AMS

AMSTERDAM INSTITUTE FOR
ADVANCED METROPOLITAN SOLUTIONS

Project report

Project title:	Evidence-based Food System Design (EFSD)
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Lead Project partner:	Wageningen Environmental Research (WEnR)
Project partners:	Hogeschool van Amsterdam (HvA), AERES hogeschool
Project start date:	June 1st, 2017
Duration:	12 months
Project end date:	May 31st, 2018
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1. Project Information

1.1 Project title

Evidence-Based Food System Design

1.2 Authors

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1.3 Project partners

The EFSD project is carried out by a research consortium consisting of Wageningen Environmental Research (WEnR), Hogeschool van Amsterdam (HvA) and Aeres Hogeschool, and supported by AMS / Flevo Campus. Partners participating in the cases studies include: Gemeente Zaanstad (Louise Ronner), Gemeente Almere (Simone Eijsing), Vervoerregio Amsterda, (Martijn Kas), Bedrijvencoalitie Food Center Amsterdam (Martijn Daalder), Havenbedrijf Amsterdam, (Eduard de Visser), Schiphol Area Development Corporation (SADC) (Frans van der Beek), Food Council MRA. Other partners are Provincie Noord-Holland, Provincie Flevoland and Gemeente Haarlemmermeer, to whom we are grateful for providing data for the food actor map.

2. Extended abstract

2.1 Keywords

Metropolitan food system, Data management, Regional development, Footprint analysis, Food flows

2.2 Introduction

2.2.1 Scope and objectives

Growth of the world's urban population, by 2050 will increase to 7 billion people. Today more than 50% of the world population lives in metropolitan areas. This will increase to 70% in 2050. Growth of the urban middle-class with increasing purchasing power, revolutionizes food consumption in quality and quantity. This will lead to high demand and changing preferences and diets. In western society, and especially in Metropolitan areas, obesitas is a problem, which will cause increasing health problems. Next to that Metropoltan Areas have to deal with limited resources as available production land, space, water. The agrofood sector has to deal with the challenge to decrease the ecological footprint. This leads to a complex challenge to secure food for metropolitan areas, which needs an efficient organisation of food production, processing and distribution, finding an optimum in high productive food systems and sustainable production with limited resources and with a low ecological footprint, either within or around the city, either connected to the global food logistics, that may contribute to more healthy consumption patterns.

This challenge can be set in the place based approaches on regional development, which are increasingly built on societal and environmental problems. Mazzucato (2018) has developed mission driven approaches, which are nowadays adopted by the EC and diverse National Governments. Ketels has published about regional innovation beyond GDP. Regions have determined their RIS 3 strategies and have developed triple helix approaches. These networks of governments, industries and knowledge institutes are being extended to quadruple or quintuple helices in which civil society will be engaged. Regional innovation systems are being challenged to develop innovative solutions for the regional and metropolitan problems. Many Metropoles (global, European and in the Netherlands) cities have set policies and strategies on sustainable and healthy food, including resource efficiency and food waste. Two main scenarios can be distinct: resilient metropolitan food shed (rural – urban, large scale) and smart and inclusive cities (small scale, urban agriculture, vertical farming).

In order to find an optimum, based on evidence from data and research, tools and practices are being developed within research organizations and programs as the MetSol program. The collection of data on food (production, distribution and consumption) and environment (landscape, soil, resource use efficiency) and health and mobility, at the level of the Metropolitan Area has till now only been in early stages of development. Big data and interactive tools will enhance the opportunity to find answers, and have the potential to support decision making and developing a coherent vision on the future of food in the metropolitan region in which different scenario's and narratives are being integrated (Marsden, 2017), and will also enable to develop new services for improvement of the configuration of the food system within metropolitan areas.

The overall goal of the EFSD project is to contribute to an evidence base for public as well as private stakeholders that supports them in shaping the future food system. This goal is broken down into four concrete objectives to be achieved within the timeframe of the project:

1. To establish baseline data on the urban flows relevant for the MRA food system and the spatial characteristics underpinning these flows (i.e. availability of production space, location of food actors, infrastructure)

2. To develop appropriate methodologies and tools for evidence-based food system design and on-going data collection and monitoring

3. To develop scenarios and design solutions for current and future challenges in the MRA food system

4. To build partnerships between stakeholders from different domains and sectors as a springboard for future research and interventions and initiatives towards a sustainable MRA food system.

The project focuses on the Metropolitan Region Amsterdam (MRA), consisting of 33 municipalities within eight sub-regional clusters. Since 2014 Amsterdam has a local policy and agenda "Voedsel en Amsterdam", with attention for healthy food and education, food distribution, from perspectives of congestion and connectivity, and sustainability. But also witha focus on local food production and consumption, and innovation by collaboration between the triple helix partners. At the level of the MRA, food is also important, economically, with a sustainable production in balance with the natural capital. The Amsterdam Economic Board has a focus on developing innovative solutions for local challenges. Circularity and Health are related to Food. Rabobank (2014) has advised to raise a Food Council, just like frontrunner cities as Toronto and Boston. This Food Council has been erected in 2017. The new local coalitie (2018), has decided to maintain the food policy.

EFSD delivers to the Amsterdam challenges and policy goals The aim of EFSD is to build various datasets which, either by themselves or when combined, offer input for analysis and evidence-based food systems design as well as food system policy and food innovations. The approach towards achieving this objective builds on the Metropolitan Food System concept, combined with a focus on the urban-spatial-functional nexus in the context of sustainable regional development. The development of methodologies has two main components:

a. To adjust the Metropolitan Foodscape Planner developed for FOODMETRES to MRA. Goal is to arrive at a schematic illustration of the main food production pathways, regarding physical characteristics, qualities and potentials. relevant for sustainable concepts at the level of the region.

b. To develop an approach for collecting, manipulating and visualizing data on food actors and food flows, and making them available to private and public stakeholders in the form of dashboards and visualisations that can be updated regularly (if not in real-time)

The data collected under objective 1 will serve to identify challenges and work towards solutions for these challenges in the MRA food system, through analysis of the data, scenario development and design. In view of the need to focus, specific locations within the MRA will be identified based which offer potential as smart food districts.

The project will engage a wide range of food system stakeholders from the private and public sector. This engagement is crucial for obtaining and verifying research data, ensuring that research objectives are relevant, and disseminating findings. Active engagement of stakeholders is further seen as a way to place the food system challenges identified on stakeholders' agendas, thus paving the way for future research ,interventions and initiatives. This requires active collaboration as well as targeted actions and actively building one or more platforms in which stakeholders can regulary meet up, share information and work together in living labs.

We will describe the experiences with the data collection, the application of the interactive tools with metropolitan partners in order to develop scenario's, solutions, innovations and initiatives for improved approaches and practices and enhanced engagement.

2.2.2 Literature

The debate around local food systems is of particular interest at the metropolitan level. The question whether local food systems are more sustainable or just than systems at other scales is still under debate (see, for example, Born & Purcell, 2006). However, re-territorialisation or re-location of agriculture is increasingly seen as a way forward. Berti & Mulligan (2016) argue that short food chains and regional systems of food production and consumption might be very important in the transition towards a more sustainable food system. In the Netherlands, the Planbureau voor de Leefomgeving (PBL, 2012) considers short chains as an important strategy for farmers to transition towards more sustainable production whilst ensuring affordability to consumers. However, to make this transition, a better view is needed on interrelations between food production, food consumption and spatial characteristics and the possibilities for new arrangements between these in the metropolitan context. This means calculation and assessment of consumer demands and possible local or regional supplies, logistics, environmental, economic and spatial consequences and interrelations. Based on the existing

work by Wascher et al. (2015a; 2015b; 2016), the research on Metropolitan Footprint Analysis focuses largely on the spatial–quantitative dimensions of impact assessment. Research has shown that the ecological footprint, however, is being calculated using different methods, spatial scales, and reference systems, including land use (change) and anthropogenic impacts, energy, carbon or metabolic flows, and life cycle assessments (Lin et al. 2015; Virtanen et al. 2011; Wackernagel et al. 2006). Metropolitan regions have frequently been portrayed as Thünen-style concentric circles or boundary-less zones around urban agglomeration centers (Smeets, Harms, and van Steekelenburg 2004; Tress et al. 2004; van Steekelenburg, van Latesteijn, and TransForum 2012; von Thünen 1966). However, the functional distances between supply and demand of food have been changed due to international trade, industrialization and economies of scale. Metropoles have more attention to food for reasons of healthy lifestyles, the access to good and affordable food, sustainability (footprint, climate), social benefits (Van der Schans and Wiskerke, 2012), and potential of innovative business (Mazzucato, 2017). This has contributed to a growing interest in City Region Food Systems (Dubbeling et al, 2017). Big data and interactive tools will enhance the opportunity to find answers, will support decision making and developing a coherent vision on the future of food in the metropolitan region in which different scenario's and narratives are being integrated (Marsden, 2017).

2.2.3 Methods

A literature review on methodologies for mapping food actors and food flows (van Bossum, 2017) uncovered a limited but growing number of studies exploring metropolitan food system, ranging from small-scale qualitative exercises to more data-driven mappings.Studies attempting to map food or organic flows at the metropolitan level include Amsterdam (Voskamp et al., 2016) and Paris (Billen et al., 2011; Barles, 2007. None of these studies specify the various actors involved in the food supply chain. Barron et al. (2010) attempted to uncover "the process by which New York City's food is produced, transformed, distributed, consumed, and disposed of or recycled" (p6). The study combines national macro-economic data on the food supply level (in terms of volume, economic value and mode of transport) with case studies at city level, drawing on interviews with key informants. Carey (2011) identifies food flow actors through the use of small surveys, interviews with food flow actors and limited (mostly national) public data. Edwards and Mercer (2010) describe student projects to sketch the foodscape in selected Melbourne neighbourhoods through identifying the chain of actors involved in their consumption. Recent studies in Almere are based on the demand of food supplied to the city (Van Dijk et al., 2017) one specific product or sustainable aspects of the food system (Sukkel, Stilma & Jansma, 2010). Aspects of the system to consider when developing a regional food system are known, but an overview of the current situation of type of products, origin and price is missing.

All of the studies offer one-off snapshots of the food system. Almost all of the researchers point out lack of data on the subject and on the level of cities, metropoles or regions, and the lack of access to (often privately held) data on food flows and food actors, hampering the research. There is no tool as yet that produces accurate and up-to-date (location) data on actors or the food flows between them throughout the metropolitan food chain.

2.3 Methods

Since an integrated evidence based method for data analysis is missing, we decided to unravel the food system in five layers and start to collect data and information on these layers on the scale of MRA. We distinct Food production, Food Flows and Food Consumption. As the ecological footprint is a leading principle, we will develop insight in the potential sustainable production of Food. Next to these we will map actors, who will be engaged in the processes of giving meaning to the findings and in the development of scenario's and strategies, see figure 1.

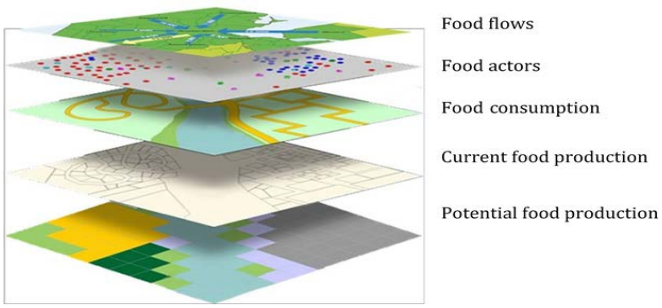


Figure 1: Food system unravelled in five layers

2.3.1 Methodologies to map food foodprint

The method of the Metropolitan Footprint (Wascher et al. 2015), developed within the Foodmetres project (www.foodmetres.eu), is a GIS-based assessment of the ecological footprint for MRA according to European land use and food consumption data (CORINE, EFSA, HSMU, Natura 2000) complimented by food consumption data drawing upon national statistics, is based on the calculation of land requirements per food item that were determined combined with data on the per capita food consumption of various food packages, varying from subsistence to affluent (Gerbes Leenis, 2002). Foodmetres also assesses the quantitative dimension of urban food consumption addressing spatial, logistical and resource aspects. The Metropolitan Foodprint tool identifies the location, type and amount of agriculturally productive land in reach of urban centres to supply metropolitan populations with regionally grown food. The Metropolitan Foodscape Planner (MFP) tool, allows the spatial allocation of food groups on the basis of regional demand figures derived from food consumption census data compiled by the European Food Safety Authority.

Food production: The analysis of the food supply is based on actual regional agricultural conditions depending on climatic and bio-physical conditions, such as soil fertility, resulting in differences in crop yields. Therefore average values for the different commodity types are taken from agricultural statistics, mainly from regional databases, complemented by national and international figures for crops, which cannot produced locally, such as exotic fruits, cacao, tea, coffee, etc. global yield values from FAO statistics are taken into consideration.

Food consumption: The food demand is determined by the quantity of the regional population as well as average food consumption patterns (diets), which are also characterised by substantial differences, e.g. between countries or urban and rural areas (see Gerbens-Leenes & Nonhebel (2002)). The basic per capita values is then projected for the overall regional population for the reference situation (conventional production, current food consumption and food losses and waste levels). This will be used as starting point for the application of different scenarios of population change, food consumption, food loss and waste as well as different production intensities.

Potential Food production: Building upon the classical market-centred Von Thünen (1826) model, but translating it into the system environment of today's agro-food-sector and spatial planning strategies, the following spatial areas are identified: (1) urban core area, (2) green buffer & fingers, (3) metropolitan food production, and (4) transition zone. Land cover such as urban areas, water bodies and nature conservation areas are excluded from this food production zone. MFP allows users to detect concrete spatial locations and the available amounts of suitable farmland (supply) around cities for the most essential food groups on the basis of urban population figures (demand).

While the footprint methodology makes use of standard indices of land use per capita, a more accurate picture of actual consumption is created based on national consumption survey data (Voedselconsumptiepeiling), translated to the MRA municipalities by taking the averages per gender-age group and multiplying these with the demographic figures in the MRA. While these consumption data are not used in the footprint calculation, they do offer a basis for further analysis of food demand.

2.3.2 Methodology for mapping food actors

The approach to creating a dataset of food actors was to identify (semi) publicly accessible data sources and write code that can be used to create a dataset of actors in the MRA food system out of these sources. Food actors were defined as all establishments located in the MRA who play a direct role in the physical food flows in the MRA (i,e, 'nodes' in these flows): Primary producers, food industries, food logistics establishments, wholesalers, retailers, food service establishments and establishments collecting and/or processing food waste.

Relevant data sources were identified through web research and contacting municipalities, research / consultancy institutes and others with potential access to such data. The identified data sources were then assessed against a number of criteria: Timeliness (frequency of updates), reliability (degree to which data are an accurate representation of the MRA food system), completeness, continuity (remaining available over time), accessibility and cost.

Script was written for cleansing and combining the various datasets, in programming language R. This language was chosen based on the expertise at HvA with this language; its suitability for manipulating and analysing data and its versatility in terms of visualisation and creating maps. Subsequently the dataset was analysed. Missing data was identified, and alternative sources were sought to add these missing data. By means of algorithms, an attempt was made to filter out non-food related establishments.

2.3.3 Methodologies to assess food flows

Mapping the food flows for the entire MRA is not feasible within the scope of the project. Therefore, four cases were selected[1] in which different methodologies were tried out, to assess which methodologies are suitable for further development and upscaling. The methodologies range from micro-level consumption analysis at retail and household level (Case 1. Almere) to regional macro-level logistics analysis, based on cargo traffic flows in and out of the region (Case 4 Regional logistics flows). The aim of using such diverse methods was to explore their usefulness and complementarity in mapping food flows, and to assess the availability of data required for the different methods. The approach in each of the cases is briefly explained below.

Methodology Case 1. Almere

In the Almere case study, a tool or method will be developed for periodically measuring quantities and origin of food flowing into the city. The case study focuses on mainly on retail flows and the method is intended to be replicable for food flows towards consumers by production location and products from primary producers. Aeres Hogeschool Almere is responsible for this case study. In the early stages, HvA engaged with Aeres to align methodology, among other things by establishing a shared definition of food actor categories. When definitions are aligned methods are developed in collaboration and data is shared among the consortium. The data will be combined, matched and then shown in an interactive map with retailers and consumer data in Almere and the production landscape of Flevoland.

The following mixed methods approach is used to collect data in Almere and get a grip on the complexity of the system:

1. Literature review: Aeres has a history of local food production and consumption research. These local studies were used as a base to capture methods that could be applied in the area. Knowledge from these studies formed the base to link broader conclusions to this research. This particular study to products in retail is previously conducted in Vietnam (Wertheim-Heck, 2015). These methods are applied here as well.

2. Observation and count of products in Almere retail: Based on previous research in Hanoi (Vietnam), this method is adjusted to local conditions and repeated in Almere. Products in retail is counted and following aspects are tracked:
   - Indicative percentage food versus non-food in store;
   - Within food categories: indicative percentage ultra-processed, whole and minimally processed food;
   - Fruit and vegetable section by product: origin (country), price and whether or not the food is organic.

3. Interviews and surveys: To collect data from producers and consumers this research provides interviews (n=13) and surveys (n=96). Both unstructured and semi-structured interviews gather qualitative data from experts, major retailers and producers. Surveys are developed for consumer data collection and executed in two different areas in Almere for comparison.

4. Manual web scraping and big data analysis: To add to collected data, big data from open sources is used to fill potential data gaps. Sources like CBS, FoodCube, RUG, PBL and Rabobank provide

[1] The four cases reflect the priorities and concerns of the project partners: Case 1 reflects Almere's ambitions to source more food regionally (but lack of insight into its current connection to production in the region). Case 2 stems from mobility issues in Amsterdam, as tabled by Vervoerregio Amsterdam. Case 3 reflects Zaanstad's concern over the competition between residential development and food industry along the Zaan, and case 4 addresses the concerns of the Vervoerregio around decreasing mobility in the MRA, as well as strategic interests of the Port of Amsterdam and the Schiphol Area Development Corporation (SADC).

open data sources on local, regional and national scale land use, product and consumption rates. This provides the context for local small scale data collection. Web scraping of (supermarket) websites gives insight in national collaborations between producers and retail chains.

5. Stakeholder analysis: To understand the relations in the playing field regarding local food provision in the context of Almere, a stakeholder analysis is constructed. This analysis is based on three core principles, namely: interactions between stakeholders; interests of stakeholders concerning the local food system; and influence of stakeholders on this issue. The analysis of the interests and influence of the considered actors that will lead to some graphic representations which will highlight the potential facilitators for a transition in the food system.

Methodology Case 2. Amsterdam: Horeca
In this case, an attempt is made to quantify the food flows from wholesale to food service establishments in Amsterdam. This case was chosen in consultation with project partner Vervoerregio Amsterdam, based on the fact that food service logistics make up a disproportionately large share of logistics flows in the MRA (see also Findings case 4).

The approach taken in this case is to build a data-driven model for estimating food deliveries/logistics flows. This model is built using publicly available data on food service establishments (generated as part of the food actor dataset) as well as a one-off collection of primary quantitative data on deliveries. Using machine learning (Random Forest method), correlations between characteristics of food service enterprises, and the number and type of deliveries made to these establishments are identified and applied to a test set, to determine their accuracy.

To provide context to these data, and to identify opportunities for change, the collection of quantitative data is supplemented by qualitative research into the practices, motivations and interests of both the wholesalers and food service establishments that determine deliveries. This was done through, on the one hand, a focus group interview with wholesalers and interviews with a sample of food service establishments. In order to provide some focus, the interviews concentrated on the Zuidas area where good contacts exist with the sector through a partnership with Hello Zuidas.

In addition to this primary research, the case will draw data from previous research by HvA, its students and others in other Amsterdam neighbourhoods. This primary data consisted of vehicle counts and delivery data from food service establishments.

Methodology Case 3. Zaanstad: Flows to and from the food industry. In this case, the food industry is taken as the starting point. Through interviews, the agro-food-related in- and outflows of five companies[2] are quantified, and logistics routes determined. The research was conducted by a group of 5 students as part of the HvA minor 'Airport Seaport logistics'. This case study research was carried by a group of six HvA students within the minor Airport Seaport Logistics.

Methodology Case 4. Regional logistics flows. The methodological approach within this case is to convert vehicle counts on the major transport axes into and out of the metropolitan region into estimates of agro-food volume. To this end, traffic data were obtained from national and regional sources (Vervoersonderoek Randstad 2016, RWS Grootschalig goederenvervoersonderzoek, CBS). Based on the different classification of vehicles in these datasets, assumptions were made about whether their cargo was agro-food related. Vehicle counts were converted to tonnage, using the assumption that every cargo vehicle transports on average 12,2 tonnes. As no data at MRA level were available, the Provinces of Noord-Holland and Flevoland were taken as geographical scope. Based on the same traffic count data, geographical routes in and out of the MRA were inferred. A further attempt was made to map the relative share of food logistics in total logistics.

[2] This small sample of companies was selected based on the available time and resources, their major share in food flows, willingness to participate, but also on their location in or near areas marked for housing development - reflecting Zaanstad's concerns regarding clashes between residents' and industry needs. As such, and due to the small size, the sample is not representative

2.3.4 Methodologies for Scenarios & design

Focussing at the spatial extent of the footprint of food production, the Metropolitan Area Profile and Scenario (MAPS) tool represents a spatial model which takes both parameters of regional yields and diets into consideration, broken down to a set of commodity groups. This allows the model's sensitivity regarding alternative agricultural systems (conventional and organic), reduction of food loss and waste, different diets (given and health recommendations) and temperate domestic and necessary global production. The combined method applies quantitative and qualitative methods and engage with a variety of actors in metropolitan regions including food producers, civic food organisations, and government bodies, who are mobilized in a scenario development and design workshop, in which they will elaborate on different scenario's of the regional food system.

Figure 2: Food system scenario's

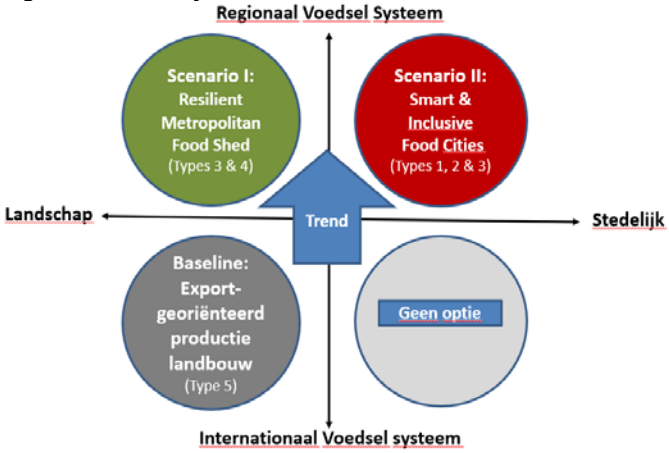


Figure 2 shows the development from an international Food system to a regional (or metropolitan) food system; Two scenario's can be distinct:

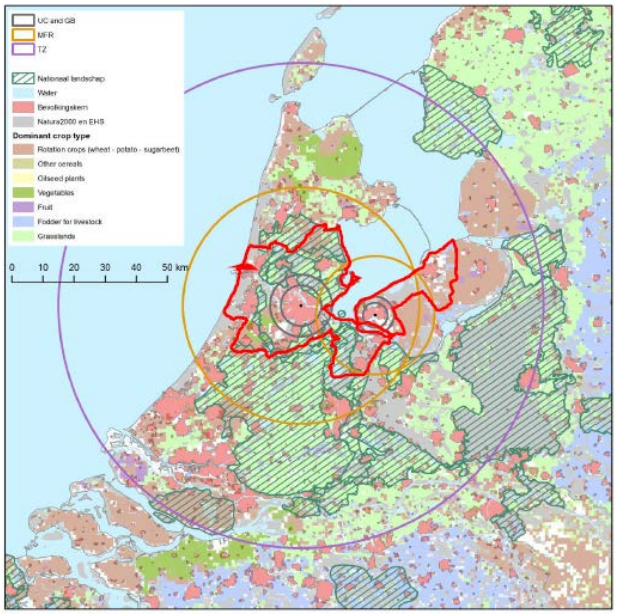
- Resilient metropolitan food shed: high productive and sustainable agriculture in the metropolitan region, which connects supply and demand with short value chains, less emissions and food waste (Wiskerke, 2017).
- Smart and inclusive food cities: small scale agriculture in and arount the metropole, vertical farming, new lacal food chains, diverse local production and enhancement of the awareness of food production (MTD, 2017).

2.4 Findings and arguments

2.4.1 Foodprint

We developed a database and interactive map of landscape units by their potential for different crop production. This map layer is based on the Metropolitan Foodscape Planning (MFP) tool and is hence accompanied by a demand-supply assessment of the corresponding food production groups (grassland, fruit, oilseed, vegetables, livestock feed, rotation crops, other cereals). The interactive map (figure 3) shows a variety of relevant layers related to land use, soil types, nature conservation areas, landscape types, urban settlements and the ecological footprint rings around both Amsterdam and Almere. This baseline map offers a schematic and internationally comparable insight into the metropolitan foodshed.

Figure 3: Food print map



We can see the deficit of livestock fodder crops is proportionally increasing if we compare Amsterdam, Amsterdam and Almere and the MFR. The same is true for the surplus of grasslands. This shows that the food supply ring matching the overall food demand is relatively consistent in terms of its agricultural land use structures. Only in the case of the vegetable production, the TZ is offering a clear additional surplus of more than 8 times the actual demand of the 2,3 million inhabitants. Not shown are the greenhouse locations of which most are located at the periphery of the TZ in the Rotterdam region. But even within a distance of 38km – hence within the Metropolitan Food Supply Ring, we identified a total of 776 ha.

The agricultural land requirement of the MRA Food demand for 7 Food Groups is with 331,000 ha almost 1.4 times larger than its absolute surface area of 241,000 ha of which most is covered by buildings and streets. Within the wider radius beyond the Metropolitan Food Supply Ring that has been calculated with the MFP, the TZ approximately 200,000 ha grasslands, 66,000 ha rotation crops (wheat-potatoes-sugar beet), 37,000 ha fodder plants for livestock, 26,000 ha vegetables and almost 5000ha fruit. Not taken into account when calculating the available agricultural lands for food production are the areas of the European Habitat Directive (Natura 2000) and the national Ecological Main Structure (EHS).

Case Almere: the Food demand of Almere for 7 Food Groups in comparison to surplus and deficit within the Almere Food Supply Ring and the regional comparison between the food demand of the 197.000 inhabitants and the actual supply levels within the food ring zone of 19km radius, shows that there is a substantial short-coming with regard to fruit, oilseed and of course livestock feed crops. On the other hand we see clear surplus for vegetables – in this case there is evidence for large onion productions for the world market, a theme that is being followed up as a case study of this project.

The Land use map of MRA (source: LGN7) and the Farm types in MRA/Footprint region (Giab 2015) show different farm types, a single point representing a farm and showing the regional clustering of farm types. Within the contour of the Amsterdam footprint, south of the metropolitan region, horticulture is located. Near the coast this is mainly bulb growing, while the more inland concentration is mainly tree nursery and glasshouse horticulture mainly for flowers. Note that the greatest deal of horticulture in the metropolitan region is non-food orientated. Further arable farming, dairy farming and cattle breeding are the most common farm types.

The Agricultural heat-map of MRA/ Footprint region (Giab 2015) represents the economic intensity of agriculture and should be combined with the previous map of the farm types, which shows that

horticulture has the highest yield per hectare. This means that in the metropolitan region horticulture has a high added value, while the other farm types have a relatively low added value.

Lisa (2010) is also use to identify companies that are part of the food industry, small, middle or big companies. Annex 2 gives an overview of the companies that are included and the hotspots of the food industry are mainly located in bigger city's as Amsterdam and Utrecht, Leiden etc. Also Zaandam, Alkmaar are important for the food industry.

Food consumption
Based on national consumption data, corrected for the age-sex distribution in the MRA, the total consumption of food and beverages of the MRA population was calculated to be 2,4 million tonnes (weight). (see annex 1). Beverages (non-dairy) take up almost 60% of this consumption. The largest share in the remaining consumption lies in milk and milk products and bread and grain products.

In addition to the current consumption (2016), the recommended consumption according to the Voedingscentrum 'Schijf van Vijf' and healthy vegetarian diet was also calculated. Interestingly, these recommendations would entail higher consumption in practically all food groups except for meat and fish products, beverages, sweets and condiments and sauces.

2.4.2 Food actor map

Based on the defined criteria (see 2.3.2), the Establishment register (Vestigingenregister)[3] was chosen as main dataset, to be validated and enriched with the help of other datasets. The Chamber of Commerce Handelsregister (trade register) was obtained for a small fee in order to add (establishments with) food-related subsidiary activities (these are not present in the Establishment register). Additional data were obtained with an API from the public address register (Basisregistratie Adressen en Gebouwen BAG). Finally, data from the Horeca Informatie Systeem were obtained from the municipality of Amsterdam to verify and enrich the food service data for that city. Each obtained dataset was analysed to assess structure, size, attributes and missing values, all of which were captured in metadata files.

The aim was to automate the retrieval of these data as much as possible, through, for instance, APIs. In practice, most datasets had to be (and will continue to be) obtained in csv format. The combined dataset was analysed through comparison with other data files (Horeca Information System, Google Places, Yelp, data on waste companies from the AMS Repair project, information from logistiek.nl, consultation with experts) to verify the food-related nature of the establishments, but also potential missing establishments. Rules were designed to automate the filtering out of irrelevant establishments, but could not all be implemented within the scope of this project. Particularly within the Waste and Logistics categories, work still needs to be done. Finally, descriptions of the economic activities were added (CBS, 2017) in both Dutch and English.

The gathering, cleansing and filtering of data resulted in a dataset of 44703 observations and 30 variables. The dataset contains 39062 unique establishments, some of which appear multiple times in the dataset as they engage in various different food-related activities.The code for creating this dataset was written in R and allows for the updating of the dataset or replication in other geographical areas or sectors.

A subset was created from the full dataset that can be plotted on an on-line map. Potentially sensitive information was excluded in this subset: establishments with one or less full-time employees were omitted to avoid privacy issues; employee numbers were aggregated into size categories; and address details were omitted. In addition, descriptions of the economic activities were added, both in Dutch and in English. The dataset was then plotted onto a map. Through this visualisation the data become more accessible, allowing for their use to initiate debate and stimulate further questions. Through a number of mock-ups (based on parts of the dataset), the desired functionalities and design of the maps were explored and discussed with stakeholders. These included, at the minimum, a zoom function, a function

[3] The MRA is covered by four establishment registers: that of Amsterdam (covering Amsterdam and adjoining municipalities), Haarlemmermeer, Provincie Noord-Holland and Provincie Flevoland. These registers were individually obtained and then merged

to select the category and sub-category of food actors, and a pop-up with more detailed information when clicking on an object in the map.

The resulting interactive on-line map can be accessed here - see Figure 4. It contains all found establishments (>1 fte) in the MRA who are active in the MRA food cycle: Primary producers, food manufacturers, food logistics enterprises, wholesalers (>7fte), retailers, food service enterprises and enterprises collecting and/or processing food waste.

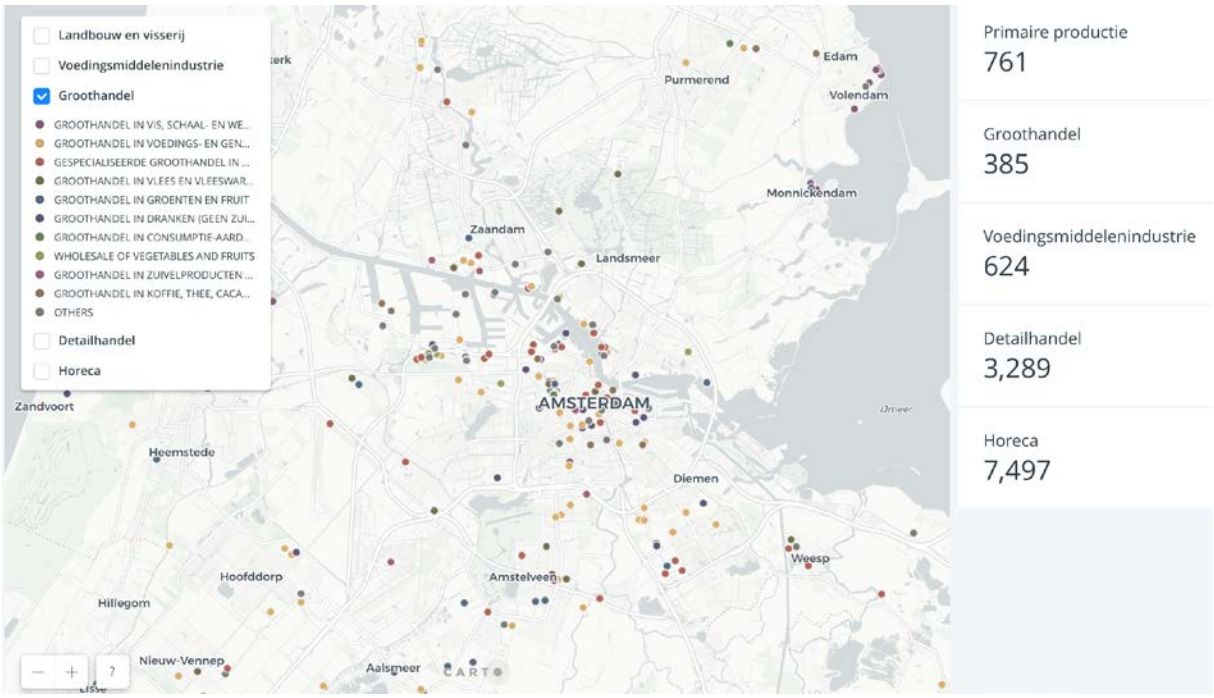


Figure 4: Screenshot of food actor web map

Conclusions re. food actor map:
The food actor dataset provides a not previously unavailable resource on the food system in the MRA. While there is scope for increasing the accuracy of the dataset, it already serves as an invaluable basis for further research. Interactions of stakeholders and the wider network with the maps made it clear that this new resource is of interest to many and comes at an opportune time (coinciding with the launching of the MRA Food Policy Council, among others). The mapping of the dataset provides scope for meaningfully engaging stakeholders in dialogue, and raising questions for further analysis.

2.4.3 Food Flows research per case

Findings Case 1. Almere

The aim of this case study is based on a policy goal set by the municipality of Almere. They aim that by 2022, 20% of the food in Almere is locally sourced. This study shows how and if the food flows between the actors are connected now and what potential hurdles are before the flows can be localized. This study focuses on the foodflows between the (1) primary producers in Flevoland, (2) the retailers in Almere and (3) consumers in Almere. Stakeholder analysis gives more insight in the complexity and functioning of the food system.

Producers - The Flevopolder was planned in order to harbour high productive agriculture (Van Dijk et al., 2017). The land yields per acre in Flevoland are higher than other parts of the world because of the fertile land. In Flevoland are 1784 agricultural businesses, 1141 of these businesses grow vegetables. Most important vegetable of the region is the onion. More than 91% of the business grow (even besides other vegetables) onions on their land. However 90% of the onions are exported internationally through the harbour of Rotterdam and Vlissingen. Onions from Flevoland are known for a long preservation time and therefore appropriate for export. Exportation through the harbour is relatively cheap in The Netherlands, therefore Dutch onions have a high stake in the world market. Other important vegetables

in Flevoland are carrot and chicory. Smaller vegetables grown in Flevoland are for instance spinach, turnip and kale. Not enough kale is produced in the area to feed Almere. Many agricultural businesses in Flevoland also grow potatoes (1025 businesses). Only 3.2% of the consumption potatoes grown in Flevoland in a year, would be enough to feed Almere for a year. Most farmers don't know where there product is sold after they deliver it in bulk to an intermediate.

Retail - However, based on counts and observation among fruits and vegetables in Almere supermarkets, most of the products in Almere are internationally sourced. In an Albert Heijn in fall this is 82% of the fruits. Vegetables do a little better with 58% internationally sourced but potatoes do best with 93% national sourcing. In the organic section of Albert Heijn we see a shift in the vegetable offer; more than half of the organic vegetables are nationally sourced. Counts in other type of shops show other results. Natuurwinkel only sells nationally sourced potatoes, but fruits and vegetable origin is comparable to the organic section of AH. Prices are however higher in Natuurwinkel than in AH. In the average toko and at the market, not all origins are mentioned on the products. However in toko's we see more international sourcing than in supermarkets. As well on markets, where one would expect local products, most products were internationally sourced. Potatoes are mostly nationally sourced. When we isolate specific vegetables grown in Flevoland, we see that onion, carrot and chicory are nationally sourced by supermarkets more often than other vegetables. However this depends on season on supermarket (See Annex 3).

Consumers - According to interviews with stakeholders, consumers' demands on quality and price of products plays a big role in the food system. Also the type of products demanded depends on the cultural background of consumers. Almere is a very divers city with many different cultural backgrounds. In this study we compare Parkwijk and Stedenwijk. Main differences on grocery behaviour were on: place to do groceries (Parkwijk more differentiation), household composition, perceived health (lower in Parkwijk) and big differences in the amount of money available for groceries every month (higher in Parkwijk). Main source of food purchasing is the supermarket, where almost no local products are available. Many participants did not know if they bought local products. The effect of diet, which products Flevoland produces and where these products are for sale is often unknown among consumers.

Food actors - The day the Floriade starts in 2022, according to interviewees from the Flevoland Province, Flevofood and Floriade, is considered deadline for change. Stakeholders recognized that Floriade and the 20% policy ambition contribute to changes in the domain of Almere's food system. To enforce the local economy investments have been done by the local governmental agencies. One is providing funds to Flevofood (local food producers network). During the interview with the owner of Stadsboerderij it was remarked that the policy ambition is seen as an opportunity for farmers to get new subsidizes. On the other hand, Floriade is a big national attraction, and an opportunity for promotion.

In conclusion: Besides the agricultural history of the city, Almere has hardly any relation to the agricultural hinterland. The Floriade 2022 causes a window of opportunity for this policy ambitions to be integrated in city development plans. Main products like potatoes, onions and carrots are now mainly produced for the international market. In order to reach the policy goal of 20% local these products need to be sold directly to the city retailers. Unprocessed fruit and vegetables need a short supply chain and could stay within the region. Other vegetables could be locally sourced to provide for the many different cultural kitchens in Almere. Further research on this topic is necessary when transitioning towards a 20% local food system.

Findings Case 2. Horeca Amsterdam

A data model was developed by Jan Haenen of the HvA Urban Analytics team to correlate and predict the number and type of food deliveries to food service enterprises, based on the (publicly available) characteristics of those enterprises. This model requires two types of data:

- Data on characteristics of food service establishments: These data are taken from the Food actor dataset, to be enriched with data obtained from the municipality (Horeca Informatie Systeem, Functiekaart) and on-line dinner site Yelp (through an API). These data sources provide information on type of cuisine, quality, price segment, public rating (as proxy for occupancy rate), opening hours, type of enterprise and type of horeca-permit.

- Data on deliveries. these data were obtained from four wholesalers (one year of deliveries to all customers in Amsterdam) and 30 food service enterprises, ranging from hotels, coffee bars and lunchrooms to star restaurants.

The model, if successful, will offer insight into the logistical needs per area (depending on the profile of food service enterprises present there). Not surprisingly, obtaining data from wholesalers and food service enterprises proved difficult. In the former case, data are commercially sensitive, and smaller wholesalers do not always have data available. Most food service establishments do not see the benefit of providing data. This difficulty reinforced the usefulness of a model that does not require recurrent collection of such data. Due to these difficulties, not enough data was collected at the end of the project to test the model. This is now planned for September 2018.

Conclusions can already be drawn from the focus groups and interviews. Besides the characteristics of the food service enterprises (as apparent from the public data), the number of deliveries and suppliers highly depends on the type of entrepreneur: professionalism in the ordering process plays a key role. (Large) establishments with dedicated purchasing staff, or entrepreneurs with a business-oriented or logistics background have less deliveries. Mission or drive also plays a role: Establishments profiling themselves as sustainable appear to have a larger number of (specialty) suppliers. All establishments interviewed work with one large supplier for commodities, and multiple specialised suppliers. Limited space for stock (and high cost per m^2) also influences the delivery frequency, though through smarter use of space this need not be a constraint. Opportunities for collaboration between food service establishments within an area (without giving up flexibility and uniqueness) include collective contracts with the large wholesalers and waste companies; sharing of stocking space; coordination of deliveries and joint lobbying for delivery windows in that area.

Findings were validated with stakeholders at a special Zuidas-edition ‘food services logistics’ during the We Make the City festival. The session brought together food service entrepreneurs, wholesalers, hotels, logistics service providers, real-estate developers, policy-makers and other municipal staff for the first time. The meeting served to form a common picture of the issues, participants indicated the wish to continue dialogue on solutions.

Findings Case 3. Zaanstad

This case focused on the logistics of food companies along the Zaan, located in or adjacent to areas tagged for residential development, in view of potential logistical conflicts. This resulted in a report to the the municipality of Zaanstad identifying such potential conflicts and providing recommendations on how to manage them. As part of this report, an analysis was made of the food flows to and from food industry companies along the Zaan. Interviews with logistics and/or operations managers in five companies yielded the following findings:

- All five companies are supplied over water with their primary ingredients (cocoa, oils, nuts)
- Supply routes to and from the five selected food industries mapped. Supply flows mostly originate from the Ports of Amsterdam and Rotterdam. Clear traffic bottlenecks identified for onward flows
- As most customers are not located near water, transport from the companies to customers almost exclusively takes place by truck. This applies to waste flows as well. This leads to between 10 and 50 truck movements a day.
- Scenarios developed for 2040 addressing uncertainties in relation to mobility and logistics by 2040

The methodological approach led to a one-off snapshot of the logistics flows, at quite a detailed level. The data have potential to inform the debate on modal shift and assess risks in the planned residential areas. However, this type of data collection is time-intensive and covers only a fraction of the food flows in the MRA. Due to its limited scope, there is no useful way to connect the data from this case to the other cases, or extrapolate them to build a more comprehensive picture of food flows beyond the companies interviewed. Data are privately held, considered sensitive and thus difficult to obtain. In all, this research approach is not suitable for upscaling.

Findings Case 4. Regional agrifood logistics flows

In this case, an assessment was made of the food flows through the lens of logistics, looking at, among other things, food transport in terms of volume moved and traffic congestion; the relative share of food logistics in the total logistics and mobility flows in the MRA; and the difference between the flows in urban areas, mainports and rural areas.

Together with the building sector, the agri-food sector[4] accounts for the largest share in cargo traffic flows in the Netherlands (30%). Agri-food transport accounts for about 40% of trucks on the main road network. While outside the urban areas, agri-food transport predominantly takes place by truck, inside the urban areas, delivery vans are by far the most common mode of cargo transport an estimated 75% of food transport takes place within built-up areas. This implies that in order to map food flows, different units of measurement and data sources apply depending on location: trucks for highways and (inter)regional flows, and delivery vans for urban flows.

Another way to look at the food flows is by examining the supply chains and distribution systems. This reveals considerable variations within the agrifood sector. The agro-sector is dominated by bulk flows in trucks, and, for the greater part, internationally oriented. The retail sector is dominated by four buying consortiums, the largest two of which have a market share of 44%[5] (Pas, 2018). This implies a great concentration of food flows via regional distribution centres and supermarkets. The food service sector, on the other hand, is highly fragmented. The five largest wholesalers hold 60% of this market; the remaining market share is divided among the ~10.000 other wholesalers and the 1500 food producers. As such, food service flows are much more dispersed than flows in other parts of the supply chain.

The above findings are based on national data. While no specific data for the MRA were found, it is assumed that the findings apply to the MRA as well. It would make sense to include the entire Noord-Holland province in the research, given the links between the production and greenports in the rural areas, and the food industry, retail and food service in the urban areas. The data sources at the national level are all at a high aggregation level. The different datasets are often unreliable contradictory contradict each other. Many assumptions are needed to extract the food from the general cargo or transport flows, further reducing the reliability. Results to date are enough to provide logistical context, but not fine-grained enough to draw conclusions regarding food logistics in the region, or to connect them to the food flow data from the other cases. While rough data from highways may be adequate for providing insight into the large agricultural flows, to get a handle on the real mobility problems associated with food flows, the level of focus should be on smaller vehicles within urban areas and the secondary road network.

2.4.4 Scenarios and design

The scenarios, (see 2.3.4) have been elaborated, discussed and made specific for the MRA. This has been done in workshop in Haarlemmermeer (March, 2018). Next to this two WUR students and the department of landscape architecture have developed a design (May, 2018).

The workshop was attended by local stakeholders and people with a specific interest in food initiatives and planning in the MRA. The objective was to discuss new forms of local food supply and distribution, towards a regional food strategy. The discussion started with the two scenario's to explore the transition from an international oriented food system to a more regional food system. Resilient Metropolitan Food Shed and Smart and Inclusive Food Cities. Both of the scenario's do contrast, but do also complement to each other, both representing potential directions for strategic choices and local initiative.

Scenario 1: Resilient Metropolitan Food Shed	Scenario 2: Smart & Inclusive Food Cities
Based on the different landscapes in the MRA, this scenario combines: ▪ High productive and resource use efficent, climate neutral agriculture in the polders of Noord Holland and Flevoland. ▪ Small scale agriculture at less suitabel soils of the Veenweide Area. Characteristics of this scenario:	▪ Food innovation, circularity and vertical farming are part of the city development plans ▪ Involvement of citizens and consumers with food production. Characteristics: ▪ Development of new smart food districts in the city ▪ Food parcs and community gardens for the use of citizens

[4] Agri-food is defined here as the (inputs for) primary production on the one hand (including non-food products), and food processing, food service and retail on the other.
[5] Pas, H. t. (2018, 01 26). *IRI: Jumbo wint, AH verliest marktaandeel*. Retrieved from www.distrifood.nl

▪ Enhance the regional food supply of plant based proteins fruit and vegetables. ▪ Guarantee drink water supply, agro forestry ▪ Decrease of CO2 emissions ▪ Apply new and sustainable forms of mixed farming ▪ Create hubs and distribution infrastructures towards the consumers in the Metropole. ▪ Create multi functional landscapes ▪ Avoid soil subsidence and reduce costs of water management	▪ New synergies with other sectors, circularity ▪ Small scale inititiatives. Social benedits, ▪ New local distribution systems ▪ Aquaponic systems and vertical farming

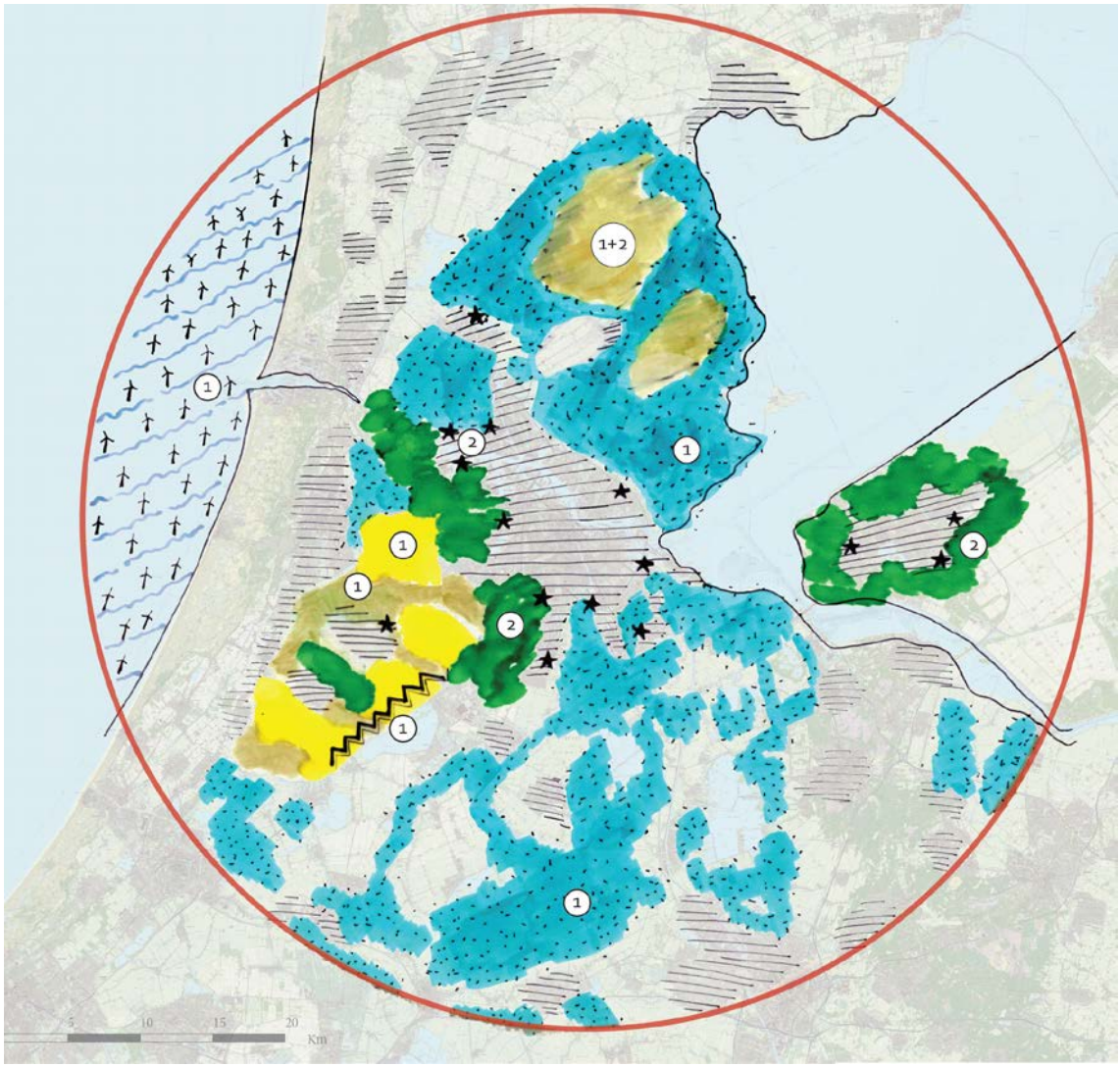
In both of the scenarios, the value chain approach (production, processing, distribution and retail) will be applied.,The workshop has lead to a better understanding of the actual situation and of the future directions. Also some more concrete ideas for initiatives or projects have been developed.

Design
Based on the scenario's and the data, the landscape architects have made an integrated design for the MRA. The quality of the soil will determine what the agricultural landscape can produce and deliver to the MRA. The design has taken into account also the climate adaptation needs and measures. A distinction has been made in type of products, productivity (per hectare) and available surface.

The Foodprint has shown a small surplus for the total need, but a deficit on some specific products and ingredients: oilseed plants, livestock feed en fruit. The question is if the transition will be able to replace products to broaden the production of specific crops or ingredients? This seems to be possile for fruit production, but seems to be less attractive for oilseeds and livestock, because of the potential benefits are lower than in other production areas in the Netherlands. It is also the question whether food production in the cities under far from excelent circumstances should be promoted, as in the meantime the city is expanding by using fertile agricultural production land?

The architects found 11 spaces and initiatives just outside the metropolitan area which are very suitable for agricultural activities and production for the metropole, in a close distance to the market:

1	Haarlemmermeer: transition to fruit production in the lease seepage sensitive areas
2	Haarlemmermeer: transition to livestock in the most seepage sensitive areas.
3	Park 21 as food plantage
4	Beemster and Purmer Polders: transition to livestock feed en oilseed plants
5	Veenweide: transition to aquacultures en paludicultures
6	Aalsmeer: transition of old greenhouse complex to new vegetable production complex
7	old industrial complexes and building: transition to integrated production of fish, vegetables and feed
8	Greenbelt of urban farming in the parcs around the urban areas: plantages, community gardens.
9	Seewead production on sea. In combination withwind energies
10	Fresh water production of crops and fish in Broek in waterlan
11	Almere: new plantages at the edge of the urban areas.



Verbeelding scenario 1 & 2 MRA

Legenda

- Zoetwaterteelt, aquacultuur en paludicultuur
- Minst kwelgevoelig: fruitteelt
- Greenbelt/ groene lobben/ voedselplantage
- Zeer kwelgevoelig: lifestock feed/ oilseed plants
- Bebouwd gebied
- Zeewierproductie + windmolenparken
- Transitie van bedrijventerreinen naar stadslandbouwcomplexen
- Afronden glassanering naar nieuwe groente-complexen
- 1 Scenario 1: resilient metropolitan foodshed
- 2 Scenario 2: smart & inclusive food cities

Figure 5: Scenario map

2.4.5 Data management

The project aim is to provide data and insights to change agents. Data management and communication are key to impact, which requires data to be accessible and available in a way that stakeholders can grasp and use. Data management efforts focused on the food actor dataset, which is designed for continuous updating and sharing. Key issues that came up:

Agreements about access to data. Most data used in the project to create new datasets were made available by public bodies, for the specific purpose and duration of the project. Continuous access to the newly created datasets raises issues around data ownership (when has the dataset been altered to

such an extent that ownership lies with the consortium?), business case (can cost recovery fees be charged in future when the original data are not to be used for commercial purposes?) and confidentiality (are there privacy or commercial concerns around sharing the data?). Discussions with the five original data owners feeding the food actor dataset showed that each held a different position regarding these questions; overall, protocols are lacking for dealing with these questions; and concerns around the GDPR which came into force during the project led to uncertainties around sharing of data. An outline for longer-term collaboration and sharing of data was drafted, to be further developed.

Communication and representation of data. Due to its complex nature, communicating about the food system is a challenge which requires bringing different scales and types of data together in a coherent way. Visualisation is key, but proved time-intensive due to the diversity in data types and formats . Choice of colour, scale and complexity of visualisation has a great impact on its use. Tools and platforms like Carto and QGIS helped to quickly visualize simplified datasets, but one platform to connect and visualize different types of data and scales has yet to be found. This is a priority for future research

Data collection and updating. While the food actor dataset was designed to be continuously updated, other parts of the project did not have this focus, and thus, placed less emphasis on continuous access to source data. The consequence of this disparity is that not all data collected could be connected in the food system map, as they carry different use conditions and frequency of updates.
The intention is to update the Almere food flow data yearly, through student projects. In collecting data students are involved in observation, surveys and counts. Briefing students takes time and needs constant monitoring, which will be provided by integrating this activity into the Aeres education programme. The food actor dataset is designed for semi-annual updates. A higher frequency makes no sense as three out of the four establishment registers that it is built on are only refreshed on a yearly basis. Updating requires contacting the data owners to obtain csv files, loading them into the R script, and running the APIs to pull in additional data.

Data infrastructure. Data infrastructure requiremens were explored, in terms of ensuring continuous and cost-effective access to the generated food system data for target groups with varying levels of authorisation. Together with the AMS data steward, consultations were held with the Wageningen Research data team; the WUR Agro-food cube and the UvA / HvA research data management team, among others. For the time being, the project partners' infrastructure suffices for keeping the data safe. For the future, a partner should be sought with existing data infrastructure and expertise, who can offer a) a secure server environment that allows for different datasets to be stored with relations to each other; b) server capacity for running calculations (code), and c) a portal through which outsiders (upon authorisation) can get secure access to (parts of) the data. Potential partners include VU Amsterdam, Wageningen Agro-food cube and the Flevoland food cube.

2.5 Conclusion

The data gathered by the project has led to a good picture of the current agrofood production and the agricultural potential; we know the numbers and the actors. The project also resulted in novel methodologies to gather much more elusive data on food flows. These need further elaboration. The direction of the transition has been made clearer by using the scenarios. This is not enough to change the system, but requires much more alignment and engagement with different public, private and knowledge partners, civil society, urban as well as rural actors. Discussions and workshops with stakeholders led to sharing evidence, and to enhanced awareness of, a small part of the Amsterdam Regional network. At the level of cases we have arrived somewhat further in the application of our insights in specific environments and networks.

New insights on current production and the potential of the larger region to enhance the local/regional food production and to develop or plan a regional food system. This evidence based research debates current approaches and initiatives and shows new directions. We need more focus on the agricultural production outside the urban area (metropolitan food shed), and transition of current production in certain parts of the region. Also we need less focus on inner city production (Smart city farming).

The cases provide valuable methodological learnings and some first insights. For the next phase, we recommend a) to broaden the project findings to other parts of the supply chain and geographical areas, and b) to deepen the findings

a) Broadening findings. An important conclusion is that, when considering the regional food system, the whole of Noord-Holland should be included in the analysis due to its key role in food production and inextricable ties to the rest of the MRA in terms of production and logistics. Also, broadening means testing methodologies on other links in the food chain: do methods to map Horeca food logistics also apply to retail? Can the food flows in Almere be traced not only from retailer to consumption, but also from producer to retailer? This will require involving new partners and stakeholders, such as regional rural actors and networks (agricultural producers, farmer organizations, Greenport Noord-Holland-Noord and Flevo Food Netwerk.

b) Deepening findings: This entails improving the quality of data and insights gained. We need better data of consumers, for example more insight in actual diets of citizens and personal data on social class, age, lifestyle, and neighbourhoods. We need also more information about the caloric and nutritional information of current and potential crops and agrofood production systems. The accuracy of the food actor map needs improvement, by fine-tuning the algorithms for filtering data and finding other data sources to complement and validate the dataset. Finally, there is the need for more details on production landscape as soils, weather conditions and innovation pathways.

The debate about food is dominated by multiple ideologies, beliefs and convictions. The Evidence Based Food System Design project leads to new knowledge, insights and directions that do not necessarily match these beliefs. To arrive at a sustainable regional food system, more time is needed for interactions, for pilots, for new concepts, visions and strategy to come to a common understanding of the regional food system. We need to invest more in interactions, in bringing people together in workshops, scenario planning and design activities. Organizing workshops will not be enough. The MRA network, AMS and the EFSD partners need to invest more in network development, and Engagement and Alignment strategies, and create triple and quadruple helix networks and overcome the urban rural divide.

Another key recommendation is to invest in the creation of a data platform, where information is stored and made accessible. The information generated by the project is still fragmented at different institutions or databanks, and is far from comprehensive, due to different levels of aggregation, time frame and accuracy. We have started to explore initiatives to improve data collection and the development of new information services, together with AMS, and partners. The next step is to define the requirements, institutional set-up and business case of the data infrastructure that can unlock the food actor data for further research and use by stakeholders. Such infrastructure should take into account the need to regulate access (at different levels) to the data. It should leave scope for expanding the datasets (in terms of breadth and time series), and linking them with other food system data.

2.6 Impact and benefits for the Metropolitan Region Amsterdam

The added value of the EFSD project lies in integrating and iterating between these layers and levels. Connecting research and methodology development at MRA level with specific case studies at municipal level ensures that concepts are grounded in reality. Also, by taking into account the different aspects of the food system and their interlinkages, insights are rooted in deep understanding of the various relevant aspects of the food system, so that they are of use in practice

The exchange between WEnR, HvA, AERES and AMS implies opportunities for synergy in terms of objective setting and methodology, allowing for an integrated approach benefiting both efficiency and available research resources. By pooling their resources, the project partners make optimal use of limited funds and expertise, and create a larger network that will benefit each of the project components.

More concrete EFSD will have impact on:

Politics and policies at the level of municipalities and MRA: Awareness of civil servants and politicians was increased through one-on-one interaction, input into municipal debates, conferences, working groups and briefings (for example, the new city council of Amsterdam during We Make the City) As such, EFSD provided input and fostered support for local food policies, both in Amsterdam and Almere. The added value lies in awareness raising, agenda-setting and providing insights. Furthermore, a foundation was laid for tools to monitor and evaluate policy– specifically Almere's aim to procure 20% of its food consumption regionally by 2020.

Network development. In the project cases, actors with different backgrounds and politics, society, education and the data community were brought together and mobilised around a common goal.

Data sharing. The project made various actors working on Regional Food System transitions aware of the (need for) data on the system. These include Food Circle (network of organisations combating food waste) and Amsterdam Made (promoting regional food producers). Also, he project surfaced and created awareness of the challenges and opportunities around collection and sharing data on the Regional Food System. This has moved actors to examine their own contribution and protocols, and led to initiatives to improve data management

2.7 Spin-off and valorisation

The EFSD project significantly raised interest in building food system evidence base, not least through its many outreach activities (see Chapter 3). This led in concrete assignments and requests for proposals from, among others, gemeente Haarlemmermeer (December 2017 - May 2018) and Flevocampus (from September 2018) to expand, broaden or deepen the research. Of even greater value than the research funding released for the topic, is the fact that the food system as unit of research is now on the research agenda of relevant institutions such as Flevocampus, and on the policy radar of (municipalities in) the MRA.

There is a clear business opportunity to develop an interactive dashboard or simulation game as a tool to offer data and advisory services to help policymakers derive actionable insights from the project data. Explorations are ongoing (among others, with the HvA/Uva IXA department and the Aeres Geomedia design department, how to turn this into a start-up business. Such a startup would not only provide the financial means to cover the cost of keeping the food actor data up-to-date, but also an invaluable way to support change agents in the food system to utilise the (insights derived from the) data for effecting change. A grant has been requested from the Rabobank and gemeente Zaanstad to keep the data up-to-date and in the air until the start-up is up and running.

Besides the dashboard, there are opportunities for building an infrastructure that makes the project data available for other researchers, as well as a basis for tailor-made data analysis. Already during the project, almost 10 requests were received for access to the data - ranging from students and PhD candidates to government officials and a network of NGOs. The business case of managing these efficiently, responsibly and at cost is a business challenge in itself that will be further explored.

Already during the project, the data generated were already valorised in education and research, introducing the concept of metropolitan food systems and methodologies for understanding their characteristics and value. Methodologies and cases on food system and flow mapping, data manipulation and visualisation were brought to students for learning and testing, and provided new angles for education and research. At Aeres, the results serve as input for the Geomedia and Design (GMD) track, and will serve as a foundational element of the new Urban food systems Master (to be launched in 2019). The HvA integrated project results in the Afstudeeratelier Food-City-Afval, giving the participating logistics students access to the methodology and part of the data. Project findings formed the basis for sessions at various summer courses in Amsterdam and Wageningen (see 3.2 Presentations). A subset of the food actor data was shared with students and researchers at Wageningen university and TU Delft (through AMS) for their research projects.

2.8 Key references

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3. Key publications realized by project members

3.1 Publications

- Brochure on the EFSD project in colour and A5 format (1000 copies), in collaboration with AMS
- Wertheim-Heck S., Levelt, M., Brug, L. ten, Bossum, J. van (2018-submission), Meeting the growing appetite of cities - delivering an evidence base for urban food policy. Extended abstract submitted to the International Conference - Reframing Urban Resilience Implementation, Barcelona 10-15 December 2018.
- Almeerse Voedsel stromen CoE Food report/brochure
- Kranendonk (2018, in prep). EFSD, chapter in Sustainable Cities; Nature-based solutions for the metropolitan areas of the World '' Book on Metropolitan Solutions Research Program''.

3.2 Presentations

- *Summer school UvA AMSIB* (6 July 2018). Sustainable food distribution in the Amsterdam Metropolitan Region Kees-Willem Rademakers and Melika Levelt (guest lecturers)
- *SamenNH ToekomstCongres 2018* - (Haarlem 5 July 2018). Jessica van Bossum (Invited speaker).Pitch about the value and applications of data on the food system
- *Summer School UvA The Urban Food Experience* (Amsterdam, 5 juli). Melika Levelt (guest lecturer). Sharing insights from the EFSD project on food logistics
- *Summer School UvA The Urban Food Experience* (Amsterdam, 4 juli). Jessica van Bossum (guest lecturer). Sharing insights from the EFSD project on mapping urban food systems
- *Summer school WUR Operations Research* (Wageningen, 2 July). Sustainable food logistics in the Amsterdam Metropolitan Region. Kees-Willem Rademakers (guest lecturer / case owner)
- *We Make the City gebieds-meetup# 6: Zuidas. Verduurzaming van de logistieke infrastructuur ter verbetering van de leefbaarheid* - Stakeholder session Verduurzamen van Horecalogistiek op de Zuidas (Amsterdam, 22 June 2018). Jessica van Bossum (Speaker/facilitator), Kees-Willem Rademakers (content)
- *We Make The City - De Hongerige Stad : Hoe ziet het voedselsysteem van morgen eruit?* – Expedition Stromen van de stad: Hoe ons eten door de stad beweegt (Amsterdam, 21 June 2018). Arjen Spijkerman (Speaker), Jessica van Bossum (Speaker), Kees-Willem Rademakers (Speaker).
- Rabobank Amsterdam - Presentation of web map and dataset (Amsterdam, 30 May 2018). Jessica van Bossum
- Open Forum on Collaborative Food Waste Solutions - Working session on food data collection, access and web mapping (Amsterdam, 29 May 2018). Jessica van Bossum
- Horeca-overleg Hello Zuidas - Pitch Food service research (case within Evidence-based Food System design) (Amsterdam, 28 May 2018). Jessica van Bossum, Kees-Willem Rademakers
- Provincie Noord-Holland - Presentation on data process Evidence-Based Food System Design (Haarlem, 28 May 2018). Jessica van Bossum
- AMS Science for the City 9: Food-proof cities: How do we feed the increasingly car-free, yet growing city of Amsterdam? (Amsterdam, 8 May 2018). Arjen Spijkerman (Speaker), Melika Levelt (Speaker) Jessica van Bossum (roundtable host), Kees-Willem Rademakers (roundtable host)
- Provincie Flevoland - Presentation of the data process Evidence-based Food System Design (Lelystad, 24 Apr 2018) Jessica van Bossum
- Datalab Amsterdam Demo donderdag - Evidence-based food system design (Amsterdam, 12 Apr 2018). Jessica van Bossum (speaker). Link: https://www.meetup.com/nl-NL/DataLab-Amsterdam/events/248693014/
- Stakeholder Consultation Food Center Amsterdam(Amsterdam, 20 Mar 2018) Jessica van Bossum, Kees-Willem Rademakers

- Presentation ‘Voedselstromen Almere-Flevoland’ during inauguration Sigrid Wertheim-Heck as Lector Food and Healthy Living, Aeres University of Applied Sciences.
- Flevocampus - Progress presentation on EFSD project (Almere, 8 Mar 2018). Dirk Wascher, Melika Levelt, Arjen Spijkerman, Lisa ten Brug
- Flows of Food conference – session food logistics (Amsterdam, 7 Dec 2017) Melika Levelt, Kees-Willem Rademakers
- Voeding voor de stad: Een conferentie over duurzame voedselvoorziening in Haarlem - Research input and maps of Haarlem food system (Haarlem, 3 Nov 2017). Jessica van Bossum.
- Landschapstriennale 2017: Het volgende landschap - Workshop Evidence-Based Food System Design (Nieuw-Vennep, 18 Sep 2017). Jessica van Bossum, Melika Levelt. Workshop to sharpen the research questions around sustainable regional food systems in the MRA
- Zero Hunger Partnerships for Impact' August 30-31, 2018 in Wageningen. Conference on SDG’s, Wageningen. Session on Metropolitan Solutions, the Case of EFSD. Remco Kranendonk.

3.3 Audiovisual material

Vlog: Flevocampus on research programma: Sigrid Wertheim-Heck on Food in the city:
https://www.youtube.com/watch?v=7ZzSH3nKGuo
Film: Student Challenge 2017-2018 by Dirk Wascher and Arjen Spijkerman, WEnR**:**
https://www.youtube.com/watch?v=ErrWCeeXkKo&t=3s
Livestream AMS Science for the City session at Pakhuis de Zwijger:
https://dezwijger.nl/programma/food-proof-cities
Movie Food logistics in the MRA (HvA communications, in production. Expected publication mid-July 2018)
Film: Student Data Crunch day at the Big Data Value Centre
https://www.pluraal.nl/actueel-media/248777_voedselstromen-in-flevoland

3.4 Social media

Melika Levelt@Voedsel in de stad (project staff HvA): 15 tweets and 33 retweets about the project, with 41 likes.

4. Key datasets realized by the project

Below table gives an overview of the datasets produced during the project, their attributes and the level and type of access. The datasets produced by HvA (and their metadata) are archived on Figshare, with their own DOI. Explorations on where to
Discussions with the AMS data steward

Dataset	**Data steward**	**Attributes**	**Access**
Food actors MRA - public	HvA	Categorisation by economic activity, English and Dutch descriptions thereof, size category, geocoordinates	Open access. Access through web map.
Food actors MRA - semi-public	HvA		Restricted. Available to specific target groups upon request, subject to conditions and NDA
Food actors MRA - full dataset	HvA	See annex 4 - Metadata Food actors MRA	Confidential. Access to raw data only for researchers directly involved in the EFSD research
Deliveries Horeca Amsterdam	HvA	Name, category	Confidential
Food consumption MRA	HvA	Municipality, food group (17 groups), no. of residents, total consumption current / healthy / vegetarian in tonnes per year	Open access. Data and code available upon request
Database Almere markt	Aeres	Fruit and vegetables stalles per market. Info on prices and origin per product per market in Almere	Aeres Hogeschool
Dataset Almere supermarket	Aeres	Fruit and vegetable product data on origin / price / if they are organic in Almere supermarket	Aeres Hogeschool
Dataset Almere toko	Aeres	Fruit and vegetable product data on origin / price / if they are organic in Almere toko	Aeres Hogeschool
Interviews retailers, policy makers and producers	Aeres / Wageningen	information on local produce and local retail	Aeres Hogeschool
Survey consumers	Aeres	information on shopping behaviour and local purchases	Aeres Hogeschool

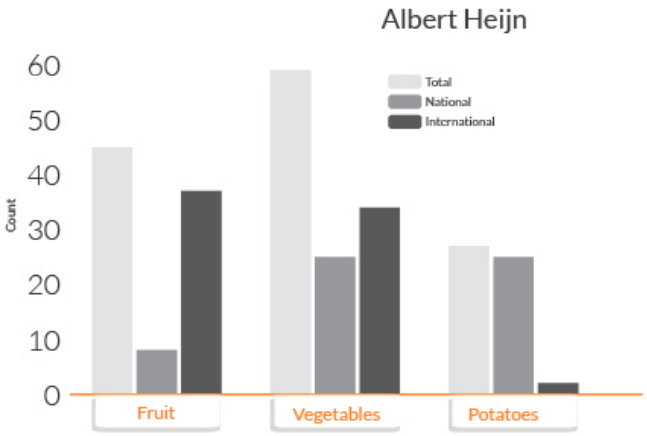
Annex 1 - Food consumption in the MRA

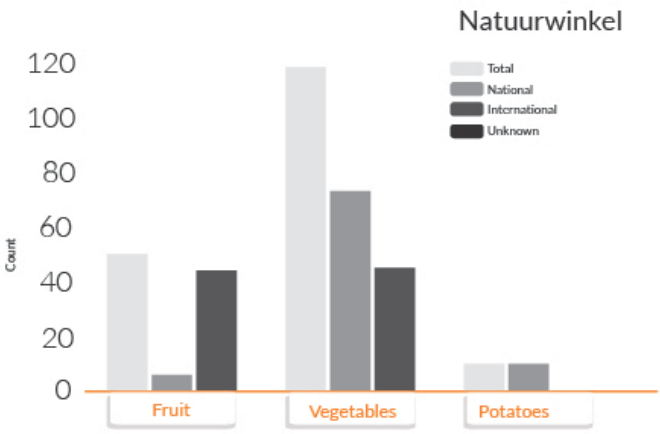
Food group	Current	Healthy	Vegetarian
01. Potatoes and other tubers	72.603	113.450	113.450
02. Vegetables	94.997	187.581	187.581
03. Legumes	2.277	14.500	28.997
04. Fruit	94.050	156.486	156.486
05. Milk and milk products (incl. cheese)	301.281	375.929	375.929
06. Bread and grain products	156.679	224.338	224.338
07. Meat and meat products	81.622	55.164	-
08. Fish and seafood	12.172	10.780	10.780
09. Eggs	9.057	14.241	19.822
10. Fats and oils	20.705	38.996	38.996
11. Sugar and confectionery	39.168	-	-
12. Cakes, biscuits and pastries	37.832	-	-
13. Non-alcoholic beverages	1.258.267	940.801	941.044
14. Alcoholic beverages	134.181	-	-
15. Condiments and sauces	24.105	-	-
16. Soups, bouillon	47.611	-	-
17. Miscellaneous	13.676	17.466	22.312
Total consumption	**2.400.283**	**2.149.732**	**2.119.735**
Consumption excl. Beverages	**1.007.835**	**1.208.931**	**1.178.691**

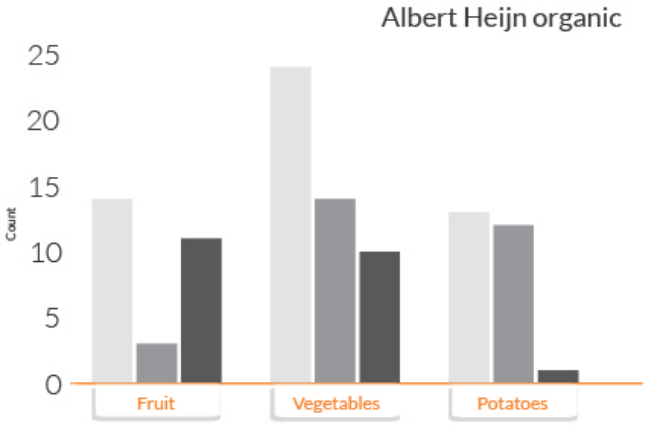
Table xxx. Total consumption in the MRA by EPIC food group, in tonnes per year.

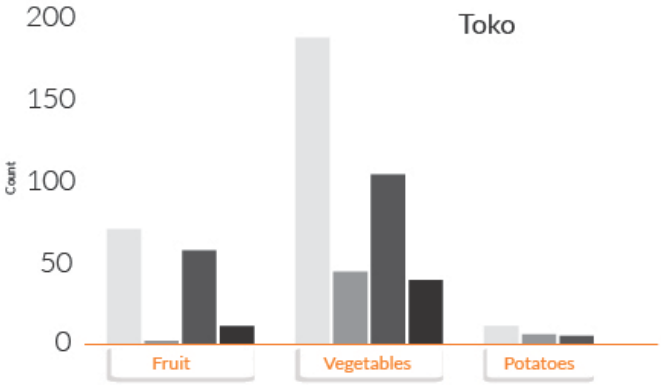
Annex 2 – Origin of food products by retail outlet, Almere

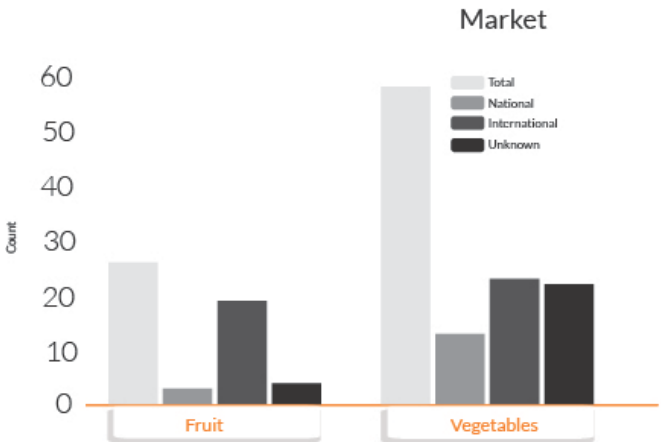
Annex 3 - Visualisations Case 1 Almere



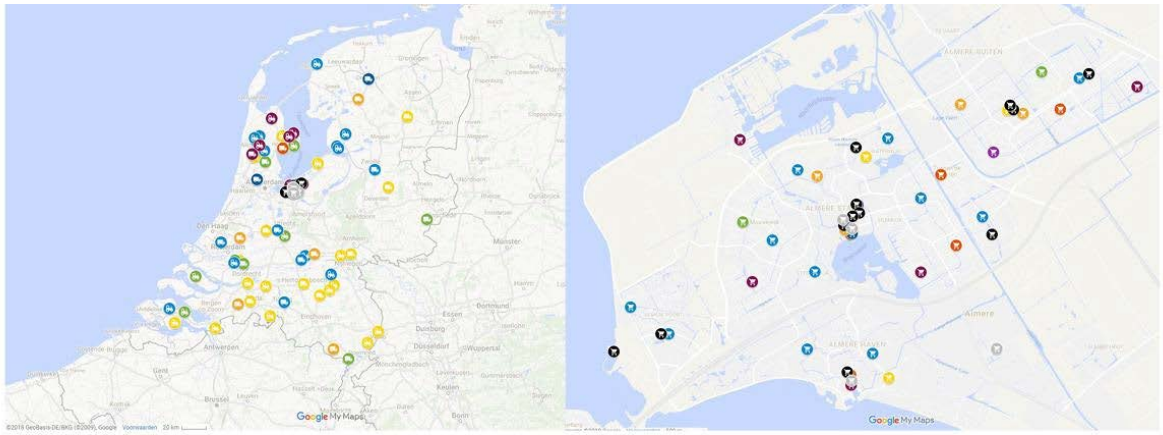








Overview collected data region - retail - consumer _ Overview created mapsfrom data



Annex 4 - Metadata of food actor dataset

Title	180604_DataSet_complete_EN
Date	04-Jun-18
Date type	Work in progress. See 'Status'
Dataframe dimensions	25728 observations, 30 attributes
File size	987 KB
Name	Dataset Food actors MRA 2017
Summary	The dataset contains the geolocation and a number of attributes of all commercial establishments identified as engaged in Food Service, within the Amsterdam municipal borders (excl. Event catering)
Purpose of creation	The dataset was created under the umbrella of the Evidence-Based Food System Design research project. This project was executed by a consortium of research institutions (Wageningen UR, Hogeschool van Amsterdam, Aeres Hogeschool, AMS). Goal of the project is to provide stakeholders in the MRA food system (government bodies, NGOs, private sector) with insights that help them to realise the transition to a more sustainbale regional food system. The full EFSD Food actor dataset is intended as the basis for a dashboard to monitor the composition and nature of the food value chain in the region. This subset, focused on food service in Amsterdam, was created for the purpose of research by students and researchers at the institutions involved in the EFSD consortium
Status	Work in progress. The dataset contains various errors and omissions. Issues currently being addressed: Elimination of duplicates; addition of not-for-profit establishments; filling data gaps by drawing on the Horeca Informatie Systeem (municipality of Amsterdam) and web data; further refinement of filters to identify non-active establishments and refinement of categorisation
Geographical coverage	Amsterdam Metropolitan Area
Coordinate Reference System	WGS 84 / EPSG 4326
Owner	
Organisation	Hogeschool van Amsterdam
Name of contact person	Jessica van Bossum
Contact details	j.j.van.bossum@hva.nl
Availability	
Frequency	Semi-annually
Available through	Contact person
File format	Csv
User limitations and conditions	
Legal access restrictions	The dataset may only be used for research purposes, and only with prior consent from the owner. Sharing the data with third parties is not allowed. The dataset may not be used for commercial purposes, nor may individual establishments included in this dataset be contacted based on this dataset. The data, or derivatives thereof, may only be published or made public in any form with prior consent of the owner. Users must sign a statement agreeing to these conditions prior to receiving the data

Other restrictions	In any publication of results (partly) derived from the data, reference must be made to the owner (Hogeschool van Amsterdam) and the EFSD project
General description of origin and creation of the dataset	The dataset is composed of (cleansed and combined) data from the following sources: the employment register Amsterdam Region of the Municipality of Amsterdam (ARRA); the Chamber of Commerce Trade register (HR) ; and the registry of addresses and buildings (BAG). These data, which cover all postcode areas within the Amsterdam Metropolitan Area, were filtered to yield a set of establishments that play a physical role in the food flows within the MRA: primary production, food industry, wholesale, retail, food service, logistics services and waste flow processing (*the latter two categories have not yet been filtered on food-related activities*). All establishments with less than two full-time employees were eliminated from the dataset, to avoid identification of natural persons. An English translation of activity descriptions was addedGeo-coordinates were transformed from RD coordinates to WGS1984 coordinates, which is more current in web cartography.
Other remarks regarding use of the dataset	One establishment may have more than one food-related activity. In this dataset, establishments with more than one food-related activities are included multiple times, so as to enable plotting them on multiple map layers. This means the dataset contains duplicate establishments

Annex 5 - Research used in gathering data on Case 2 - Delivery to food service establishments in Amsterdam

Balm, S., Stam, R., Ferreira, E. (2015). *Verkeersonderzoek Ferdinand Bolstraat.* Amsterdam: Hogeschool van Amsterdam Urban technology

Dufec (2016). *Onderzoek naar hinder van laden-lossen verkeer*. Amsterdam: Gemeente Amsterdam

Koldenhof, B. (2018) - *in development* [bachelor thesis]. Amsterdam: Hogeschool van Amsterdam Logistics Engineering.

Ploos van Amstel, W. Balm, S., Kooi, M. …. (2016). *Stadslogistiek in beeld. De bevoorrading van goederen in de Oude Pijp in Amsterdam: kenmerken en kansen*. Amsterdam: Hogeschool van Amsterdam, EVO, LeanCargo Consultancy, Gemeente Amsterdam Stadsdeel Zuid.

Schillemans, P., de Wilde, E., de Vries, J. Azgar, M. (2015). *Adviesrapport Haarlemmerbuurt. Advisering over hoe de logistiek in de Haarlemmerbuurt beter, slimmer en schoner kan worden geregeld* [minor thesis]. Amsterdam: Hogeschool van Amsterdam Logistics Engineering.

van den Berg, G. (2018). *De aantrekkingskracht van de stad Amsterdam. Onderzoek naar horecadistributie op het Bellamyplein* [bachelor thesis]. Amsterdam: Hogeschool van Amsterdam Logistics Engineering.

Vergeer, S. (2017). *Stadsdistributie op straatniveau. Onderzoek naar horecadistributie in de binnenstad van Amsterdam op een integrale manier* [bachelor thesis]. Amsterdam: Hogeschool van Amsterdam Logistics Engineering.

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