Working in progress:

How New York's Food Donation Policies Might [or Might Not] Improve Fresh Produce Rescue and Reduce Wasted Food?

Mariana Torres Arroyo[1], Luis Luna-Reyes[2], Natasha Pernicka[3], Stacy Pettigrew[4], Ben Attwood[4], Beth Feingold[1]
[1]School of Public Health, SUNY University at Albany; [2]Rockefeller College of Public Affairs and Policy; [3]The Food Pantries for the Capital District; [4]The Radix Ecological Sustainability Center.

1. INTRODUCTION

The current U.S. food system produces an overabundance of food in face of 13.8 million households struggling to get sufficient food [1]. Moreover, while food systems are major drivers of earth's transformation through climate change, resource depletion, and other forms of environmental degradation [2], recent estimates show that about a third of the country's food supply is lost or wasted. Wasted food accounts for 17% of freshwater use, 42% of fertilizer use, 16% of land use, and 16% of all the greenhouse gas emissions of the country's food system [3]. When food is wasted, we also lose important nutrients [4] and valuable natural and human resources embedded in this food [5–8].

Fresh fruits and vegetables are the major share of all wasted food in the U.S [9]. These foods are essential sources of nutrients important for human health and substantial evidence demonstrates that consuming these foods reduces the risk of diet-related illnesses such as cardiovascular disease [10,11]. People at risk of food insecurity already experience limited access to these nutritious foods and a disproportionate burden of disease [12–15]. Food supply chains are also increasingly disrupted by shocks–such as the ongoing COVID-19 pandemic that started in 2020 [16,17]–, further damaging low-income households for which any loss of purchasing power (*e.g.*, due to loss of income and price spikes) can threaten their ability to get enough nutritious food [16].

2. PROBLEM FOCUS

Distribution of food surplus has been a largely supported strategy to tackle both food insecurity and the waste of food [18–20]. As nutrient-poor highly-processed foods have become more available, diet-related diseases have been rising, and food & nutrition insecurity persists [12,13,15,21], there has been greater awareness about the nutritional quality of donated food, resulting in agencies expanding fresh produce rescue and limiting the receipt of food with little nutritional value [22,23]. Yet, several challenges and limitations remain unsolved.

In New York, where 3.9% of surplus[1] fresh fruits and vegetables produced are donated and 15.9% recycled [9], three policies (two "farm policies" and one "waste ban") are intended to divert produce away from landfill through food donation: a *'Farm to food bank' tax credit* (enacted in 2018); *Nourish New York* (2020), introduced in response food security concerns during the first year of Covid-19 and provided to purchase fresh produce from farmers within the state; and the *NYS Food Donation and Food Scraps Recycling Law* (effective on January 2022), which forces large generators of wasted food to divert excess edible food to food rescue organizations and food scraps to recycling facilities. *These policies still lack evaluation to understand their effect on waste; however, this knowledge is needed to anticipate potential consequences for nutrition & food security and the environment.*

2.1. ***Problem Statement***

Recovering nutritious food surplus such as fresh fruits and vegetables represents an opportunity to improve food and nutrition security and reduce wasted food [20,24–26]. However, the extent to which food rescue can contribute to these purposes and is yet to be understood across different dimensions of the food system, and environmental,

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[1] **Surplus** in ReFED's methodology encompasses farm surplus (not harvested, packhouse losses, buyer rejections), unsold food (finished product not shipped, buyer rejections, purchased by retailers but not sold, waste from food service), residential surplus (obtained but not consumed).

economic, and health-related co-benefits and trade-offs need to be identified and might need to be negotiated [27–30]. For example, since environmental impacts tend to accumulate across the food supply, it has been suggested that waste reduction efforts should target sectors at the end of the supply chain (*e.g.*, restaurants, households) rather than the farm level [7]. However, this might not be applicable to food rescue, and it is crucial to considering the underlying dynamics within system that can drive changes in wasted food and food successfully distributed to the community. <u>*Model purpose and audiences:*</u> To address this research gap, *we aim to build an evidence-based system dynamic model to analyze the joint effect of the New York State food donation policies on fresh produce rescue and waste in the Capital Region.* The model also seeks to address the concerns of community partners about the effect of these policies on their organizations, and to inform policymakers and academia about possible unintended effects of these policies, suggesting ways to maximize co-benefits and negotiate the trade-offs.

3. METHODS

Grounded in systems theory [31–34] we built a *stock and flow diagram* of food surplus diverted to food rescue organizations in the New York Capital Region and carried out computer simulations using Vensim software. We used *causal loop diagrams* to describe feedback processes of the food rescue system. We further identified time horizons for the model based on potential changes associated with policies.

Building an initial model consisted of an iterative non-linear process that included familiarization with the food rescue system, defining the dynamic problem through reference modes, and identifying accumulations, key variables, and basic mechanisms[31,35]. We have also identified and listed the next steps of this research.

*3.1. **Information sources***

The model was conceptualized based on various sources of information, including group-model building with stakeholders, and diverse information from partners of the Capital Region FRESH project[2]:

Group-based model building [36–39]. Through this method, we aimed to incorporate stakeholders' perspectives and expertise. Workshops were carried out from October 2020 to March 2021–during the first year of COVID-19–with executive directors and program managers from organizations providing fresh fruits and vegetables in the New York Capital Region (referred to as 'food rescue organizations' in this paper; their activities, though, extend beyond food rescue). The structure of workshops was based on previously developed scripts ("Variable elicitation", "Graphs over time", and "Initiating and elaborating a causal loop diagram")[36–39], adapting activities to an online environment [40]. Sessions were recorded to maximize the information obtained and minimize recall bias (for example, information not captured in the diagrams could later be revisited).

Food pantry surveys. Four consecutive surveys from November 2017 through August 2018 were responded by staff at food pantries in the NY Capital Region. We used qualitative and quantitative information from these surveys to triangulate information and set parameters related to food pantries in the model.

Data from regional food rescue organizations. Quantitative data from Capital Region FRESH are the total pounds of fresh produce acquisitions from different sources and fresh produce distributions by food rescue organizations. Qualitative information from these organizations also comes from continuous personal communications with project partners. Project partners have also proposed 'what-if' scenarios for the modeling that are relevant for their organizations.

Literature review and databases. Academic and gray literature, including food policy reports and state databases, provided context about the policies and has been useful to triangulate information about dynamics within the food rescue system. This information is also useful for setting initial time horizons for the model. Data for produce types donated from retail and farms were obtained from ReFED Food Waste Monitor[9], and produce shelf-life estimates by produce type from the U.S. Department of Health & Human Services[41].

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[2] Capital Region FRESH (http://www.albany.edu/FRESH/) is supported by the Foundation for Food and Agriculture Research and carried out in collaboration of academic (UAlbany and Johns Hopkins) and community partners. Beth Feingold and Xiaobo Xue Romeiko are co-Primary Investigators).

*3.2. **Model conceptualization***

3.2.1. *Key variables, relationships, and identification of important stocks*

Drivers of waste and destination of waste within food rescue organizations include aspects related to the *product (fresh produce)*, organizations' capacity to handle and sort food, as well as factors affecting this capacity. *Organizations' capacity* depends on physical and human resources such as human power (staff and volunteers), access to distribution sites, transportation, pantry open days, and cold storage. Shelf-life and packaging of fresh produce at the time it reaches organizations are different depending on the food source, and, in general, direct donations from farms and community gardens have a higher shelf-life compared to retail donations.

In group-model building, participants also identified the potential of policies to change relationships that can lead to more waste through mechanisms such as shifts in accountability across organizations that can transfer the burdens related to organic waste management to the food rescue system when donated food has insufficient quality. *Figure 1* represents relationships across categories and identifies *endogenous variables* for the model.

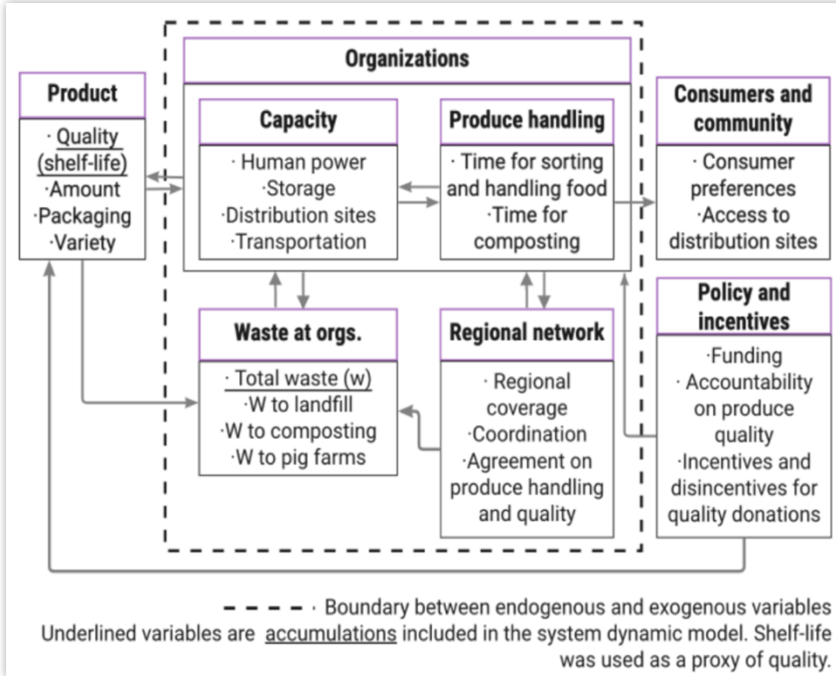


Fig. 1. ***Variable categories with examples and their relationships within the regional food rescue system***

Stocks identified were *fresh produce for donation* (*lbs*) at the food bank and food hubs and food pantries, produce *shelf-life (weeks),* and *waste (lbs).* The flow of *shelf-life* of fresh produce to food rescue organizations was identified as a proxy of *quality* based on participants' narratives.

3.2.2. *Problem dynamics and reference modes*

Wasted food (total amount and per capita) in the U.S. has been increasing over time [42], as well as the amount of food diverted to landfills and the associated environmental impacts (e.g., carbon footprint). Meanwhile, the food insecurity problem persists–exacerbated by shocks like the ongoing COVID-19 pandemic–, and the availability of unhealthy food and diet-related diseases have been rising in a context where low-income people have difficult access to nutritious foods such as fresh fruits and vegetables [12,13,16,43]. (Represented as graphs over time in *Fig.2A* in *Annex A)*

In New York, as the waste of fresh produce remains high and donations low

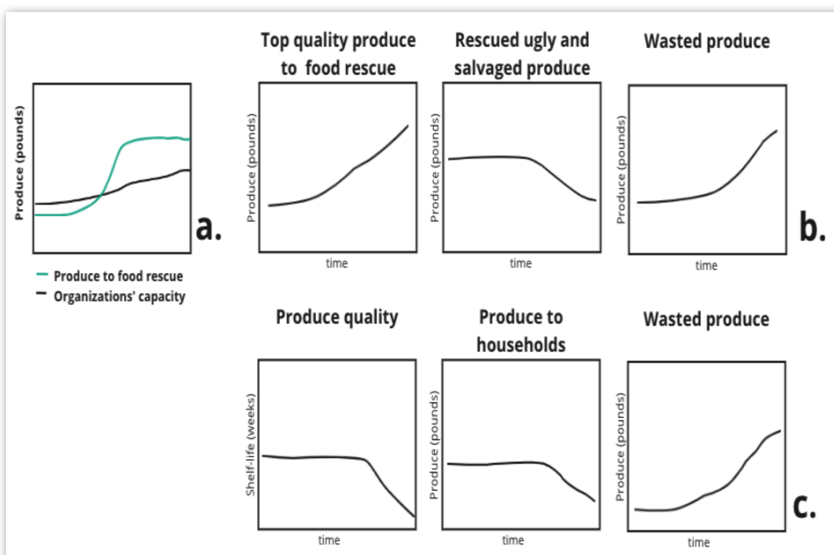


Fig. 2. ***Reference modes:*** *(a)* ***Produce to food rescue and organizations' capacity,*** *(b)* ***feared behaviors about the "farm policies", and*** *(c)* ***feared behaviors about the "waste ban" in the NY Capital Region.***

relative to generated surplus[9] (see destination of wasted food in New York in *Figure 1A* in *Annex A*), state-level policies intend to address food security and waste by diverting surplus from farms, retail (grocery stores, supermarkets), and other food businesses to food rescue organizations. However, *expanding food rescue organizational capacity to distribute fresh produce might take time, and increases in the amount of produce entering the food rescue organizations and donations of insufficient shelf-life can create pressures on the system that can overrun organizations' capacity by increasing the time needed to handle and sort food, resulting in more waste and reduced quality of food distributed to households* (*Fig. 2a*).

Feared behaviors about the farm policies (tax credit and Nourish NY) are the increase of top-quality fresh produce at the expense of "ugly" and "salvaged" produce, which can increase overall waste (*Fig. 2b*). Feared behaviors about the waste ban are the increase in donated produce of insufficient shelf-life that allows it to reach end-users, thus increasing waste (*Fig. 2c*).

3.2.3. *Model boundaries and aggregation*

We have modeled the food rescue subsystem composed of food rescue organizations performing recovery, handling and sorting, and redistribution of fresh produce surpluses. Surplus produce entering food rescue organizations comes from growers and retailers. Fresh produce is handled, sorted, and moved across organizations and distributed by food pantries to households. The food rescue system is connected to the waste management system. The portion of wasted produce is diverted to composting, pig farms, or landfills.

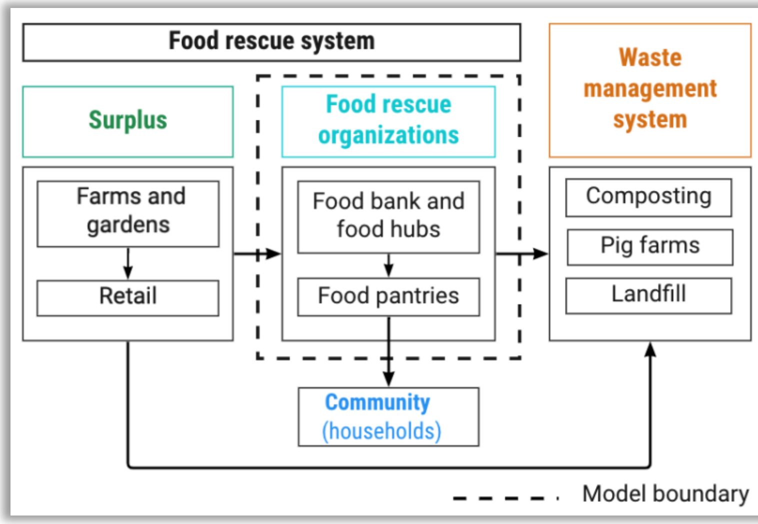


Fig. 3. ***Simplified model structure***

We have aggregated food rescue organizations in two stages. The *"earlier stage"* of food rescue includes the food bank, food hubs, and a food rescue coalition. Food banks and food hubs receive the major share of the surplus, which then is distributed to food pantries. The coalition serves as an intermediary between the food bank and hubs and the *"food pantries stage"*, which distribute to the community. (*Figure 3*)

3.2.4. *Time horizons*

Table 1 **Relevant time horizons based on potential changes in food rescue and waste associated with donation policies**

Type of change	*Horizon (yrs.)*
Direct sourcing (from farms, gardens)	0-5
Indirect sourcing (retail)	0-5
Produce quality	0-5
Food rescue capacity	2-10
Waste management capacity	2-10
Desirability for fresh produce by pantry users	0-10

Potential changes in fresh produce diverted to food rescue organizations and waste in the context of the policies examined here were useful to establish relevant time horizons for the modeling (*Table 1*). In general, while some changes can happen relatively fast, such as increases in donations, other aspects such as increasing the overall food rescue capacity might take more time. Based on these time horizons, we decided to run the simulations over a 10-year period (521 weeks).

3.2.5. *Stock and flow diagram*

The food rescue system was modeled in a stock and flow diagram as an aging chain (*Figure 4*). We modeled flows and accumulations of *fresh produce, shelf-life,* and *waste*. (Variables included in this diagram are listed and grouped by sector and type of variable in *Table 1B* in *Annex B*)

As seen in *Figure 4*, the food bank and food hubs source fresh produce **surplus** produce from growers and non-farm businesses (e.g., retailers, wholesale) and distribute this food with the help of a coalition to food pantries. Based on the quality (average shelf-life) of produce received and organizations' standards of quality, a fraction of the produce accumulation goes to **waste**. Distribution of produce from the early stage to food pantries and from food pantries to households depends on organizations' **capacity**, which in our model is represented by the *storage capacity* and *sorting capacity* of early-stage organizations, and the *distribution capacity* of food pantries. Across the distribution process, produce loses **shelf life** due to natural decay and due to waste, and the remaining shelf-life moves from one stage to another until it is distributed to households. Dynamics related to **pantry users,** which at the same time depend on the quality of available food, determine how much produce pantry users take home.

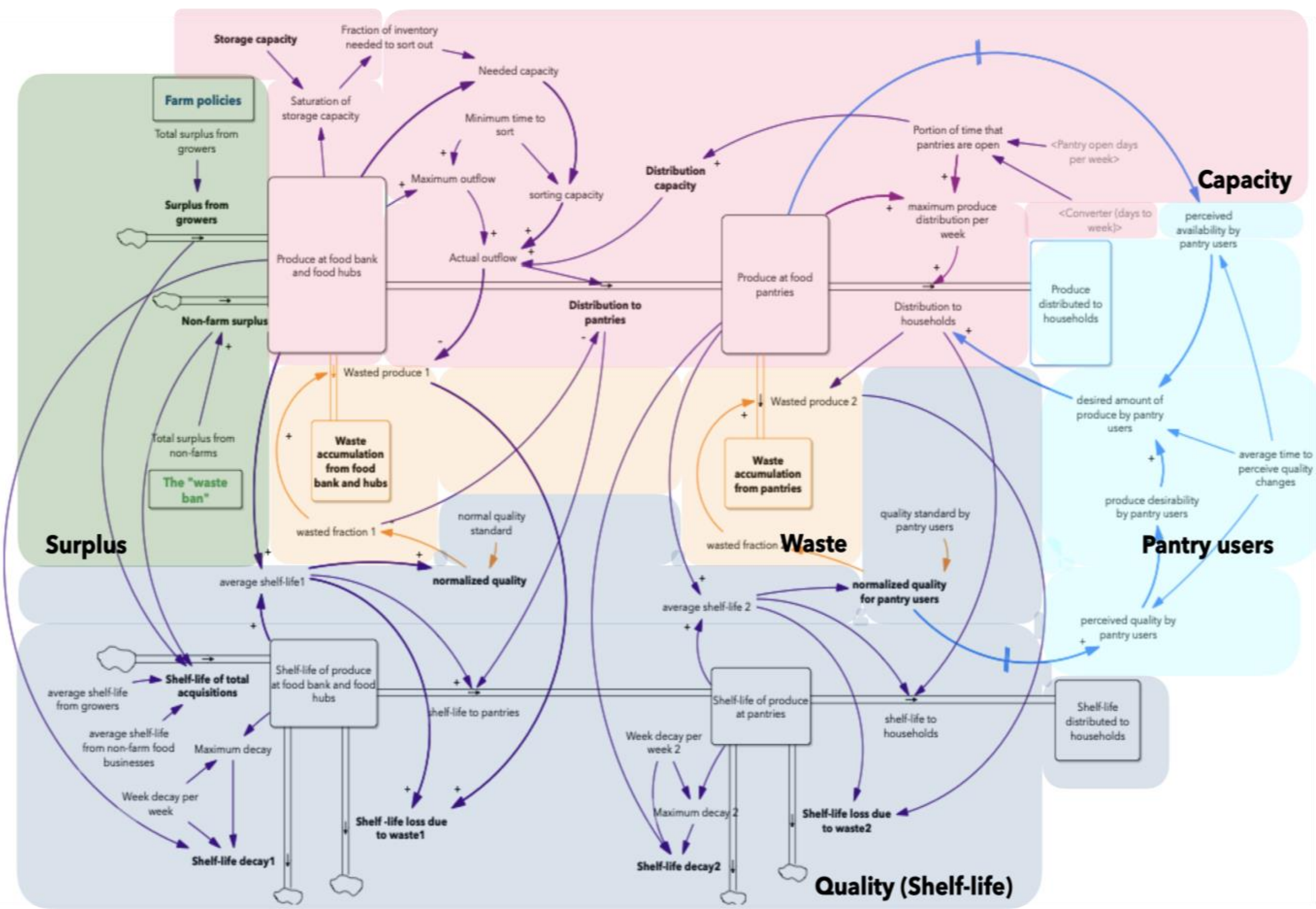


Fig. 4 Stock and flow diagram of fresh produce rescue

Feedback related to pantry users is detailed in the causal loop diagram in *Figure 5.* In summary, these feedback structures show that higher produce quality entering food rescue organizations increases produce availability due to waste reduction, which is driven by produce turnover. Fresh produce availability, on the other hand, is "balanced" by distribution to households: as produce available and produce quality increases, people take more produce home, which reduces produce availability.

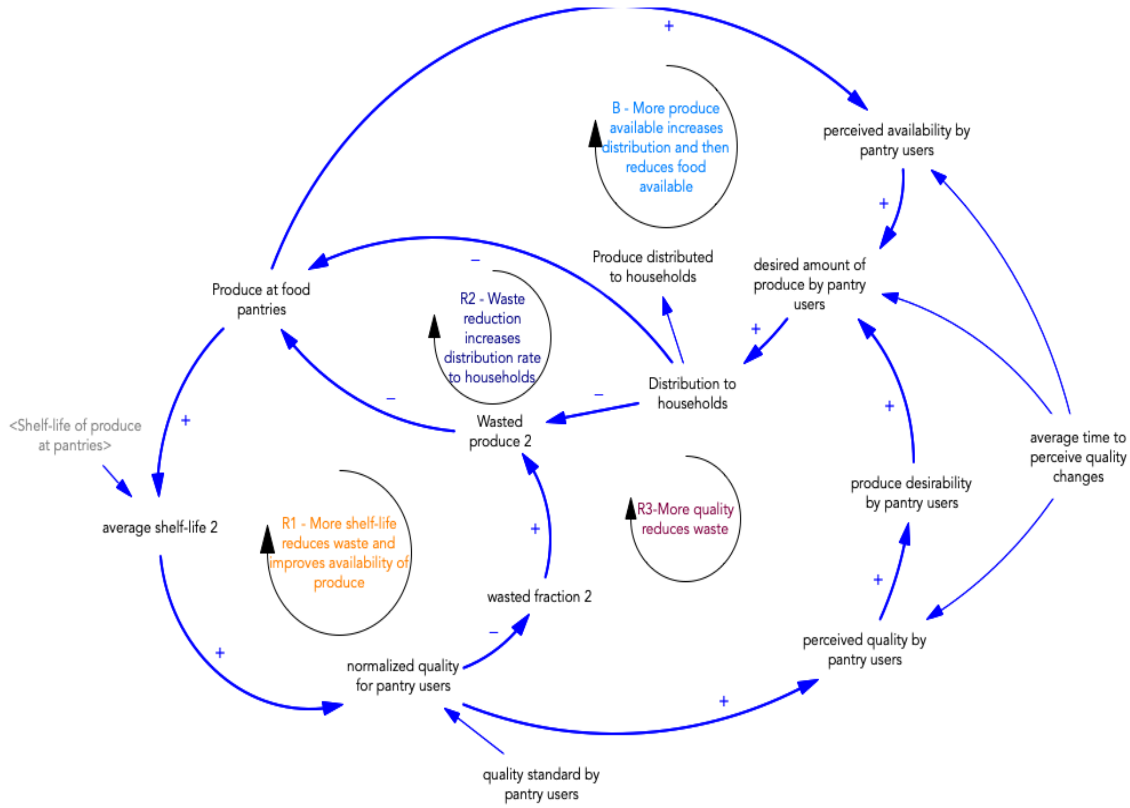


Fig. 5 Causal loop diagram representing dynamics regarding food pantry users. *R1:* Greater average shelf-life at food pantries reduces waste, which in turn increases the amount of fresh produce available and the average shelf-life of produce at pantries. *B*: as produce available at food pantries increases, the greater is the distribution rate to households, which in turn reduces food availability. *R2:* waste reduction increases produce at pantries and the perceived availability by pantry users, increasing the amount of food that they take home, which further reduces waste. R3: greater produce quality increases distribution to households and reduces waste (favors produce turnover).

3.2.6. Model assumptions and initial parameters

Based on available data from the various information sources specified in the methods section, we have established initial parameters (a list of these parameters is presented in Table 3).

Average shelf-life (early stage and food pantries). Based on group-model building, the average shelf-life of fresh produce from growers is higher than the average shelf-life or produce from non-farm businesses. We triangulated this information with state-level data of pounds donated by the farm and retail sectors in 2019[9], and intervals of shelf-life by produce type [41]. We used the average of the highest values of shelf-life for produce retail (2.4 weeks/pound) to avoid overestimating waste from this source. For produce from growers, we used the average of the low and high points. The *average shelf-life of produce from growers* was set at 4.8 weeks, whilst the *average shelf-life from non-farm businesses* was set at 2.4 weeks (produce types donated by sector are plotted and listed in *Annex C*).

Table 3. **Initial parameters**

*Parameters**	*Value*
Storage capacity (lbs.) **	150,000
Pantry open days per week (days) **	2
Total surplus from growers (lbs.) **	22,500
Total surplus from non-farms (lbs.) **	127,500
Minimum time to sort (days)	1
Normal standard of quality, early stage (weeks)	1.5
Quality standards by pantry users (weeks)	1
Average shelf-life from growers (weeks)	4.8
Average shelf-life from non-farm businesses (weeks)**	2.4
Average time to perceive quality changes	4.35
Week decay per week, early stage (weeks/week) **	0.8
Week decay per week, pantries (weeks/week) **	1

*For time units, we used the equivalent in weeks in the model.
**Parameters modified in simulation runs to generate scenarios.

Average time to perceive quality changes. We assumed that pantry users go to pantries once per month (every 4.35 weeks). This is the average time that they will take to perceive changes in fresh produce quality available at pantries.

Normalized quality and Normal standard of quality (early stage and food pantries). (Table and Figure 3D in Annex D). A greater *average shelf-life* relative to a *normal quality standard* results in higher *normalized quality*. The *normal quality standard* represents the perception of an acceptable shelf-life for a mix of fresh produce; it was set to 1.5 weeks for the early stage (food bank and food hubs) and 1 week for food pantries. The function is the same for both stages. (Next steps related to this function are described in *Annex D*)

Pantry open days per week and distribution capacity (food pantries). We assumed that, on average, pantries are open 2 times per week. Based on food pantry surveys and group-model building, we know that pantry open days are important in determining the capacity of pantries to distribute all produce in the stock during this time. Distribution capacity is a function of pantry open days (see lookup function in *Annex D*).

Produce sourcing. Based on 2019-2020 data from organizations, fresh produce from growers is approximately 10-15% of produce from other sources; we used the upper estimate of 15% given that the food hub sources from growers only.

Sorting (early stage). The minimum time to sort was set to 1 day (0.14 weeks). To adjust to the *needed capacity* (which depends on the stock of produce), organizations move people from other operations within the organization to produce sorting and handling as needed. We used a function where *sorting capacity* = *SMOOTH(Needed capacity, Minimum time to sort).*

Storage capacity (early stage). Based on 2019-2020 data from organizations, the estimate of *storage capacity* for fresh produce at food bank and food hubs is 160,000 lbs.

Week decay per week. Each week, a pound of produce loses 1 week of shelf-life under normal conditions. Cold storage or other factors would reduce this decay. The initial value of week decay per week is 0.8 weeks/week at the early stage (due to greater cold storage), and 1 week/week at pantries.

4. SIMULATIONS

4.1. Scenarios

We have considered 9 scenarios based on current policies and alternative changes in the system (*Table 4)*.

Table 4. **Policy-based and alternative scenarios**

Scenario	Storage capacity, early stage (lbs.)	Pantry open days (days/ week)	Total surplus from growers (lbs.)	Total surplus non-farms (lbs.)	Average shelf-life from growers (weeks)	Average shelf-life from non-farm businesses (weeks)	Week decay per week, early stage (weeks/week)	Week decay per week, pantries (weeks/week)
Base	*150,000*	*2*	*22,500*	*127,500*	4.8	2.4	*0.8*	*1*
1	150,000	2	base + 45%	base	4.8	2.4	0.8	1
2	150,000	2	base	base+ 45%	4.8	2.4	0.8	1
3	150,000	2	base + 45%	base + 45%	4.8	2.4	0.8	1
4	150,000	2	base	base+ 45%	4.8	3.44	0.8	1
5	201,600	2	base	base	4.8	2.4	0.8	1
6	150,000	4	base	base	4.8	2.4	0.8	1
7	150,000	2	base	base	4.8	2.4	0.6	1
8	150,000	2	base	base	4.8	2.4	0.8	0.75
9	201,600	4	base	base	4.8	2.4	0.6	

Scenarios changing produce *inflows*: 1: "The farm policy"; 2: "The waste ban policy"; 3: "Combined policy". Scenario increasing *quality* of donations: 4: "Waste ban policy plus donor-recipient agreement and an 'accountability policy'". Scenarios changing organizational *capacity*: 5: "Increased storage capacity at the early stage"; 6: "Increased capacity of food pantries"; 7: "Increased cold storage at the early stage"; 8: "Increased cold storage at pantries"; 9: "Increased overall capacity of food rescue".

Baseline scenario: "No policy". In this scenario, use used the initial evidence-based parameters' values (in *Table 3*), and the system is in equilibrium (*Figure 1E* in *Annex E)*. To test the effect of policies, scenarios 1 to 9 are compared with this baseline scenario.

Scenarios 1-3: Increasing the produce inflows. *In "Scenario 1: The farm policy", we* simulated a 30% increase in fresh produce from farms in the second year and an additional 15% increase (compared with the initial surplus inflow) in the third year. In "*Scenario 2: The waste ban policy*", we simulated a 30% increase in fresh produce from retailers in the second year and an additional 15% increase (compared with the initial surplus inflow) in the third year. *"Scenario 3: Combined policy",* represents the effect of the farm policy and a waste ban policy *(Scenarios 1 and 2).*

Scenario 4: Waste ban policy plus donor-recipient agreement and an 'accountability policy'. We considered a scenario where the quality of produce donated by the retail sector (non-farm food businesses) is higher due to an increased agreement between donors and recipient organizations about standards quality of food for donation that allows food to get to end-users and an increase in corporate accountability. Both increased donor-recipient agreement on fresh produce quality and corporate accountability can translate into actions such as donating food at an earlier time and improved sorting prior to donation. Meanwhile, corporate accountability can be increased due to a greater donor-recipient agreement or through mechanisms designed to disincentivize low-quality donations. To simulate this effect, we increased fresh produce from retailers by 30% in year 2 and an additional 15% in year 3 (same as in *Scenario 2*) and added a gradual increase in average shelf-life from retail from year 2 to 3 where shelf-life reaches a value of 3.44 weeks/pound. The latter change represents a 30% increase in the average shelf-life from retail, but the final value is still lower than the shelf-life of produce from growers by 29% (see *Figure 2E* in *Annex E*).

Scenarios 5-9: Increasing organizations' capacity. In *Scenario 5 "Increased storage capacity at the early stage",* we simulated a gradual increase in storage capacity at this stage from year 2 to year 6. In year 6, storage capacity is about 34.4% higher than the initial value. In *"Scenario 6: Increased capacity of food pantries",* more pantry open days improve distribution capacity and the maximum produce distribution per week. We simulated a gradual increase in *pantry open days* from year 2 to 6; in year 6, *pantry open days* are approximately 4 days per week. *"Scenario 7: Increased cold storage at the early stage".* We simulated an increase in cold storage at the early stage through a gradual decrease in the week decay per week from year 2 to 6. In year 6, the week decay per week at the early stage is close to 0.6 weeks/week, which represents a decrease of 25% compared to the initial value. In *"Scenario 8: Increased cold storage at pantries", we* simulated an increase in cold storage at a decrease in the week decay per week from year 2 to 7. In year 7, the week decay per week at pantries is close to 0.75 weeks/week, which corresponds to a decrease of 25% compared to the initial value (see the change in *week decay per week* in *Figures 3 and 4E* in *Annex E*). In *"Scenario 9: Increased overall capacity of food rescue"*, we simulated the increase in the overall capacity of food rescue organizations (storage, sorting, and cold storage and the early stage and food pantries). This scenario combines 5, 6, 7, and 8 scenarios.

5. RESULTS (SIMULATION)

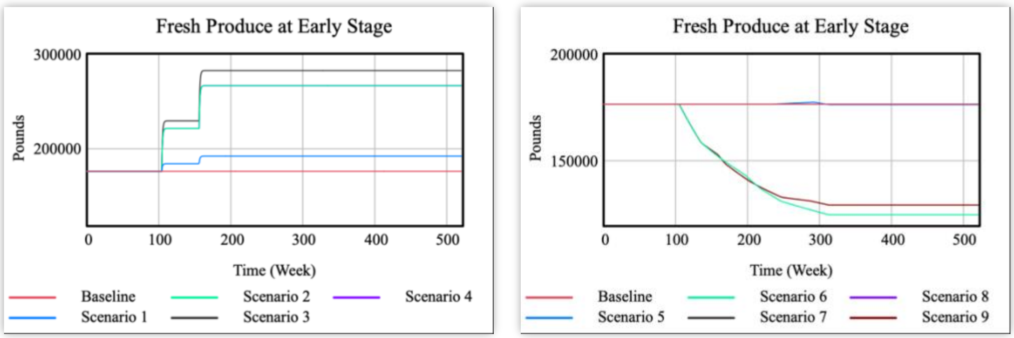
The simulation runs for the baseline and 9 scenarios show behaviors of produce availability (*Figure 7*), produce distribution to households (*Figure 8*), produce decay (Fig. 9), and waste of produce (*Figures 10* and *11*).

5.1.1. ***Fresh produce availability***

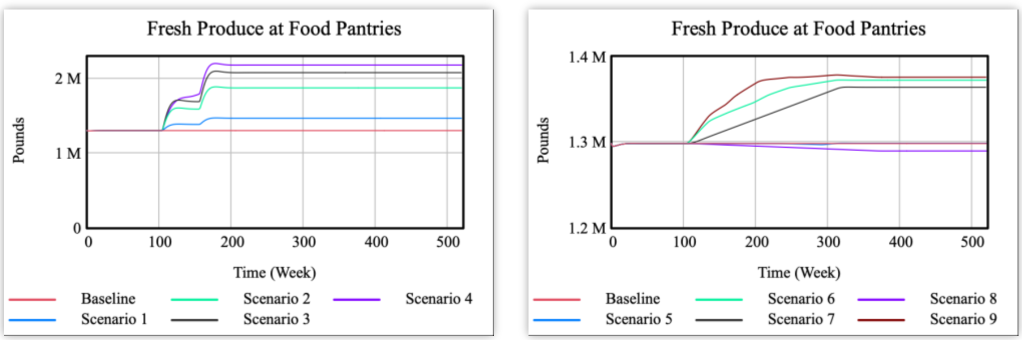
At the early stage: The effect of increasing fresh produce from growers is the same as the effect of improving the quality of donations from retail (see that *Scenario 2* is equal to *Scenario 4*). Increasing pantry open days (*Scenario 6*) reduced the fresh produce stock by ~30% by year 6. The reduction in the stock of produce was lower, ~26%, when we increased the capacity of all organizations (in *Scenario 9*). *(Fig. 7a)*

At food pantries: The waste ban policy along with an improvement in the quality of food from retail (as in *Scenario 4*) had the greatest effect on increasing the stock of fresh produce, followed by the combined policy (*Scenario 3*), and the waste ban only (*Scenario 2*). Increasing pantry open days (*Scenario 6*), cold storage at the early stage (*Scenario 7*), and the capacity of all food rescue organizations also lead to more fresh produce. Improving cold storage at food pantries only (*Scenario 8*) decreased the stock of food at this stage. *(Fig.7b)*

Scenarios 1 to 4: *Scenarios 5 to 9:*



a. Fresh produce at the early stage



b. Fresh produce at food pantries

Fig. 7 ***Fresh produce availability (stocks)***

5.1.2. ***Produce distribution to households***

Policies increasing fresh produce inflows (*Scenarios 1-3*) and improving produce quality (*Scenario 4*) lead to greater increases in the rate of produce per week distributed to households compared to those increasing capacity (see for example that the distribution to households is close to 120,000 lbs./week in *Scenario 4* and close to 74,000 in *Scenarios 6* and *9*). However, strategies increasing storage capacity at the early stage–except (*Scenario 5*) and cold storage at pantries (*Scenario 8*)–also result in a greater rate of distribution to households compared to the baseline. (*Fig. 8*)

Scenarios 1 to 4: *Scenarios 5 to 9:*

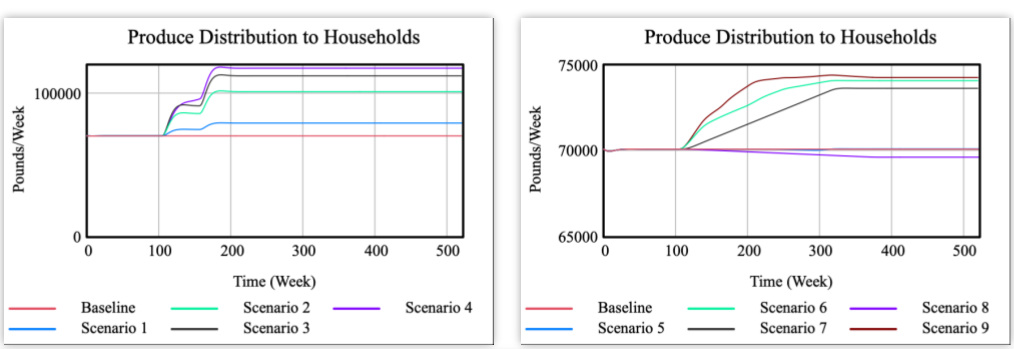


Fig. 8. ***Fresh produce distribution to households***

5.1.3. ***Produce decay***

At the early stage: Produce decay is highest in the combined scenario (*Scenario 3*) and when only retail donations are increased (*Scenario 2*). On the other hand, all strategies improving capacity reduce decay (*Fig. 9a*). *At food pantries:* Produce decay skyrockets when there is an increase in produce from retail and an increase in shelf-life from this source (Scenario 4). Increasing cold storage at pantries (*Scenario 8*), is the only measure reducing produce decay at this stage *(Fig 9b*).

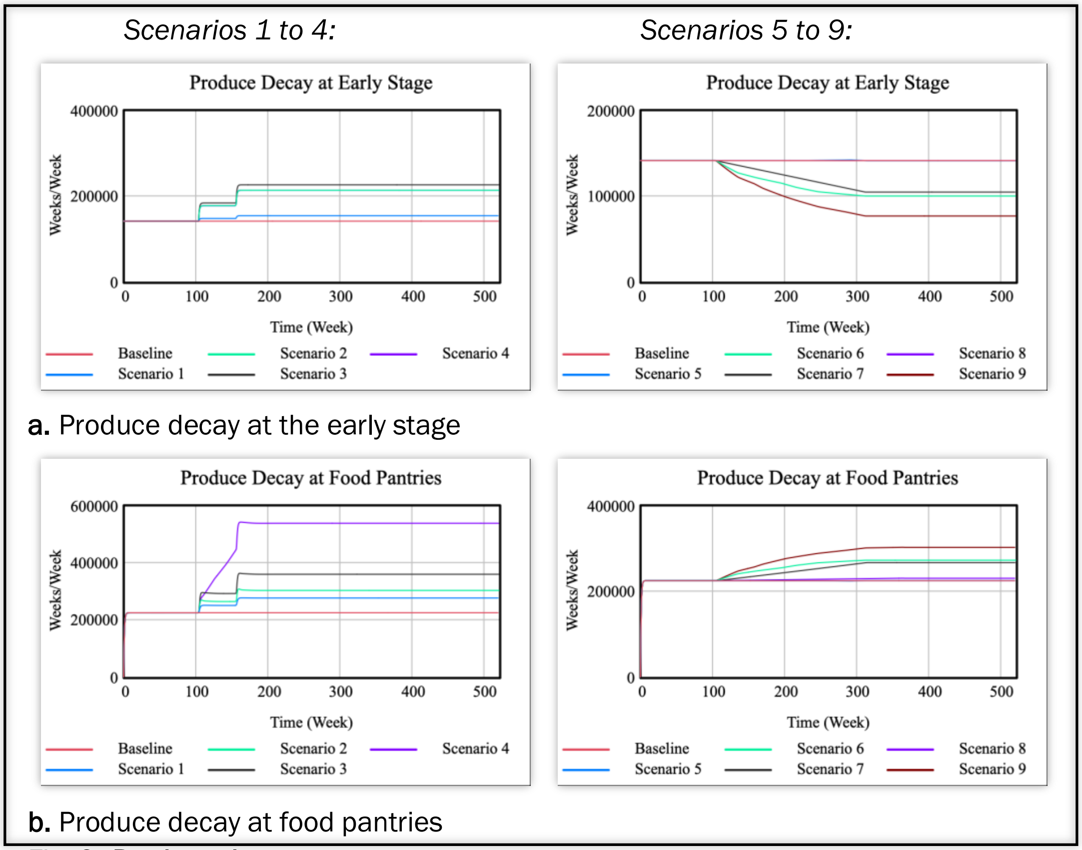


Fig. 9. ***Produce decay***

5.1.4. ***Produce waste***

At the early stage: Increasing retail donations of produce (*Scenario 2*) leads to the greatest accumulation of waste, while increasing produce from farms (*Scenario 1*) reduces waste. Increasing produce from retailers along with an increased quality from this source is the most effective measure for waste reduction at this stage. All scenarios increasing capacity (*Scenarios 5 to 9*) reduce waste (*Fig. 10a*). *At food pantries:* all policies lead to more waste compared to the baseline. Note: Overall waste from pantries is not a good indicator of policy success, because it depends on the amount of produce that enters the system (*Fig. 10b*). *Total waste:* For the two stages of food rescue (the early stage and food pantries), bringing more produce led to more waste (again: total waste is not a good indicator). However, we observed that in all scenarios increasing capacity reduced the total waste (*Fig. 10c).*

5.1.4.1. Wasted fraction

At the early stage: While increasing retail donations without improvement in quality increases the wasted fraction (*Scenario 2*), this same increase along with improvements in food quality results in the greatest reduction in wasted fraction. All increases in storage capacity–except for storage capacity at the early stage (*Scenario 8*)–lead to reductions in the wasted fraction. Note: the wasted fraction is a better indicator than total waste (*Fig. 11a*). *At food pantries:* The patterns observed at food pantries are similar to those observed at the early stage. The difference is that in this case, increasing cold storage at pantries (*Scenario 8)* and increasing the overall capacity of food rescue (*Scenario 9*) lead to slight increases in the fraction wasted. Increasing pantry open days (Scenario 6), and improving cold storage at the early stage, lead to a lower fraction wasted at pantries. (*Fig. 11b*)

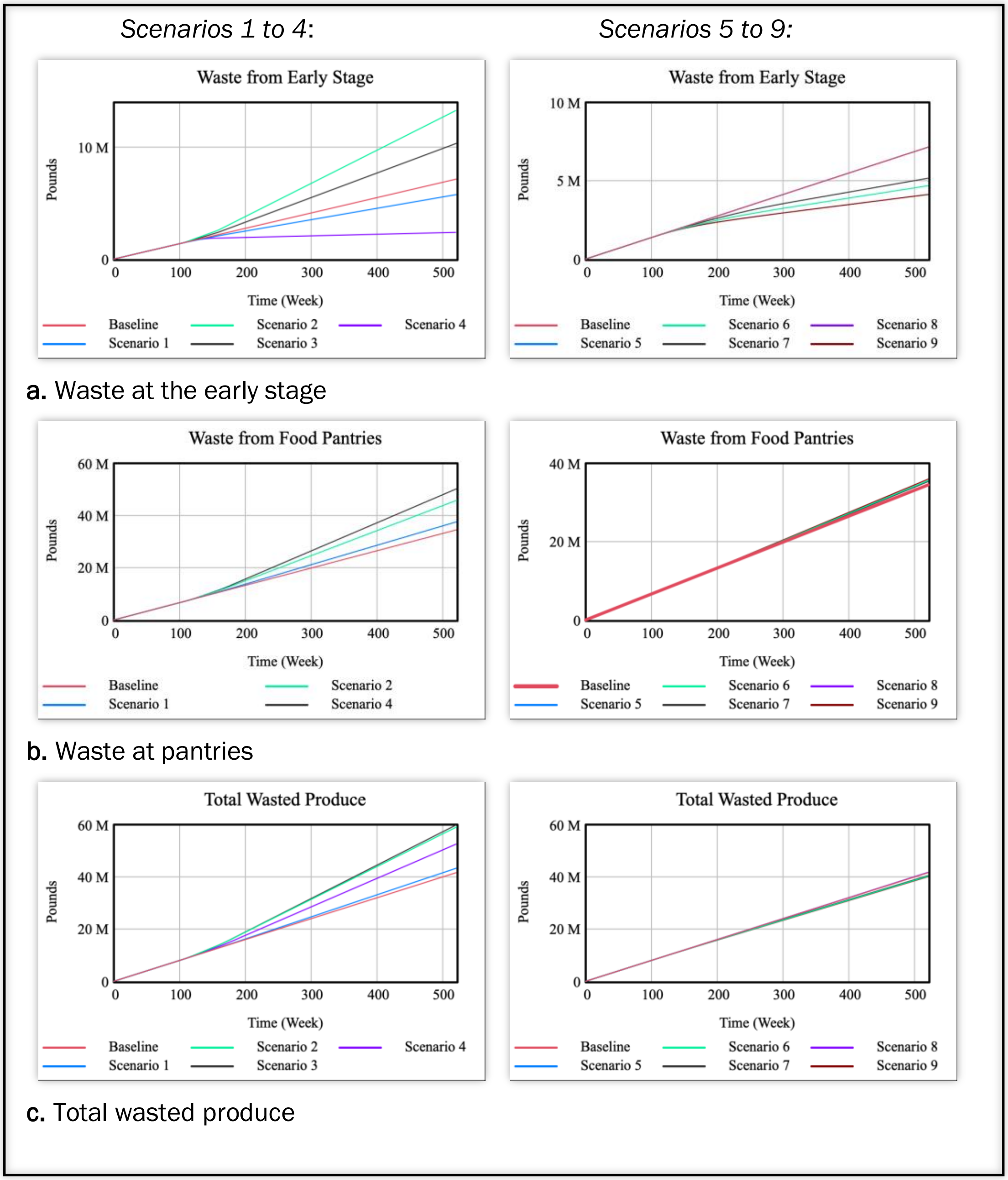
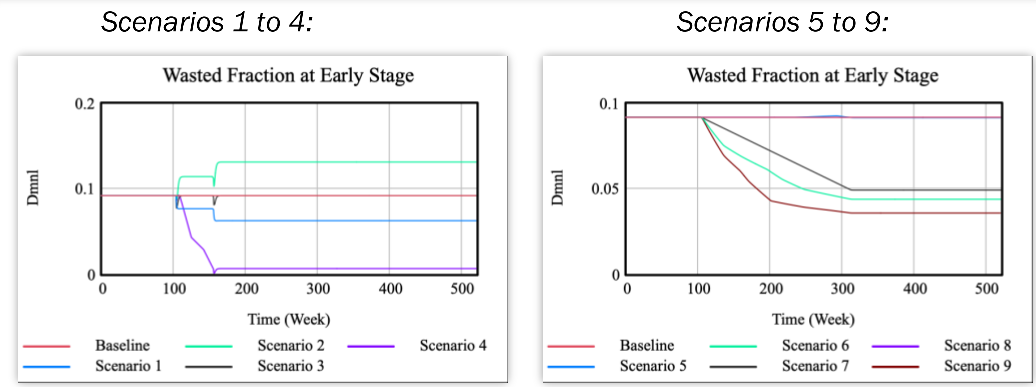
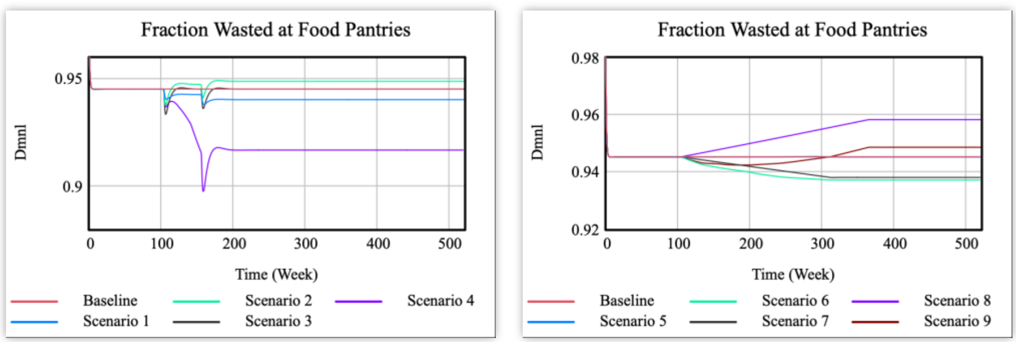


Fig. 10a-b ***Generated waste***



a. Wasted fraction at early stage



b. Wasted fraction at food pantries

Fig. 11 *Wasted fraction*

6. MODEL IMPROVEMENT

The current model will be improved through repetitive testing and correction of weaknesses and seeking points of correspondence with existing data [31]. This will help us to build confidence in the model. The validity of the model will be evaluated relative to the model purpose [31,44,45]. In general, aspects to be tested for include the capacity of the model to generate behavior modes that correspond to the ones observed or expected in the real world, the plausibility of the causal mechanisms representing this reality, the plausibility of the values of model parameters, the compatibility of individual assumptions with established knowledge, and the internal consistency of the full model structure [31]. This testing will allow us to demonstrate the degree of correspondence between the model and the reality it seeks to represent [45]; we will delineate the limits of this correspondence.

6.1. Next steps

The following are specific steps needed to improve the model related to the conceptualization of the model and structure, definition of initial parameters, and simulation.

6.1.1. *Model conceptualization and structure*

Currently, distribution to pantries depends on dynamics at the early stage and the pantries' distribution capacity (which is dependent on open days per week only). Based on loop B in the causal loop diagram (Fig. 5), we might need to connect distribution to households (which represents the demand by pantry users) to the distribution to pantries rate, given that pantries will order more fresh produce based on this demand.

We further need to determine whether specific food sources imply important differences in the packaging and handling of fresh produce. A possible solution is the use of subscripts.

A causal loop diagram will be useful to explain the dynamics related to corporate accountability dynamics and the role of current policies and potential strategies in changing these dynamics.

6.1.2. *Initial parameters*

We will refine model parameters based on available data. For example, the model seems to be highly sensitive to changes in average shelf-life from different sources. Thus, a next step is to refine the average shelf-life based on types of produce donated using data for more years, weighted data for produce types, and triangulating information from organizations regarding produce types received. Obtain information about possible changes in food types associated with any of the policies examined here and determine if these changes affect our estimates.

6.1.3. Simulation

Scenarios will be presented to project partners and the research team, and we will simulate those based on their input. We also need to further explain and describe dynamics within this model, such as those related to changes in waste at each stage after increases in organizations' capacity.

Acknowledgments

This work is part of Capital Region FRESH, supported by the Foundation for Food and Agriculture Research. We thank the FRESH team (Beth Feingold, Xiaobo Romeiko, Akiko Hosler, Christine Bozlak, Mary Riley-Jacome from UAlbany, and Roni Neff from Johns Hopkins University) and the time and expertise that stakeholders contributed to this project.

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ANNEX A

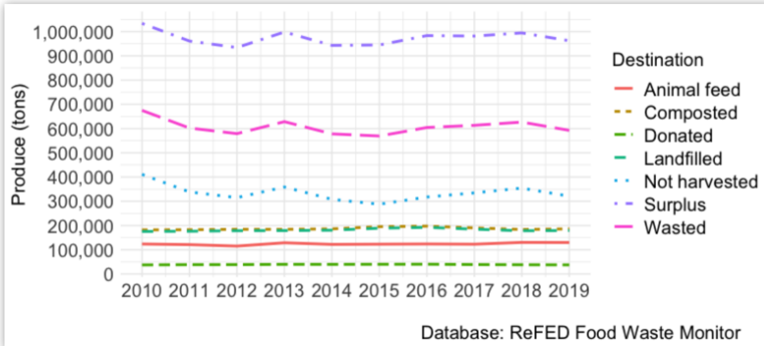

Fig. 1A **Produce surplus in New York, 2010-2019**

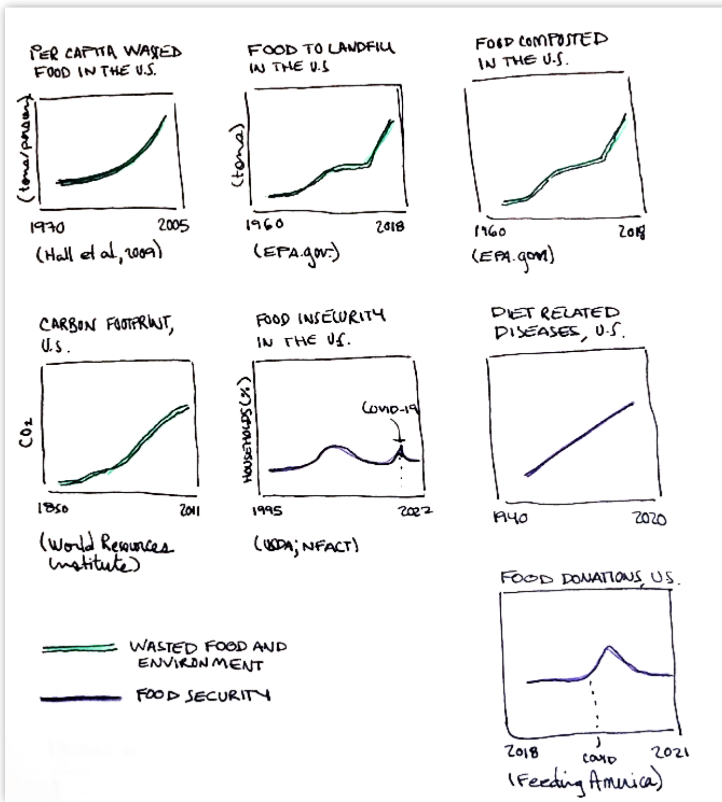

Fig. 2A **Problem dynamics: food & nutrition security and wasted food in the U.S.**

Fig 3A. **Total fresh produce to the regional foodbank (moving average)**

ANNEX B: LIST OF VARIABLES

Table B1 **List of variables included the stock and flow diagram**

Sector	*Variables* *Stocks (accumulations)*	*Flows (rates)*	*Auxiliary variables*
Capacity *(Organizations' capacity to handle and distribute food)*	<u>*Early stage*</u> - Produce at food bank and food hubs (lbs.) <u>*Food pantries*</u> - Produce at food pantries (lbs.)	<u>*Early stage*</u> - Distribution to pantries (*lbs./week*) <u>*Food pantries*</u> - Distribution to households (lbs./week)	<u>*Early stage*</u> - Actual outflow (lbs./week) - Fraction of inventory needed to sort out (dmnl) - Maximum outflow (lbs./week) - Needed capacity (lbs.) - Saturation of storage capacity (dmnl) - Sorting capacity (lbs./week) - Storage capacity (lbs. <u>*Food pantries*</u> - Distribution capacity (dmnl) - Portion of time that pantries are open (dmnl) - Pantry open days per week (days/week) - Maximum produce distribution per week (lbs./week)
Pantry users *(Recipients of food from food pantries)*	- Produce distributed to households (lbs)	- Distribution to households (lbs/week) - Shelf-life to households (weeks/week)	- Average time to perceive quality changes (weeks) - Desired amount of produce by pantry users (lbs./week) - Perceived availability by pantry users (lbs) - Perceived quality by pantry users (dmnl) - Produce desirability by pantry users (dmnl)
Shelf-life *(Proxy of produce quality)*	<u>*Early stage*</u> - Shelf-life of produce at food bank and food hubs (weeks) <u>*Food pantries*</u> - Shelf-life of produce at pantries (weeks) -Shelf-life distributed to households (weeks)	<u>*Early stage*</u> - Shelf-life decay 1 (weeks/week) - Shelf-life loss due to waste 1 (weeks/week) - Shelf-life of total acquisitions (weeks/week) - Shelf-life to pantries (weeks/week) <u>*Food pantries*</u> - Shelf-life decay 2 - Shelf-life loss due to waste 2 - Shelf-life to households (weeks/week)	<u>*Early stage*</u> - Average shelf-life from growers (weeks/lbs.) - Average shelf-life from non-farm food businesses (weeks/lbs.) - Average shelf-life 1 (weeks/lbs.) - Maximum decay 1 (weeks/week) - Normal quality standard (weeks) - Normalized quality (dmnl) - Week decay per week (week/(week*lbs.) <u>*Food pantries*</u> - Average shelf-life 2 (weeks/lbs.) - Maximum decay 2 (weeks/week) - Normalized quality for pantry users (dmnl) - Quality standards by pantry users (weeks) - Week decay per week 2 (week/(week*lbs.)
Surplus	-	<u>*Early stage*</u> - Surplus from growers (lbs. /week) -Non-farm surplus (lbs./week)	<u>*Early stage*</u> -Total surplus from growers (lbs./week) -Total surplus from non-farms (lbs./week)
Waste	<u>*Early stage*</u> -Waste accumulation form food bank and food hubs (lbs.) <u>*Food pantries*</u> -Waste accumulation from pantries (lbs.)	<u>*Early stage*</u> - Wasted produce 1 (lbs./week) <u>*Food pantries*</u> - Wasted produce 2 (lbs./week)	<u>*Early stage*</u> -Wasted fraction 1 (dmnl) <u>*Food pantries*</u> - Wasted fraction 2 (dmnl)

ANNEX C

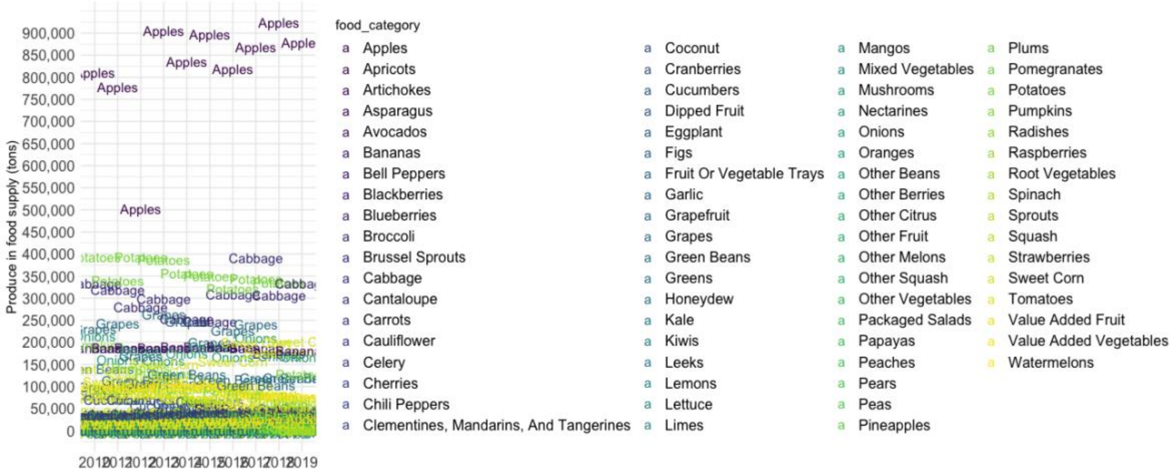

Fig 1C. **Produce supply by food type *at the retail and farm levels* in New York State, 2010-2019**

Fig 2C. **Donated produce types by the retail sector in New York State, 2010, 2019**

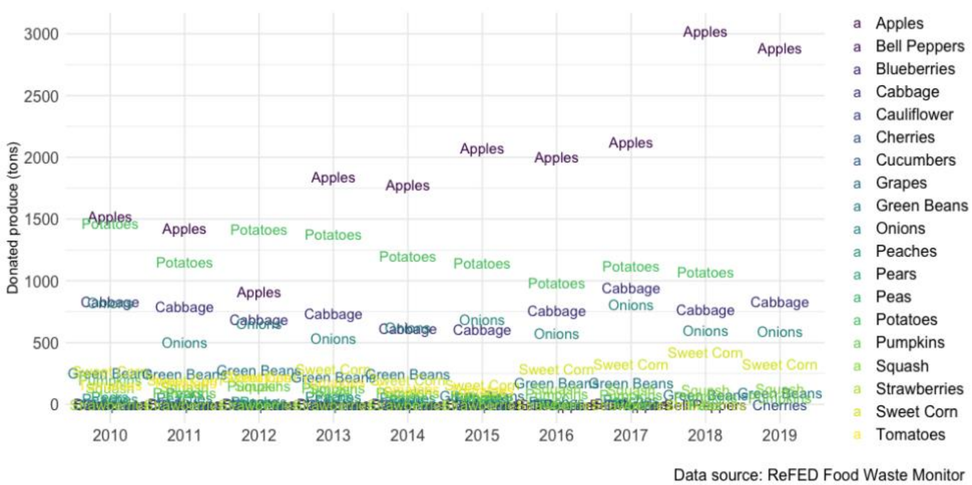

Fig 3C. **Donated produce types *from farms* in New York State, 2010-2019** (Figure generated from ReFED Waste Monitor data)

Table 1C.

PRODUCE DONATED BY RETAIL IN 2019

Produce type	tons donated	Percent	Cumulative percent
Watermelons	3825.21209	12.0%	12.0%
Apples	2919.570268	9.1%	21.1%
Potatoes	2023.629994	6.3%	27.4%
Avocados	1709.135109	5.3%	32.7%
Tomatoes	1468.311992	4.6%	37.3%
Bananas	1420.238495	4.4%	41.8%
Pineapples	1219.556591	3.8%	45.6%
Clementines, Mandarins, And Tangerines	1154.329309	3.6%	49.2%
Salad/Lettuce	1296.739246	4.0%	53.2%
Onions	653.0166501	2.3%	55.5%
Bell pepper	612.6013217	2.3%	57.8%
Strawberries	945.8111828	3.0%	60.7%
Grapes	829.3530907	2.6%	63.3%
Cucumbers	820.2384295	2.6%	65.9%
Greens	754.1542681	2.4%	68.3%
Oranges	736.4585564	2.3%	70.6%
Total	*32003.78304*	*70.6%*	-

Data source: ReFED Waste Monitor

Table 2C.

PRODUCE DONATED BY FARMS IN 2019

Produce type	tons donated	Percent	Cumulative percent
Apples	2884.386621	48.1%	48.1%
Potatoes	1077.572183	18.0%	66.1%
Cabbage	829.8518638	13.9%	80.0%
Onions	592.6006007	9.9%	89.9%
Sweet Corn	329.5075371	5.5%	95.4%
Squash	124.4285865	2.1%	97.5%
Green Beans	95.4043879	1.6%	99.0%
Pumpkins	56.9011353	0.9%	99.9%
Cherries	0.3990758	0.1%	100.0%
Total	*5991.051991*	*100.0%*	-

ANNEX D: LOOKUP FUNCTIONS

1D. *Fraction of inventory needed to sort* out at the early stage *(food bank and food hubs)*.
At this stage, organizations sort and distribute fresh produce to food pantries according to the amounts received from various sources. This process needs to occur as fast as possible to prevent food from decaying before reaching end consumers. We also know that when the inflow and stock of fresh produce increase, mass distributions help to sort out more produce. Using this information, we have created a lookup function in which at higher levels of *saturation of storage capacity* increases the *fraction of inventory needed to sort out*.

Table 1D. **Fraction of inventory needed to sort out, early stage**

x = Saturation of storage capacity	*y = Fraction of inventory needed to sort out*
0	0.2
0.0997963	0.417062
0.160896	0.50237
0.234216	0.611374
0.293279	0.668246
0.364562	0.729858
0.415479	0.772512
0.456212	0.805687
0.511202	0.834123
0.560081	0.848341
0.598778	0.862559
0.635438	0.886256
0.668024	0.895735
0.702648	0.905213
0.749491	0.905213
0.782077	0.909953
0.832994	0.909953
0.85947	0.909953
0.898167	0.900474
0.949084	0.905213
1	0.905213

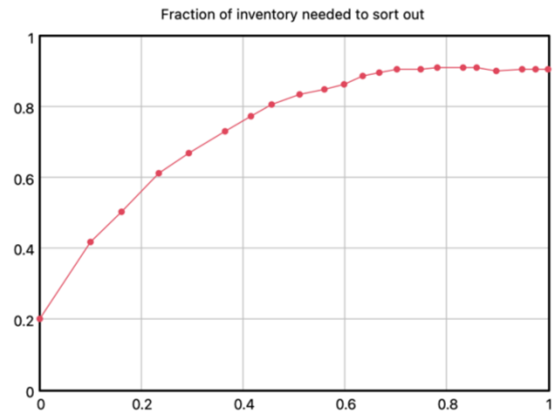

Fig. 1D ***Fraction of inventory needed to sort out, early stage***

2D *Distribution capacity* of food pantries.
Food pantries order food from early-stage organizations (food bank and food hubs) depending on their capacity to distribute food and the demand for fresh produce by pantry users. The *distribution capacity* of food pantries depends on their open days (*e.g.*, some pantries open a couple of times per month, while others several days within the week), and it was represented as a linear function in which the more days food pantries are open, the greater their distribution capacity.

Table 2D. **Distribution capacity at pantries**

x =Pantry open days (converted)	*y = Distribution capacity (dmnl)*
0.00	0.00
0.11	0.15
0.23	0.33
0.33	0.50
0.49	0.77
0.66	1.00
0.99	1.49

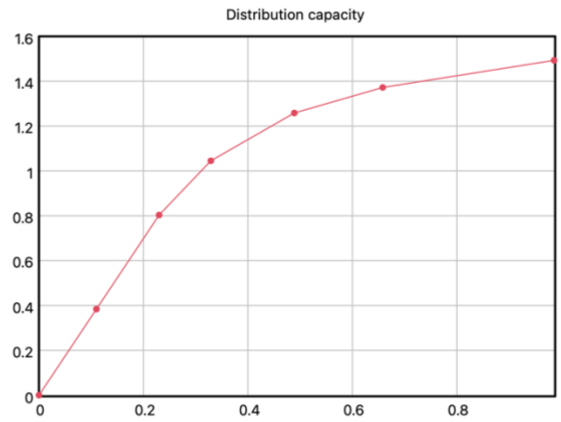

Fig. 2D ***Distribution capacity, food***

3D Normalized quality (early-stage organizations and pantry users)

We created an s-shaped lookup function, where a greater *average shelf-life* relative to a *normal quality standard* results in higher *normalized quality*. The *normal quality standard* represents the perception of an acceptable shelf-life for a mix of fresh produce; it was set to 1.5 weeks for the early stage (food bank and food hubs) and 1 week for food pantries. The function is the same for both stages. Next steps: triangulate this information with organizations at different levels (*i.e.*, food bank, food hub, pantries). At the same time, *normalized quality* is related to the *wasted fraction* (*wasted fraction = 1-normalized quality).* Example: if *normalized quality = average shelf-life/normal quality standard* = 0.3 weeks/1.4 weeks = 0.21, then *wasted fraction = 1-0.21 = 0.79.*

Normalized quality

x= average shelf-life1/normal quality standard	*y = Normalized quality*
0.00	0.00
0.21	0.05
0.40	0.17
0.60	0.30
0.80	0.55
1.00	0.80
1.20	0.91
1.40	0.96
1.60	0.97
1.80	1.00
2.00	1.00

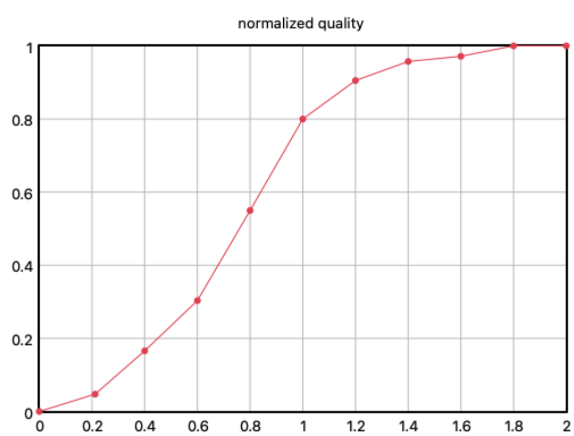

Fig. 3D ***Normalized quality***

ANNEX E

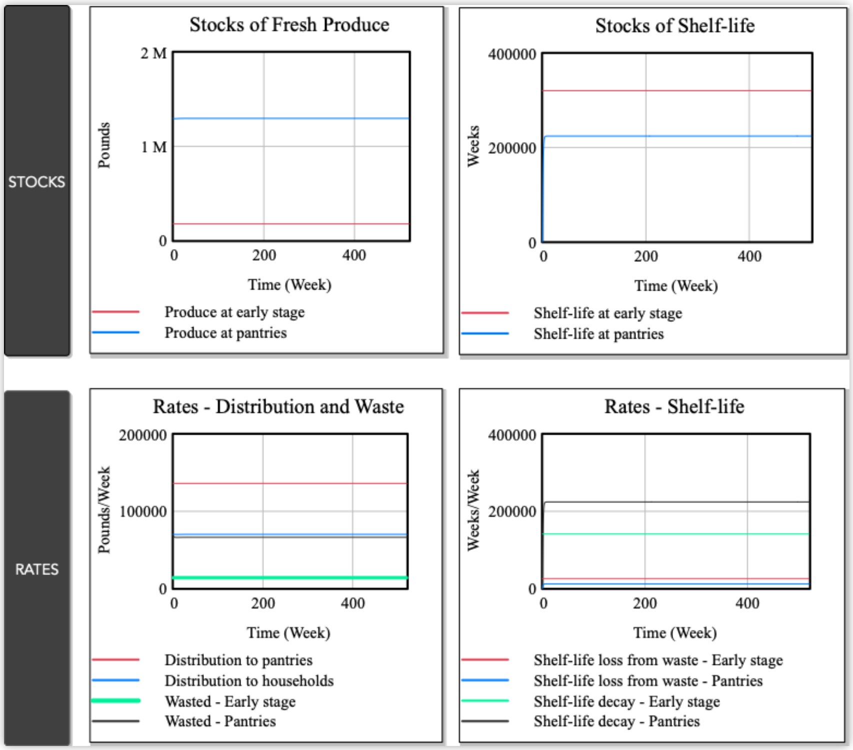

Fig. 1E ***Baseline scenario with the system in equilibrium.*** The baseline scenario shows the stocks of fresh produce, and shelf-life, as well as rates of distribution, waste, and shelf-life of the system in equilibrium.

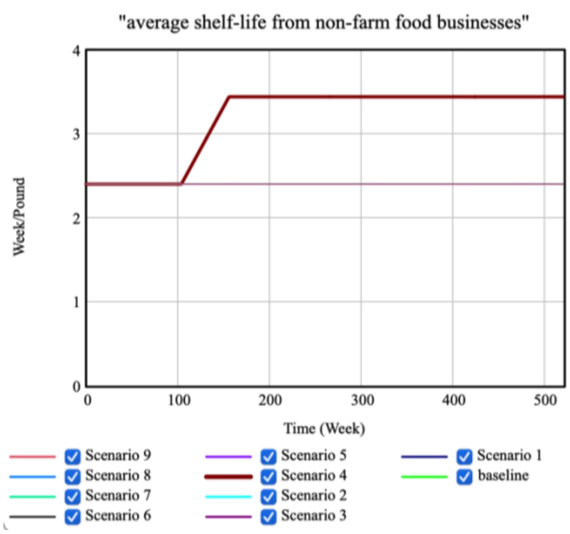

Fig. 2E. ***Simulated increase in Average shelf-life from non-farm food businesses from year 2 to 6 in Scenario 4.*** We used the function: *Average shelf-life from non-farm food businesses = 2.4 + RAMP(0.02 , 104 , 156)*

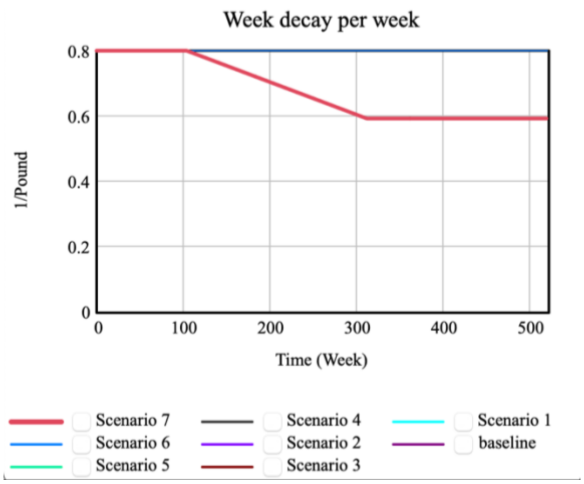

Fig. 3E ***Week decay per week at the early stage.***

Week decay at the early stage is 0.8 and decreases due to cold storage with a slope of -0.001 until the year 6. In year 6, week decay per week is close to 0.6 weeks/week (a decrease of 25% compared to the initial value). We used the function: *Week decay per week = 0.8 + RAMP(-0.001 , 104 , 312)*

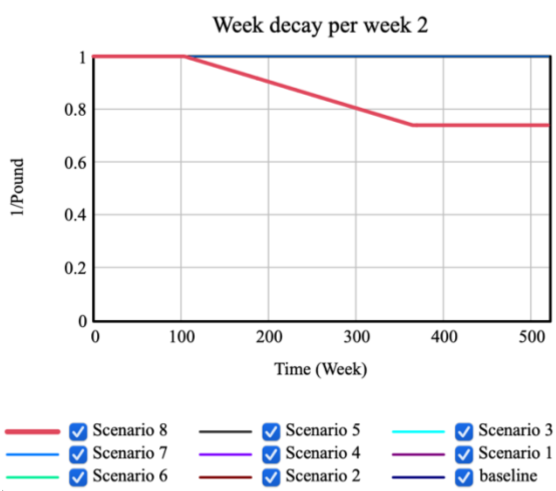

Fig 4E ***Week decay per week at food pantries***

Week decay at the early stage is 1 and decreases due to cold storage with a slope of -0.001 until the year 7. In year 7, week decay per week is close to 0.75 weeks/week (a decrease of 25% compared to the initial value). We used the function: *Week decay per week2 = 1 + RAMP(-0.001 , 104 , 365)*

ANNEX F – DOCUMENTATION

```
Actual outflow=
        MIN(Maximum outflow*Distribution
capacity,sorting capacity*Distribution
capacity
    )
    Units: Pounds/Week

"average shelf-life 2"=
    ZIDZ("Shelf-life of produce at
pantries", Produce at food pantries)
Units: Week/Pound

"average shelf-life from growers"=
    4.8
Units: Weeks/Pound
Based on produce types donated by farms in
New York State and
        average shelf-lyfe of these produce
types. Refer to "Data
        analysis from ReFED.xls" and
"Torres_Food Rescue and
        Waste_FinalProject_Apr12022.doc".

"average shelf-life from non-farm food
businesses"=
    2.4
```

```
Units: Weeks/Pound
Based on produce types donated by retail in
New York State and
        average shelf-lyfe of these produce
types. Refer to "Data
        analysis from ReFED.xls" and
"Torres_Food Rescue and
        Waste_FinalProject_Aprl2022.doc".
For the "accountability
        policy", increase average shelf-life
by 30% in year 3: 2.4 +
        STEP(2.4*0.30, 156)

"average shelf-life1"=
    ZIDZ("Shelf-life of produce at food bank
and food hubs", Produce at food bank and
food hubs
)
Units: Weeks/Pound

average time to perceive quality changes=
    4.34524
Units: Weeks
1 month = 4.34524 weeks, asumming that
pantry users go to
        pantries on average once a month

"Converter (days to week)"=
    0.142857
Units: Weeks/day

desired amount of produce by pantry users=
    (perceived availability by pantry
users*produce desirability by pantry users
)/average time to perceive quality changes
Units: Pounds/Week

Distribution capacity= WITH LOOKUP (
    Portion of time that pantries are open,
        ([(0,0)-
(1,1.5)],(0,0),(0.10998,0.383886),(0.23,0.80
3318),(0.329,1.04502)
,(0.488798,1.25829),(0.658,1.37204),(0.986,1
.49289) ))
Units: Dmnl

Distribution to households=
    MIN(maximum produce distribution per
week, desired amount of produce by pantry
users
)
Units: Pounds/Week

Distribution to pantries=
    Actual outflow*(1-wasted fraction 1)
Units: Pounds/Week

Fraction of inventory needed to sort out=
WITH LOOKUP (
    Saturation of storage capacity,
        ([(0,0)-
(1,1)],(0,0.189573),(0.0997963,0.345972),(0.
160896,0.421801),(0.234216
,0.526066),(0.293279,0.611374),(0.364562,0.6
72986),(0.415479,0.720379),(0.456212
,0.748815),(0.511202,0.791469),(0.560081,0.8
34123),(0.598778,0.862559),(0.635438
,0.876777),(0.668024,0.881517),(0.702648,0.8
95735),(0.749491,0.905213),(0.782077
,0.909953),(0.832994,0.909953),(0.85947,0.90
9953),(0.898167,0.900474),(0.949084
,0.905213),(0.97556,0.905213),(1,0.905213)
))
Units: Dmnl
When there is more produce coming in that
can be stored, then
        mass distributions help to sort out
more produce.

INITIAL TIME  = 0
Units: Week
The initial time for the simulation.

Maximum decay=
    "Shelf-life of produce at food bank and
food hubs"/Week decay per week
Units: Weeks/Week

Maximum decay 2=
    "Shelf-life of produce at pantries"/Week
decay per week 2
Units: Weeks/Week

Maximum outflow=
    Produce at food bank and food
hubs/Minimum time to sort
Units: Pounds/Week

maximum produce distribution per week=
    Produce at food pantries/Portion of time
that pantries are open
Units: Pounds/Week

Minimum time to sort=
    0.1429
Units: Weeks
1 day as min. time to sort out all produce

Needed capacity=
    Produce at food bank and food
hubs*Fraction of inventory needed to sort
out
Units: Pound

"Non-farm surplus"=
    "Total surplus from non-farms"
Units: Pounds/Week

normal quality standard=
    1.5
```

```
Units: Weeks [0,2,0.1]
1.5 weeks assuming that this is what it
would be acceptable for
        a mix of produce Check this
assumption with partners?

normalized quality= WITH LOOKUP (
    "average shelf-life1"/normal quality
standard,
        ([(0,0)-
(2,1)],(0,0),(0.224033,0.07109),(0.4,0.16587
7),(0.6,0.303318),(0.8
,0.549763),(1,0.8),(1.2,0.905213),(1.4,0.957
346),(1.6,0.971564),(1.8,1),(2,
1) ))
Units: Dmnl
According to this lookup, the greater the
shelf-life relative to
        a normal quality (1.4 days) the
higher the normalized quality
        will be

normalized quality for pantry users= WITH
LOOKUP (
    "average shelf-life 2"/quality standard
by pantry users,
        ([(0,0)-
(2,1)],(0,0),(0.224033,0.07109),(0.4,0.16587
7),(0.6,0.303318),(0.8
,0.549763),(1,0.8),(1.2,0.905213),(1.4,0.957
346),(1.6,0.971564),(1.8,1),(2,
1) ))
Units: Dmnl
With this s-shaped lookup, greater average
quality relative to a
        normal quality standard of 1.4 weeks
results in a lower wasted
        fraction. For example: if average
shelf-life/normal quality
        standard = 0.3 weeks/1.4 weeks =
0.21, the normalized quality is
        0.21, and wasted fraction is 1-0.21,
so wasted fraction would be
        0.79.

Pantry open days per week=
    2+ RAMP( 0.01 , 104 , 312 )
Units: days/Week [0,7]
On average, we will assume that pantries are
open 2 times per
        week ( 8 days/month, or 0.263
weeks/week). They will have to
        distribute all produce in the stock
during this time Scenario 6:
        Pantry open days is increased with a
slope of 0.01 from year 2
        to year 6 (when total pantry open
days reaches 4 open days/week,
        see pantry open days graph) 2+ RAMP(
0.01 , 104 , 312 )

perceived availability by pantry users=
    SMOOTH( Produce at food pantries
,average time to perceive quality changes
 )
Units: Pounds
Delay time = 4, assuming that a reasonable
average of pantry use
        would be once per month. Change this
parameter based on data
        from food access surveys.

perceived quality by pantry users=
    SMOOTH(normalized quality for pantry
users, average time to perceive quality
changes
 )
Units: Dmnl
Perceptions of quality depend on the quality
normal (wuich is
        the average shelf-life of produce
relative to a normal of
        quality). This percption will take
time to form. For now, let's
        assume that perceptions of quality
would take 5 weeks to be
        formed among pantry users.

Portion of time that pantries are open=
    Pantry open days per week*"Converter
(days to week)"
Units: Dmnl [0,1]

Produce at food bank and food hubs= INTEG (
    "Non-farm surplus"+Surplus from growers-
Distribution to pantries-Wasted produce 1
,
        176408
        )
Units: Pounds

Produce at food pantries= INTEG (
    Distribution to pantries-Distribution to
households-Wasted produce 2,
        1.29771e+06)
Units: Pounds
1.29771 M is the value of produce at
pantries with the system in
        equilibrium

produce desirability by pantry users= WITH
LOOKUP (
    perceived quality by pantry users,
        ([(0,0)-
(2,1.5)],(0.00407332,0.234597),(0.0773931,0.
234597),(0.203666,0.227488
),(0.317719,0.227488),(0.505092,0.270142),(0
.623218,0.298578),(0.737271,0.341232
),(0.949084,0.661137),(1.0835,0.966825),(1.2
7088,1.30095),(1.45418,1.4218),
```

```
(1.67006,1.44313),(2,1.5) ))
Units: Dmnl

Produce distributed to households= INTEG (
    Distribution to households,
        0)
Units: Pounds

quality standard by pantry users=
    1
Units: Weeks [0,6]
1 week is the Normal quality standard by
pantry used (assuming
        that this is what it would be
acceptable by pantry users for a
        mix of produce) Check this
assumption with partners and food
        access survey Next steps: Este puede
ser un smooth de perceived
        quality

Saturation of storage capacity=
    Produce at food bank and food
hubs/Storage capacity
Units: Dmnl

"Shelf -life loss due to waste1"=
    "average shelf-life1"*Wasted produce 1
Units: Weeks/Week

"Shelf-life decay1"=
    MIN(Maximum decay, Produce at food bank
and food hubs*Week decay per week)
Units: Weeks/Week

"Shelf-life decay2"=
    MIN(Maximum decay 2, Produce at food
pantries*Week decay per week 2)
Units: Weeks/Week

"Shelf-life loss due to waste2"=
    Wasted produce 2*"average shelf-life 2"
Units: Weeks/Week

"Shelf-life of produce at food bank and food
hubs"= INTEG (
    "Shelf-life of total acquisitions"-
"Shelf -life loss due to waste1"-"Shelf-life
decay1"
-"shelf-life to pantries",
        320914)
Units: Weeks
Initial value was set at 320914 (the value
of shelf-life at
        equilibrium

"Shelf-life of produce at pantries"= INTEG (
    "shelf-life to pantries"-"Shelf-life
decay2"-"Shelf-life loss due to waste2"
-"shelf-life to households",
        0)
Units: Weeks

"Shelf-life of total acquisitions"=
    Surplus from growers*"average shelf-life
from growers"+"Non-farm surplus"*
"average shelf-life from non-farm food
businesses"
Units: Weeks/Week

"shelf-life to households"=
    "average shelf-life 2"*Distribution to
households
Units: Weeks/Week

"shelf-life to pantries"=
    "average shelf-life1"*Distribution to
pantries
Units: Weeks/Week

sorting capacity=
    SMOOTH( Needed capacity , Minimum time
to sort )
Units: Pounds/Week
Organizations adjust to the needed capacity
by moving people
        from other operations within the
organization to sorting and
        handling as needed.

Storage capacity=
    160000 + RAMP(200, 104, 312)
Units: Pounds [0,500000,50]
Increase with a slope of 200 until year 6
160000 + RAMP(200,
        104, 312) Function: RAMP(slope,start
time,end time)

Surplus from growers=
    Total surplus from growers
Units: Pounds/Week

Total surplus from growers=
    22500
Units: Pounds/Week [0,200000,50]
+ STEP(22500*0.30,104) +
STEP(22500*0.30,156) First time step is
        an increase of 30% at the second
year. The second time step is
        an additional 15% increase (compared
with produce from growers
        at time 0) at the third year.

"Total surplus from non-farms"=
    127500
Units: Pounds/Week [0,500000,50]
127500 + STEP( 127500*0.30 , 104) +
STEP(127500*0.30, 156) 30%
        increase in second year and an
additional 15% increase (compared
```

with initial value) in the third year.

```
Waste accumulation from food bank and hubs= INTEG (
    Wasted produce 1,
        0)
Units: Pounds

Waste accumulation from pantries= INTEG (
    Wasted produce 2,
        0)
Units: Pounds

wasted fraction 1=
    1-normalized quality
Units: Dmnl
Reminder: Normalized quality is a function of average quality
        and normal standard of quality

wasted fraction 2=
    1-normalized quality for pantry users
Units: Dmnl

Wasted produce 1=
    Actual outflow*(wasted fraction 1)
Units: Pounds/Week

Wasted produce 2=
    Distribution to households*wasted fraction 2
Units: Pounds/Week

Week decay per week=
    0.8
Units: Week/(Week*Pound)
0.8 + RAMP( -0.001 , 104 , 312) Week deday at early stage is 0.8
        and decreases due to cold storage with a slope of -0.001 until
        the sixt year.

Week decay per week 2=
    1
Units: Week/(Week*Pound)
1 + RAMP( -0.001 , 104 , 365)
```