THE DYNAMICS OF FOOD WASTE IN RELATION TO CONSUMPTION, PRODUCTION, AND SHOPPING PATTERNS

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The food waste problem has become a global concern in recent years due to its severe implications in terms of the environment, economy and food security. High levels of waste produced by the current food system call for attention and restructuring. The rapid increase in world population following the industrial revolution made it even more complex and challenging to create and maintain sustainable food systems.

Food waste may take place at different stages of the food chain such as processing, retail, and consumer stages. These stages are not independent of each other. The structure and operation principles of one can have determining effects on the waste levels produced in another. To understand the dynamics of food waste, particularly in the retail market and household consumption stages, we modeled of food chain system including the dynamic relations between the market share of local food (LF) and food waste levels (see Figure 1.1). The model is simulated in STELLA 10.0.4 software for 25 years between 2015 and 2040 with a time unit as one month.

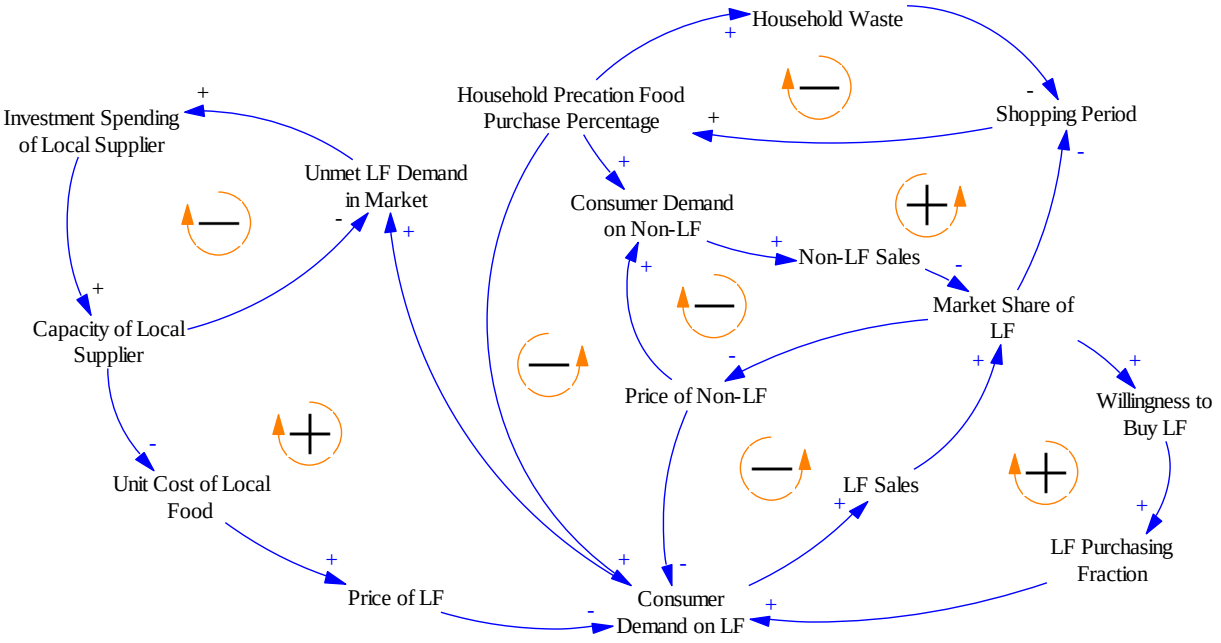

Figure 1.1: Causal Loop Diagram

Our main dynamic hypothesis is that over time we expect the local food market share to go up together with a gradual decrease in food waste over time. The model results for local food market share and food waste in households and retail markets are plotted in Figure 1.2.

To test the structural validity of the model, both sensitivity and extreme condition tests are conducted. The results of these tests matched our expectations.

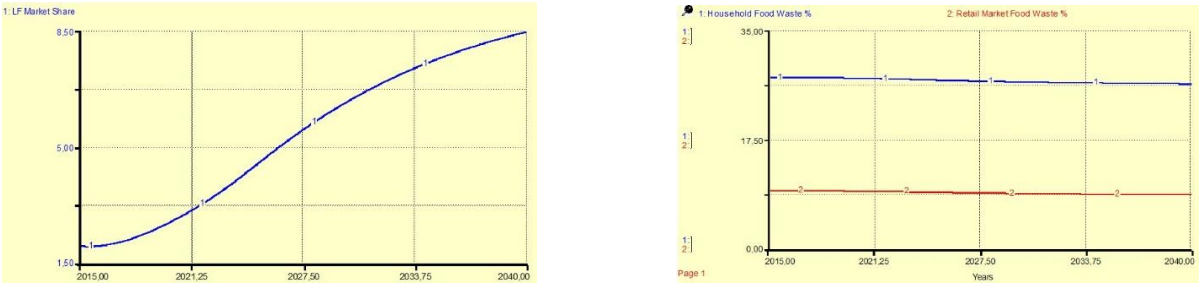

Figure 1.2: Base Run Results

In the base run, we found out that when the non-local supplier does not intervene with the growth of the local supplier by means of price cutting, the market share of local food grows significantly and leads to remarkable decreases in both household and retail market waste percentages.

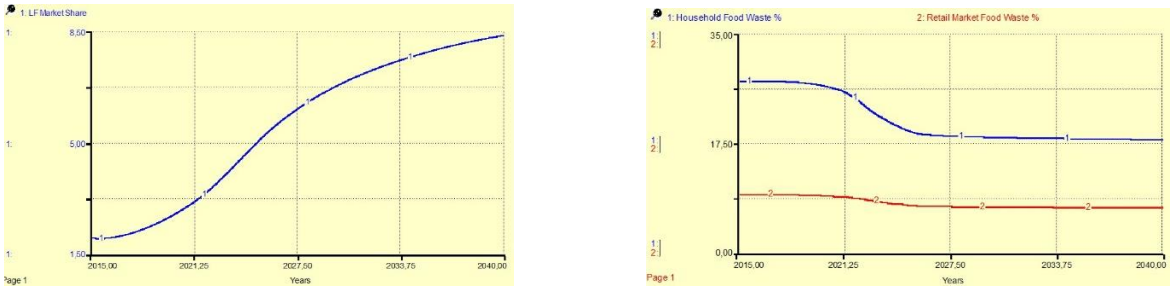

Figure 1.3: Scenario 1 Results

In the first scenario analysis, we introduced a new reinforcing loop into the model between shopping period and average distance to the closest retail market. We observed that this new addition to the model did not have much effect on the trajectory of local food market share; however, it led to much lower percentages of food waste (see Figure 1.3). As the second scenario, both base run and scenario 1 are simulated once again under the assumptions of delayed price cutting strategy by non-local supplier, high household food waste awareness level and low interest rate for investment loans. As the third scenario, both base run and scenario 1 are simulated once again under the assumptions of instant price cutting strategy and high household food waste awareness with standard and low interest rate. From these scenarios, we observed that the more aggressive the price-cutting strategy of non-local supplier becomes, the more strongly it counteracts the other loops. In extreme conditions, it prevents local food market share from growing and waste percentages from falling almost completely. In cases where price cutting actions are not taken immediately but instead taken with a delay, all the main variables in the model reach a state of sustained oscillations, since none of the counteracting loops can grow strong enough to suppress the other.

We believe that the outputs of this study illustrate how certain structural changes in the production and retail market stages may potentially help us address the food waste problem by changing food consumption and supply patterns. Increasing the density of smaller retail markets in neighborhoods or the market share of local food are only two of these structural changes that need to be studied more extensively. For further research, this model can be improved by enabling retail markets to price their produces differently with respect to their freshness/expiration date and examine whether this extension can result in any improved dynamics.

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