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Data Article

A dataset of the food self-sufficiency assessment of Bristol and Vienna based on a foodshed approach

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ABSTRACT

The food self-sufficiency assessment of Bristol and Vienna was developed by applying the Metropolitan Foodshed and Self-sufficiency scenario (MFSS) model [1] in the proposed respective foodsheds. In the case of Vienna 25 surrounding districts (i.e. Niederösterreich region) were selected, whereas for Bristol 5 districts surrounding the city were included. The model takes the consumption patterns as well as the available area for agriculture in the proposed foodsheds as the main inputs. Intermediate calculations are developed using data on population and yields. The outputs after applying the MFSS model are: (1) the area demand (i.e. surface needed to meet the populatioń dietary requirements) in terms of surface and radius, and (2) the potential food self-sufficiency, at district level and for the whole foodshed area. The outputs are shown for 12 scenarios resulting after combining four variables: (1) production system (conventional vs organic), (2) dietary shifts (domestic vs current diet), (3) reducing food losses and waste, and (4) population growth 2015–2050. The analytical outputs from the MFSS model are converted in spatial data after applying GIS software. Whereas

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some of the supporting information on the inputs are shown spatially, the spatial outputs are shown in the co-submitted publication [2], as well as a summary of the datasets shown here. These data can be used to develop food policies in both city-regions as well as to test whether a specific policy is feasible. The data might be especially useful for policymakers and governance actors (e.g. food policy councils) when developing or assessing the food policies for both cities. The data can be used also by policymakers in other cities developing foodshed assessments. Furthermore, other stakeholders (e.g. education, NGOs) might use the data to increase the awareness of the impact of dietary patterns on the food land footprint.

Specifications Table

Subject	Geography
Specific subject area	Landscape and food modeling, sustainable food systems, foodshed assessment
Type of data	Table Figure
How data were acquired	Numerical statistical data (e.g. food consumption, crop yields) were collected from official statistics at the national and regional levels and used as input for the MFSS model. Spatial and remote sensing information (e.g. land use, spatial boundaries) were collected from official European statistics by using a Geographic Information System (GIS). Some numerical data initially shown in spatial format (e.g. area of each land cover) were converted into numerical values by using the specific tools in the GIS. The results (i.e. area demand, radius of the area demand, potential food self-sufficiency) were acquired after running the MFSS model with the above mentioned numerical and spatial input data.
Data format	Basic raw data Self-calculated raw data (filtered and analyzed)
Parameters for data collection	There are two types of data: statistics and spatial data. The statistical data were collected from reliable sources and adapted to be used as input data in the MFSS model (surface and radius of the area demand, and self-sufficiency calculations). The spatial data were collected from a reliable source in a format compatible with the use of GIS.
Description of data collection	Data on food consumption that were used corresponds to the food supply quantity (Kg/capita/yr) from the official FAO statistics at country level. Data on yields for domestic plant-based products were taken from agricultural statistics at country and regional levels (t/ha/yr). For non-domestic plant-based products yields were taken from Zasada et al. (2019). Yields for animal products were calculated by using the plant-based yields and the conversion factors from Zasada et al. (2019). Data on population and population growth rate 2015-2050 were taken from EUROSTAT. Utilizable agricultural area (UAA) was selected from the Corine Land Cover Map by including two categories: non-irrigated arable land and pastures. The area was calculated by using GIS and selecting only the area covered by the foodshed.

(*continued on next page*)

Data source location	Institution: FAO City/Town/Region: Rome Country: Italy Institution: EUROSTAT (European Commission) City/Town/Region: Luxembourg Country: Luxembourg Institution: Statistik Austria City/Town/Region: Vienna Country: Austria Institution: Gov.uk City/Town/Region: online Country: UK Institution: Copernicus Land Monitoring Service (European Evironment Agency) City/Town/Region: Copenhagen Country: Denmark
Data accessibility	Basic and self-calculated raw data are shown in the Supplementary Material
Related research article	J.L Vicente-Vicente, A. Doernberg, I. Zasada, D. Ludlow, D. Staszek, J. Bushell, A. Hainoun, W. Loibl, A. Piorr. Exploring alternative pathways toward more sustainable regional food systems by foodshed assessment – City region examples from Vienna and Bristol. *Environ. Sci. Policy* 124:401-412. [2]

Value of the Data

- The data show the estimated area demand – in terms of total surface and radius – as well as the potential food self-sufficiency for the districts and the whole region (i.e. foodshed area) for the cities of Vienna and Bristol. Different scenarios on the production and dietary patterns are considered. These data can be used to develop food policies in both city-regions as well as to test whether the proposed food policies are feasible considering the available area for agriculture under the different scenarios proposed.
- Policymakers, governance actors, consulting organisations and professionals involved in science communication and dissemination can highly benefit from these data.
- The data are especially useful for policymakers when developing or assessing the food policies for both cities. The data can be used also by policymakers and governance actors in other cities developing foodshed assessments. Furthermore, the data can be used also by other stakeholders (e.g. education, NGOs) to increase the awareness of the impact of dietary patterns on the food land footprint.

1. Data Description

The MFSS modeling approach [1] as well as the databases and scenario elements are described in Fig. 1. The approach is divided into two main parts: (i) the production and (ii) the consumption.

Regarding the food production, the agricultural statistics were used to obtain the yields of regional plant-based products, whereas the conversion factor for the organic farming as well as the scenarios on food losses and wastes were the ones included in the MFSS model. Considering the food consumption, the average dietary patterns were taken from the FAO statistics .The area demand is calculated by considering yields, diets and population (actual and projections for 2050). Finally, the self-sufficiency is calculated by comparing the potential regional agricultural production and the regional consumption. For estimating the results per capita (e.g. area demand), and being one of the main drivers of the potential food self-sufficiency, data on population density was needed (Figs. 2a and 3a). They were calculated by taking the values on total population from the official statistics [3] for the different administrative units for both regions

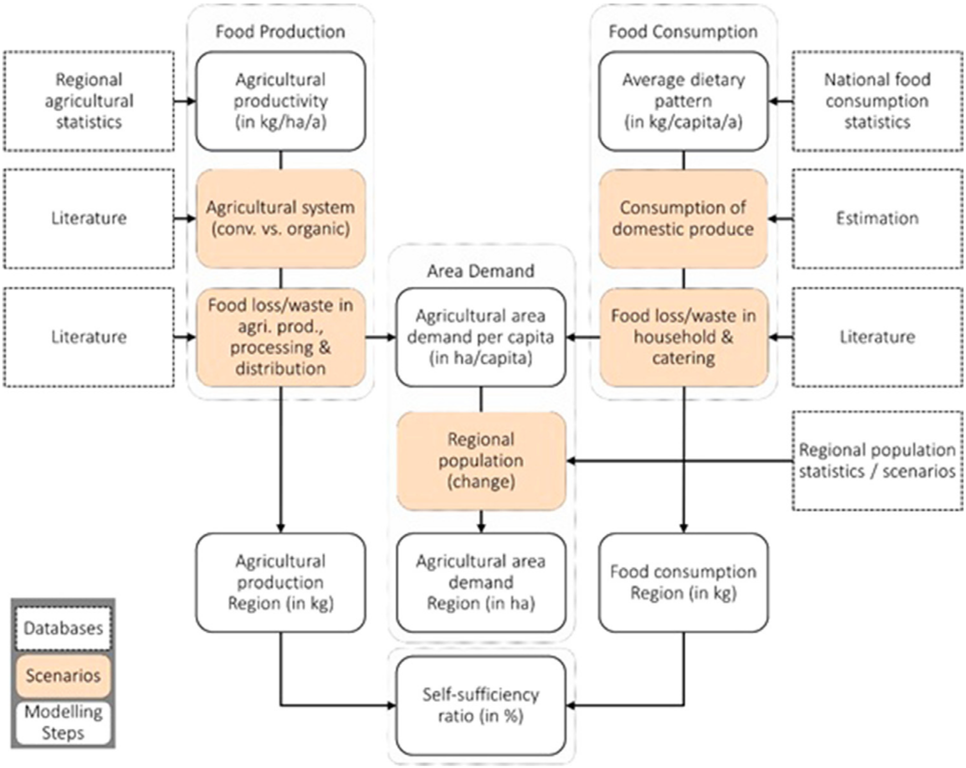

Fig. 1. Graphic description of the MFSS modeling approach, databases and scenario elements [1].

and considering the surface of the administrative units, previously estimated by using GIS software [4].

Apart from the data on food consumption, the other necessary input data is the surface of Utilizable Agricultural Area (UAA) (Fig. 1). The UAA in both regions is composed by two categories: non-irrigated arable land and pastures, and it is a result of an adaptation from the Corine Land Cover Map [5]. The GIS software [4] was used for selecting the two land uses and estimating the surfaces (Figs. 2c and 3b). Furthermore, in the particular case of Vienna, in addition to the population density, the geomorphology of the area was a key driver of the UAA and, therefore, for the potential food self-sufficiency. Geomorphology refers to the Digital Elevation Model over Europe (DEM) [6], showing values from 100–2000 m over the sea level (Fig. 2b).

All the raw data are shown in the supplementary material. There are two types of raw data: basic and self-calculated. Basic raw data are composed by the average annual food consumption and yields of Vienna and Bristolś proposed foodsheds for the different food commodities that are included in the MFSS model and data on population. Data on food consumption are taken from the official FAO statistics for 2013 [7]. Yields of plant-based products are taken from national and regional statistics for 2015 [4,5], whereas yields of animal products and non-regional plant-based products were taken from the MFSS model [1]. However, after collecting the data on yields some commodities were grouped in order to match the FAOś food consumption – which are less specific – and to make less complex the application of the MFSS model. Thus, values on yields for the groups (e.g. vegetables, cereals) were obtained by applying a weighted average considering the different surfaces occupied by each crop in the region. On the other hand, there are three self-calculated data: (i) Surface of UAA, (ii) potential food self-sufficiency, and (iii) radius of the area demand for the different scenarios and the two case-studies. The area

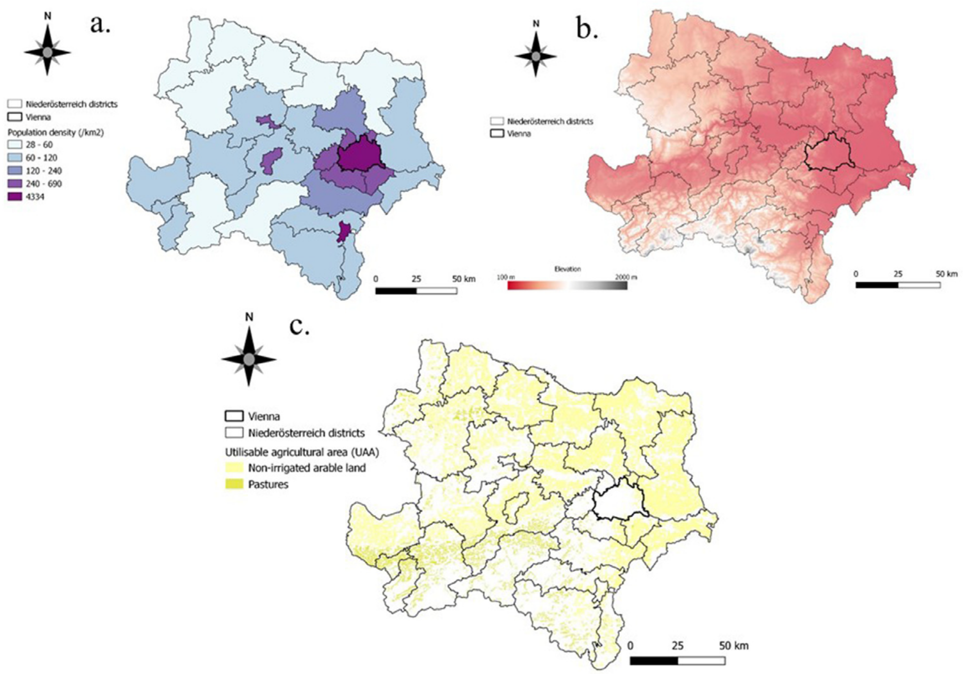

Fig. 2. Population density (a) and geomorphology (b), main drivers affecting the amount of utilisable agricultural area (UAA) in Niederösterreich (Vienna‘s selected foodshed) and Vienna (c). The UAA is composed by non-irrigated arable land and pastures. Adapted from the Corine Land Cover Map [5]. Please, see Table 2 in the Supplementary Material for detailed information on the figure, Tables 4–6 for numeric and [2] for spatial results on area demand, self-sufficiency and radius.

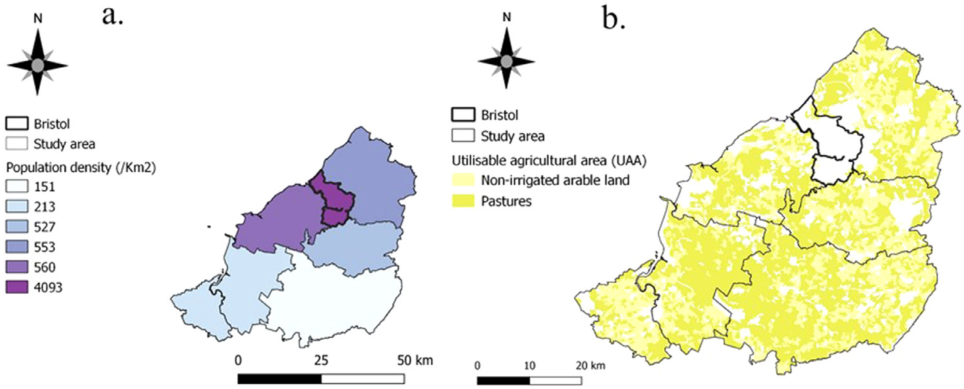

Fig. 3. Population density (a), main driver affecting the total amount of utilizable agricultural area (UAA) of Bristolś foodshed (b). The UAA is composed by non-irrigated arable land and pastures. Adapted from the Corine Land Cover map [5]. Please, see Table 3 in the Supplementary Material for detailed information on the figure, Tables 7–9 for numeric and [2] for spatial results on area demand, self-sufficiency and radius.

demand is the first output of the MFSS model and it is a result of combining the values on food consumption and yields for each commodity or group of commodities. Self-sufficiency values result from the quotient – in percentage – between the utilizable agricultural area (UAA) and the area demand. Values higher than 100% mean that the selected area could be food self-sufficient, whereas lower values show scenarios where the production cannot fulfil the demand and, therefore, food imports are needed. The radius shows the spatial representation of the area demand previously calculated. The radius is calculated considering the agricultural available area within and outside the district boundaries. For calculating the radius of the whole region (i.e. foodshed), the area inside the districts that cannot be used for agricultural production is considered. Thus, the total available regional area is represented as the share of agricultural area of the region. Finally, the radius is calculated based on the calculated foodshed area.

2. Experimental Design, Materials and Methods

The food self-sufficiency assessment of Bristol and Vienna was developed by applying the Metropolitan Foodshed and Self-sufficiency scenario (MFSS) model (V1.0) [1] (Fig. 1). First, a foodshed for each metropolitan area was proposed. Then, based on the Corine Land Cover Map [5] the total potential utilisable agricultural area (UAA) in the foodshed was estimated. Two categories from the map was included as UAA: pastures and non-irrigated arable land, whereas the rest of the categories were excluded from the assessment.

On the other hand, the area demand per capita for each specific food product is calculated by transforming the yields into area demand per kg of final product and by considering the food consumption patterns [7]. For domestic plant-based products data on regional yields [8,9] were used, whereas for non-domestic products default values from [1] were applied. In the case of animal products conversion factors from [1] using plant-based commodities were applied. The conversion factors arise from a modeling exercise considering specific data on livestock production and fodder demand. The conversion factors consider also the weight loss that takes place while food processing not only for the livestock production (e.g. meat, milk, eggs) but also for arable crops and fruits (e.g. sugar, cereals, fruits, alcoholic beverages), to obtain the final product (e.g. edible sugar, milk, butter, cheese, fish).

Thus, the total area demand per capita results from the average diet [7] and considering the commodity-specific area demand per capita. The resulting area demand is shown in twelve scenarios according to: (1) production system (organic vs conventional), (2) diet (business-as-usual vs domestic), (3) food wastes and losses, and (4) population growth (2015 vs 2050). Thus, the twelve resulting scenarios are: (i) “Base 15”: Conventional, current diet, including all current food waste and loss, 2015 (Baseline); (ii) “Base L15”: Conventional, current diet, excluding food loss and waste in agricultural production, handling, processing, distribution, 2015; (iii) “Base LW15”: Conventional, current diet, excluding food loss and waste in agricultural production, handling, processing, distribution and household, 2015; (iv) “Org 15”: Organic, current diet, including all food waste and loss, 2015; (v) “Org L15”: Organic, current diet, excluding food loss and waste in agricultural production, handling, processing, distribution, 2015; (vi) “Org LW15”: Organic, current diet, excluding food loss and waste in agricultural production, handling, processing, distribution and household, 2015; (vii) “Org D15”: Organic, diet from domestic sources only, including all food waste and loss, 2015; (viii) “Org DL15”: Organic, diet from domestic sources, excluding food loss and waste in agricultural production, handling, processing, distribution, 2015; (ix) “Org DLW15”: Organic, diet from domestic sources, excluding food loss and waste in agricultural production, handling, processing, distribution and household, 2015; (x) “Base 50”: Conventional, current diet, including all food waste and loss, 2050 population estimate; (xi) “Org 50”: Organic, current diet, including all food waste and loss, 2050; (xii) “OrgD50”: Organic, diet from domestic sources, including all food waste and loss, 2050.

For estimating the area demand in the different scenarios, conversion factors from Zasada et al. [1] were used. For the production system, the values come from different studies and meta-analysis where the reference system was the conventional production. For building up the scenarios on food losses and wastes five steps of food loss and waste from Zasada et al. [1] were distinguished: "(1) reduced production output through animal sickness and death in agricultural production and mechanical damage and spillage during harvest; (2) spillage and degradation during postharvest handling, storage and transportation and (3) processing and packaging inefficiencies (e.g. through technical malfunction and over or underproduction); (4) losses and waste in the wholesale, retail and distribution system (write-offs or spoilage; and within households and catering); and (5) waste by the end consumer at home or eating out". It was assumed that at each step a specific share of food gets avoidably lost, increasing thus the area demand, whereas the area demand is decreased when food losses and waste are avoided. Finally, for estimating the difference in the area demand over time, data on expected population growth for 2050 for the different administrative units were used [3].

The commodity-specific area demand per capita is calculated by transforming the hectare yields into area demand per kg final product following the equation:

$$A_{cap} = A_0 * \beta_{conv} * \beta_{org} * \beta_{Loss.prod} * \beta_{Waste.cons} * \beta_{local} \quad (1)$$

Where A_0 is the raw production, β_{conv} and β_{org} the convention factors for the conventional and the organic production systems. On the other hand, the potential area reduction by preventing food loss and waste in agricultural production, post-harvest, processing and distribution, as well as in household consumption and catering is included through the β_{Loss} prod and $\beta_{\text{Wastecons}}$ factors, respectively. Finally, the share of the domestic production is included with the β_{local} factor.

The demand for the overall region, A_{agg}, is estimated by projecting the area demand per capita A_{cap} according to the total district and regional population figures:

$$A_{agg} = A_{cap} * N_{reg.pop} \quad (2)$$

In the MFSS model the aggregated agricultural area demand for a specific district or the whole region is represented by a circle with a center point of the administrative boundary polygon. Thus, the aggregated area demand for the whole foodshed is defined by a radius (r_{FS}) and calculated through the following Eqs. (3) and (4):

$$A_{FS} = \frac{A_{UAA.reg}}{A_{total.reg}} * \left(A_{agg} + A_{total.distr.} - A_{UAA.distr.}\right) \quad (3)$$

$$r_{FS} = \sqrt{\frac{A_{FS}}{\pi}} \quad (4)$$

For the spatial representation of the land footprint (i.e. area demand), two factors are considered: (i) the agricultural available area within ($A_{UAA.distr.}$) and (ii) outside the district boundaries. For the spatial modeling of the whole region (i.e. foodshed area, A_{FS}), the aggregated area demand (A_{agg}) has to consider the area inside the district ($A_{total.distr.}$) that cannot be utilized for agricultural production (e.g. forests, water areas, settlement) and, therefore, it will be eventually increased. When the area demand is higher than the UAA in the district, neighbouring areas are considered. The available regional area is represented as the share of agricultural area of the region ($A_{UAA.reg/Atotal.reg}$), which increases the required foodshed area (A_{FS}) and being used as the basis for the calculation of the radius of the area demand (r_{FS}).

On the other hand, along with the foodshed analysis, self-sufficiency at district and regional level represents the other important indicator for regional food planning that has been assessed. We understand self-sufficiency as the capacity of a specific area to meet the populationś domestic food requirements [10] within its physical boundaries [11]. The self-sufficiency is translated in the MFSS model as the relationship between the aggregate area demand (A_{agg}) and the available agricultural area ($A_{UAA.distr.}$). Thus, a 100% of self-sufficiency would be achieved when all the area demand for food production can be covered within the district or regional boundaries. Thus, food imports would be required when the self-sufficiency is lower than 100%, whereas exports are possible when values of self-sufficiency exceed the 100%. The analysis of the spatial distribution of the self-sufficiency for individual districts provides information about the possibility of satisfying district demand through adjacent agriculture.

Originality and Plagiarism

The authors declare that they have written entirely an original work, and that the different sources have been appropriately cited.

Declaration of Competing Interest

This work has been carried out as part of the project SUNEX (Formulating sustainable urban FWE strategy by optimizing the synergies between food, water and energy systems) in the scope of the Belmont Forum and JPI Urban Europe Joint Research Programme SUGI/FWE NEXUS (EU Horizon 2020, grant agreement No. 857160). The project SUNEX has received funding from the BMBF in Germany (grant agreement number 033WU003), from FFG in Austria (grant agreement number 730254), and from ESRC in the United Kingdom (grant agreement number ES/S002286/1).

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article.

Supplementary Materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.dib.2021.107434.

CRediT Author Statement

José Luis Vicente Vicente: Software, Data curation, Visualization, Writing – original draft; **Alexandra Doernberg:** Data curation, Supervision; **Ingo Zasada:** Conceptualization, Supervision; **Annette Piorr:** Conceptualization, Writing – review & editing, Supervision.

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