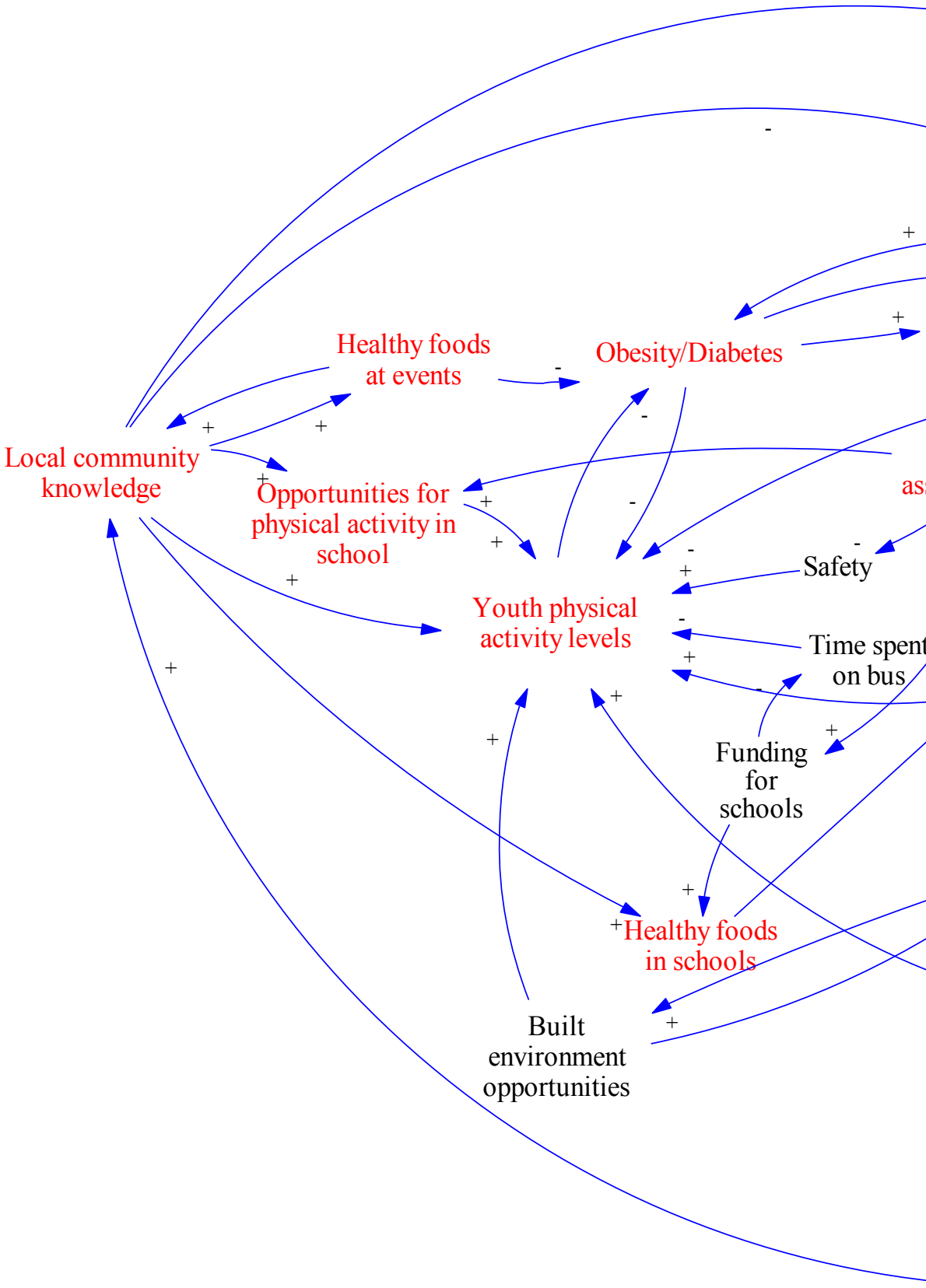
Cuba, New Mexico: *Healthy Kids, Healthy Cuba*	
Categories	**Number of Graphs**
Active Living Behavior	8
Active Living Environments	0
Funding	1
Healthy Eating Behavior	8
Healthy Eating Environments	5
Marketing and Media Coverage	1
Obesity and Long Term Outcomes	3
Partnership & Community Capacity	1
Policies	2
Programs & Promotions (Education and Awareness)	1
Social Determinants of Health	2
Total Graphs	**32**

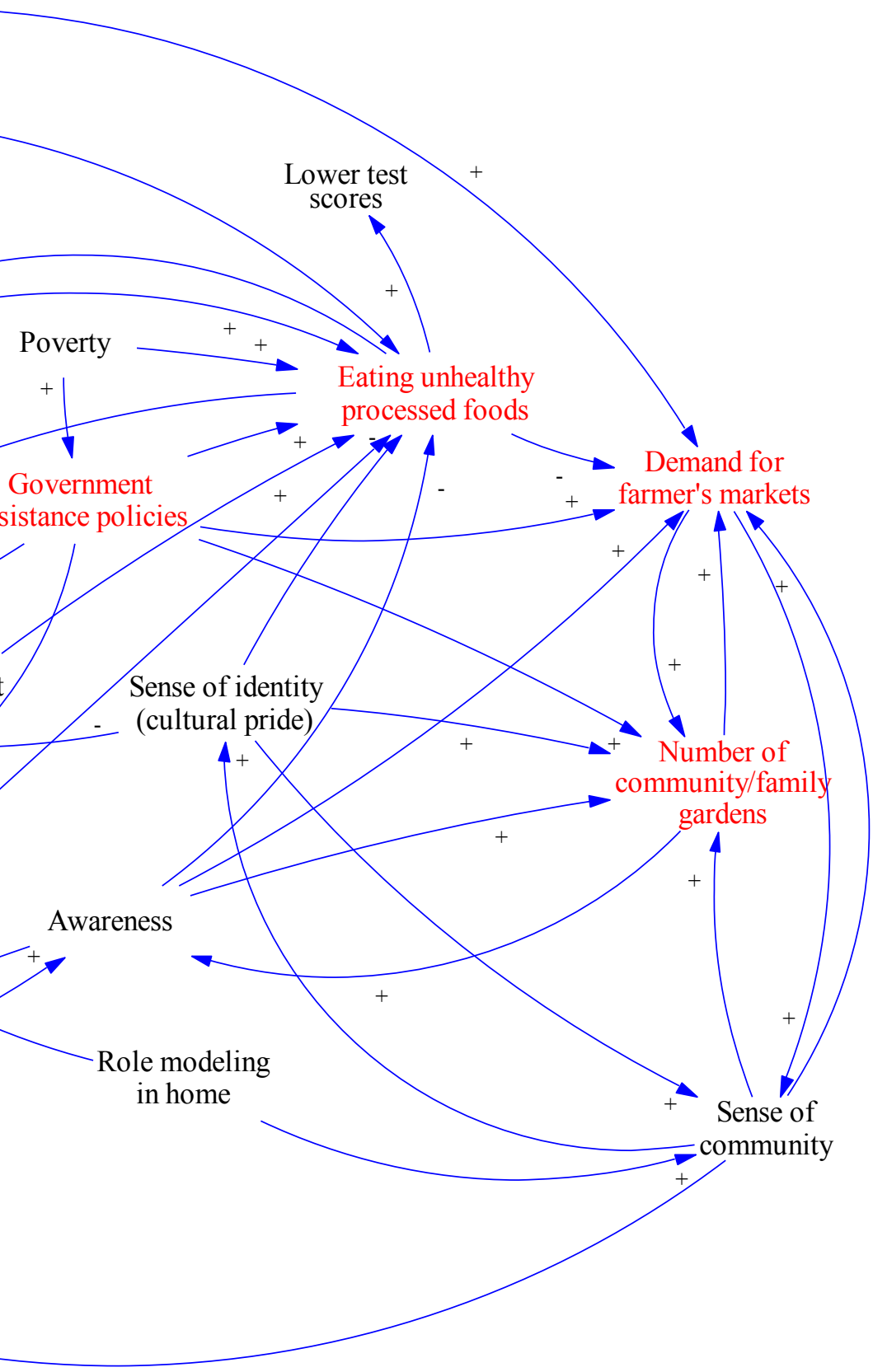
Appendix B: Photograph of the Original Version of the *Healthy Kids, Healthy Cuba* Causal Loop Diagram



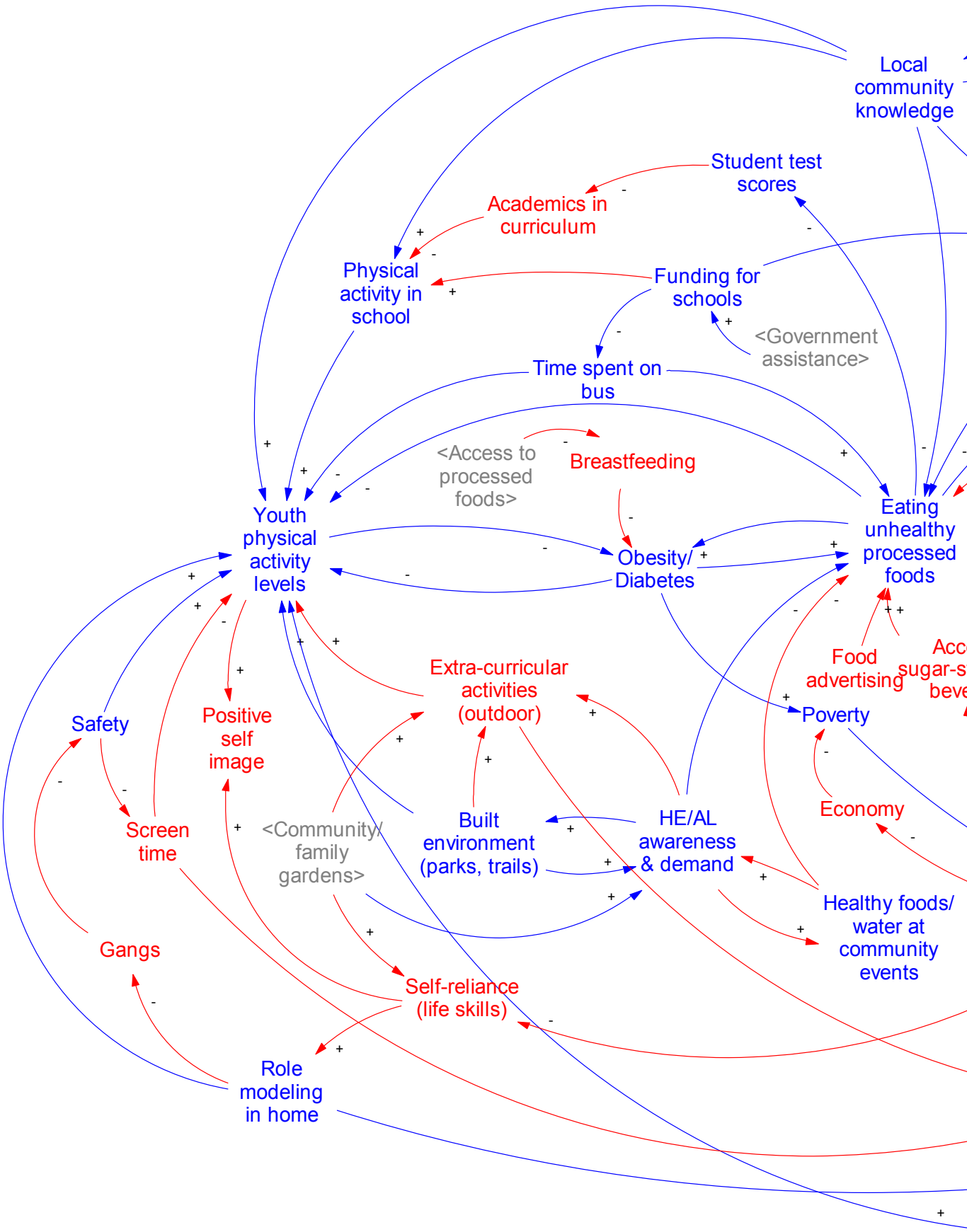

policy, system, or environment change in your community.
Childhood obesity
Sense of identity
(Cultural pride)
community
wledge
Eating unhealthy
Processed foods
Obesity/Diabetes
R
B
Healthy foods
at events
Healthy foods
in schools
R
9/27/2012 8:35pm

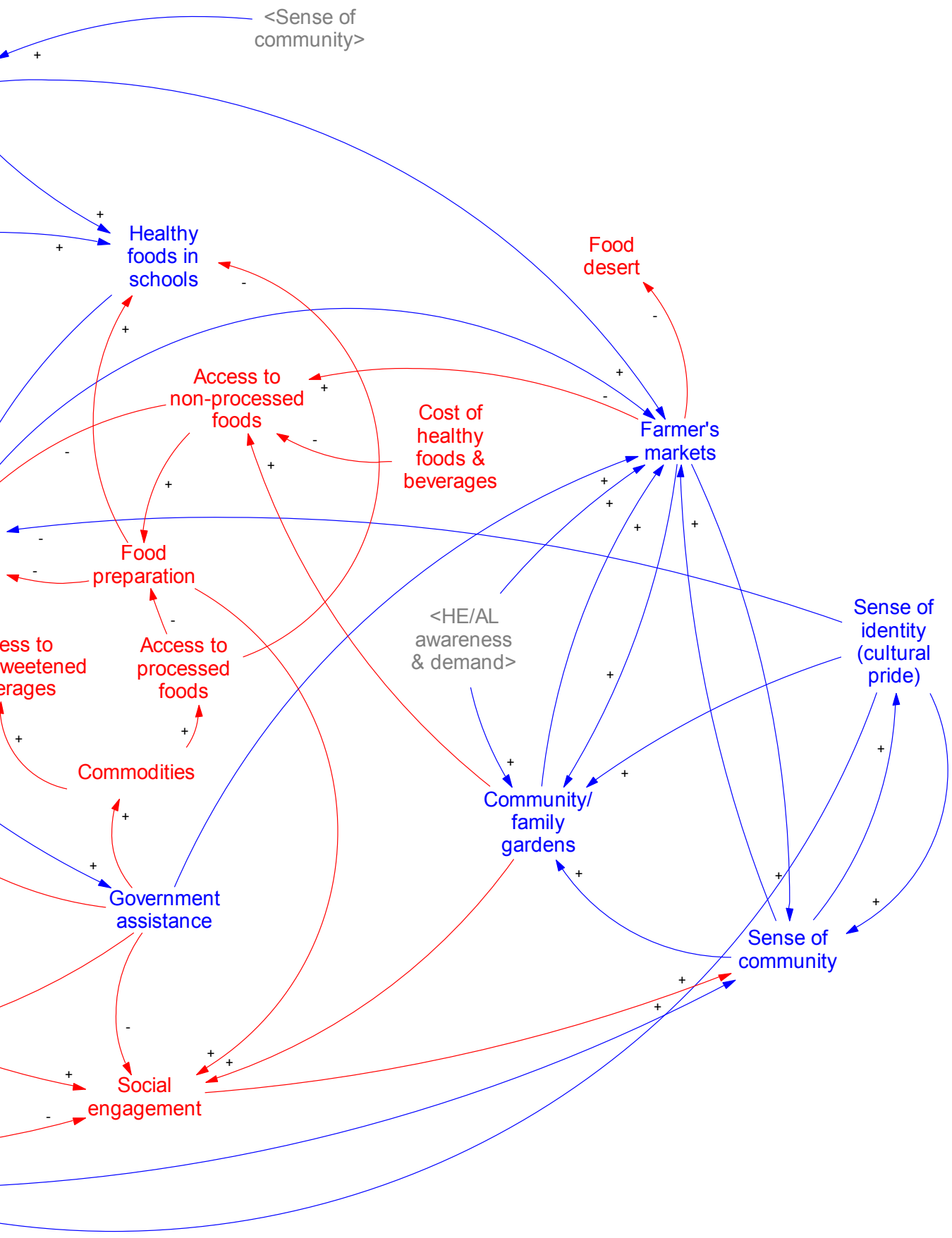
Appendix C: Original Translation of the Causal Loop Diagram into Vensim PLE



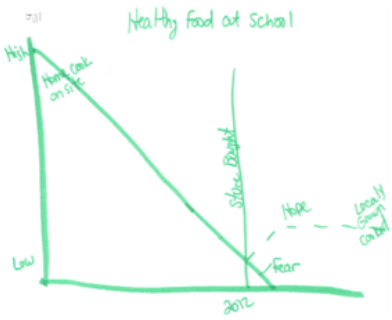

Lower test scores
Poverty
Eating unhealthy processed foods
Government sistance policies
Demand for farmer's markets
Sense of identity (cultural pride)
Number of community/family gardens
Awareness
Role modeling in home
Sense of community

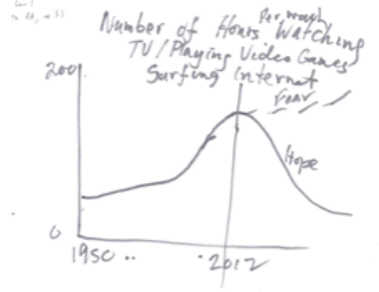
Appendix D: Transcript Translation of the Causal Loop Diagram into Vensim PLE

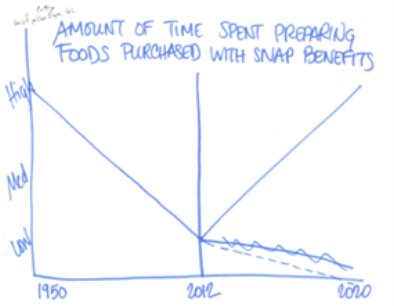


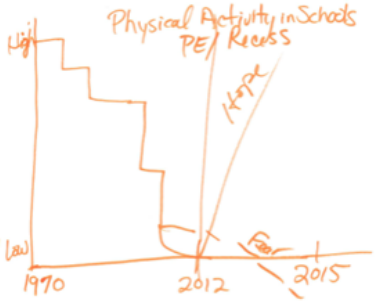

<Sense of community>
Healthy foods in schools
Food desert
Access to non-processed foods
Cost of healthy foods & beverages
Farmer's markets
Food preparation
<HE/AL awareness & demand>
Sense of identity (cultural pride)
ess to weetened erages
Access to processed foods
Commodities
Community/ family gardens
Government assistance
Sense of community
Social engagement

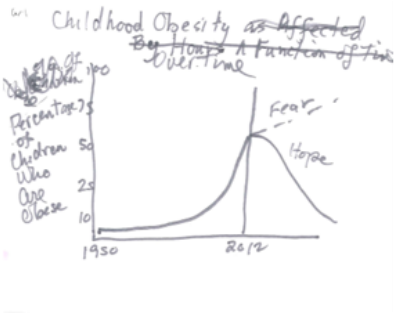
Appendix E: Behavior Over Time Graphs not Represented in the Storybook

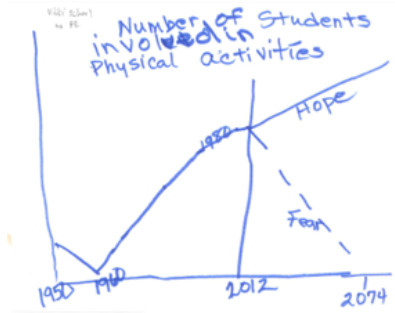


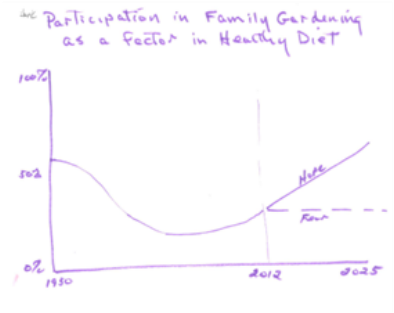


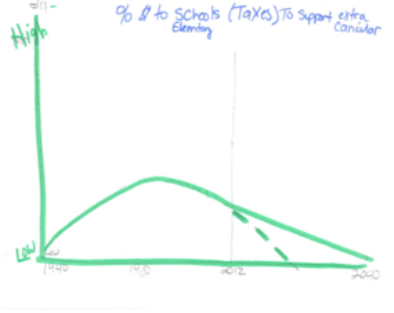


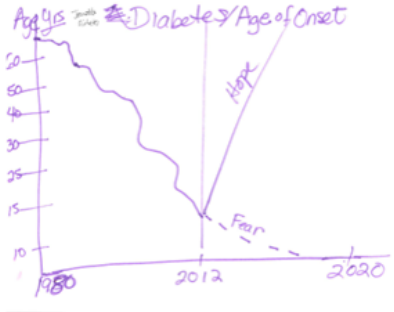


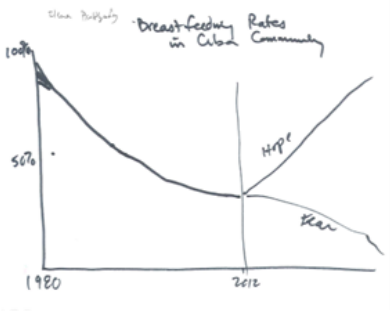


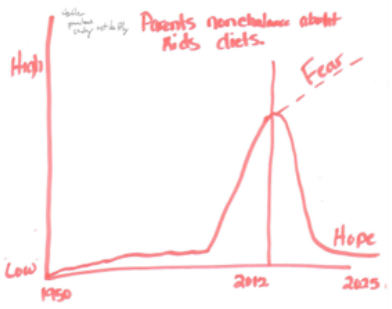


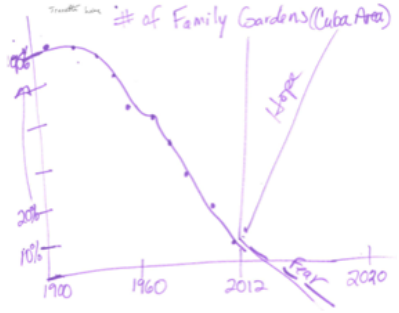




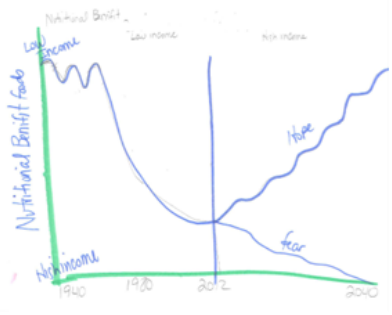


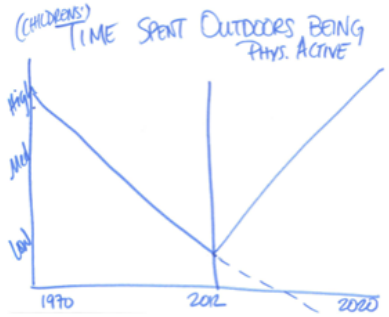

Breast-feeding Rates in Cuba Community
100%
50%
Hope
Fear
1980
2012


Parents nonchalance about kids diets.
High
Low
Fear
Hope
1950
2012
2025


# of Family Gardens (Cuba Area)
Hope
20%
10%
Fear
1900
1960
2012
2020


Healthy food at School
High
Low
Hope
Fear
2012


Nutritional Benefit foods
Low income
Hope
fear
1940
1970
2012
2040


(CHILDRENS) TIME SPENT OUTDOORS BEING PHYS. ACTIVE
High
Low
1970
2012
2020


(Non) Availability of NON processed Food.
High
Low
fear
Hope
1990
2012
2020