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A METROPOLITAN FOOTPRINT TOOL FOR SPATIAL PLANNING AT THE EXAMPLE OF FOOD SAFETY AND SECURITY IN THE ROTTERDAM REGION

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Keywords: food consumption, ecological footprint, spatial planning, sustainable cities

Abstract: Recognizing that food production and consumption is not only linked via one-directional food chains in terms of processing and logistic pathways, but also part of cross-sectoral and hence multi-directional value chains associated with bio-economy, the EU project FOODMETRES has explored the role of metropolitan footprint assessments as decision support tools for spatial planning at the regional and European level, estimating self-sufficiency at the level of metropolitan regions. The tools are also able to derive spatial zoning with an urban core area, followed by a green buffer reserved for nature and recreation, a metropolitan food production zone differentiating a plant-based and a protein-based supply zone, and a transition zone, which is meant to provide food for adjacent urban areas. Within this zoning strategy, food safety aspects are incorporated by placing livestock farming at a remote position following the need to reduce direct expose of core urban population to this sector's impacts (health, odours and food safety issues). Central to these efforts has been the attention to metropolitan regions. As global hotspots for trade, transport and tourism, metropolitan regions hold extremely high stakes in food logistics, safety and quality. At the same time they are places where local, regional and global agro-food processes have a great potential for generating synergy. Therefore, metropolitan regions can be considered as being privileged for agro-food system innovation. This paper illustrates possible applications of this tool in the context of the Metropolitan Region Rotterdam-DenHaag (MRDH) and puts forward spatial planning recommendations for food safety and food security targets.

1. Background: Food Safety

Conventional food production operates in a global food supply network, which has been increasing exponentially since the 1960s. Figure 1 illustrates that the per-capita trade activity at the level of Global Agro-Food Systems (GAS) is largest for The Netherlands and hence a case in point to act as a potential vector for microbiological or chemical contaminations. Ercsey-Ravasz et al. (2012) stress the need to monitor, understand, and control food trade flows as it becomes "an issue no longer affecting just single countries, but the global livelihood of the human population".

At the level of Local Agro-Food Systems (LAS), food safety and quality usually depends largely on one person, or a small team and are therefore prone to conflict with other daily activities or transparency issues. Production of healthy food requires avoiding excessive accumulation of undesirable – or even harmful – substances like heavy metals or nitrates in food products, which can be a problem in urban agriculture. Most food produced in cities is consumed directly by the growers themselves, without having passed any safety assurance system. More analyses, more evidence, targeted professional advice to practitioners, and better media information are crucial on these issues. On the other hand, with raw materials usually coming from local sources and food storage, processing or transactions being clearly restricted, food safety risks associated with LAS must be considered as rather marginal, certainly when compared to the inevitable delays when tracing contamination pathway within the complex nature of GAS. The really limiting factor of LAS, however, is the size of the area available for

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food production: the 105 urban agricultural initiatives within the Municipality of Rotterdam cover about 31.5 hectare in total (Kirsima, 2013) which amounts to less than 0.05% of the area needed for 600.000 citizens (see Figure 2).

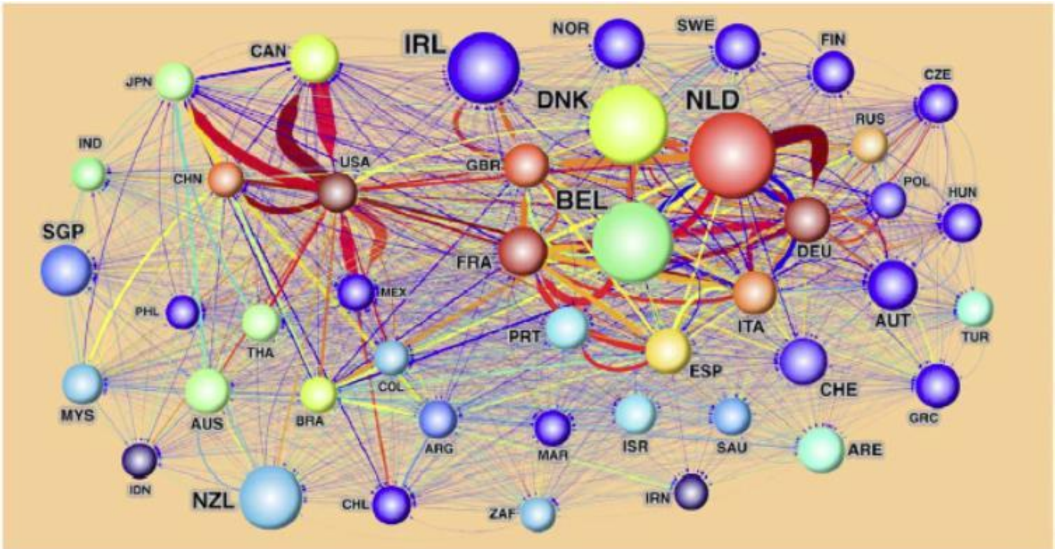


Figure 1. International trade activities in 2007 at the level of GAS (Ercsey-Ravasz et al., 2012).

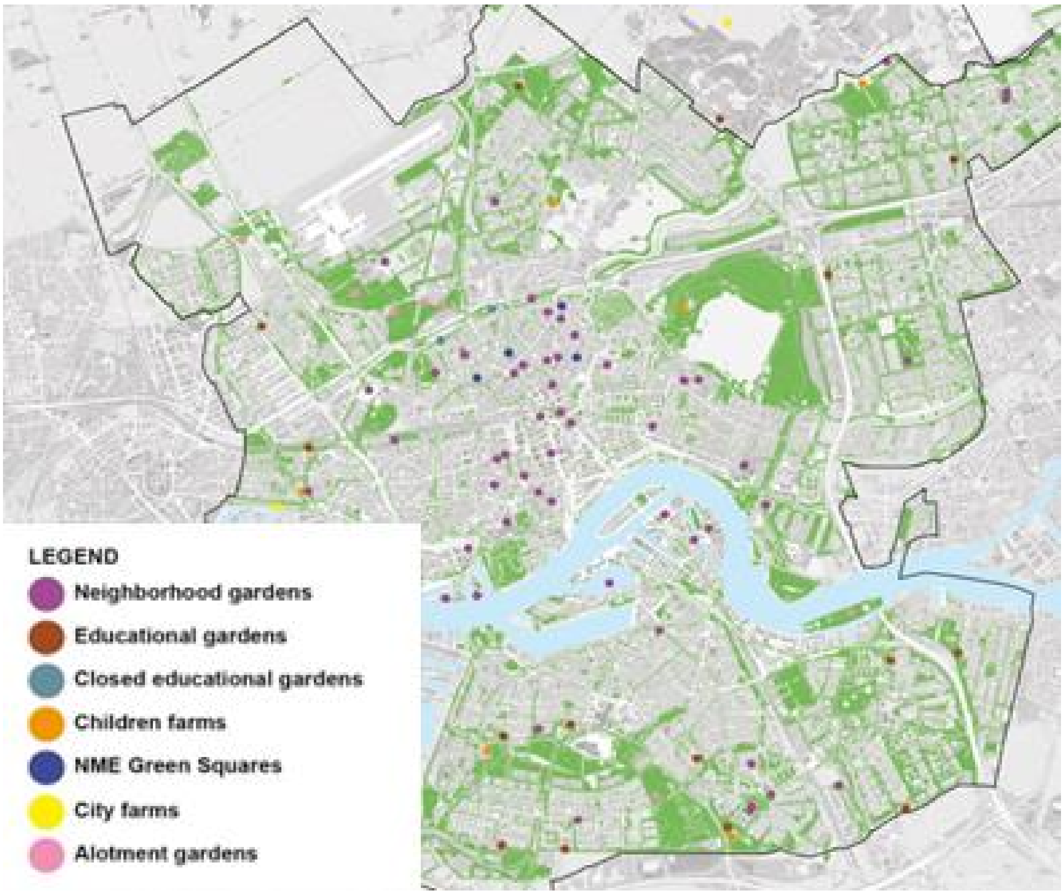


Figure 2: Local Agricultural Food Systems of Rotterdam

Being the global hotspot for agricultural world trade, the Metropoolregio Rotterdam – Den Haag (MRDH) holds extremely high stakes in food logistics, safety and quality. At the same time it is a place where local, regional and global agro-food processes have a great potential for generating synergy. To date, food safety problems are often directly related to the fact that many people live in high population density areas, animals are intensively kept, transport networks are complex and pathogenic vectors affecting human health are extremely mobile by air, water and organisms. At the same time, the ongoing 'transition' toward a 'low carbon' society calls for a new 're-localisation' of energy and matter flows, especially between urban and rural domain. In this context, The FOODMETRES project seeks to contribute with spatial and functional assessment tools that are based on the principles of coherent 'food sheds' or zones.

Such an approach needs to adhere to the following principles: (1) *resource efficiency measures* for saving energy, water, nutrients and space, (2) *circular economy* to minimize waste and optimise value chains, and (3) *spatial zonation* to better manage health risks associated with intensive livestock farming, such as Q-fever, MRSA, ESBL, and the threat of an H5N1 pandemic (CEG, 2012).

2. Ecological Footprint as a Conceptual Framework

The European Sustainable Development Strategy (CEC, 2009) addresses a broad range of 'unsustainable trends' ranging from public health, poverty and social exclusion to climate change, energy use and management of natural resources. A key objective of the SDS is to promote development that does not exceed ecosystem carrying capacity and to decouple economic growth from negative environmental impacts. A report commissioned by the European Commission (2008) came to the conclusion that the Ecological Footprint should be used by EU institutions within the

Table 1: Ecological footprints in global and local hectares based on the population figures for the six case study areas

	Inhabitants (million)	Global Hectares per capita*	Global area (km2)	Local Hectares per capita**	Local area (km2)
Berlin	3.5	2.05	71750	0.18	6300
Rotterdam	1.2	2.21	26520	0.21	2520
London	8.6	2.36	202960	0.15	12900
Milano	1.2	1.55	18600	0.20	2400
Ljubljana	0.3	1.04	3120	0.15	450
Nairobi***	3.5	0.80	28000	0.10	3500

Sources:
* EUREAPA online scenario modelling and policy assessment tool (Briggs, 2011)
** National references and estimates based on EFSA (2011)
*** EUREAPA data for S-Africa & estimates

Sustainable Development Indicators (SDI) framework.

The Ecological Footprint measures how much biologically productive land and water area is required to provide the resources consumed and absorb the wastes generated by a human population, taking into account prevailing technology. The annual production of biologically provided resources, called bio-capacity, is also measured as part of the methodology. The Ecological Footprint and bio-capacity are each measured in *global hectares*, a standardized unit of measurement equal to 1 hectare with global average productivity (CEC, 2008).

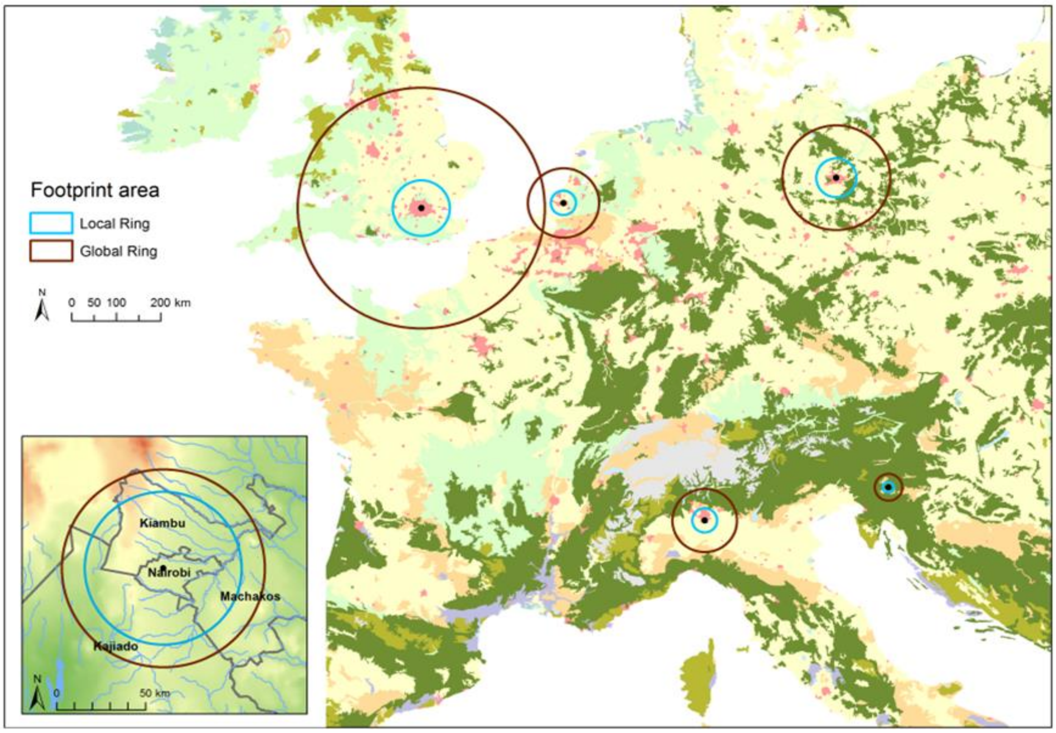


Figure 3: Ecological footprint (EF) in global and local hectares for London, Rotterdam City Region, Berlin, Milano, Ljubljana and Nairobi*2*. Large dark circles as global hectares and small blue circles as local hectares showing the land requirements in terms of food production areas based on national accounts.

However, due to a fragmented research history with simultaneous and largely uncoordinated efforts across sectors, research institutes and regions, ecological footprint calculations are manifold and differ substantially in terms of underlying data and methodologies. While the ecological footprint is still considered as a key reference and communication tool when comparing environmental impacts at highly aggregated levels, the above mentioned inconsistencies have been a matter of concern for both research and policy. With the emergence of the European Footprint Tool (Briggs, 2011) this situation has clearly improved. The new, internet-based assessment tool offers a harmonized methodology for all 27 EU countries plus another 16 countries and regions of the world which allows statistical modelling and even scenario developments for different sectors, among which food consumption impacts, as global hectares (see Table 1).
Another challenge of the ecological footprint approach is the abstract dimension of its currency – the *global hectares* which represent the total impact of certain economic sectors and activities as the sum of all processes along the production chain – in this case the food chain from farm to fork. This includes all energy, water, land and material input resources such as fertilizers, machinery and packing material that occur along the full food chain. Using global hectares as a normalized unit

[2] Calculations of both global and local hectares for Milano, Ljubljana and Nairobi are based on estimates.

allows Ecological Footprints to be expressed in comparable area terms, despite differences in bio-productivity among land types, regions and countries. EUREAPA tracks the use of six categories of productive areas: cropland, grazing land, fishing grounds, forest area, built-up land, and carbon demand on land. The translation into global hectares uses *yield factors* and *equivalence factors*, which relate the bio-productivity of each land type to the global average bio-productivity. Because the bio-productivity of land types varies by country, *yield factors* are used to relate national yields in each category of land to the global average yields. Equivalence factors adjust for the relative productivity of the six categories of land and water area. EUREAPA figures have been used to illustrate the global hectare requirements of the six case study areas in comparison to local hectares based on different references (see Table 1 and Figure 1). The annual production of biologically provided resources, called *bio-capacity*, is also measured as part of the Ecological Footprint methodology, and is also accounted for in terms of global hectares. While global hectares can be considered as a typical dimension of evidence-based impact assessments, the associated land demands appear rather virtual in terms of their spatial-geographic explicitness.

3. Methodology of the Metropolitan Foodscape Planner (MFP)

Here is where the FOODMETRES Metropolitan Foodscape Planner tool come in. Rather than relying on global hectares as the basis for communicating the impacts of urban food consumption, this tool is designed to translate the principles of the available 'bio-capacity' into a spatially explicit reference base that manages both 'demand' and 'supply' data simultaneously at the scale of metropolitan regions. MFP thrives largely on European data making it – to a certain degree – independent from national/regional data sources (see Table 2). The latter must be considered as a pre-requirement for European-wide applications at virtually all metropolitan regions with the European Union.

Table 2: Data Layers applied in the MFP model.

Data Layer	Source
Cities_startpoint_Berlin	
Corine Land Cover 2006	www.eea.europa.eu/data-and-maps/data/corine-land-cover-2006-raster-3 version 8 april 2014, download 13 jan 2015 in arccat export .tiff als esrigrid in MFT.gdb
Natura2000	www.eea.europa.eu/data-and-maps/data/natura-5#tab-gis-data shapefile Natura2000_end2013_rev1.shp
Lanmap2v1	European Landscape Typology LANMAP (Mücher et al. 2006) lanmap2_v1_level_4_ls-cod
Multi-ring-buffer around city_startpoint: first calculate radii based on:	combine distance-raster and 3 rasters with the correct legenda and greyed areas total demand per ring
HSMU	Homogenous Soil Mapping Units (HSMU) as modelled by CAPRI (Kempen et al. 2005) and Eurostat crop area data desaggregated to hsmu's by CAPRI. Year per country: NL 2008, BL 2008, DE 2008, PL 2004.

Building MFP requires a series of data management and GIS operations to be performed in Excel and Arc-Info. Using the example of the Rotterdam Metropolitan Region procedure, we will illustrate the following sequence of steps that are required:

- Creating the dynamic footprint-driven spatial zoning framework (von Thünen, 1826);

- Disaggregation of the CORINE land cover units to arrive at distinctive land use types in form of commodity groups (HSMU);
- Establishing commodity group allocation rules on the basis of landscape units (LANMAP);

Building upon the classical market-centered von Thünen (1826) model, but translating it into contemporary agri-environmental and spatial planning strategies, we developed the following concept of metropolitan zones: (1) urban core area, followed by (2) a green buffer reserved for nature and recreation, (3) a metropolitan food production zone differentiating a plant-based and a protein-based supply zone, and (4) a transition zone which is meant to provide food also for adjacent urban areas.

Making use of the figures for urban food demand, MFP projects the corresponding land demand figures in the form of 'local hectares' to those areas of land that can be considered to be eligible for farming. We hence excluded all land covered by urban areas, waterbodies (sea, lakes & rivers), nature and landscape conservation sites, forests and other non-farmlands such as rocks, beaches and swamps. Around urban centers we reserved a zone as 'green buffer' for mainly biodiversity and recreational functions – but without investing into further elaborations. Here we obviously consider all land to primary serve this potential function. The guiding principle for introducing such a green buffer was based on the assumption, that (1) urban dwellers will appreciate short travel distances to enjoy these functions, and (2) there is a basic need to offer micro-climatic compensation for high density urban zones in terms of air quality and circulation.

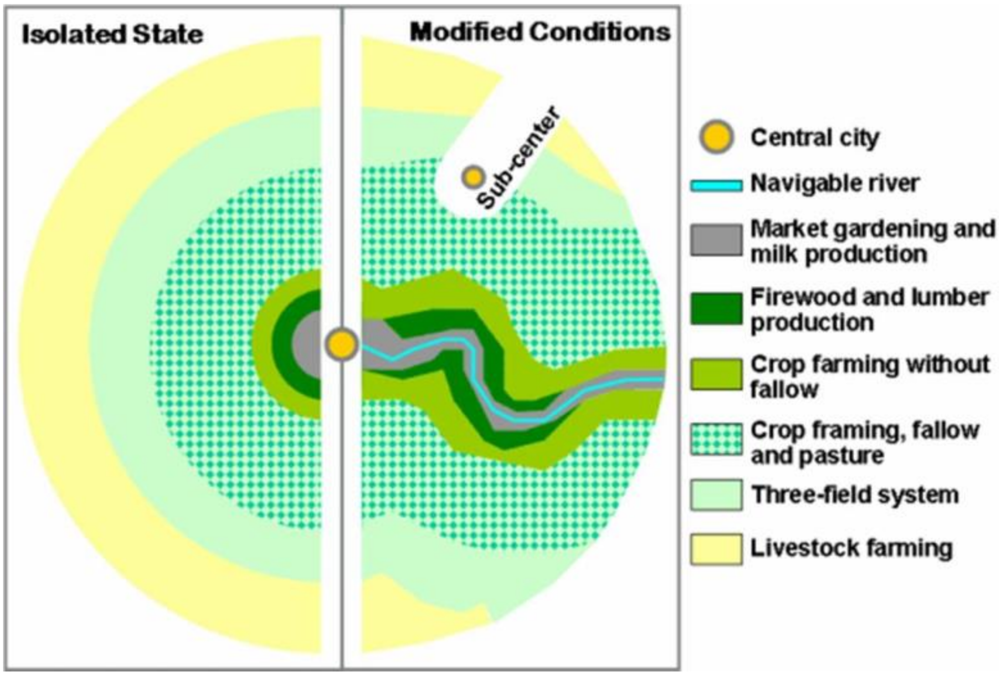


Figure 4: The von Thünen model in two variation – as isolated state and a modification displaying river access and a sub-centre location.

Following the green buffer, we gave full priority to the supply with plant-based food groups such as rotation crops (wheat, sugar beet, potatoes), other cereals, oil seeds, vegetables and fruit, taking the total hectare requirements for calculating the width of the plant-based metropolitan food-ring, as we

call it. This means that the amount of available farmland within this ring matches exactly the total amount for land needed for all plant-based food groups, but that actual distribution of these food groups within this ring shows of course large deficits and surpluses, thus the type of expected imbalance we consider as an important reference when exploring potentials for optimizing the supply with regional food on the basis of the available land. Directly following the plant-based ring, follows the protein-based food production ring which extension corresponds exactly to the amount of hectares requires for fodder crops and dairy farming. The decision to place livestock farming at a remote position follows the need to reduce direct expose of core urban population to this sector’s impacts (health, odors, food safety issues).
Figure 4 shows the von Thünen model in two variations with market gardening and milk production in the direct periphery of the central city. This corresponds in the MFP approach with the concept of the urban agriculture as part of the central core area and extensive dairy farming at the fringe and in the green buffer. Not being part of the agro-food sector, firewood and lumber production has not been taken up in the scheme. Crop farming and three-field system corresponds with the plant- based food ring, so does the location of livestock farming at the outer periphery in line with the MFP’s zoning concept.
In the following we explain the step-wise approach towards building the MFP zoning framework for Rotterdam (see Figure 5).

3.1 Green buffer

Determining the green buffer is the only step that is not driven by the ecological footprint data derived from EFSA/national data. This is because the area demand for recreation and nature experience is not considered to be directly related to matters of food consumption. At the same time research has shown that urban dwellers benefit from a certain minimum of available open green space to compensate for urban density, noise and pollution. However, technical references differ quite largely and given the fact that the urban buffer is not the only space offered preserved for nature and recreation – all existing protected areas, forests and water bodies are exempt from food planning objectives – we decided to establish a certain minimum distance as the rule of thumb: namely 50% of the urban core’s average radius between its periphery and the subsequent metropolitan food rings dominated by high agricultural production.
For Rotterdam the radius of the Urban Core is 10km. For the Green Buffer half that distance – thus 5 km – has been taken. Within this Green Buffer we did not consider existing land use areas to be eligible for land use change/food group allocation plans. We did though consider to maintain existing grasslands to contribute to extensive livestock farming as in the past. Remaining areas are meant to be successively converted to extensive cultural landscapes, nature areas and recreational parks.

3.2 Metropolitan food rings (plant- and protein-based)

The radii of the “Metro-Food-Ring veg”, the “Metro-Food-Ring prot” and the “Transition Zone” are calculated based on the total demand in ha for the population and the total area available for agriculture per ring. For Rotterdam the city population for the Metro-Food-Ring is 1.2 million and the region population for the Transition Zone is 6.6 million (see Table 3). The demand per capita can differ for different zones and for vegetable products and animal products. Table 3 shows the demands we used to calculate the rings. The total area available for agriculture is the area classified in Corine Land Cover as agricultural areas, sport and leisure facilities, green urban areas, natural grasslands and sparsely vegetated areas, minus the protected areas in Natura2000. The allocation of crops within the zones is based on the land cover, landscape typology and the protected area database.

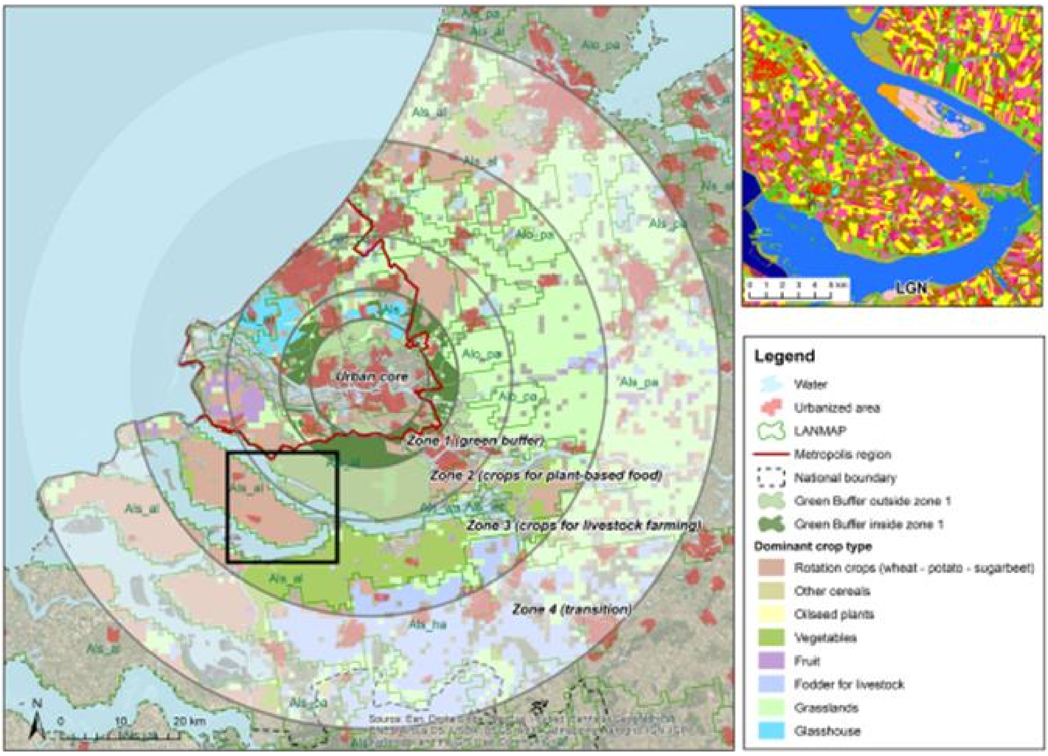


Figure 5: MFP zonation for both Rotterdam city (Zones 1 – 3) and Metropoolregio Rotterdam Den Haag (zone 4) at the level of Metropolitan Agro-Food Systems (MAS)

The crop data per HSMU comes in *.gdx format. The approach was as follows:

- Calculate per HSMU the area for each crop category according to the crop category table, both absolute and relative to the total HSMU area (= density). Also determine the dominant crop (qua area).
- Join these data to the HSMU geometry.
- Make a selection of the HSMU’s with crop data, and extract the HSMU’s within the outer zone boundary.
- Union the above with the zones (rings) defined previously and aggregate based on the zone-id and HSMU-ID. If the zones cross national borders combine the HSMU data of those countries.
    - Calculate for each crop category the absolute value of the area in that HSMU polygon in that zone in ha as: percentage crop area multiplied with the HSMU polygon area in ha.
    - Calculate the total area per zone for each crop category.
    - Calculate for each zone the division of area’s between the crop categories. Base the calculation of the “Status quo” of crop area per zone and per crop type on these divisions.
    - Comparison of the status quo with the demand results in the surplus/deficit.

Table 3: Calculations for the MFP zoning distances for the City Region and OECD Region of Rotterdam.

Ring types (zones)	Distance (km)	Surface area of rings (ha)			Demand factor (ha/p)			Population	Required surface area (population x demand factor)	
		Arable or grass	Arable	Grass (includ. protected)	Arable or grass	Arable	Grass-land		surface (ha)	land use type
Rotterdam city region								1,200,000		
Rotterdam OECD region								7,800,000		
Urban Core	0-10	12642								
Green Buffer	10-15	25608								
Organic dairy in UC & GB	0-15	38250		14,436			0.05	288,720		grass, irrespective of protection
Metro-Food-Ring (plant-based)	15-24	68930	41,129			0.0341		1,200,000	40,920	arable, not protected
Metro-Food-Ring (protein-based)	24-40	163,445					0.178	911,280	162,208	arable and grass, not protected
Transition-Zone	40-150	1,402,085			0.2121			6,600,000	1,399,860	arable and grass, not protected

3.3 *Landscape allocation rules*

Since the objective is to actively change land use on the basis of ecological footprint data, there was need to ensure that the changes that are being proposed are taking into account aspects like elevation, soils and climate. For this purpose we introduced the LANMAP (Mücher et al 2006) layer to the approach which offers a European landscape classification with the above features (see Figure 6). Based on expert judgment we established allocation rules that would prevent users from implementing changes that must be considered as not suitable given the corresponding landscape type.

A lookup table was created containing suitability values for LANMAP-Corine combinations. For each combination the table provides a suitability value (-1 unsuitable, 0, 1 suitable) for each of the seven crop types (see example in Table 4). The tool generates initial suitability values for the start crop type situation. As soon as a new crop is ‘painted’ to one or several grid cells within the study area, the tool utilizes the lookup table to grab the suitability value of this new crop type on the basis of the background layers for land use, HSMU, etc.

Table 4: Landscape allocation rules for the Rotterdam region.

LANMAP CORINE	WhPoSu	OthCer	Oils	Fodd	Veget	Fruit	Grass	GTB
Atlantic lowlands on organic materials with pastures (Alo_pa)								
12 Non-irrigated arable land	-1	-1	0	0	-1	-1	1	-1
18 Pastures	-1	-1	-1	0	-1	-1	1	-1
Atlantic lowland sediments with arable land (Als_al)								
12 Non-irrigated arable land	0	0	0	0	0	0	1	-1
18 Pastures	-1	-1	-1	-1	-1	-1	1	-1
20 Complex cultivation patterns	0	0	1	0	1	1	1	0
888 Glastuinbouw	-1	-1	-1	-1	-1	-1		1
Atlantic lowland sediments with hetrogenous agri (Als_ha)								
12 Non-irrigated arable land	1	1	1	1	1	1	1	1
20 Complex cultivation patterns	1	1	1	1	1	1	1	1
Atlantic lowland sediments with pastures (Als_pa)								
12 Non-irrigated arable land	-1	-1	-1	0	0	0	1	0
18 Pastures	-1	-1	-1	-1	-1	-1	1	0
Atlantic lowland sediments with water bodies (Als_wa)								
12 Non-irrigated arable land	-1	-1	-1	-1	-1	-1	1	-1

The abovementioned check is performed for all crop types. A ‘suitability’ layer is generated for each crop type. Each of these seven layers generated contains the selection of grid cells marked as ‘suitable’ according to the check for a given crop type. Such grid cells are highlighted by way of colouring the outlines with the same colour used to code crop types. The result is a layer with outlines that can be overlaid on the drawing layer to visualize high suitability on top of dominant crops. Each of these can be toggled on and off whenever the focus is given to a particular crop type.

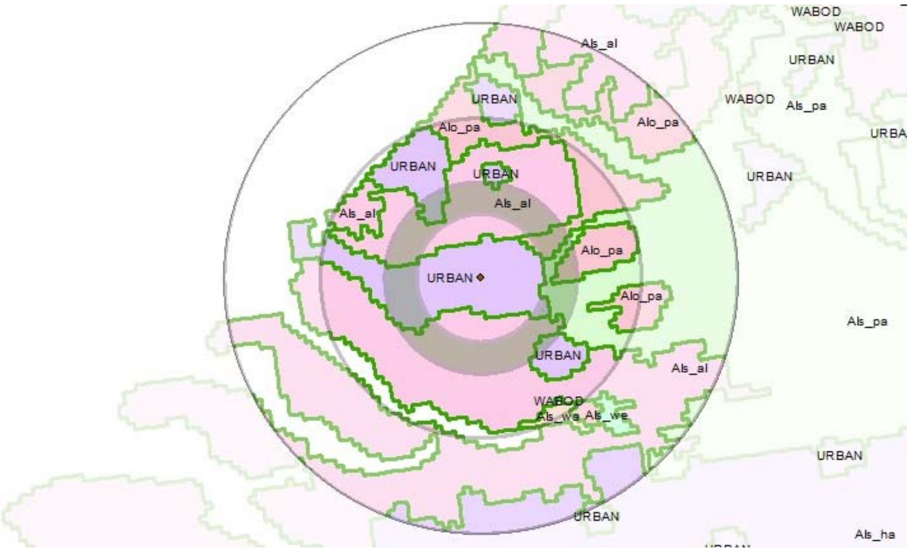


Figure 6: Boundaries and codes of the LANDMAP units for the Rotterdam region.

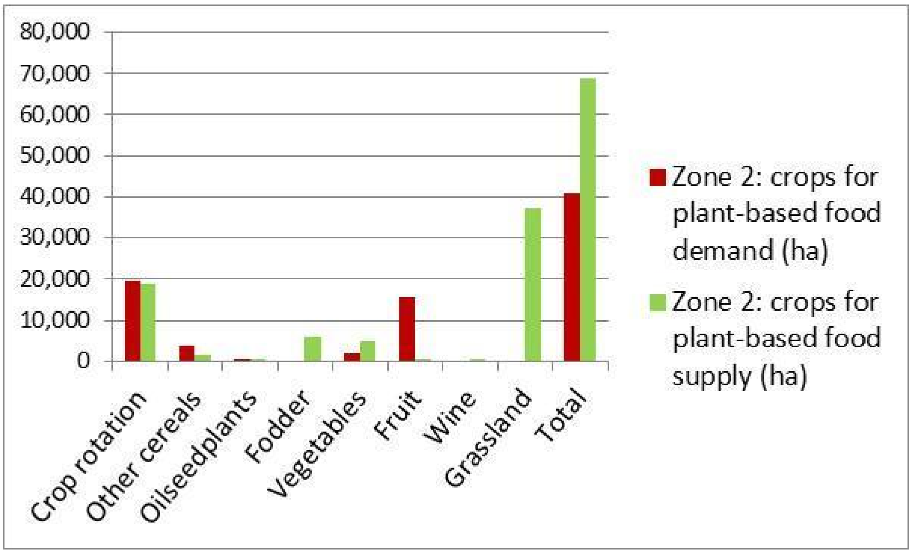


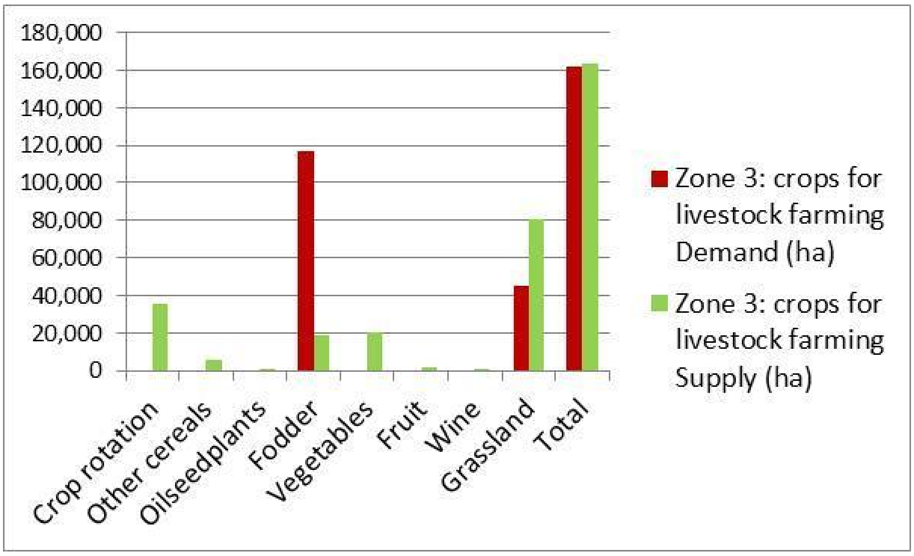
Figure 7: Demand-Supply analysis for 8 food groups of the Metropolitan Food Zone 2 (crops for plant-based food) for 1.2 million people (in hectares)

4. Tool results from Rotterdam

Zone 2 (Figure 7) is between 15 and 24 km distance from the city centre and can be entirely dedicated to producing crops for plant-based food: all the consumption needs arising from the 1.2

million Rotterdam people can theoretically be satisfied within this zone. However, Figure 7 shows that the current land use is still focusing strongly on livestock farming and that there are clear deficits fruit (15.000 ha missing) and slight deficits for rotation crops, other cereals and oilseed plants. Exceptional, certainly when comparing to other European metropoles, is the major surplus for vegetables (more than 3000 ha). This can be explained with the presence of the extensive areas of Dutch glasshouse production in Westland and Oostland (see Figure 7). Today this production is dedicated to 90% for food export and is strongly dominated by a few lead crops such as tomatoes, zucchini and bell paprika.

Zone 3 (Figure 8) follows between 24 and 40 km distance from the city centre. According to our scheme, this zone is entirely dedicated to crops supporting the city's demand for livestock such as dairy and meat products. Given the resource intensity of animal-based food products it is not surprising that this zone requires a surface area four times as large as the one for plant-based food products in Zone 2: more than 160.000ha. In this zone the largest deficit is for fodder crops (almost 100.000 ha). Today these fodder crops are being imported from more remote Dutch locations and of course in the form of soya feedstuff from oversee amounting to about 20% of the total (van Gelder and Herder 2012). On the other hand we see a clear surplus of grassland production for dairy farming. In terms of the zones diameter (16km) it should be kept in mind that this is also a consequence of the city's location close to the North Sea where no land-based food production is possible.



Figures 8: Demand-Supply analysis for 8 food groups of the Metropolitan Food Zone 3 (crops for livestock farming) for 1.2 million people (in hectares)

Zone 4 (Figure 9) spans over a distance from 40km to 150km measures from the city centre. This means that the Transition zone spans well into Belgium and Germany. Applying the OECD scheme as a reference (7.8 million people) means that such a region covers almost half of amount of the total Dutch population (16 million). Also here it is important to acknowledge the fact that the sea-side location of this region almost doubles the distance of the zone towards the inland. Even so, the large area demands in terms of local hectares (almost 1.4 million) demonstrates the realities of densely populated regions here and elsewhere in the world. In terms of the demand-supply relationship, the transition zone mirrors the situation of Zone 3: the biggest deficit is for fodder crops required for livestock farming.

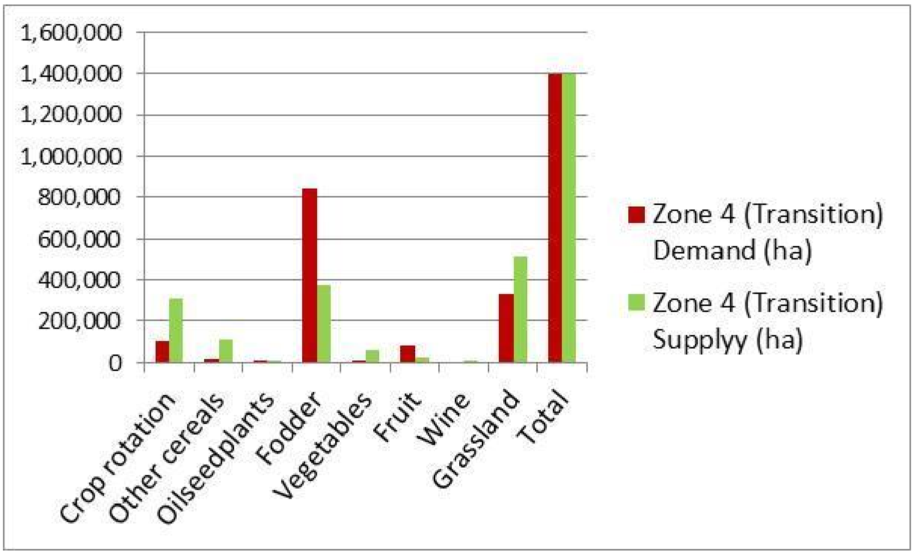


Figure 9: Demand-Supply analysis for 8 food groups of crops in Zone 4 (Transition) providing crops for plant-based food and livestock farming for 6.6 million people of the OECD region (in hectares)

The MFP out presented in figure 5 to 8 are not only meant as assessment results for framing the impact of urban food production on the different metropolitan zones, but are also providing operational input to a stakeholder-oriented foodscape-planning device. For this purpose we introduce the data into the so-called 'digital maptable' which allows users to perform land use allocations by means of a digital pen. Addressing the surplus/demand figures resulting from the assessment, users can than make proposals for where and how to change the existing land use (food crops) in order to more properly meet the demands identified by the tool. Please see for further illustrations of the maptable approach Wascher et al., 2015.

5. Conclusions and Recommendations

Tools have been developed to assess food security and food safety at local and metropolitan regions. These tools showed that, depending on the region, areas can be self- sufficient. However, more densely populated areas limit the possibilities for metropolitan food supply. Spatial planning of activities should take various aspects, such as food safety, into account.
The food safety questionnaire proved to be successful in pinpointing critical areas that need further attention to improve food safety at the local level.

Recommendations Food Safety:

- Introduce spatial planning modules as a pre-cautionary food safety principle according to which food chain operations are managed within clearly defined zones.
- Increase the resource efficiency of food system operations within dedicated regional zones that separate livestock farming from vegetable production.

- Make use of tools developed within the project (Sustainability Impact Assessment & Metropolitan Footprint Tools) to support policy makers in establishing optimal spatial planning of metropolitan food production.
- A food safety questionnaire derived in the project can be used by actors within the food supply to assess possible critical points for food safety and quality.
- Enable more research into the food safety consequences of a transition from global to metropolitan or local food production.

Recommendations Food Security:

- Integrate the notion of metropolitan regions into Rural Development programmes and funding schemes. It is crucial to achieve a common understanding on how metropolitan regions are triggers for sustainable development in rural regions, and that funding instruments and rules require appropriate consideration in territorial eligibility settings.
- Provide incentives and financial support for the agro-food sector where system innovation including aspects of governance and social embedding are properly addressed at the level of metropolitan food sheds.
- Establish European Cross-border Partnerships between policy makers, spatial planners and entrepreneurs to share experiences and to build up cross-border food shed activities for metropolitan regions.
- Make RIS 3 (Regional Innovation Strategies of Smart Specialization) an approach to develop metropolitan innovation strategies targeting at *Agrofood clusters* that act as technological, infrastructural and economical hubs.
- Use footprint assessment tools in knowledge brokerage session to raise the awareness regarding impacts of urban food consumption;
- Monitor and report on innovation impacts on the ecological footprints at the level of metropolitan regions metropolitan regions at a regular base.

The *Metropolitan Foodscape Planner (MFP)* offers (1) hands-on impact assessment tool for balancing commodity surpluses and deficits, (2) a visual interface that depicts food zones to make impacts spatially explicit, (3) landscape-ecological allocation rules to base land use decisions on sustainable principles, and (4) European data such as EFSA, LANMAP, HSMU and CORINE Land Cover to allow future top-down tool applications for all metropolitan regions throughout the EU.

Though less accurate as the national land use survey data, HSMU is available for the whole of Europe, allowing direct top-down assessments without resource-consuming data gathering procedures. The concept of spatially allocating specific food groups for which a certain supply deficit has been recognised – e.g. vegetables or oil seeds are typically underrepresented in the metropolitan surroundings of cities – to areas with clear food supply surplus coverage, for example grasslands, points at the need to guide such stakeholder decisions by offering additional land use related references. We are aware that introducing clear spatial demarcations for different food groups in the forms of zones is drastically contrasting with the everyday situation in our current metropolitan regions. In order to provide further guidance during this process, MFP offers the spatial references of the European Landscape Typology (LANMAP) to ensure that stakeholders receive 'alert' messages if their changes they propose are in conflict with the allocation rules laid down as part of the landscape- ecological references. Both the MFP-zoning concept and the LANMAP-based allocation rules are in principle open to stakeholder revisions. This way, a high level of tool transparency and flexibility can be achieved – the basis for gaining trust and ownership throughout the process.

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