ODD+D protocol of the MEET-eaters model: An agent-based model to simulate consumption practices at the household level

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Background

There is increasing recognition, in Western countries like The Netherlands, that a dietary shift from primarily animal-based to more plant-based foods is essential for both human and planetary health (Aiking and de Boer 2020; Aleksandrowicz et al. 2016; McMichael et al. 2007; Pimentel and Pimentel 2003; Sabaté et al. 2015; Tilman and Clark 2014). Dietary patterns of animal- and plant-based consumption are increasingly understood as emergent outcomes of a complex system (Blokhuis et al. 2024; Wierda et al. 2025; Wopereis et al. 2024). MEET-eaters, the simulation model presented in this ODD+D protocol, covers the interactions within the food environment and the food decision-making in households. More details about the background and theoretical framework can be found in the main article (Blokhuis et al. submitted).

MEET-eaters aims to explore how each instant of performing the social practice of having dinner, which involves negotiations about what to eat, obtaining groceries, and evaluating the meal, provides opportunities to shift dietary patterns in the Netherlands towards more plant-based. Food outlets align their inventory level and product range with household demand as a strategy for profit maximization. As the model is situated in the Netherlands, the meal practice is customized to this country's cultural and normative context. Interpersonal dynamics are based on status conferrals as described in the status-power theory by Kemper (2006). Initial dietary preferences are included as reported by Statistics Netherlands (2024a) and ratio of animal- and plant-based products in food outlets is informed by monitoring results from Green Protein Alliance and ProVeg Nederland (2024). The model was developed in NetLogo 6.4 (Wilensky 2023).

This document presents the MEET-eaters model using the ODD+D protocol (Overview, Design concepts, and Details + human Decision-making), an extension of the original protocol for describing agent-based models (Grimm et al. 2020) that includes human decision-making (Müller et al. 2013). As a standardized format, the ODD+D protocol facilitates transparency, replication and comparison of models that include human behaviour (Müller et al. 2013). The manuscript entitled "MEET-eaters: An agent-based model to simulate consumption practices at the household level" has been submitted to a peer-reviewed journal on November 2nd, 2025.

Model description

The ODD+D protocol consists of the three parts *Overview*, *Design concepts*, and *Details*, which are presented in the sections below. The model is available at a GitHub repository (Blokhuis and Polhill 2025).

Overview

Purpose and patterns

The proximate purpose of this agent-based model is to provide a potential explanation for the prevailing high consumption of animal protein sources in the Netherlands resulting from the interaction between food outlet product ranges (supply) and food decision-making at the household level (demand). Blokhuis et al. (2025) identified the archetypes "Supply and demand", which shows how availability and purchase of animal- and plant-based protein sources mutually interact, and "Success to the successful", which demonstrates why food outlets prioritize products that contributes most to their profit (e.g. through visibility or promotion). These archetypical patterns have been selected as the foundation of this ABM. The model is evaluated by its ability to reproduce a reciprocal response in the interaction between food outlet product range and food decision-making at the household level. A key motivation for developing this model is to enable simulations of potential leverage points, providing policymakers with insights into household decision-making patterns and the physical and social aspects influencing these patterns.

Entities, state variables, and scales

Model entities in MEET-eaters include persons, households, and food outlets. All state variables characterizing these entities are listed in Table 1. Since the simulation period is ten years, population birth, death, and changes in household composition are omitted. Each person can invite other persons for dinner; each person can attend other households' dinners. The model is two-dimensional and represents space in a square patch grid of sixty-one continuous x and y coordinates.

Person-agents have a set of attributes and a number of relationships. Persons are defined by their household ID, social position in relation to other persons, their level of neophobia, their cooking skills, and their dietary preference at t=t. Household ID corresponds to the household in which the person lives and directs them back home after eating at a friend's place. The social status is dynamic and varies according to the appreciation of cooks towards their dinner guests, and dinner guests towards their cooks. In this model, it is assumed that commensality, the act of eating together, is the only social activity that influences social position. Level of neophobia refers primarily to an individual's food neophobia, the reluctance to eat unfamiliar foods. Food neophobia was reported to negatively correlate with the personality traits openness and extraversion (Knaapila et al. 2011; Nezlek and Forestell 2019). Cho et al. (2014) found that frequency of enjoying a meal together negatively correlates with food neophobia. For this reason, the person-agent parameter neophobia is also serves as a proxy for how often a cook invites friends over for dinner. Cooking skills of each cook influence the meal's quality and are assumed static; no one will ever improve their cooking. Dietary preference at t=0 are distributed based on data by Statistics Netherlands (2024a). In the meal enjoyment table, enjoyment values for each of the four protein sources (i.e. meat, fish, vegetarian, vegan) are stored and adjusted based on meal time experience.

Person-agents are connected in a family network, consisting of their household members, and a friends network, consisting of friends, colleagues and acquaintances. Each person in a person-agent's network is treated similarly, i.e. strength of relationships does not differ between friends and acquaintances. Each person-agent in the model can invite each of their family and friends for dinner and each person-agent can attend other households' dinners. The person-agents that are cooking on a particular day, the cook-agents, visit the food outlet to obtain groceries. The variables a) at home, b) is cook, c) the dinner guests, and d) meal to cook are part of the procedure for gathering the dinner group and deciding what to eat. The variables sorted e) food outlets, f) number of supermarket changes, g) my supermarket, h) basket full, and i) bought, are used in the procedures for obtaining groceries (see Obtain groceries (6-8)). Variables j) my last dinner, k) my cook, l) my cook's cooking skills, m) last meal's quality, and n) last meal's enjoyment are variables used in the procedures for evaluating the meal (See Cooking and evaluating the meal (9-13)). Network diet diversity is a variable that shows how many different dietary preferences exist in a person's social network. During the dinners that follow after groceries have been obtained, person-agents consume their preferred or alternative protein sources and may adjust their dietary preference. Population birth, death and changes in household composition are omitted.

Household-agents are the entity that unites person-agents in a family and serves as the home for each resident. Households are ascribed an ID and members. The ID links each house to its resident person-agents. The variables a) is house empty? and b) is meal cooked? are used in the procedure for gathering the dinner group (see Select cook (3), dinner group (4) and meal to cook (5)).

Food outlet-agents serve a neighbourhood size person-agent population by providing food while aiming for profit maximization. They respond to demand by adjusting their inventory levels. Food outlets are defined by their business orientation, potential customers, product selection, initial inventory level and inventory level tables, sales tables, potatoes table (reflecting the alternative choice in case all protein sources are sold out which can happen before homeostasis is reached), diet sub lists table, complaints from customers table, and a no sales count. The business orientation reflects managerial choices and influences the extent to which a food outlet adjusts the quantity on offer of each of the four protein sources when the intervention "The formidable choice architecture" is activated (see Initial model setups and interventions). A value of business orientation between 0 and 1 will result in a reduced quantity; a value between 1 and 2 will increase the availability. Potential customers is dependent on the population density and determines the initial inventory level tables. Product selection reflects the number of protein sources a food outlet offers and can change when users activate the intervention that targets inventory levels. The sales and diet sub lists tables keep track of the daily and forever sales of each food outlet, respectively. In the rare case a food outlet protein inventory is depleted, cooks opt for a non-protein source called "potatoes". These occurrences are stored in the potatoes table. When a cook has to buy a non-protein source, the cook will file a complaint at the food outlet's management for insufficient protein inventory. These occurrences are stored in the customer complaint table and used to update the inventory at the end of each review period, if the initial model setup is "dynamic inventory management" (see Initial model setups and interventions).

*Table 1 State variables of each entity. *When model setup "infinite inventory" is selected, initial inventory levels, inventory levels and sales are not updated; when "static inventory management" is selected, initial inventory levels are not updated; when "dynamic inventory management" is selected, initial inventory levels, inventory levels and sales are updated every time step.*

Variables	**Description**	**Possible values**	**Initial values**	**Change**
Person				
At home?	Indicates if the person is at home	Boolean	True	Dynamic
Basket-full?	Indicates if the person has found groceries to buy	Boolean	False	Dynamic
Bought?	Indicates if the person has purchased groceries	Boolean	False	Dynamic
Cooking skills	Indicates the cooking skills	0-1	0-1	Static
Diet	Highest preference for one of the protein sources	[Meat Fish Vegetarian Vegan]	One of [Meat Fish Vegetarian Vegan]	Dynamic
Household ID	Identification of the household where the person belongs to	1-n	1-n	Static
Is cook?	Indicates if the person is the cook of today	Boolean	False	Dynamic
Last meals' enjoyment	Indicates if the person enjoyed the meal or not	[Positive Negative]	None	Dynamic
Last meals' quality	Indicates the quality of the meal the person has consumed	0-1	None	Dynamic
Meal enjoyment table	Table in which the person "remembers" his appreciation of each of the protein sources	For each, [Meat Fish Vegetarian Vegan], 0-1	For each, [Meat Fish Vegetarian Vegan], 0-1	Dynamic
Meal to cook	The meal that will be prepared	[Meat Fish	None	Dynamic

		Vegetarian Vegan]		
My cook	The person who prepared the meal	Any person	Nobody	Dynamic
My cook's cooking skills	Cooking skills of the person that prepared the meal	0-1	0	Dynamic
My dinner guests	List of persons for which a person will cook	Length of list can vary from 1 – n, including the cook	Nobody	Dynamic
My last dinner	The type of protein source the person has consumed during their last dinner	[Meat Fish Vegetarian Vegan]	None	Dynamic
My supermarket	The food outlet the person will initially visit	First three on the list of sorted food outlets	None	Dynamic
Neophobia	Level of aversion to new foods Proxy for inviting friends	0-1	0-1	Static
Network diet diversity	Number of different diets amongst the persons' household members and friends	1-4	0	Dynamic
Number of supermarket changes	Indicates how often a person can change food outlet	0 - 3	3	Dynamic
Sorted food outlets	List of food outlets sorted on distance from person's house	Length of list is equal to initial number of food outlets	List of food outlets sorted on distance from person's house	Dynamic
Status	Social position accorded by others, dependent on perceptions of respect and prominence.	0-1	0-1	Dynamic
Household				
ID	Number to identify the household	1-n	1-n	Static
Is house empty?	Indicates if any of the household members are at home	Boolean	False	Dynamic
Is meal cooked?	Indicates if a meal has been prepared in the household	Boolean	False	Dynamic
Members	Persons belonging to the household	[Person 1 – person n]	Persons who have hatched at the house's patch.	Static
Food outlet				
Business orientation	Extent to which the food outlet considers sustainability in its assortment	0-2	0-2	Static
Complaints from customers table	Table containing the quantity and type of protein sources that were insufficiently available in the food outlet	For each, [Meat Fish Vegetarian Vegan], 0-n	For each, [Meat Fish Vegetarian Vegan], 0	Dynamic
Diet sub lists table	Table containing the sales lists of each protein source up to the present time step	For each, [Meat Fish Vegetarian Vegan], 0-n	For each, [Meat Fish Vegetarian Vegan], 0	Dynamic
Initial stock table	Table containing the initial inventory level of products per protein source in the food outlet at the start of each time step	For each, [Meat Fish Vegetarian Vegan], 0-n	For each selected protein source, 0-n	Static or Dynamic*

No sales count	Keeps track of how often a food outlet does not sell anything up to six months i.e. 180 time steps. After six months of not selling anything the parameter is reset and the no sales count is stored in a global parameter.	0-180	0	Dynamic
Potatoes table	Table containing the number of potatoes that have been sold during the present time step because protein sources were not available.	0-n	0	Dynamic
Potential customers	Number of customers the food outlet expects to serve	0-n	0-n	Static
Product selection	Selection of protein sources in the food outlet's assortment	Length of list can vary from 1-4 items, [Meat Fish Vegetarian Vegan]	Length of list can vary from 1-4 items, [Meat Fish Vegetarian Vegan]	Static
Sales table	Table containing the number of products per protein source that have been sold during the present time step	For each, [Meat Fish Vegetarian Vegan], 0-n	For each selected protein source, 0-n	Static or Dynamic*
Stock table	Table containing the remaining inventory per protein source in the food outlet during the present time step	For each, [Meat Fish Vegetarian Vegan], 0-n	For each selected protein source, 0-n	Static or Dynamic*

Process overview and scheduling

At initialization, a setup procedure is executed. The model space is cleared and the stop conditions are deactivated. All the general variables are set to their initial values. Households are located randomly and each create a family consisting of persons. Each person connects themselves to other persons to create a social network. Food outlets locate themselves at any model space that is unoccupied and decide their product range and inventory level. Finally, persons locate the food outlets. If enabled, a new random seed is created for enabling reproducibility. The number of households in a neighbourhood, household size and food outlet density are informed by data from Statistics Netherlands, as well as the initial distribution of dietary identities of meat-eaters, pescatarians, vegetarians, and vegans. Food outlet product range is informed by data from *Eiweet*, an initiative by two Dutch NGOs to monitor the market share of protein sources. In this model, protein sources are aggregated in four product groups: meat, fish, dairy & eggs, and plant-based. More details about initialization can be found in Initialization. Portions of meat and fish, or their veg*n[1] replacements, are largest in size during dinner time (RIVM 2022). As the authors aimed to concentrate on the major contributors of consumption, the model solely simulates the evening meal. The model runs for ten consecutive years, where each time step represents one day, and thus one evening meal. After initialization, at each time step the model simulates the processes illustrated in Figure 2. Details about these processes can be found in Submodels.

During process (1), the model checks the stop condition, which is activated when 10 years have passed (i.e. 3650 time steps) or when the model is halted because of an error. During process (2), the simulation reinitializes the persons, households, food outlets. Exceptions that are not reset are: the dietary preference of persons and the initial inventory levels of food outlets. Several dynamic general variables are reset as well, including the tables storing total inventory levels and sales, and the tables storing total changes in meals cooked, dietary preferences, inventory levels, and sales.

During process (3), each household randomly selects one of their members at home to become the cook of that day. Next, the cook will compose a group of dinner guests (4). He will invite family members that are still available, since it is possible that some have already been claimed by other cooks. Friends can be invited as well, but not every day. It is important to note that dinner guests are not always physically present after being invited, as dinner time in the Netherlands is typically well-organized. It is usually agreed in advance who will attend, and spontaneously joining a meal or inviting an additional guest is uncommon. Once the dinner guests have been established, the cook will choose a meal to cook based on the preferences of the guests and themselves (5).

After determining what to have for dinner, each cook will obtain groceries (6-8). First, the cook will select a supermarket, if they have not already done so (6), proceed to buying their preferred ingredient. If the supermarket has their ingredient in stock, the cook will collect the desired number of items (7a) and check-out at the counter (8). If the desired ingredient is not available or not sufficiently in stock, the cook will file a complaint at the supermarket's management. They might buy another item from the supermarket they are currently at (7b), or opt for another supermarket (6). This choice is simulated based on the person's level of neophobia: the higher their level of neophobia i.e. the pickier they are, the more likely they are to switch supermarket. After changing supermarket three times and still not purchasing their desired item, the cook will choose to buy alternative groceries (7b), reflecting a maximum time and effort someone is willing to spend on doing groceries.

After returning home from the supermarket, each cook will prepare the dinner (9). The prepared meal is provided with a quality indicator, based on the cook's cooking skills and a hard-coded meal quality variance, as everyone can have a good or bad day. Implicitly, all dinner guests are now physically present in the household to share the meal. Each guest, including the cook, will assess if they enjoyed the meal they just had (10). Irrespective of whether they liked the meal or not, each person will evaluate how much they enjoyed the type of meal they have just consumed. If they liked the meal, they will increase their enjoyment value for this protein source; if not, they will decrease it. Next, each person will check which of the protein sources they prefer most, and set this protein as their dietary preference.

Once each individual person has re-evaluated their dietary preference, the dinner group will evaluate the meal together and in doing so, confer or withdraw social status (12, 13). The cook and his guests confer status based on the guests' liking of the meal and the cook's appreciation of the feedback he receives

[1] From here onwards veg*n refers to both vegetarian and vegan.

about his cooking. After updating dietary preference and status conferrals have taken place, each person's status is normalized (14) and the person visuals in the model interface are updated (15).

Food outlets check their sales (16) and replenish (17), if activated in the simulation. Replenishing occurs following a user-specified review period, depending on the settings activated. Next, the food outlets provide their sales and inventory levels for the general variables collecting the total sales and inventory levels (18). As the Netherlands is an affluent country where food is plentiful, it is assumed that food outlets cannot (regularly) end up with empty shelves. Failed yields and logistical problems are omitted from the model.

The final processes of the simulation consists of preparing the general variables that provide input for the plots in the model interface (19) and updating the plots (20). See also Figure 4.

Figure 1 Conceptual model of the reciprocal response between food outlets and households and the reciprocity between social structure and individual agency. Households purchase what is available at the food outlet; food outlets include in their assortment products that have previously been sold. Individuals show food behaviour that is determined by social processes; the social structure is made up by the individual's agency. The reciprocity between food outlet supply and household demand reflects the food consumption practice at time t.

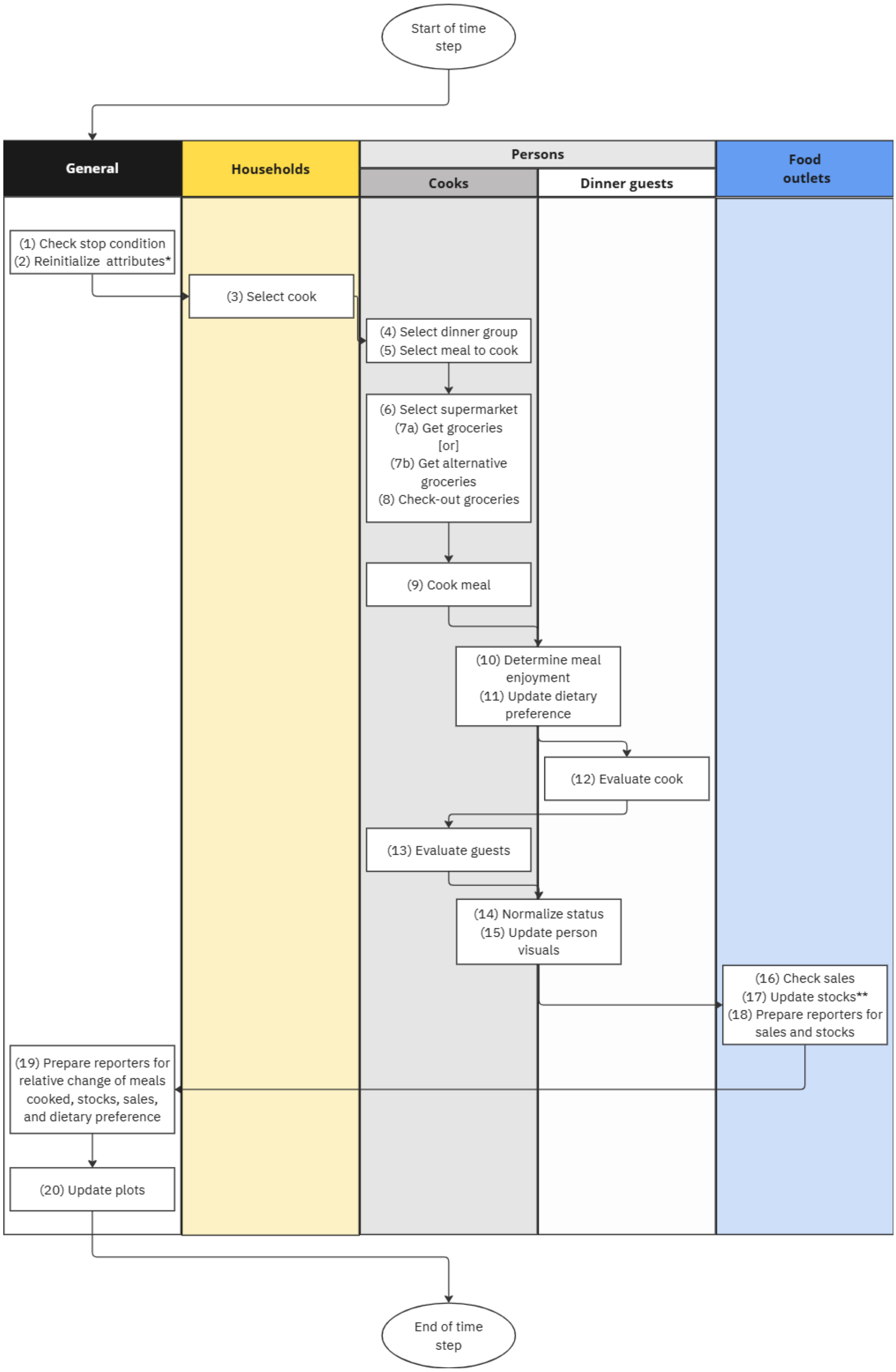


*Figure 2 Flowchart combining the decision-making for households, persons and food outlets per time step. *Except for dietary preference of persons and initial inventory levels of food outlets. **When "infinite inventory" is selected, inventory levels are not updated; when "static inventory management" is selected, inventory levels are reset to initial inventory levels; when "dynamic inventory management" is selected, inventory levels are updated based on sales. See* Submodels *for more details*.

Design concepts

This design concepts section follows the terminology and order of concepts as described in Supplementary file S1: ODD Guidance and Checklists by Grimm et al. (2020). The concepts "Adaptation" and "Prediction" are not applicable to this model.

Basic principles

MEET-eaters is designed as a virtual lab that allows for exploring the individual and combined effects of physical and social elements of the food environment to model outcomes. Model outcomes include meals cooked, dietary preferences, sales and food outlet inventory levels, and sales. MEET-eaters allows for exploring the respective contribution of food outlet product range and household decision-making, the effect of different meal time negotiation processes, and the effect of interventions targeting either dietary preferences or supply on model outcomes.

The MEET-eaters model is based on the dynamics of the evening meal as a social practice, where the current high levels of animal-based consumption, food outlet assortment, and household decision-making are considered the evolving elements of a social practice (Shove et al. 2012). Two system archetypes identified by Blokhuis et al. (2025), "Supply and demand" and "Success to the successful", are used as the structure on which the elements of the evening meal as a social practice are mounted. From the various aspects that are known to play a role in the food environment, two concepts are modelled here: meal practices of household members and their social interaction, and profit maximization of food outlets. Meal practices are assumed to result from the cultural and normative context of the households (here, in The Netherlands), interpersonal dynamics based on status that determine meal choice and evaluation, and consumer response to availability of food products. The strategy implemented for profit maximization involves food outlets aligning their inventory level and product range with household demand. Details about the applied concepts and theories can be found in the main article.

One particular design concept for MEET-eaters is the meal time situations that the model should be able to simulate. The meal time situations were defined based on two principles: 1) a status difference between the cook and guest(s) and 2) different dietary preferences in the dinner group. The first principle assumes that individual eating behaviour is shaped by social configuration, which is incorporated in MEET-eaters through the implementation of status-power theory (Kemper 2006). The second principle assumes that consumers can be classified by their dietary preference or identity. By implementing a meal enjoyment table (Table 1), the model accounts for variations in the strength of these preferences, reflecting that some individuals are more flexible than others. Based on meal-time scenarios derived from these principles, four key situations were selected to guide model development and validation (Figure 3).

In "The Odd One Out", from the people that have gathered to have dinner, the majority share the same dietary preference, while a minority has an alternative preference. For example, one vegetarian amongst meat-lovers, or one pescatarian amongst vegans. In this situation, the odd one out can be both the cook or one of the dinner guests.

In "Mix 'n Match", a diverse group of people is served a particular dish. For example, a group of friends with various dietary preferences gathers for a celebration dinner. In both cases, the majority decides. In case the select a meal to cook procedure (Figure 2) produces a tie, one of the preferred meal is selected.

In "The Admirers' Complex", one or more people are served a meal that contrasts with their preference, but they cannot refuse or be judgemental about the meal as they regard the cook very highly. For example, a vegetarian is served a meaty dish prepared by his beloved grandmother.

Alternatively, in "The Altruistic Cook", the cook is willing to set aside his preference for the sake of his guest(s). For example, when your love interest comes over for dinner and they like steak, while you are a vegan. In both cases, the dinner guest with the highest status determines the meal to be cooked.

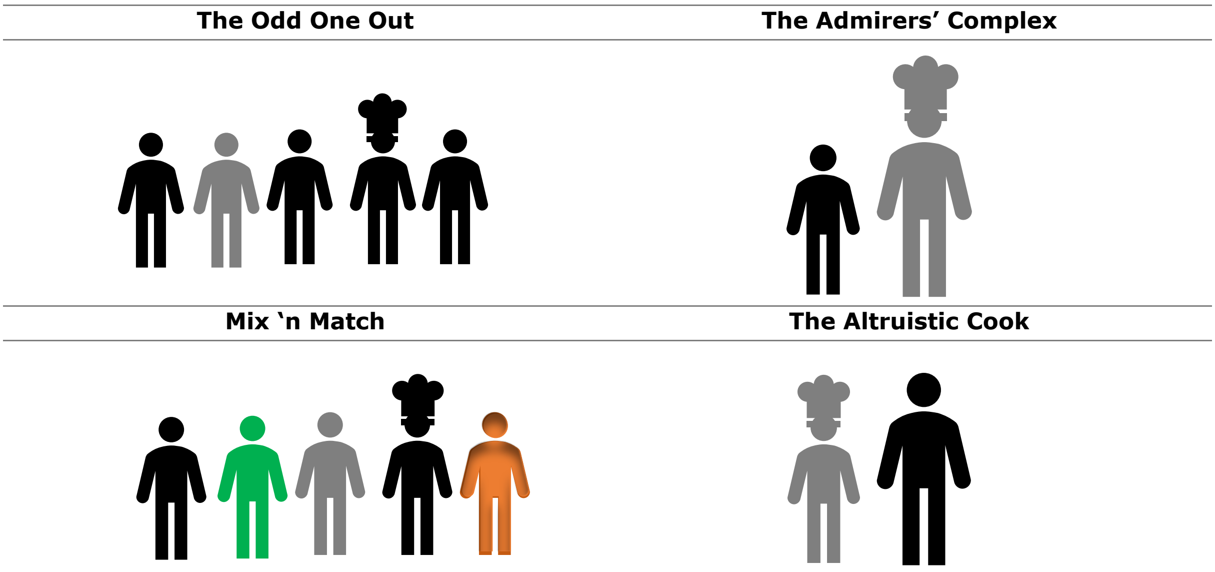


Figure 3 Meal time situations for model validation and guidance to development of the model.

Emergence

Key model results for the MEET-eaters model are the consumption practice as reflected in the type of meals cooked, the dietary preference, and product inventory levels in food outlets at the end of each year (= 365 time steps). Status distribution of the population is also emergent. Imposed patterns in the model include the inventory management behaviour of food outlets and the interventions (see Initial model setups and interventions).

Types of meals cooked represents the actual consumption of either of the four meals cooks can choose to prepare. This is an emergent property of the model as it changes depending on the agent characteristics dietary preferences of dinner guests ("majority-selects", see Submodels), the status division between dinner guests ("status-based", see Submodels), and neophobia of the cook, which determines their choice for an alternative product or supermarket. The dinner group forms an emergent collective that is dependent on the household size, each agent's social network, and the tendency of the cook-agent to invite guests for dinner. Food products on offer in food outlets is the sole environmental characteristic that influences the type of meals cooked. Here the purchasing behaviour of one cook-agent also influences the potential purchasing behaviour of each other cook-agent.

The dietary preference of person-agents can also be considered emergent. At initialization, dietary preferences for each of the four dietary protein sources are assigned as values between 0 and 1 (see Table 1). During the model run, these values will vary based on the outcome of several processes (Figure 2): selection of the meal type (5), getting the meal's ingredients (7,8), determination of meal enjoyment (10), and eventually a potential update of the dietary preferences (11).

Inventory levels are another emergent property of the model. The availability of each protein source is influenced by the replenishment, as well as the purchasing behaviour of cook-agents.

Status distribution in the population emerges as a result of status conferrals that occur after dinner. Status conferral is dependent on the status difference between the cook and each of their guests, the meal enjoyment of the guests, and the cook's appreciation of each of his guests. The status emerges from a process that is collective and usually largely unconscious; in the model we simplified this process by assuming that status is collectively agreed upon (instead of the possibility that each person can regard each other person in a unique way) and only changes during dinner time.

The inventory management behaviour of food outlets is partially imposed by model parameters. The type and amount of product each food outlet replenishes is dependent on actual purchases (=sales) by cook-agents. The review period is user-specified and occurs only at specific intervals. Safety margins are implemented in constants.

The interventions included in MEET-eaters influence the type of meals cooked by targeting either the food outlet's inventory levels or the person-agents dietary preferences. When one or both interventions are activated, the adjustments are implemented at time step 730 (= two years after initialization). The products or dietary preferences to be adjusted, along with the extent of modification, are entirely user-specified.

The inventory management behaviour has been partially imposed, as simulating the exact mechanisms that food outlets apply to respond to sales was determined unnecessary for this model's purpose. Since the model does not intend to explore the motivations behind food outlets offering a more sustainable product range (apart from profit incentives), the intervention of modifying food outlet inventory levels is implemented as an imposed pattern. Likewise, the model explores the effect of a certain number of individuals from a particular social status altering their dietary preference; any reasons as to why this group would suddenly change their diet are considered outside the scope of this study.

Objectives

Persons aim to consume the protein sources they prefer while at the same time each person aims to give appropriate status to those in their dinner party. Cooks aim to select and prepare meals that are preferred by their dinner group and visit their go-to supermarket for time-saving purposes. Food outlets implicitly aim to maximize profit by responding to demand.

Learning

Persons in the MEET-eaters model execute two adaptive behaviours that include learning: setting their supermarket and changing their dietary preference. Food outlet execute one type of learning: inventory management.

Initially, individuals acting as the cook during a given time step will choose the nearest food outlet as their supermarket. If the desired protein source is unavailable, the cook can visit up to three other supermarkets before deciding to purchase an alternative protein source. Once cooks successfully purchased the desired item at a particular supermarket, that food outlet becomes theirpreferred choice until it fails to meet their needs. This implicit learning process is modelled as the cooks' journey to find food outlets that consistently satisfy their demand.

During meal evaluation, persons can potentially change their dietary preference based on previous experiences with consumption of the various protein sources. Each time step, persons evaluate the meal they just had based on the quality of the meal and their level of neophobia. Next, they update their personal enjoyment of each protein source. The learning process is modelled to reflect appreciation or disliking of different types of foods over time.

Under "dynamic inventory management", food outlets follow a periodic review policy, using average sales from the previous review period to determine order quantities. Issues related to perishable foods and food waste fall outside the model's scope, and lead time is not considered. In Dutch supermarkets, sales data from specific days (e.g., Mondays) are averaged to estimate demand, which then informs order quantities. Since the model does not differentiate between specific days or parts of the week (e.g., weekends), it assumes that consecutive time steps can be averaged to determine inventory replenishment needs at the end of each review period. In addition to actual sales, complaints filed by customers are incorporated the daily demand of each respective protein source. A safety stock of ten percent is added to the order quantity.

Sensing

Persons are assumed to sense the exact location of food outlets in the entire model space. Persons compile a sorted list based on the distance of each food outlet to the location of their house. The rationale is that people favour to buy their groceries in a way that saves time, for instance by visiting the most nearby supermarket, or by revisiting the one that certainly sells their preferred protein source(s).

Cooks are assumed to know the dietary preference of their dinner guests. The rationale is that people in the Netherlands communicate their dietary restrictions and/or preferences to their family and friends.

Person-agents can perceive and influence each other's status during dinner. It is assumed that status of each person is a collective agreement, meaning that all persons assign the same status to agent i_1, agent i_2, etc. In this model, cooking skills and gratitude for meals also affect status. Guests can praise or criticize the cook, shaping social dynamics. In Dutch culture, it is accepted to express criticism towards the cook or guests.

Food outlets know exactly how many person-agents live in their service area. The service area is user-specified. During initialization, the number of potential customers determines the number of product items a food outlet initially has in stock. The rationale is that when opening a new food outlet, the management of the store is aware of the population size and type of neighbourhoods it will serve.

If "dynamic inventory management" is activated, food outlets know exactly how much they sell of each protein source and use the sales to optimize their stocks. Each time step, cooks add their purchase to the sales table of the food outlet where they got their groceries. Food outlet-agents in the model keep track of their sales, initial inventory levels, and current inventory levels during each time step using tables. The rationale is inventory management: each food outlet keeps records of products that enter and exit the store. We assume that each store has optimally integrated its point-of-sales system with its inventory management software, meaning that the number of items per protein source on the shelves matches exactly with the inventory levels recorded in the inventory management system.

Interaction

Agent interactions in the present model occur at two interfaces: person-person and person-food outlet. Person-agents interact with other person-agents when selecting and evaluating the evening meal. Cook-agents interact with food outlet-agents when obtaining groceries. Cook-agents indirectly interact with each other by competing for the available products. Three types of interaction occur in this model: inviting, purchasing groceries, and meal sharing. Persons can share meals with persons they are linked to via family or friendship links. It is also possible that person A is invited to have dinner at the house of person B, a friend of person A, and person B invites person C, who is a friend of person B but not of person A. In selecting a meal, cooks obtain dietary preference or status of their dinner guests, which is directly shared. In evaluating a meal, guests communicate their appreciation implicitly, leading to increase or reduction of the cook's status; cooks do the same to their guests. The rationale is that people in the Netherlands generally share dietary restrictions or preferences with family and friends. Person-agents interact after dinner, as they can perceive and influence each other's status. At the food outlets, cooks compete for protein sources through mediated interaction. Cooks can visit any food outlet, which is a form of global interaction, whereas food outlets prepare to serve customers in their service area, a form of local interaction.

Stochasticity

Stochasticity is used in three ways.

First, the model is initialized stochastically in such a way that a) the location of each house and food outlet, b) the size of each household, c) the number of friendships and who to be friends with, d) status and neophobia of persons, e) business orientation and product selection of food outlets, and f) the dietary preferences of persons, are all stochastic. After initialization, the model represents a neighbourhood with a diversity of persons and density of food outlets that could represent the Dutch context.

Second, in deciding which meal to prepare, cooks either choose the preference of the dinner guest with the highest status ("status-based"), or the preference of the majority ("majority-selects"), reflecting meal negotiation in the Dutch context. This decision-making process is stochastic to avoid simulating all details of information gathering and discussion that could affect what is prepared for dinner.

Third, the model incorporates stochasticity in the decision-making at the supermarket. Instead of simulating a detailed search through aisles, comparing products, and trying an alternative supermarket, the model contains two simplifications. One, the cooks can only choose from four product groups: meat, fish, vegetarian, vegan. Second, in case the preferred ingredient is not sufficiently available, a cook's neophobia level adds randomness to the model in determining whether the cook will try a different food outlet or opt for an alternative product. We should note here that before the model reaches homeostasis, it is possible that cook-agents are forced to buy "potatoes", the alternative option in case all protein sources are sold out at the food outlets they visited. Although it is technically possible, we did not observe food outlets running out of "protein stock" while the model was in homeostasis.

Collectives

This model contains three types of emergent collectives: family members network, a friendship network, and dinner guests. These collectives are included in the model to represent social networks. A social network is relevant to this model as eating habits of an individual are influenced by their peers. The family network is included in the model to represent family members living in the same household. The friendship network is unique for each person and is included to reflect a wider social network of extended family, friends, neighbours, colleagues, and acquaintances. The collective "dinner guests" is included to represent a temporary assembly of persons that enjoy a meal together. Which persons are included in the dinner guest assembly is dependent on the family and friendship network of the cook. During dinner, the guests and cook can influence each other's dietary preference and status. As status conferrals take place during dinner, the collective "dinner guests" can be regarded a reference group: "which is a way of characterizing those parties in our social relations whose opinion matters when we must choose a course of action" (Kemper 2016: 2).

Observation

The model interface shows the households, family members and food outlets in a neighbourhood of Dutch proportions. Colours and labels of persons inform about dietary preference and number of friends, the label of food outlets inform about number of customers served and type of proteins provided. Several plots provide the user with information about the supply and demand dynamics: cumulative count and relative change of inventory levels, sales, meals cooked and dietary preferences, a check for empty shelves, distribution of number of protein sources offered by food outlets, and a plot of population vs total inventory levels. Plots of distributions of diet variety and status in the population provide the user with information about some social aspects. See Table 2 and Figure 4 for more details. The observations of meals cooked, dietary preferences at the population level, sales and inventory levels are the key model outcomes; diet variety in networks and households are considered secondary model outputs.

Table 2 Observations and how these are included in the model.

Observation	**Included in model as:**
Dietary preference per person per time step	Colour of person-agent
Dietary preferences of population per time step	Graph of each dietary preference
Meals cooked per protein source per time step	Graph of each meal cooked
Total inventory levels in all food outlets per time step	Graph of all inventory levels
Total sales of all food outlets per time step	Graph of all sales
Relative change in dietary preference at the population level per time step	Graph of numerical change in each dietary preference
Relative change in type of meals cooked at the population level per time step	Graph of numerical change in each type of meal cooked
Relative change in type of inventory levels per time step	Graph of numerical change in each type of protein source offered at food outlets
Relative change in sales per protein source per time step	Graph of numerical change in sales of each type of protein source
Empty shelves in all food outlet per time step	Graph displaying number of time steps all food outlet ran out of one of the four protein sources
Number of protein sources sold in food outlets per time step	Histogram with distribution of number of protein sources
Number of protein sources sold in a food outlet relative to other food outlets	Size of food outlet-agent
Inventory level sufficiency relative to population size per time step	Graph comparing inventory level and population
Diet variety in the population per time step	Histogram of diet variety
Status per person per time step	Size of person-agent in interface
Variety in status in population per time step	Histogram of status distribution
Type of protein sources sold in food outlet per time step	Label on food outlet-agent
Number of customers served by a food outlet (fixed)	Label on food outlet-agent
Number of friends per person (fixed)	Label on person-agent

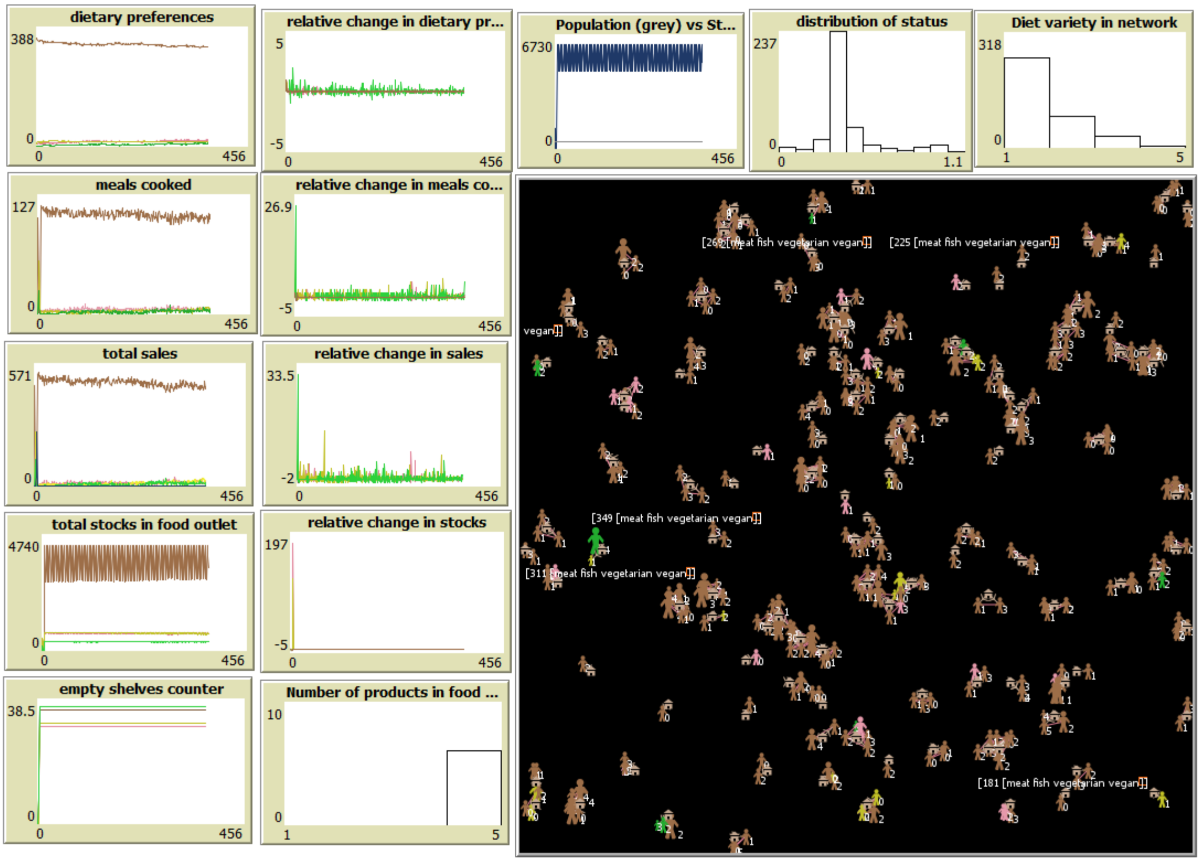


Figure 4 Observations in model interface (2025-02-20).

Initialization

At the model initialization, in this order, households, persons, a social network and food outlets are created (Figure 5). The user can specify: the exact number of houses, food outlets and friends each person has. This way, users can specify a desired density of population, supermarkets and network. Number of households in a Dutch neighbourhood amounts to a median of 315 and an average of 575. The 10th and 90th percentiles amount to 15 and 1425, respectively (Statistics Netherlands 2024b), and are set as the minimum and maximum number of households in the model as the distribution is extremely right-skewed. Dutch citizens have to travel 0.9 km on average to the nearest large supermarket and the number of large supermarkets within a 1, 3 and 5 km radius amounts to around 2, 11, and 23 respectively (Statistics Netherlands 2022). Size of neighbourhoods amounts to a median of 54 hectares and an average of 241, with the 10th and 90th percentiles amounting to 14 and 687 hectares, respectively (Statistics Netherlands 2024b). Considering a neighbourhood area is typically between 0.14 and 6.7 km^2, number of food outlets is set to vary between 1 and 11.

Location of houses is randomized but excludes any location that is already occupied by another house. Persons are placed inside a household i.e. at the location of the house that "created" them. Food outlets locate themselves at any location that is still empty.

Household size reflects the Dutch average of 2.1 in 2024 (Statistics Netherlands 2024c) and is assigned using a random Poisson distribution. Persons are initialized with enjoyment values for their dietary preferences, i.e. meat, fish, vegetarian and vegan. The dietary preference with the highest enjoyment value is set as their diet and is initially distributed as reported by (Statistics Netherlands 2024a). By implementing enjoyment values for these four diets, all persons in the model are omnivorous. Some people might, however, have a stronger preference for one type of protein source than others. Evidence suggests that consumers with different dietary preferences are likely to consider different types of meat alternatives. For example, cultured meat is particularly unattractive to people with a high level of neophobia (Bryant and Barnett 2020) and seaweed and pulses are most likely embraced by vegans (Onwezen et al. 2021). For matters of simplicity, neophobia levels and enjoyment values are however set randomly. Throughout human evolutionary history, a link between meat consumption and status has arisen, likely due to the association of meat with strength and health. This, in turn, provided social benefits, as those who were able to eat meat, were conferred more status by those who could not (Chan and Zlatevska 2019). In this model, consumption of meat is not linked to social status and status conferrals. A study by Groufh-Jacobsen et al. (2023) investigated the difference in food preparation skills between omnivores, flexitarians, pescatarians, vegetarians and vegans and reported no significant differences between the dietary groups. Therefore, cooking skills are attributed randomly as well.

After being located into a house, the households add each person at their location as a family member. From initialization onwards, households start keeping track of their members being at home and whether or not a meal is cooked. All persons in a household form a family network. Each person considers his family members as his initial group to have dinner with. Each person will choose randomly a user-specified number of persons to be friends with, who he will consider his dinner friends. In the Netherlands, people usually have 5 close friends and another 10 friends in an 'outer circle' (DirectResearch 2021). To enable simulations experimenting with the effect of the social network density, the minimum and maximum number of friends are set to 0 and 15, respectively.

Food outlets initialize their inventory level based on the reported market share of animal- and plant-based foods by individual supermarkets, of which plant protein volume varied between 35% and 53% in 2023 (Green Protein Alliance and ProVeg Nederland 2024). A critical remark here is that only 5% of the market share originates from plant-based protein sources such as legumes, nuts, seeds and plant-based dairy- and meat alternatives; 27% are plant-based products that are not considered rich in proteins (e.g., bread, fruit); 14% consists of products that are a mix of animal- and plant-based products; and 55% consists of meat, fish, dairy, eggs and cheese. Food outlets set a business orientation i.e. level of favoring a sustainable product range to reflect variation in managerial decisions of supermarkets. Hence they determine their number of potential customers to set values of initial inventory level including a ten percent safety margin (Figure 5).

For more details on agent attributes, see Table 1.

Initial model setups and interventions

The MEET-eaters model developed to serve as a virtual lab as the combined mutual interaction of food outlet product range and household decision-making is hard, if not impossible, to separate in reality. This model integrates both the physical environment (i.e. food outlets) and the social environment (i.e. household decision-making) in shaping the model's key outcomes, i.e. meal types, dietary preferences, sales, and inventory levels. It allows for analysis of the individual contributions of these contexts to dietary patterns, as well as the impact of their interaction. An explanation of each initial model setup and the corresponding settings is displayed in Table 3**Error! Reference source not found.**. In addition to options for initial model setup of food outlet-household interaction, the model allows for exploration of different meal negotiation processes and their effect on the model's key outcomes. Finally, to provide in particular policymakers with insights into the underlying causes of observed dietary patterns, the model contains two interventions that can be activated to adjust product range of food outlets or dietary preference of people during a model run (Table 4). These interventions allow for exploring the effect of adjusted inventory levels and/or household decision-making on transitioning towards more plant-based diets.

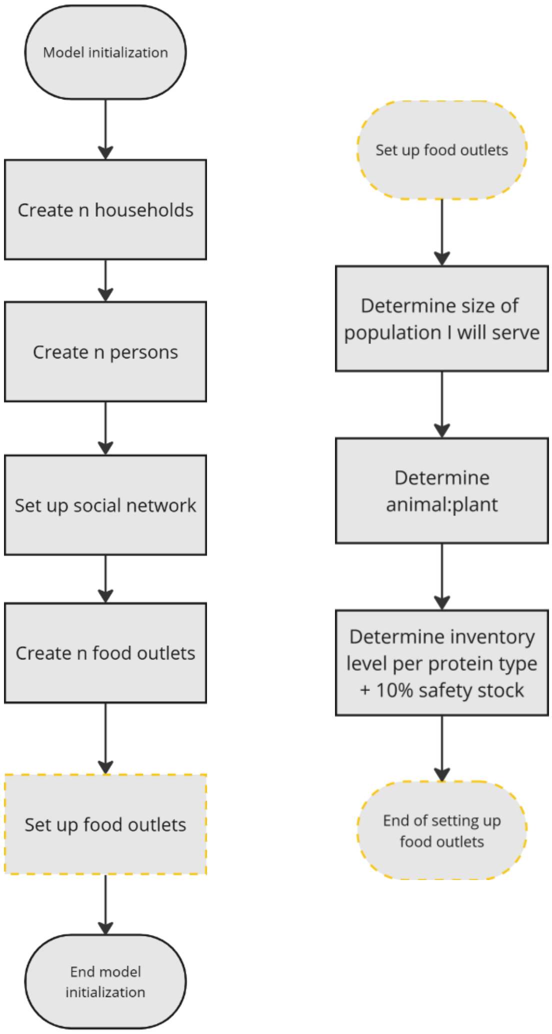


Figure 5 Flowcharts of model initialization (left) and submodel "Set up food outlets" (right).

Table 3 Initial model setups user options.

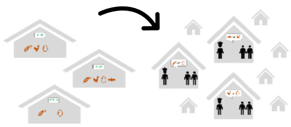
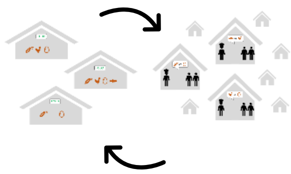
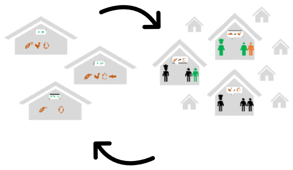
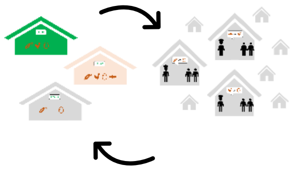
Setup	Rationale	Setting in interface	Values
	With this setup the model allows for exploring the effect of social interaction on meals cooked and dietary preference.	SUPPLY-DEMAND	INFINITE-INVENTORY
	With this setup the model allows for exploring the effect of the interaction between food product availability and household decision-making, while the food outlets are not responsive to sales.	SUPPLY-DEMAND	STATIC-INVENTORY
	With this setup the model allows for exploring the reciprocity of food product availability and household decision-making, while the food outlets are responsive to sales.	SUPPLY-DEMAND	DYNAMIC-INVENTORY

Table 4 Model interventions.

Intervention	Rationale	Setting in interface	Values
Dietary change 	With this target-seeking intervention the model allows for finding out to what extent a dietary change in the population can contribute to the protein transition and how the change depends on the number and type of persons switching diet.	INFLUENCERS?	TRUE
		status-influencers	[>0.75, <0.25, Random]
		diet-influencers	[Meat, Fish, Vegetarian, Vegan]
		p-influencers	[0-1]
		duration	[7 -730]
Inventory change 	In this target-seeking intervention the model allows for finding out to what extent adjustment of food outlet stocks can accelerate to or hamper the protein transition.	CHANGE-PROTEINS	TRUE
		plant-fraction	[1[1]-70]
		duration	[7 -730]

[1]Initial minimum plant fraction is dependent on model initialization but is always smaller than the animal fraction as a result of the initial distribution of dietary preferences, with person-agents preferring a vegan diet, thus plant-based meals, amounting to 0.4% of the population.

Submodels

The first and sixth process of the process overview and scheduling (0) do not contain any submodels. In this section, therefore, the second, third, fourth and fifth processes are explained in more detail. Sequence of each of the process steps can be found in Figure 2.

Select cook (3), dinner group (4) and meal to cook (5)

The cook is randomly selected based on the household members that are at home, since it is possible that some have already been claimed by other cooks. If the cook is alone at home, they will cook for themselves. If no one is home, no meal will be cooked in that household for that day. In reality, members of the same household do not share meal times every day. Data for the Netherlands or Europe were not available; US census data showed that families typically share dinner 3-4 times per week, with one-third sharing dinner 1-2 times per week and 25% eating together weekly seven times or more often (Gardon 2024). Data about sharing meals with friends and family members living elsewhere was not available. In the model, it can happen that no meal is cooked if all members have been invited to another household for dinner, which also implies that the family members do not enjoy their dinner together. The likelihood of inviting friends over for dinner is guided by the cook's level of neophobia.

After the cook has established his dinner guests, they will select a meal to cook. Meal selection occurs following one of the three procedures "random", "status-based" or "majority-based" (Figure 6). In the "random" meal selection, the cook will select randomly one of the options for protein sources: meat, fish, vegetarian, or vegan. When "majority-based" is selected, the cook will select the most preferred meal preference of the dinner guests. In case of a tie, the two options will be stored as a list and the cook will select the first item as the meal to cook. When "status-based" is selected, the cook will select a meal based on the preference of guest with the highest status, including himself.

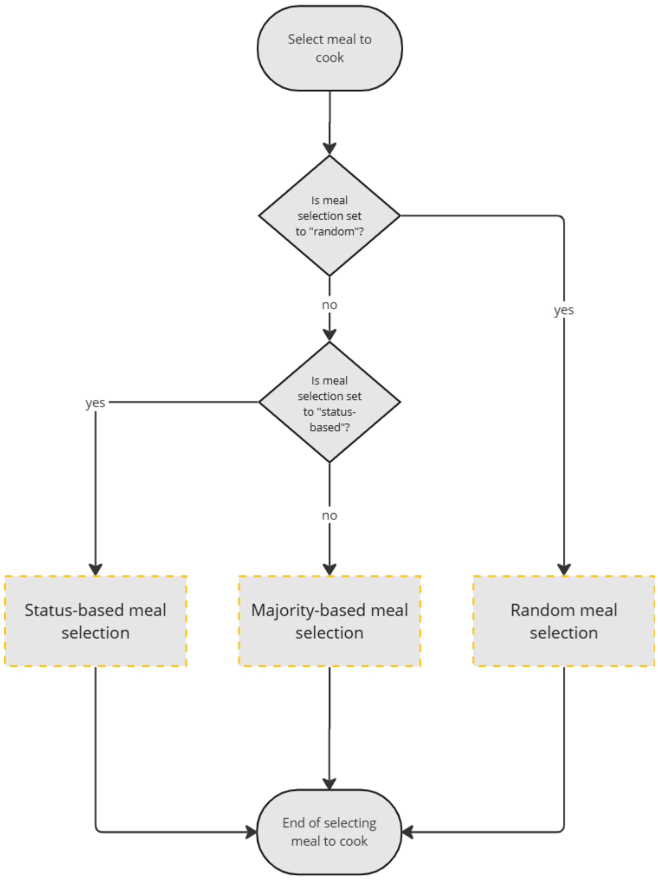


Figure 6 Flowchart of meal selection. This is a procedure for cooks only.

Obtain groceries (6-8)

During the procedure "Obtaining groceries" (Figure 7) each cook will attempt to purchase ingredients for the meal he has selected to cook, if "static inventory management" or "dynamic inventory management" is activated. The model aims to simplify the complex activity of selecting visiting a supermarket to do groceries while still simulating the several decision-making processes that a customer might encounter. These processes include selecting and remaining loyal to a supermarket, searching aisles for the desired ingredient, and settling for an alternative. Cooks can only enter the "Obtaining groceries"-procedure if they have selected a meal to cook. The primary condition in this procedure is that cooks can only return home once they have purchased any ingredient at the food outlet.

During each time step cooks will head out to a food outlet to purchase the protein product for the dinner of that day. In reality, households will stock up on food in their cupboards and fridge. We assume here that buying ingredients for each day separately or buying ingredients for several days ahead does not make a difference in observing the reciprocal relationship between food outlets and households.

In **selecting a supermarket**, the cook will choose the first food outlet from a list containing all the food outlets in his neighbourhood (Figure 9). A cook can only enter this procedure if they have not switched supermarket 3 times before.

In **getting groceries**, the cook will determine if his desired protein source, the meal to cook, is sold at their supermarket and also sufficiently in stock. If either of these conditions are not met, the cook will decide to get alternative groceries or change supermarket, depending on their level of neophobia (Figure 8).

Cooks will decide to **get alternative groceries** when their desired protein source is not available, or when they cannot switch supermarket anymore. During this procedure, the cook will create a shopping list based on the protein sources offered by their supermarket and check whether or not these are sufficiently available. If yes, the cook will decide to prepare one of the available protein sources and proceed to check-out. If not, the cook will decide to buy anything else that is not meat, fish or a vegetarian or vegan protein source. In the model, these products are collectively called "potatoes" (Figure 8).

In **buying potatoes**, the cook will first express his dissatisfaction with their supermarket's availability of protein sources and file a complaint for insufficient stock. Similar to the getting alternative groceries procedure, the cook will reset their meal to cook and proceed to check-out (Figure 9).

During **checking-out groceries**, the purchase of the cook is recorded by the food outlet. In case the cook is buying a protein source, the food outlet's stock is reduced by the number of portions they are buying, which is equal to their number of dinner guests. As it is assumed "potatoes" are infinitely available and are only included in the model to prevent cooks from returning home empty-handed, these purchases are not subtracted from the food outlet's stock (Figure 9).

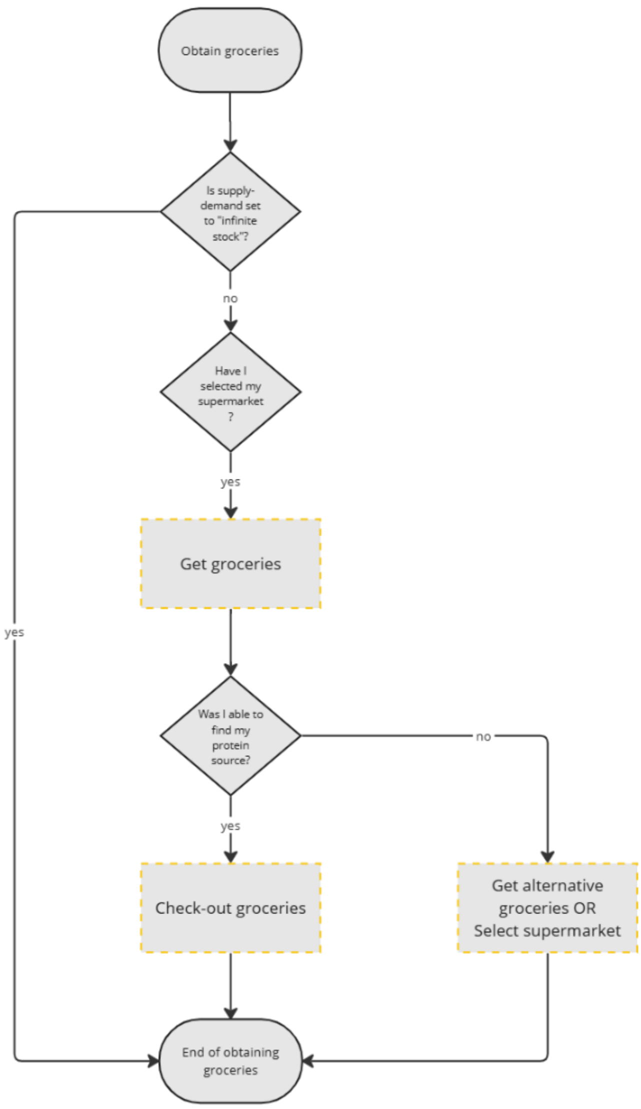


Figure 7 Flowchart of the model "Obtaining groceries". This procedure is for cooks only. Yellow dashed boxes indicate sub-models.

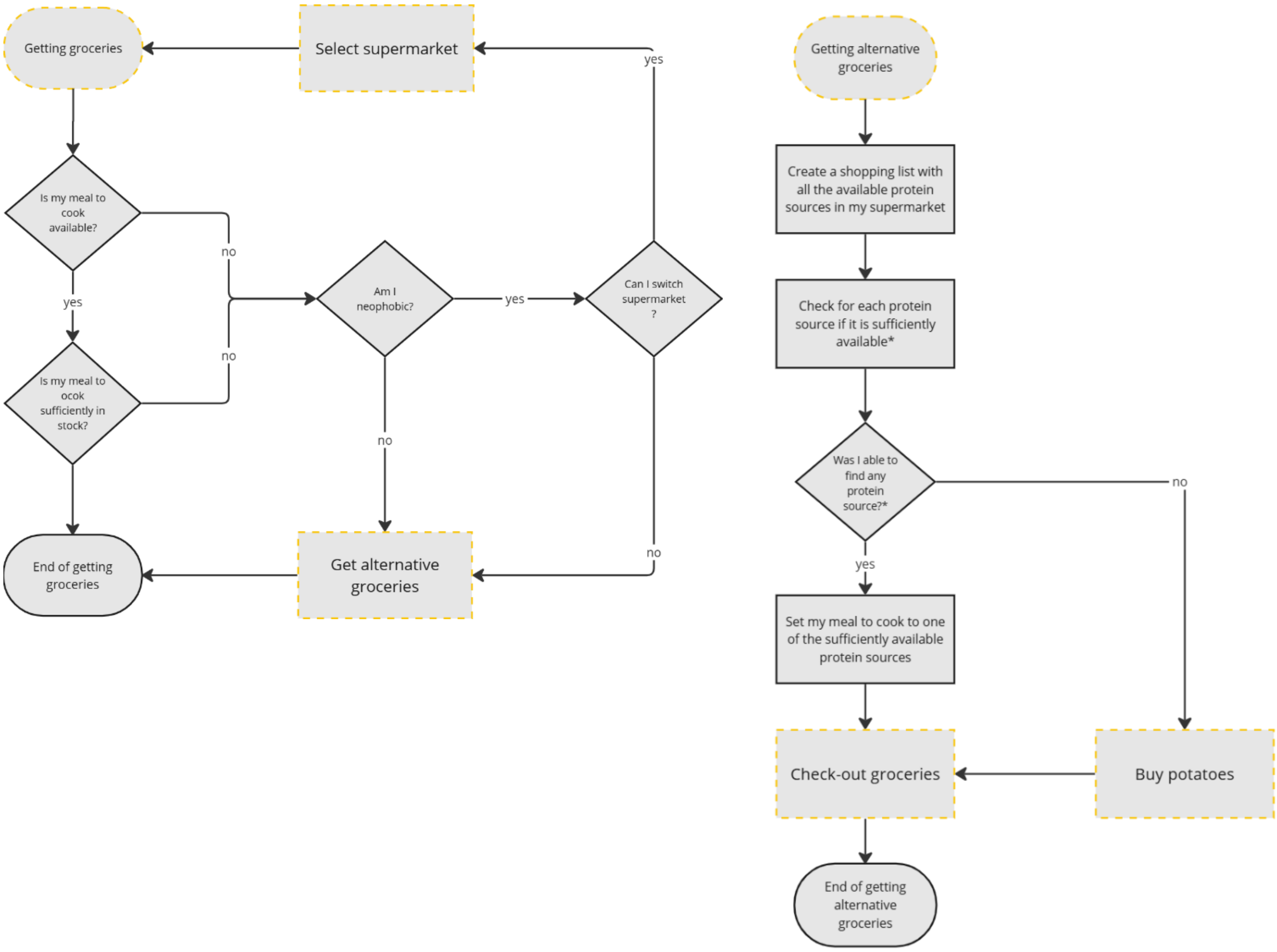


Figure 8 Flowcharts of submodels "Getting groceries" (left) and "Getting alternative groceries" (right). These procedures are for cooks only. Yellow dashed boxes indicate sub-models.

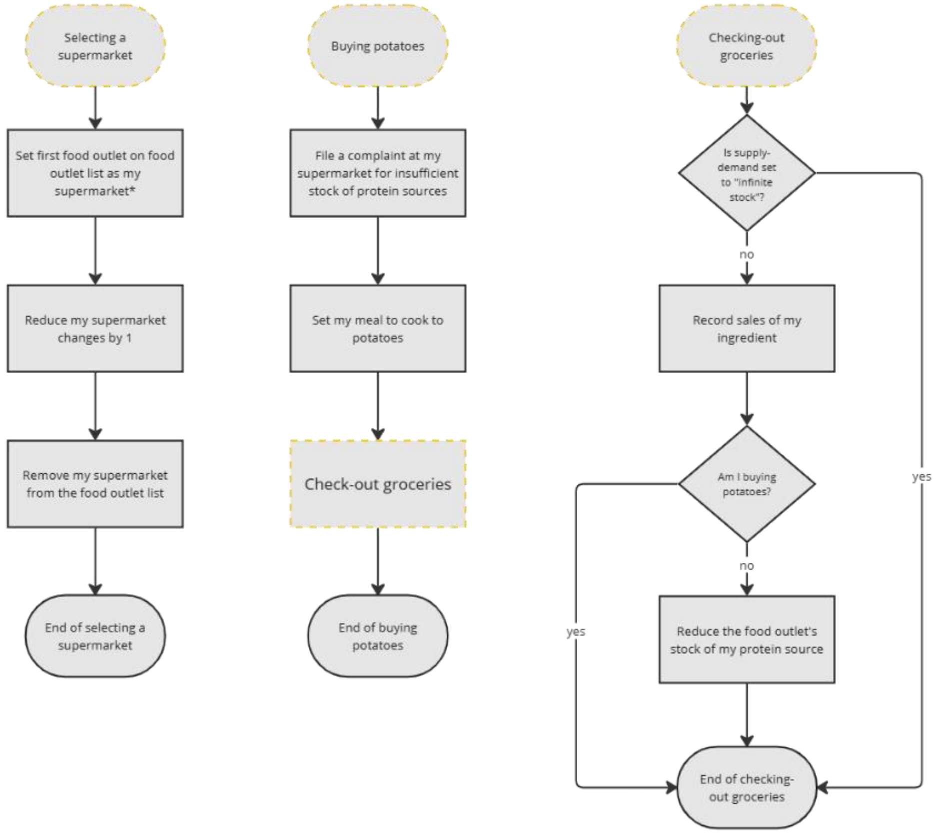


Figure 9 Submodels of "Selecting a supermarket" (left), "Buying potatoes" (middle) and "Checking-out groceries" (right). These procedures are for cooks only. Yellow dashed boxes indicate sub-models.

Cooking and evaluating the meal (9-13)

Each cook implicitly cooks a meal for his dinner guests. Meal quality (Q_m) is determined as a normal distribution ($\mathcal{N}$) based on the cook's cooking skills (μ) and a hard-coded meal quality variance of 0.1 (σ) as displayed in equation (1).

$$Q_m = \mathcal{N}(\mu, \sigma^2) \quad (1)$$

If the meal quality equals 0.55 or more, each person's last meal enjoyment is set to "positive". Otherwise, last meal enjoyment is set to "negative". The value "0.55" was chosen because, in the Dutch education system, 5.5 is considered the minimum grade to pass. Next, each person will update their current meal enjoyment ($E_{m,current}$) to a new meal enjoyment ($E_{m,new}$) based on their last meal's quality (Q_m) and their level of neophobia (ν). If the last meal enjoyment was positive, the term is added to the current meal enjoyment of the protein source served that day; otherwise the term is subtracted. See equation (2).

$$E_{m,new} = E_{m,current} \pm Q_m(\frac{1-\nu}{100}) \quad (2)$$

Once each person has updated their meal enjoyment, they will re-evaluate which meal enjoyment scores highest and set this protein source as their dietary preference (Figure 10).

At the end of each meal, cooks will evaluate guests and guests will evaluate cooks based on status difference (Figure 11). Irrespective of liking the meal, a dinner guest will always compliment their cook if the cook has a higher status. Likewise, whether or not a cook notices that their guests enjoyed the food, they will still confer status to guests with a higher status than themselves.

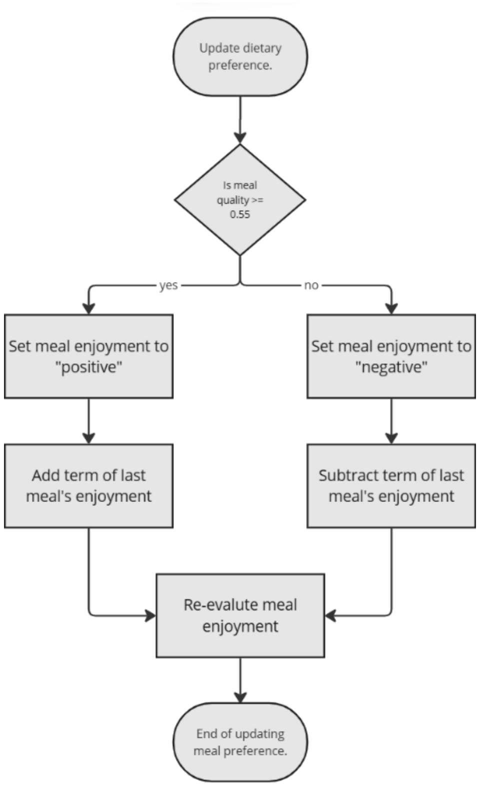


Figure 10 Flowchart of updating dietary preference.

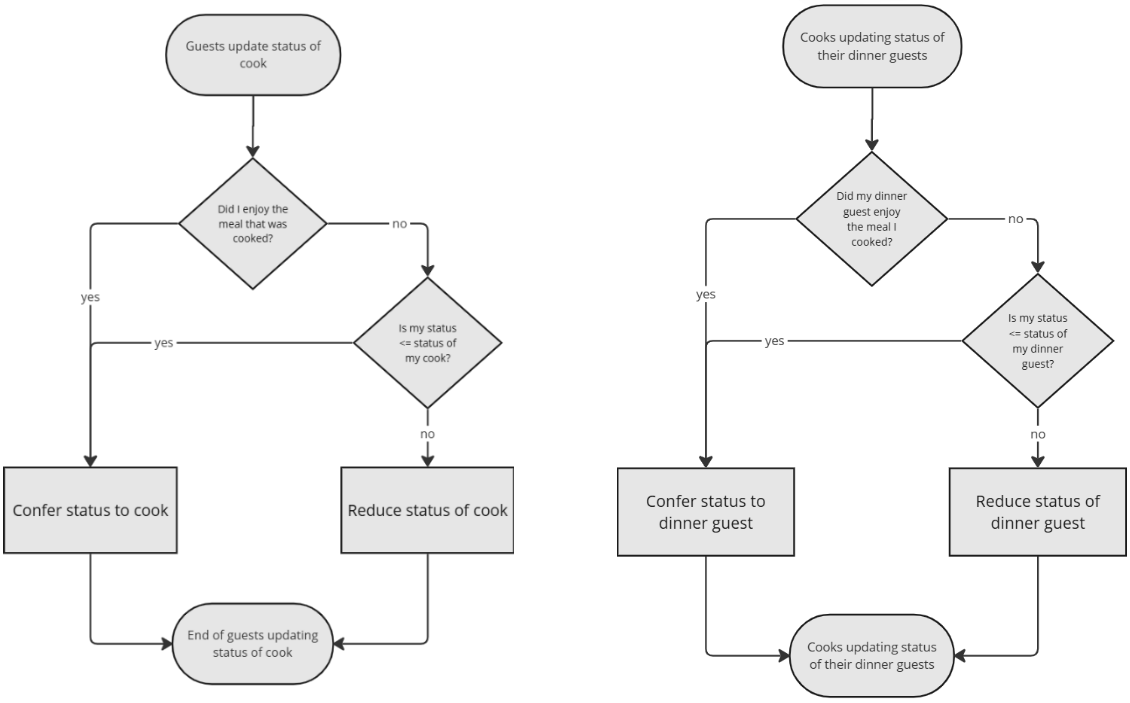


Figure 11 Flowcharts of meal evaluation. This procedure on the left is for guests; the procedure on the right is for cooks.

After the cook and their guests have evaluated each other, the status of all persons is normalized. Amount of status determines how much approval, respect and/or admiration a person receives from other persons. In this model persons want to please other persons they regard as status-worthy; persons try to impress other persons in order to claim status; and persons want to confer status because they want to be liked by those they like (Hofstede 2023). However, status of persons is an abstract value, set between 0 and 1 in this model, and its absolute value has no meaning. When performing test runs, the status distribution in the model's interface would show a binary distribution (i.e. high numbers of persons with either low or high status, and few in the middle) after ~365 time steps. This configuration would remain until the end of the run (3650 time steps). For this reason, it was decided to treat status as a relative value, aimed at enabling comparisons between the status of different person-agents. Status normalization was applied using min-max feature scaling to rescale values within an arbitrary range.

Equation (3) shows how status normalization has been implemented in the model. Every time step, status (s_{old}) of each person is rescaled (s_{new}) between 10^{-16} (a) and 0.99 (b) using the lowest ($\min(s)$) and highest status ($\max(s)$) in the population as a reference.

$$s_{new} = a + \frac{(s_{old} - \min(s))(b-a)}{\max(s) - \min(s)} \quad (3)$$

Checking sales and updating stocks (16,17)

Each food outlet offers four different protein sources, the product groups meat, fish, dairy & eggs and plant-based, in varying quantities. After cooks have obtained their groceries, the food outlets can check their sales (i.e. demand) and replenish their inventory for each of the product groups (Figure 13). Food outlets can in rare cases run out of inventory for one or more proteins during a time step. This is observed to happen between model initialization and stabilization, and when several large dinner groups located near the same food outlet prefer the same protein source. An occasional empty shelve can however be an incentive for the cooks to opt for an alternative product or another supermarket. Each instance when all food outlets ran out of inventory of one of the proteins is recorded in the model's user interface.

Food outlets follow an order-up-to level S policy, whereby the average sales during the last review period r is used to determine the order quantity Q. Issues with perishable foods and food waste are outside the scope of this model. Delays between ordering and delivery are not taken into account for this study; therefore the review period and the replenishment cycle are equal (Figure 12). Users can specify the length of each review period; the default is however set to four days. At each instance when mean demand D_R is calculated the necessary quantity is ordered with the assumption that the replenished inventory will be available the following day.

Therefore, replenishing to the desired quantity Q when supply-demand is set to "dynamic inventory management" is based on a periodic review policy with a lead time L of zero. In Dutch supermarkets, the sales of four specific days (e.g., Mondays) are averaged to calculate mean demand D_R, which then informs order quantity requirements. As the model does not distinguish between specific days or parts of the week (e.g. weekends), it is assumed that consecutive time steps can be averaged to inform requirements of inventory replenishment at the end of the review period. Complaints filed by customers sc_i are incorporated in calculating the daily demand D_i of each respective protein source. A safety stock ss_R of ten percent is added to the inventory level S and remaining inventory I is subtracted.

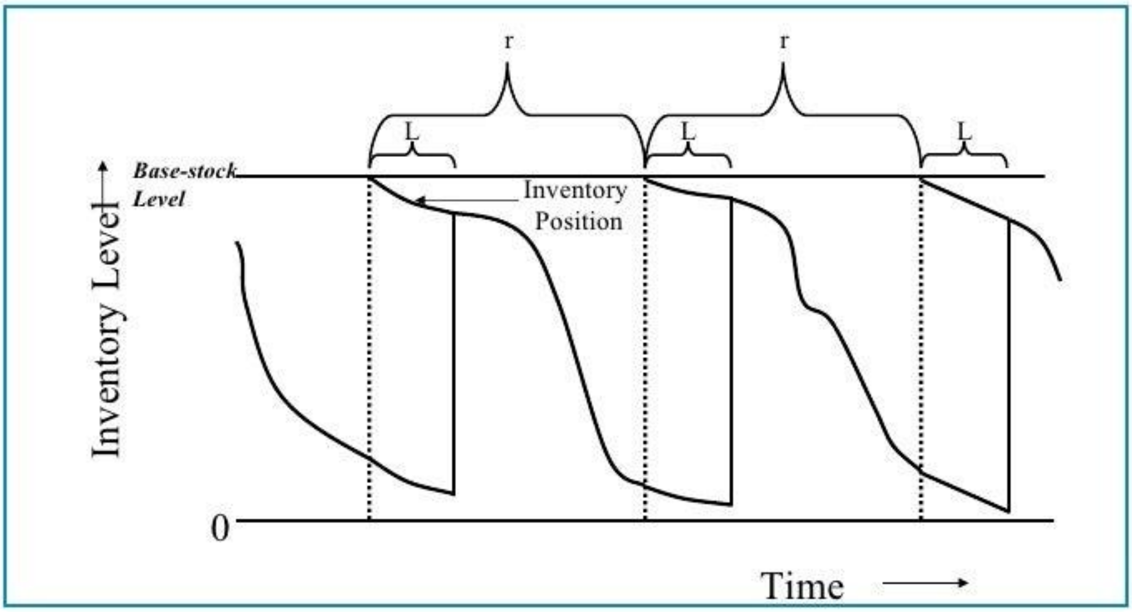


Figure 12 Periodic review policy (Simchi-Levi et al. 2008). During each review period r the inventory level I gradually decreases. At the start of lead time L, a new order is placed. At the end of the lead time, the inventory is replenished.

The inventory management procedure is summarized in equations (4) to (7).

$$Q = S - I \quad (4)$$

$$S = D_r + ss_r \quad (5)$$

$$D_R = \sum_{i=1}^{r} (D_i + sc_i) \quad (6)$$

$$ss_r = 0.1 * D_r \quad (7)$$

When "static inventory management" or "dynamic inventory management" is selected, sales of that day are stored in a table and are transferred to a table containing lists of all sales up to that time step. As demonstrated in Figure 13, determining demand and replenishing the inventory do not occur when "infinite inventory" is selected, as in that scenario cooks do not visit the supermarket. In case "static inventory management" is selected, food outlets still report their sales of that day by plotting in the model's interface and replenish based on the initial inventory.

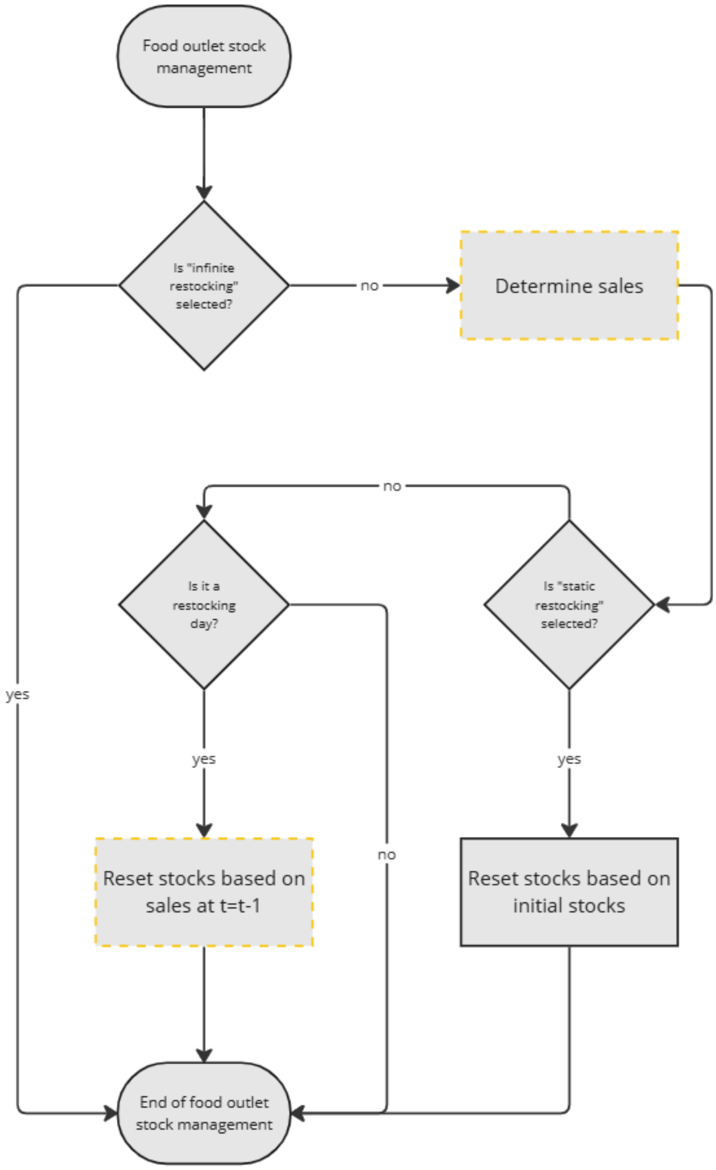


Figure 13 Flowchart of checking sales and replenishing. This procedure is for food outlets only.

Intervention to change diets

The dietary change intervention allows users to request a fraction of the population with a specific status (low, high, random), to change their diet towards a user-preferred dietary preference (meat-eater, pescatarian, vegetarian, vegan). The effect of dietary change we assumed to depend on the status of influencing person-agents, group size of influencing person-agents, and intervention duration. During the intervention period, the person-agents selected to change their diet cannot evaluate and update their dietary preference, ensuring that group exerting influence on the rest of the population remains unaltered. Once the dietary change intervention is terminated, person-agents that were participating in the intervention can freely adjust their dietary preference again. For this intervention, we assumed high status as >0.75, low status as <0.25, and random status as [0,1].

Intervention to change inventories

The inventory change intervention allows users to adjust the ratio of animal- and plant-based protein sources in food outlets' inventory. The interface provides a switch to activate the intervention (change-inventory?), a slider to set the duration in days (intervention-duration), and a slider to set the desired ratio of animal- and plant-based products (plant-share-slider). Once activated, the intervention will be implemented after 730 time steps (~2 years), allowing the model to reach a steady state before intervening in the status-quo. During the intervention period the model setup will be temporarily set to "static inventory management" to allow food outlets to persistently offer the user-specified ratio of animal- and plant-based products. Once the intervention period has passed, the intervention will be terminated and the model setup will be reset to "dynamic inventory management".

During the intervention period, food outlets set their inventories based on the desired ratio of plant-based products r. For this intervention we assumed that food outlets would adjust their product ranges while preserving total product count S. The reason for this choice is twofold. One, a ratio A:B can be adjusted by either increasing component A or decreasing component B, or vice versa. Two, a user-specified adjustment to either or both animal- and plant-based sources without preserving total product count can result in an unrestrained fall or accumulation of supply, leading to either famine or unrealistically high inventories, and crashing of the model. Therefore, the total of both animal- and plant-based products, S_A and S_P respectively, and total product count, are calculated prior to adjusting the ratio.

Meat, fish, and vegetarian $\{M, F, Vt\}$ are considered the animal-based inventory S_A; vegan $\{Vn\}$ is considered plant-based S_P. In applying the desired ratio to the protein sources, the relative product counts of meat, fish and vegetarian are preserved as well (M', F', Vt'). The reason is that, after the model has reached a steady state, food outlets offer protein sources based on the initial distribution of dietary preferences. If the desired ratio would be applied evenly across the three animal protein sources, each of these products would be offered in equal amounts after implementing the intervention. Rather than a consumer response to a shift in supply of animal vs plant proteins, MEET-eaters would simulate the response to an entirely different product range, which makes it hard to isolate the effect of the ratio adjustment. The desired plant ratio is directly applied to the vegan inventory Vn'. Performed calculations are shown in equations (8) to (15).

$$S = S_A + S_P \tag{8}$$

$$S_A = \{M, F, Vt\} \tag{9}$$

$$S_P = \{Vn\} \tag{10}$$

$$S'_A = (1 - r) * S \tag{11}$$

$$M' = \frac{M}{S_A} * S'_A \tag{12}$$

$$F' = \frac{F}{S_A} * S'_A \tag{13}$$

$$Vt' = \frac{Vt}{S_A} * S'_A \tag{14}$$

$$S'_P = Vn' = r * S \tag{15}$$

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