1. Data in Brief: Capacity and Self-Sufficiency Analysis

1.1. Data Description

This dataset (Table S1) supports the statistical and spatial analysis of food self-sufficiency and regional foodshed for 11 provinces located in the Marmara Region of Turkey. The study employs the 'Metropolitan Foodshed and Self-Sufficiency (MFSS)' model developed by Zasada et al. [14]. The dataset quantitatively assesses food demand and agricultural supply under various scenarios, taking into account production systems, and food loss and waste.

Table S1. Information of dataset.

Data format	Basic raw data Self-calculated raw data
Data source	Quantitative statistical data—such as food consumption, crop yields—were obtained from official national and provincial sources and served as inputs for the MFSS model. Spatial datasets—such as land use, administrative boundaries—were sourced from official European and Turkish sources and processed using Geographic Information Systems (GIS). Certain spatially represented figures, such as land cover areas, were converted into numerical form through GIS-based analytical tools.
Data collection	**Food consumption data:** National dietary averages (kg/capita/year) of cereals and legumes, vegetables, and fruits and spice crops were derived from the study Household Food Consumption in Turkey by C. Akbay, W. Chern, and I. Boz published in European Review of Agricultural Economics (2007, Vol. 34, No. 2, pp. 209–231). **Provincial crop yields:** Conventional agricultural statistics from TURKSTAT (2023); Organic agricultural statistics from Ministry of Agriculture and Forestry (2023). **Food loss and waste estimates:** Conversion factor of loss and waste during agricultural production, postharvest handling and storage for cereals and legumes, vegetables, and fruits and spice crops was taken from the FAO report Global Food Losses and Food Waste – Extent, Causes and Prevention. **Utilizable Agricultural Area**: Numerical statistical data from TURKSTAT (2023). Spatialisation was performed using the CORINE Land Cover Map (2018) and GIS tools. **Population data**: Numerical statistical data (population and growth rate) from TURKSTAT (2023)

1.2. MFSS Model Framework

The MFSS model is built upon two main pillars: (i) food production and (ii) food consumption. In the context of the Marmara Region, this framework enables the evaluation of current and projected food self-sufficiency levels, as well as the spatial land demand of the foodshed, by analyzing food supply and demand.

For food production, the study focuses on crop yield data for cereals and legumes, vegetables, and fruits and spices, which were obtained from agricultural statistics. Since soil productivity is influenced by regional climatic and biophysical conditions, average yield values (ton/ha) for each food category were collected at the provincial level. Conversion factors specific to ecologically sensitive agriculture were derived from organic production yield data for each food group. Due to the absence of province- or region-specific data on food loss and waste along the food supply chain, FAO's national-level coefficients were integrated into the calculations. Calculations related to production provide estimates of food supply (kg) per capita.

For total food consumption per capita, national-level data were used. This study assumes 100% local sourcing of crop production. While traditional MFSS applications

[14,15] distinguish between local production and total food consumption, this study intentionally models a scenario of complete reliance on local production, excluding any food items that cannot be cultivated within the region. This choice aligns with the study's core aim of evaluating food resilience—particularly in the context of disaster preparedness, supply chain disruptions, and emergency food access. Calculations related to consumption provide estimates of food demand (kg) per capita.

The relational analysis of food supply and demand generates three key outputs:

1. Foodshed area (ha): Agricultural land demand per capita is calculated for each food group. These values are scaled to provincial population projections to determine the total area needed to meet food demand.
2. Foodshed radius (km): A spatial representation of the area demand at the provincial level, based on a hypothetical circle. When local production capacity is insufficient, the radius expands outward to account for surrounding agricultural land.

Food self-sufficiency ratio (%): The proportion of local demand that can be met by the available Utilizable Agricultural Area (UAA) at the provincial level. Values above 100% indicate surplus production capacity, while values below 100% indicate reliance on external food sources.

1.3. Scenario Framework

The MFSS model enables scenario-based analysis to examine how key determinants influence regional food system capacity. In this study, three variables were considered in the calculation of food supply and demand:

3. Production system type: Comparing conventional versus ecologically sensitive (e.g. organic or low-input) agricultural practices;
4. Food loss and waste rates: Evaluating the effects of reducing avoidable losses across the food supply chain;
5. Population projection for 2033: Accounting for expected demographic changes in the medium-term horizon.

These variables are critical leverage points for enhancing food system sustainability and resilience. Shifts in agricultural practices influence yield and land requirements, while reductions in food loss and waste can significantly alleviate pressure on agricultural land. Population growth directly scales the demand for food and land.

Accordingly, four scenarios were developed based on plausible and policy-relevant combinations of these variables, all aligned with the 2033 population projection:

- Scenario 1a: Conventional agriculture, including food loss and waste (CONV33): A baseline scenario assuming conventional agricultural practices and no improvements in food loss and waste reduction.
- Scenario 1b: Ecologically sensitive agriculture, including food loss and waste (ECO33): An analysis of the potential impacts of sustainable agricultural practices under current inefficiencies in the food system.
- Scenario 2a: Conventional agriculture, excluding food loss and waste (CONV33-LW): An evaluation of the potential gains from reducing food waste within a conventional production system.
- Scenario 2b: Ecologically sensitive agriculture, excluding food loss and waste (ECO33-LW): The most sustainability-oriented scenario, integrating both ecologically sensitive practices and food waste mitigation.

1.4. Calculations of MFSS Model

In this study, MFSS model was adapted to estimate the land demand for local food needs under different production systems and waste scenarios, based exclusively on local

crop production. This approach provides a self-sufficient foodshed model aligned with priorities of regional resilience and disaster preparedness.

The area demand per capita (A_{cap}) for each food category was calculated by converting crop yield values (in ton per hectare) (A_0) into the amount of land required to produce 1 kg of consumable food. Conversion factors representing yield differentials between conventional (β_{conv}) and ecologically sensitive (β_{eco}) production systems were applied according to the selected scenario. Finally, potential area reductions achievable through the prevention of food loss and waste along the food supply chain were incorporated into the calculation using the β_{Loss} and β_{Waste} factors, respectively.

$$A_{cap} = A_0 * \beta_{conv} * \beta_{eco} * \beta_{Loss} * \beta_{Waste}$$

At the provincial level, the total area demand (A_{agg}) is estimated by scaling the land demand per capita (A_{cap}) according to the 2033 provincial population projection (P_{2033}).

$$A_{agg} = A_{cap} * P_{2033}$$

The foodshed's area demand (A_{FS}) is spatialized based on the total land demand (A_{agg}) and the ratio of utilizable agricultural land area (R_{UAA}) to the total surface area within provincial boundaries. Utilizable agricultural land excludes areas unsuitable for crop production such as settlements, infrastructure, forests, and water bodies.

$$A_{FS} = R_{UAA} * A_{agg}$$

The spatial representation of the foodshed is expressed as a circle centered on the provincial capital (the most densely populated area). The radius of the foodshed (r_{FS}) is calculated using the following formula:

$$r_{FS} = \sqrt{\frac{AFS}{\pi}}$$

When local production capacity is insufficient to meet demand, the foodshed radius expands beyond administrative boundaries, indicating the extension of the foodshed into neighboring regions. This spatial expansion aligns with food self-sufficiency levels (SSL). In the MFSS model, self-sufficiency is defined as the ratio between total land demand (A_{agg}) and the Utilizable Agricultural Area (A_{UAA}). Mapping this relationship allows for spatial analysis of zones of vulnerability and resilience within the regional food system.

$$SSL = (A_{UAA} / A_{agg}) \times 100$$

2. Data in Brief: Spatial and Suitability Analyses

2.1. Data Description

This dataset (Table S2) is used in GIS-based spatial analyses. Based on biogeographic and infrastructural characteristics, this dataset forms the basis of land suitability assessments for 11 provinces. Each dataset is listed with its year of origin, spatial resolution or scale, source, and the specific analytical role it played in the study. The datasets were primarily obtained from Türkiye's National Geographic Information System (TUCBS) and were selected based on the relevant literature.

Table S2. Information of dataset.

Dataset name	Year	Resolution	Source	Analytical purpose
Meteorological Observation Data (Temperature)	2025	1 km raster	Türkiye's National Geographic Information System, National Geographic Information Platform https://tucbs.gov.tr/	To assess mean annual temperature (°C) suitability for agricultural production.
Meteorological Observation Data (Precipitation)	2025	1 km raster		To assess mean annual precipitation (mm) suitability for agricultural production.
Great soil groups	2019	1:25.000 scale		To determine soil suitability for various crop types.
Land use capability	n.d.	1:25.000 scale		

Elevation	2019	Derived from DEM (10m)		To classify land's agricultural potential and land use limitations.
Slope	2020	Derived from DEM (10m)		To assess temperature changes and agricultural irrigation conditions; to determine diversity of vegetation and agricultural products.
Soil erosion	2021	1:25.000 scale		To evaluate terrain constraints for agricultural production.
Surface water body-Lake	2022	1:25.000 scale		To identify areas with erosion risks affecting long-term soil productivity.
Surface water body-River	2022	1:25.000 scale		To map freshwater access for irrigation and ecological function proximity.
Aquifers	2023	1:25.000 scale		To map freshwater access for irrigation and ecological function proximity.
Highways	2020	1:25.000 scale		To identify subsurface water availability affecting irrigation suitability.
Organized industrial zone	2021	1:25.000 scale		To evaluate proximity to transportation networks and logistic accessibility.
Land cover	2018	Vector/raster 100m	CORINE Land Cover	To identify proximity to agricultural industrial zones. To identify food-related ESs areas and potential.

2.2. Data Preprocessing

Due to the different units and scales of the spatial indicators used (e.g. precipitation in mm, elevation in meters, distance in kilometers, categorical land-use classes), it was necessary to normalize the data before integration.

Indicators were transformed into a standardized, dimensionless scale using min–max normalization, which maps original values onto a continuous range between 0 and 1. This approach ensures comparability across diverse datasets and allows for integrated analysis within a multi-criteria evaluation framework.

The min–max normalization formula is expressed as:

$$X' = \frac{X - X\,min}{X\,max - Xmin}$$

where X is the original value, X_{min} and X_{max} represent the minimum and maximum values within the dataset, and X ′ is the normalized value. This method preserves the distribution of the original data while ensuring that all indicators contribute equally within the composite suitability model.

2.3. Suitability Evaluation Grading

To interpret the normalized suitability scores, a five-level classification scheme was applied, as shown in Table S3. This scheme translates the continuous outputs of the spatial suitability model into discrete, policy-relevant categories that reflect both ecological potential and land-use constraints.

Table S3. Evaluation Grading

Level	Interval	Status	Indicator characteristics
1	[0.00-0.20]	Not suitable	Land is unsuitable for food production due to severe constraints.
2	[0.20-0.40]	Marginally suitable	

3	[0.40-0.60]	Moderately suitable	Land is weakly supportive of agriculture; significant ecological infrastructural limitations.
4	[0.60-0.80]	Suitable	Land has moderate constraints (e.g., slope, soil, or access); still usable with management practices.
5	[0.80-1]	Highly suitable	Land is favorable for food production with minor limitations; good infrastructure and ecological balance Land is optimal for food production; minimal limitations; high accessibility and ecological integrity.