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BRUFO2050

Exploring future scenarios for the food system in Brussels

Research report Q4

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Glossary

Adaptability: the capacity of actors in the system to influence resilience - in a socio-ecological system essentially to manage it (Walker et al., 2004)

Barrier: A specific factor of a system that hinders the adoption of innovative practices and strategies (proposed definition). When barriers are stronger than drivers promoting change, the current production system is strengthened and self-perpetuated, creating a lock-in (Weituschat et al. 2022)"

Exploratory scenarios: Exploratory scenarios are defined as ''multiple plausible futures described in words, numbers and/or images" (van Notten et al. 2003). The scenario methodology, rooted in systems science, aims to recognize and explore uncertainty and complexity within the decision-making context. Rather than simplifying this context or pretending to provide a single forecast, it embraces the inherent uncertainties (van der Sluijs 2005, Kok et al. 2006) in (Vervoort, Joost et al., 2016)

Food system: the entire range of actors and their interlinked value-adding activities involved in the production, aggregation, processing, distribution, consumption and disposal of food products that originate from agriculture, forestry or fisheries, and parts of the broader economic, societal and natural environments in which they are embedded. The food system is composed of sub-systems (e.g. farming system, waste management system, input supply system, etc.) and interacts with other key systems (e.g. energy system, trade system, health system, etc.). Therefore, a structural change in the food system might originate from a change in another system (FAO, 2014).

Food supply chain is a managed process, a combination of knowledge and skills, spanning electronics, biology and the social science of economics, human behavior, psychology and more (Bourlakis & Weightman, 2003)

Lever: An influential factor or mechanism that can be strategically utilized to exert influence on a system to break free from an existing lock-in situation and enable a transition to a more desirable state (proposed definition).

Lock-in: A phenomenon occurring due to the tendency for policies, technologies, cognitive frames, infrastructure, and social systems to co-evolve and reach a state of stability and self-perpetuation (Courtois et al., 2024). Lock-ins occur when links or feedback between these factors combine to lock a system or set of actors onto a particular pathway or behaviors, thereby hampering any change towards a potentially superior system (adapted from Truong, Trencher, and Matsubae 2022).

Multistakeholder scenarios: exploratory scenarios can engage multiple legitimate perspectives involved in framing and addressing messy challenges such as food security and sustainability (Reilly and Willenbockel 2010)

Resilience: the capacity of a system to absorb disturbance and reorganize while undergoing change to still retain essentially the same function, structure, identity, and feedback (Walker et al., 2004)

Resilience of food system: covers the capacity of a food system to absorb disturbance and reorganize while undergoing change. The concept of « resilience » goes beyond the « sustainability » concept by integrating risks of shocks and rupture as well as dependency relation with other components of the food system. [1]

Transition: Transition theory comes from research on socio-technical innovation (Vervoort, Joost et al., 2016). It seeks to understand how niche-level activities are up-scaled into broader socio-technical regimes, resulting in socio-technical transitions (Rotmans 2005, Geels and Schot 2007, Kemp et al. 2007). Transitions are conceptualised as co-evolutionary change processes involving many societal dimensions. (Geels and Schot 2007) central idea in transition management is a multi-level perspective that identifies niches, sociotechnical regimes, and landscapes (as the contexts for socio-technical regimes). When shifts in landscapes or socio-technical regimes happen, this can allow niche practices to flourish and create new socio-technical regimes. Transition theory elaborates on a typology of transition pathways (Geels and Schot 2007)

Transformation: The word "transformation" is typically used to refer to fundamental changes in structure, functions and relations within (social-ecological) systems (Vervoort, Joost et al., 2016). Such transformations lead to new interaction patterns and have the potential for new emergent outcomes. Transformations are complex, dynamic, and multi-dimensional, involving social, institutional, cultural, technological, ecological, and political dimensions. Therefore, transformations must be examined through inter–and transdisciplinary lenses. Transformations tend to be political, involving winners and losers, which means that aspirations for transformational change are often contested (Patterson et al. 2016).

Transformability: "the capacity to create a fundamentally new system when ecological, economic, or social (including political) conditions make the existing system untenable" (Walker 2004 in (Vervoort, Joost et al., 2016).)

Sustainable development: a development that meets the needs of the current generation without compromising the ability of future generations to meets their own needs (Brundtland Commission Report)

Sustainable consumption: the use of goods and services that respond to basic needs and bring a better quality of life, while minimizing the use of natural resources, toxic materials and emissions of waste and pollutants over the life cycle, so as not to jeopardize the needs of future generations' (1994 Oslo Symposium on Sustainable Consumption)

Sustainable food system: is a food system that delivers food security and nutrition for all in such a way that the economic, social and environmental bases to generate food security and nutrition for future generations are not compromised. (FAO, 2014). This means that:

- It is profitable throughout (economic sustainability);
- It has broad-based benefits for society (social sustainability); and
- It has a positive or neutral impact on the natural environment (environmental sustainability).

[1] Greniers d'abondance, Projet de résilience alimentaire : https://resiliencealimentaire.org/methodologie/

1 General introduction

BRUFO2050 is a forward-looking research project that asks how and through what pathways the Brussels-Capital Region can move towards a more sustainable and resilient food supply by 2050.

Funded by the Innoviris Prospective Research Program (2023), BRUFO2050 seeks to overcome current socio-technical lock-ins and foster transformative governance through participatory foresight. This approach begins by considering the city's unique context to better map the supply system, the "missing link" between consumption (in Brussels) and production (outside Brussels).

The adopted approach emphasizes inclusivity by engaging all actors across the food system and value chain. We focus explicitly on wholesale, transport, processing, and retail up to the HoReCa sector, while maintaining a holistic view of the entire food system. The project addresses three main objectives, translated into five research questions (Figure 1) :

1. **Analyse the current food supply system**
   - Question 1: How does the current system operate?
   - Question 2: How sustainable is the current system?
2. **Identify barriers, lock-ins and strategic levers**
   - Question 3: What are the barriers preventing the system from shifting toward a more sustainable system?
3. **Develop future scenarios and pathways**
   - Question 4: What can the future possibly look like for the Brussels food system?
   - Question 5: How to progress towards the most sustainable food supply system?

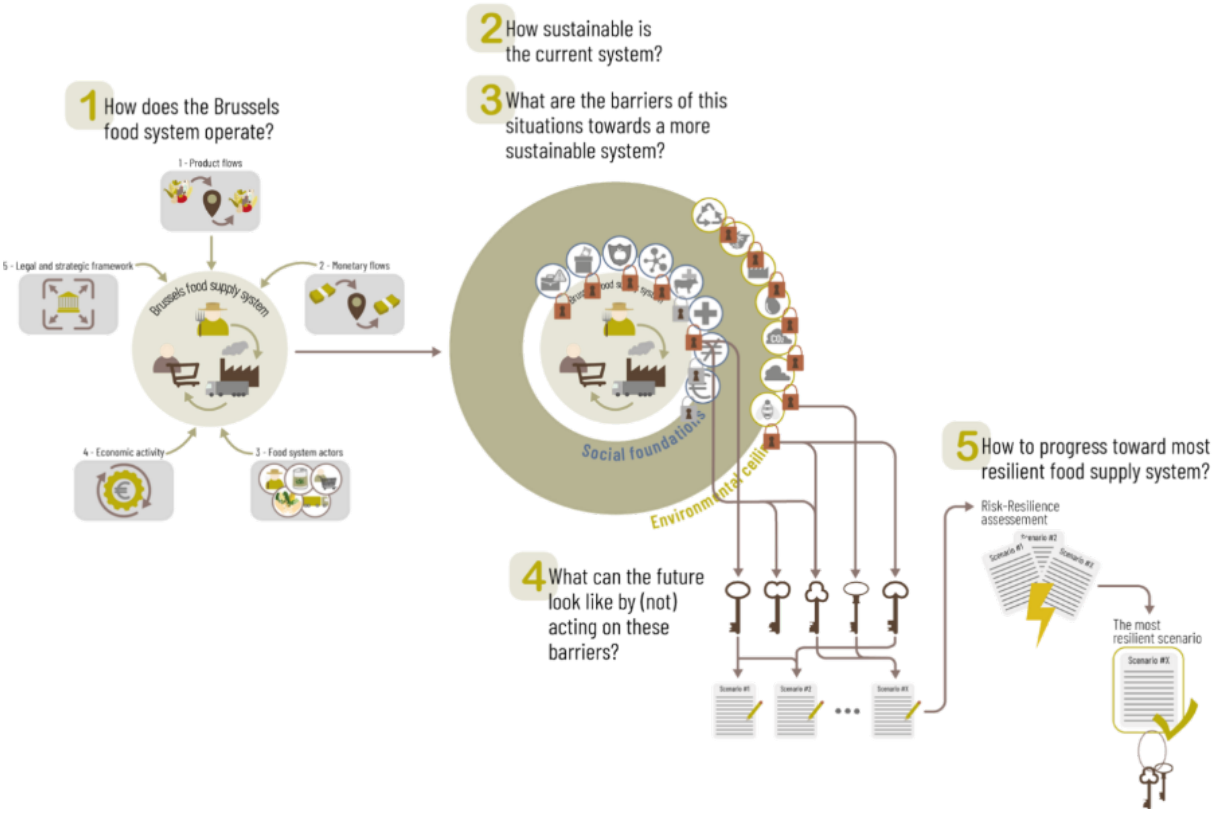


Figure 1 : *Overview of the Brufo2050 project and its five research questions.*

Each of these questions are answered through different methodologies, with the publication of one report per question[2].

This report focuses on the fourth research question 4: **What can the future possibly look like for the Brussels food system?.** The work presented here follows the research led in the previous questions. It is particularly related to question 2, which serves as a baseline to compare the sustainability of the considered scenarios, and question 3, which constitutes the starting point identifying where the system can be acted upon to design alternative futures.

[2] All reports are publicly available on https://sytra.be/publication/brufo2050/.

2 General methodology

2.1 Objectives, approach and methodological steps

2.1.1 General objective

The main objective of this report is to explore possible alternative configurations of the Brussels food system and assess their respective outcomes. In turn, this work should provide relevant insights for the following (and final) step of the project, i.e. reflecting on what concrete actions can be taken to move towards a more sustainable and resilient food system (question 5), thus acting on the barriers previously identified (question 3).

2.1.2 Methodological approach

To investigate these matters, and embedded in the foresight approach adopted throughout the project, this report resorts to developing a scenario exercise. Contrary to forecast which aims to predict insights into the futures based on past events, foresight adopts a more open-ended approach to explore mid-to long-term future situations (de Lattre-Gasquet et al., 2023; McEldowney, 2017; Woodhill et al., 2024). In this context, scenarios and scenario exercises[3] emerge as useful tools to explore these futures. The European Environment Agency defines a scenario as a *"plausible description of how the future may develop based on a coherent and internally consistent set of assumptions about key driving forces (e.g., rate of technological change, prices) and relationships. Scenarios are neither predictions nor forecasts but provide a view of the implications of developments and actions"* (European Environment Agency, 2017).

Scenarios can be both qualitative and quantitative. The former employ language or visual symbols, often presented as narrative storylines, to describe existing or potential drivers and strategic future directions. The latter correspond to simulations derived from models following a comprehensive set of assumptions, and representing a possible trajectory in time resulting from a set of variables simulated under parameter and input combinations (European Environment Agency, 2017).

2.1.3 Research steps

In this report, we develop a foresight scenario methodology comprising six steps (Table 1), which can be grouped in two main phases: the first being mainly qualitative and aimed at identifying and defining the scenarios, and the second one being mainly quantitative and aimed at providing a quantified assessment and comparison of the scenario outcomes.

As a diversity of methods and approaches exist, the next paragraph focuses on situating the adopted approach in terms of scenario design. The report then presents each of the six steps in greater detail.

[3] Scenario exercises consist of individual studies that model one or more quantitative scenarios. Thus a scenario corresponds to one single simulation whereas as a scenario exercise corresponds to the set or family of scenarios tested by authors within one scenario study (Riera et al., 2025).

Table 1 : Methodological approach and steps adopted to develop the scenario exercise in the BRUFO2050 project.

Research phases	Research steps
PHASE 1 : Qualitative Scenario development and design	STEP 1 : Identification of critical drivers
	STEP 2 : Definition of four scenarios
	STEP 3 : Narrative description of scenarios
PHASE 2 : Quantitative Scenario quantification	STEP 4 : Quantification of scenario variables
	STEP 5 : Assessment of quantitative scenarios
	STEP 6 : Quantitative comparison of scenarios results

2.2 Approach to scenario analysis

As scenario exercises can follow a diversity of methods and serve multiple purposes, we find it important to outline the main characteristics of our approach, focussing in particular on five elements (Table 2) : the aim and purpose, the type of scenarios, the scenario design, the degree of participation, the scale of application and the boundaries of the exercise. Each of these elements is introduced below, and explained in further detail in the following sections.

Table 2 : Main characteristics of adopted approach for the scenario exercise.

Elements of scenario exercise	Adopted approach
1. Aim and purpose of scenario exercise	Exploratory scenarios
2. Type of scenario	Mixed quantitative and qualitative
3. Scenario design method	2x2 matrix based on critical external drivers
4. Research process and degree of participation	Expert-based
5. Scale of application and boundaries	Mixed external and internal ; and loosely linked multi-scale (Brussels and Belgium; production and consumption)

2.2.1 Aim and purpose of the scenario exercise.

Scenario exercises can serve several purposes, with a common distinction between on one side normative scenarios, which aim to demonstrate the feasibility of a particular scenario or reach pre-identified goals, and on the other side exploratory scenarios, which assess the consequences of different trajectories which are not necessarily identified beforehand (Riera et al., 2025). **In this case, the adopted approach is exploratory.** Although the aim is to produce scenarios that are “sustainable”, neither pre-identified scenarios nor specific end-goals or targets were set before the exercise.

2.2.2 Type of scenario.

As mentioned earlier, scenario exercises can be both quantitative and qualitative, with the combination of both being often considered challenging. A main challenge in mixed qualitative-quantitative exercises resides in the trade-offs between the level of detail of scenario narratives that can be reflected in quantitative modelling. While being aware of these limitations, **the adopted approach in this case is mixed, comprising both a qualitative phase aimed at defining and describing the scenarios, and a quantitative phase aimed at assessing their outcomes.**

2.2.3 Scenario design method.

Several methods can be adopted to identify and design the scenarios, often relying on a preliminary identification of variables and factors that influence the functioning and outcomes of the system. Selecting a number of key variables and considering their possible evolutions then allows to design alternative scenarios, which can be constructed in different ways. For instance, morphological analysis defines scenarios by combining different values of different variables (as adopted for instance in Mora et al., 2023), possibly leading to as many scenarios as the combination of variables and values permits. Alternatively, 2x2 scenarios are a common and somewhat similar approach where scenarios are defined based on two key variables and two extreme values, thus resulting in four contrasted scenarios. **In our case, we resort to a 2x2 matrix based on a preliminary identification of critical drivers.**

2.2.4 Research process and participatory approach.

The extent of participation in scenario development, either through experts or through operational actors, greatly varies from one exercise to another. Actors can participate at different stages of the scenario exercise, either in a consultation phase, to actively participate in scenario design, or at later stages for restitution and validation of results. **In our case, the scenario design per se was expert-based as scenarios were constructed by the project team.** Participation with actors of the Brussels food system occurred both before, during the project steps leading to the scenario exercise (barrier and lock-in phase; research question 3), and after (restitution of scenario results and discussion of possible pathways and actions to take; research question 5).

2.2.5 Scale of application and boundaries.

Besides their normative/exploratory nature, Börjeson et al. (2006) also distinguish between external and internal scenarios, depending on whether the factors being considered for the scenario design are within the control of the actors in question or not. Additionally, Biggs et al. (2007) highlight that scenarios can be developed at single scales or at multiple scales, with the possibility to consider interactions across scales (multi-scale scenarios). While mainly targeting spatial scales, this also extends to other scales (e.g. multiple stages of supply chains from production to consumption). In this sense, **our approach can be considered as a loosely linked multi-scale approach in the sense that it considers both the production and consumption, at either Belgian or Brussels level. Additionally, the scenarios are both external and internal, as some scenario variables are within the scope of Brussels food system actors while others are external to it.**

3 PHASE 1 : Scenario development and design

3.1 STEP 1 : Identification of critical drivers

3.1.1 From internal factors to external drivers

The work carried out in previous work packages constitutes the starting point of the exercise. In particular, Q3 identified a series of barriers limiting the sustainability of the Brussels food system. These barriers were grouped in three clusters: (i) an insufficient demand for sustainable food; (ii) high prices and costs of sustainable food, and (iii) the limited availability of sustainable food.

Starting from there, the first step of the scenario exercise consisted in identifying the main external drivers shaping the Brussels food system from outside. To avoid a too broad level of analysis, the boundaries were set at the level of the Belgian food supply. As mentioned above, this was achieved based on expert judgment. To this end, a collective working session among researchers of the project team was organised. Collective discussions allowed to identify a series of external drivers (outer circle of Figure 2). Identified elements related to the evolution of farming activities and agricultural production (e.g. prevalence of certain farming systems such as agroecological or corporate farms, shifts within agricultural land use), the evolution of supply chains (trends towards more international or segmented supply chains) and the consideration of sustainability outcomes (e.g. in terms of human health, soil health and erosion and more generally the internalisation of externalities).

Causal-effect reasoning was further used to understand interdependencies between both internal and external drivers, thus allowing to draw a general picture of the main drivers shaping the sustainability of the Brussels food system, as shown in Figure 2. The inner circle corresponds to the Brussels food system and groups the three main clusters, while the outer circle corresponds to the Belgian food supply and gathers the identified external variables. Additional variables located outside of the second circle were also discussed, for instance the refederalisation of Belgium to enable regional synergies between Flanders, Wallonia and Brussels, but these were considered out of scope.

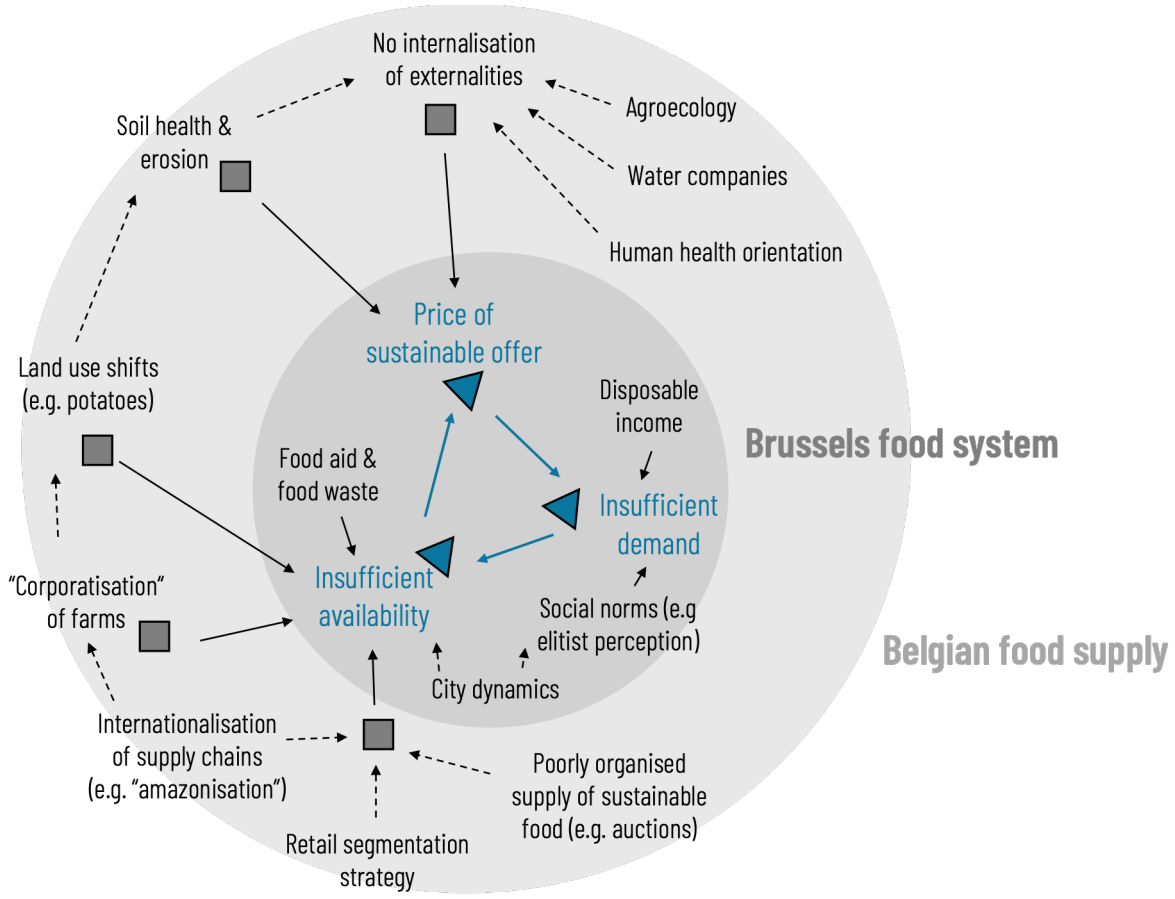


Figure 2 : *Overview of main (external and internal) drivers shaping the Brussels food system and its sustainability, as emerged from a working sessions with research team. Grey squares represent external drivers, blue triangles represent internal drivers, and arrows represent (direct and indirect) links between drivers.*

3.1.2 From external drivers to scenario variables

Based on the assembled picture, and with the objective of constructing a two-by-two matrix serving the delineation of the scenarios, the next step consisted in selecting two critical drivers. Critical drivers are relevant external factors that could provide a comprehensive societal outlook of how the Belgian food supply (and in consequence the Brussels food system), could develop in the future. The chosen critical drivers should be the ones considered to be the most impactful and uncertain.

Two drivers were discussed and preidentified as promising variables during the collective working sessions: (i) the evolution of farming systems (from intensive to extensive), and (ii) the evolution of supply and market structures (from being diverse, customised and localised to being homogenous, concentrated and globalised).

The two variables were later confirmed by confronting them to the existing literature. In particular, they were especially well aligned with the two-axis framework proposed by Therond et al. (2017) to describe farming system diversity, integrating the type of farming system on one hand and the socio-economic context affecting the functioning of farming systems on the other hand.

3.2 STEP 2 : Definition of four scenarios

3.2.1 A 2x2 matrix and four contrasted scenarios

Combining both critical drivers provides a 2x2 matrix delineating four different and contrasted scenarios (Table 3):

- Scenario 1 : “Global efficiency” (intensive and globalised)
- Scenario 2 : “Sustainable islands” (eco-intensive and localised)
- Scenario 3 : “Coordinated sustainability” (extensive and globalised)
- Scenario 4 : “Agroecological networks” (extensive and local)

Table 3 : *Two-by-two matrix defining four scenarios based on the evolution of farming practices (intensive and extensive) and the supply and market structure (homogenous and globalised vs. diverse and localised).*

		Supply and market structure	
		Homogenous and globalised	Diverse and localised
Farming practices	Intensive	**Scenario 1** **“Global efficiency”** (intensive and globalised)	**Scenario 2** **“Sustainable islands”** (eco-intensive and localised)
	Extensive	**Scenario 3** **“Coordinated sustainability”** (extensive and globalised)	**Scenario 4** **“Agroecological networks”** (extensive and local)

3.2.2 A set of variables to describe the scenarios

To give greater depth to the scenarios, a series of additional variables were selected that could provide a detailed description of what the scenarios entail for Brussels and Belgium, thus providing a comprehensive societal outlook of each scenario.

The two selected scenario variables (farming practices and market structure) and the work of Therond et al. (2017) satisfyingly cover societal dimensions such as agricultural production, economic organisation and market coordination. Yet other elements such as population dynamics, urbanisation patterns, environmental changes, diets and consumption trends and social inequalities were still underexplored. Hence, complementary variables were selected by drawing on the experience of previous scenario studies, in particular the shared socio-economic pathways for European agriculture (Eur-Agri-SSP) (Mitter et al., 2020), the SUREfarm project (Mathijs et al., 2017; Meuwissen et al., 2019), and the Agrimonde scenarios (Chaumet et al., 2009). Based on these references, a final set composed of twelve variables was selected to describe the scenarios. They include: the type of production in Belgium, the food basket, food aid & food waste, rural-urban relationships, farm structure, retail and market strategies, technology, human & health orientation, environmental conditions, governance, affordability mechanisms, protein transition.

The evolution of each variable in each scenario allows to draw a detailed picture of the four scenarios, as presented in Table 4 to Table 7.

Table 4 : *Detailed description of Scenario 1: Global efficiency (global & intensive).*

Scenario 1. Global efficiency **Global & Intensive (market-based)** *Brussels as "smart food city": connected hub with sustainable food is supplied via global chains with low-impact, processed foods*										
Type of production in Belgium and food basket	**Food aid & food waste**	**Rural-urban relationships**	**Farm structure**	**Retail & market strategy**	**Technology**	**Human & health orientation**	**Environmental conditions**	**Governance**	**Affordability mechanism**	**Protein transition**
International basket of processed, low-impact products. Imported soy "3D printed" burger in "sustainable chain".	Minimal food aid (market driven), ultra-processed foods, food waste valorised.	Regions dependent on global chains, limited interregional links, strong global trade agreements.	Large, specialized, corporate farms, contract farming; highly financialized; land concentration.	Integrated global value chains, retail & horeca chains selling processed food.	Full automation (sensors, drones, modelling, robotics), urban vertical farms, top-down innovation.	Market-led health monitoring via digital twins, insurance schemes, evidence-based labelling, taxes on environmental damage.	Pollution treatment, market-led integration of externalities.	Federal states with interstate trade, global market integration.	Prices regulated by global competition and efficiency.	Slight increase in consumption of (imported) alternative protein products, but no decrease in consumption of animal productions. No impact on local production.

Table 5 : *Detailed description of Scenario 2: Sustainable islands (local & eco-intensive).*

Scenario 2. Sustainable islands **Local & eco-intensive** *Brussels is a city of parallel sustainable food circuits: segmented markets and diverse food offerings*										
Type of production in Belgium and food basket	**Food aid & food waste**	**Rural-urban relationships**	**Farm structure**	**Retail & market strategy**	**Technology**	**Human & health orientation**	**Environmental conditions**	**Governance**	**Affordability mechanism**	**Protein transition**
50% organic, 50% precision/eco-intensive; mix of processed & unprocessed; Belgian food, feed and agro-fuels; hybrid diets Belgian soy pieces in carbonade-sauce with Belgian fries in Belgian brasserie	Voluntary food aid initiatives, food banks; food waste is processed in circular economies at regional level	Belgian value chains with regional specialisation, Flanders & Wallonia mainly producing for BXL; multi-activity	Family-farms & agroholdings linked with processors & distributors; diverse sizes; collective organisation, but specialised	Belgian retail chains, providing mix of organic and eco-intensive products	Modular machinery for organic and precision farming; limited automation with sensors; farmer decisions remain central	Mix of recommendations, public campaigns, school programs. Local cross-sectoral policies	"Common sense" tresholds; regional integrated food-energy systems	Regions coexist and collaborate, professional value chains, interregional coordination; Brussels regional government met regional policy	Prices kept low through local production efficiency and cooperative models	Increased production and consumption of (local) alternative proteins (e.g. protein crops), & reduction of animal products, in particular cattle

Table 6 : *Detailed description of Scenario 3: Coordinated sustainability (global & extensive).*

Scenario 3. Coordinated sustainability **Global & Extensive (top-down, EU)** *Brussels as hub for sustainable, ethical trade*										
Type of production in Belgium and food basket	**Food aid & food waste**	**Rural-urban relationships**	**Farm structure**	**Retail & market strategy**	**Technology**	**Human & health orientation**	**Environmental conditions**	**Governance**	**Affordability mechanism**	**Protein transition**
100% organic and fairtrade, ethnically labelled international basket. Fairtrade curry with organic vegetables and coco milk in organic restaurant.	EU-regulated food aid and waste norms, mandatory retailer donations	Brussels and regions connected through EU trade; preference for Belgian organic products, global commodity trade	Carbon farming, organic farming, agroforestry, conservation agriculture, mixed crop-livestock systems, collective organisation	Retailers selling certified products (e.g. organic, rainforest alliance, fairtrade, Nutri score…), global supply chains with big data optimisation	Limited technological intensive practices, open data platforms for risk reduction and ; The design of machinery is sharing-oriented	Top-down, policy-driven sustainability goals, pesticide-free standards, long-term EU agricultural strategies, procurement laws	Prevention, strict compliances with EU laws	Federal states, with interfederal committee, strong EU governance	Prices supported by EU subsidies and regulatory frameworks	Increased production and consumption of (local) alternative proteins (e.g. protein crops), & reduction of animal products, in particular monogastrics to preserve grasslands and cattle

Table 7 : *Detailed description of Scenario 4: Agroecological networks (local & extensive).*

Scenario 4. Agroecological networks **Local & Extensive** *Brussels in the middle of locally adapted food networks, characterized through proximity and diversity, food sovereignty*										
Type of production in Belgium and food basket	**Food aid & food waste**	**Rural-urban relationships**	**Farm structure**	**Retail & market strategy**	**Technology**	**Human & health orientation**	**Environmental conditions**	**Governance**	**Affordability mechanism**	**Protein transition**
100% agroecological; biodiversity-based, artisanal, local, seasonal food. Local chickpea salad with seasonal greens & fruits in local social kitchen.	No food aid (sharing economy); close-to-zero waste, fully circular	Brussels green belt produces for city; all regions are self-sufficient	Polyculture, small-scale, diversified farms; collective landscape management; societal participation	Farmer markets, local shops, community sharing, minimal processing	No machines, natural techniques, no industrial processing	"One health" approach, harmony between food, nature, and health	Best practices, no environmental damage	Highly localised governance, cooperative decision-making	Prices low because production costs are minimal and distribution is local	Similar to S3. Increased production and consumption of (local) alternative proteins (e.g. protein crops), & reduction of animal products, in particular monogastrics to preserve grasslands and cattle

3.3 STEP 3 : Narrative description of scenarios

As a last step of the first phase, the key characteristics of each scenario were synthetised in a comparative table to highlight the key principles and storylines laying behind each scenario (Table 8). This also contributed, along with the previous descriptions, to producing a narrative description of each scenario (Table 9), which were then visually illustrated (Figure 3).

Table 8 : *Synthetic and comparative description of the four scenarios.*

Theme	**Scenario 1** Global efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated sustainability	**Scenario 4** Agroecological networks
Core idea	Brussels as a 'smart hub' in an efficient, global chain	Brussels as a mosaic of parallel food circuits	Brussels as a hub for fair and sustainable global trade	Brussels at the centre of local food sovereignty
Food on the plate	Highly processed, low-impact, global (e.g., 3D-printed burger)	Hybrid: local, organic & technological (e.g., Belgian soy pieces)	Certified (organic, fair-trade), ethnic, global	Purely local, seasonal, artisanal, unprocessed
Production system	Intensive, large-scale, corporate, monoculture	50% organic, 50% precision agriculture	100% organic/extensive, regulated (e.g., carbon farming)	100% agroecological, small-scale, diversified
Rural-urban relationship	Fully dependent on global import chains	Regional specialization (Flanders/Wallonia producing for Brussels)	EU internal trade with a preference for Belgian organic products	The green belt produces for the city; close to self-sufficiency
Technology	Fully automated, AI, drones, vertical farming	Modular, sensors, data for the farmer	Open data platforms, machinery sharing, traceability	Natural techniques, no industrial machinery
Governance	Market-driven, global trade agreements, corporate control; deregulation by Good Food governance	Collaboration between regions, professional value chains; Strong Good Food governance coordination	Strong EU regulation, top-down, inter-federal consultation; Good Food governance for EU-laws implementation	Hyper-local, cooperative, citizen participation; Support & facilitation from Good Food governance

Table 9 : *Narrative description of the four scenarios.*

Scenario 1 – Global efficiency (Global & intensive)
Brussels positions itself as a "smart food city," a connected hub plugged into highly automated, intensive global supply chains. The food basket is dominated by processed, low-impact products (e.g. the imported, 3D-printed soy burger is emblematic), supplied through large, corporate, contract-farmed operations. Vertical farms, drones, robotics, and digital-twin health monitoring drive full automation, with innovation flowing top-down from global corporate actors. Governance rests with federal states embedded in international trade agreements. Market competition, not local policy, sets prices and standards. Environmental harm is managed after the fact, through pollution treatment and market mechanisms rather than upstream prevention.
Scenario 2 – Sustainable islands (Local & eco-intensive)
Brussels in 2050 is a mosaic of parallel, sustainable food circuits, each serving a different segment of the population with its own market logic. Farming is split evenly between organic and precision/eco-intensive methods, producing a hybrid diet of processed and unprocessed Belgian food. Flanders and Wallonia specialise regionally to supply the capital, while family farms and agroholdings collaborate closely with processors and retailers. Modular, sensor-assisted machinery supports the farmer rather than replacing them, and regional governments coordinate policy across regions. Food remains affordable thanks to local production efficiency and cooperative retail models.
Scenario 3 – Coordinated sustainability (Global & extensive)
Here, Brussels becomes a hub for fair and sustainable global trade, built on strong EU-level coordination rather than market forces alone. The food basket is entirely organic and fairtrade, ethically labelled and internationally sourced, reflecting practices like carbon farming, agroforestry, and mixed crop-livestock systems. Retailers sell certified products under strict, top-down EU sustainability standards, while open-data platforms and shared machinery support extensive, low-input farming. Governance is firmly EU-driven, combining federal states with an inter-federal committee to enforce long-term agricultural and procurement policy. Prices are kept stable through EU subsidies and regulatory support rather than local market dynamics.
Scenario 4 – Agroecological networks (Local & extensive)
In this scenario, Brussels sits at the heart of a network of locally adapted, agroecological food systems built on proximity, diversity, and food sovereignty. Production is entirely agroecological, small-scale, and seasonal, with a strong focus on developing its own green belt. Food reaches people through farmers' markets, local shops, and community sharing rather than formal retail chains, and industrial machinery and processing are almost entirely absent. Governance is highly localised and cooperative, with citizens actively participating in decisions, and a "one health" philosophy links food, nature, and wellbeing. Because production costs are minimal and distribution stays local, prices remain low despite the system's small scale.

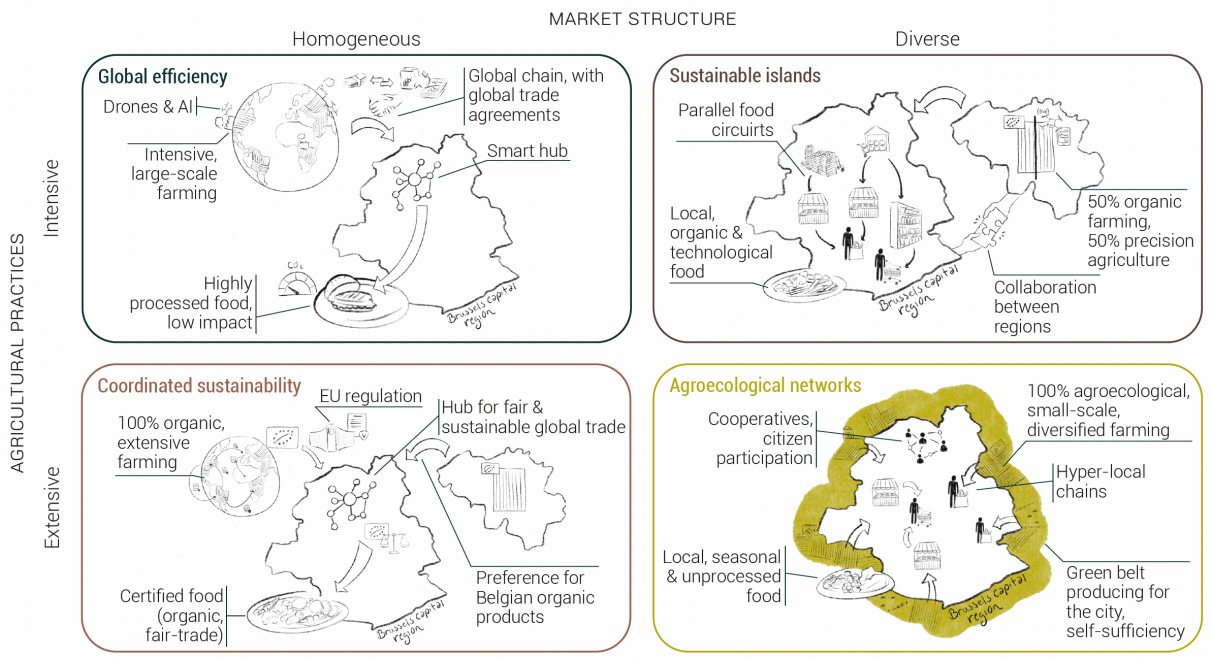


Figure 3 *: Visualisation of the four scenarios.*

4 PHASE 2 : Quantification of scenarios

4.1 STEP 4 : Quantification of scenario variables

Besides the qualitative identification and description of scenarios and their storylines, the objective of the mixed scenario exercise was to quantitatively assess their outcomes. To this end, among the twelve scenario variables described above, a series of variables were used as inputs in a modelling tool (Table 10 and Table 11).

Both internal and external variables (as presented in Figure 2) were used to translate the qualitative scenarios in quantitative simulations. This implies that the quantitative scenarios simulate alternative configurations for both Belgian agricultural production and food supply (outer circle of Figure 2) and food demand of Brussels (inner circle of Figure 2). As a result, the scenarios are assessed from both the production perspective (production-side scenarios) and from the consumption perspective (consumption-side scenarios). The results of the former assess the outcomes of Belgian agricultural production, while the results of the latter provide information on the footprint of the Brussels food demand.

Table 10 : *Production-side variables (external) and consumption-side variables (internal) considered to model the quantitative outcomes of the scenarios.*

Variable type	Variable	Explanation
Production-side variables (external)	**Farming systems**	Share of different farming systems in agricultural production, with three main categories : organic – extensive – intensive.
	Agricultural land use Land for biodiversity	Share of agricultural land set aside from production for biodiversity conservation.
	Agricultural land use Evolution of crops	Evolution of areas of different crops and plant-based sectors.
	Protein transition Animals	Evolution of the number of animals in each animal sector.
	Protein transition Crops (legumes)	Evolution of the area of legumes.
	Technology	Technological improvements considered (only in animal sectors).
Demand-side variables (internal)	**Farming systems**	Share of different farming systems in food demand, with three main categories : organic – extensive – intensive. Considered to follow the same evolution as in production.
	Diets	Share of different diets in food demand. Three diets are considered : current Brussels diet, Belgian dietary guidelines, EAT-Lancet diet.
	Food waste	Evolution of food waste along the chain (from production to consumption)

Table 11 : *Hypotheses set for the quantitative assessment of the scenarios.*

Variable	**Scenario 1** Global Efficiency	**Scenario 2** Local Eco-intensive	**Scenario 3** Coordinated Sustainability	**Scenario 4** Local Agroecology
Farming systems (production and consumption)	20% organic 80% intensive	50% organic 50% intensive	50% organic 50% extensive	30% organic 70% extensive
Agricultural land use – land for biodiversity	None	10% land set aside for biodiversity (land sparing)	10% land set aside for biodiversity (land sharing)	10% land set aside for biodiversity (land sharing)
Agricultural land use – crops	Grasslands x0,8	Vegetables x2 Oil-rich crops x2	Vegetables x3 Fruits x2 Sugar beet x0,8 Potatoes x0,5	Vegetables x3 Fruits x2 Sugar beet x0,5 Potatoes x0,3
Protein transition – animals	BAU evolution for animals + protein crops	-30% monogastrics -30% dairy cows -50% suckler cows	-50% monogastrics -50% ruminants	-70% monogastrics -100% suckler cows, replaced by dual purpose dairy herd
Protein transition – legumes	Unchanged	Legumes area x3	Legumes area x5	Legumes area x10
Technology	Improved efficiency of manure management (-15% of N2O emissions) Reduced enteric fermentation (-10% CH4 emissions) improved feed conversion ratios (10% for pigs and broilers)	Improved efficiency of manure management (-15% of N2O emissions)	Improved efficiency of manure management (-10% of N2O emissions)	Improved efficiency of manure management (-10% of N2O emissions)
Diets	90% current Brussels diet 10% EAT-Lancet diet	70% current Brussels diet 30% EAT-Lancet diet	100% EAT-Lancet diet	100% Belgian dietary guidelines
Food waste	-30% at each step	-30% at each step	-30% at each step	-60% at each step

4.2 STEP 5 : Assessment of quantitative scenarios

4.2.1 Production-consumption model of the Belgian food system

To assess the quantitative outcomes of the scenarios, we rely on a joint production-consumption model of the Belgian food system. The model consists of two separate but interconnected tools, focussing on either the production side or on the consumption side. The following paragraphs provide a general presentation of the model and its construction. A detailed description of the model (in particular the production side tool) can be found in Riera et al. (2026).

Type of model

The modelling tool is a biophysical process-based model. It follows a bookkeeping approach using either agricultural land and animal populations as initial modelling units (production perspective) or the resident population (consumption perspective), to assess a series of related biophysical flows (production/demand of biomass, nutrient flows, gaseous emissions, etc.).

Scope and boundaries

The scope of the model is the Belgian agriculture and food system. It accounts for all agricultural activities and food demand within Belgian regions: Wallonia, Flanders and Brussels.

On the production side, the model adopts a territorial LCA approach (Loiseau et al., 2018) in the sense that it accounts for all agricultural production and food consumption activities that occur on the Belgian territory. The approach focuses on all agricultural productions taking place in Belgium and all the impacts related to those production activities (whether these are direct impacts occurring in Belgium or indirect impacts occurring abroad).

On the consumption side, the model adopts a footprint perspective assessing the required production and impacts associated to the demand of the population, in this case the Brussels resident population. Importantly, the model considers the production to occur in Belgium, following Belgian farming systems, yields and impact factors, while impacts related to imported foods (e.g. tropical fruit) are not considered, except for indirect impacts occurring abroad for production in Belgium (e.g. soybean production in Brazil to feed animals in Belgium).

Linking the production and consumption perspectives allows to draw information on the (theoretical) capacity of Belgian production to answer Brussels food demand, or inversely, give an indication of what the Brussels food demand represents compared to Belgian production.

Sequences of calculation

The model relies on three types of input variables (Figure 4): production factors, farming systems and control variables.

Two main categories of production factors are considered to estimate agricultural productions and outcomes. Agricultural land (hectares) and animal populations (animal numbers) are the starting point of the calculations for the production-side tool, while the consumption-side tool starts with human population (number of residents) to estimate food demand.

A specificity of the approach resides in the consideration of a diversity of farming systems within agricultural sectors to represent the diversity of practices, and sustainability outcomes. For each agricultural sector and food category, a typology comprising two to six farming systems is proposed. Sector-specific farming systems are reclassified into generic categories (intensive, intermediate, extensive and organic) to facilitate comparison across sectors.

Finally, control variables are those that make the link between production factors, farming systems and the model outputs. They are generally expressed per production factor (per hectare; per animal; per capita). Control variables include elements such as agricultural yields, animal feeding practices (feed consumption and composition), input uses (e.g. N fertiliser and pesticides), human diets, etc. Depending on data availability, control variables are detailed at the farming system level or at higher levels (e.g. sectoral level).

The combination of production factors, farming systems and control variables allows the calculation of a series of output variables and indicators, as illustrated in Figure 4 from the production perspective (production-side tool). The sequence of calculation of the consumption-side tool is slightly different as it departs from the human population and their diets to assess a food demand and its outcomes. The data and calculations (equations) however are the same in both tools.

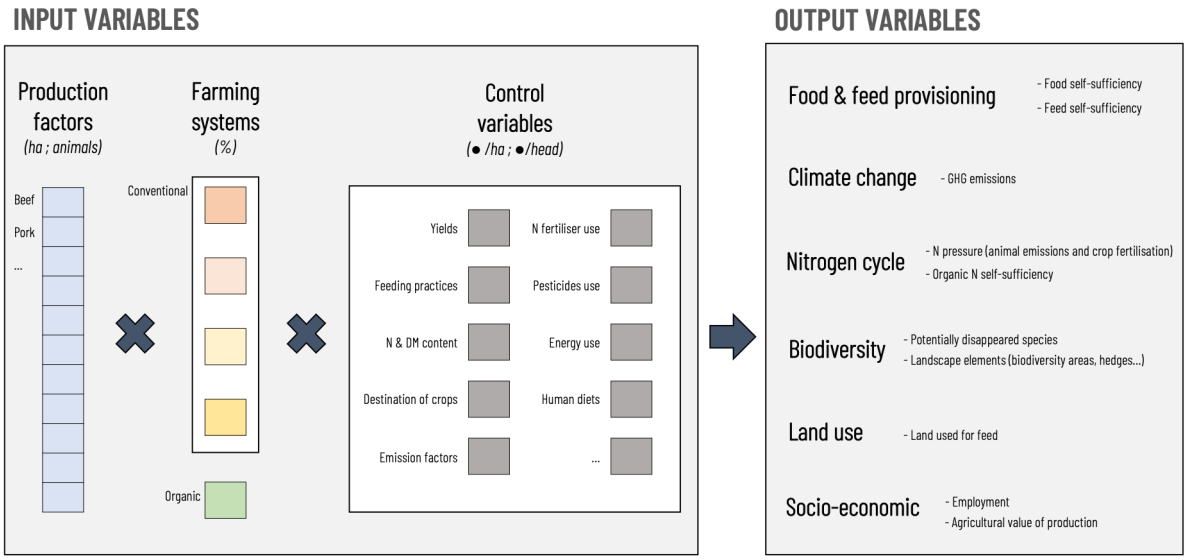


Figure 4 : *General structure of the modelling tool, including three types of input variables (production factors, farming systems and control variables) and model outcomes (output variables). Presented here from the production perspective. Taken from Riera et al. (2025).*

4.2.2 Output indicators to the assess the sustainability of the scenarios

The main objective of the quantitative phase of the scenario exercise is to assess the sustainability outcomes of the four scenarios. The second research question of the project focussed on framing and assessing the sustainability of the current Brussels food system, which thus constitutes the baseline of this assessment (see Q2 report). As a reminder, sustainability has been defined based on the sustainability compass developed by Le Basic, which, following the doughnut approach, comprises a social foundation and an environmental ceiling (Figure 5).

Twenty socio-economic indicators reflecting the societal configuration of the Brussels food system were selected and evaluated, grouped in six themes : human health, working conditions, decent income, socio-economic inequalities, food democracy, social cohesion, food security. In parallel, the environmental dimension was assessed through four indicators reflecting the footprint of the Brussels food demand, grouped in three themes : land use, climate and biodiversity. Table 31 in the appendix provides an overview of the sustainability themes and indicators selected and assessed in Q2.



Figure 5 : *Adapted figure of the sustainability compass for BruFo2050. Taken from Q2 report.*

Of the initial indicator set assessed in Q2, not all could be assessed in the scenarios as they are not covered by the modelling tool. Thus, the sustainability assessment carried out in this report to compare the outcomes of the scenarios is limited to a restricted set of indicators based on the available data. The focus particularly lies on the environmental dimensions, while the socio-economic context of the Brussels food system lies out of scope as it cannot be captured by the modelling tool. Only two health-related indicators can be assessed through the evolution of diets (Table 12).

Table 12 : *Sustainability themes and indicators covered by the modelling tool and used to assess the outcomes of the scenarios. Based on sustainability framework established in Q2.*

Dimension	Theme	Selected indicators
Socio-economic (social foundation)	S1. Impacts on human health	S1.2 Protein consumption from plant-based sources
		S1.3 Proportion of the population meeting dietary recommendations (by food group)
	S7. Risks to food security	S7.4 Brussels' food self-sufficiency level
Environmental (environmental ceiling)	E1. Land use	E1.1 Land use of Brussels food demand
	E2. Climate	E2.1 Carbon footprint (GHG emissions) of Brussels food demand
	E3. Biodiversity	E3.1 Damage score (potentially disappeared species) of Brussels food demand
		E3.2 Reliance on soybean (potentially imported deforestation) of Brussels food demand

4.3 STEP 6 : Quantitative comparison of scenarios results

This section outlines the quantitative scenario results produced by the modelling tool. Results are first presented from the production perspective, showing how Belgian agriculture and its outcomes evolve in the four scenarios. The shift then focuses to the consumption perspective, analysing the food demand of the Brussels population and its footprint. The section ends with a comparative and summary assessment of production and consumption outcomes.

4.3.1 Production-side scenarios

Evolution of agricultural production in Belgium

Land use and agricultural land

Agricultural area slightly decreases in all four scenarios as a combined result of two effects (and following the hypotheses set in Table 11) : productive land being set aside for biodiversity conservation, and evolutions in the areas of different crops and sectors (Table 13).

In all scenarios except S1 (global efficiency) new land is set aside for biodiversity conservation, reaching around 40.000 ha in S2 (sustainable islands), 25.000 in S3 (coordinated sustainability) and 30.000 ha in S4 (agroecological networks). This is coherent with the land sparing approach of S2 (separation of nature conservation and highly-productive agriculture), while S3 and S4 are closer to land sharing (pursuing nature conservation and agricultural production on the same land, through more extensive farming systems, as further detailed below).

The remaining changes are attributed to changes in crop and sector areas (Figure 6), with a gradual increase in legume, fruits and vegetable areas in S2, S3 and S4, following the objectives to embark on a protein transition. Pursuing a more localised approach, S3 and particularly S4 see a decrease in the main export-oriented crops, such as sugar beet and potatoes. S1 sees no major change in its agricultural land, except a decrease in grasslands and forage crops. As no new biodiversity areas are created in this scenario, it remains to be seen what land use category this loss of agricultural land (around 80.000 ha) is transferred to (e.g. urbanisation).

Animal populations

Belgian animal populations see significant evolutions in all four scenarios, as per the hypotheses set in Table 11 (Figure 7 and Table 14).

On one side, scenarios S2, S3 and S4 lead to significant reductions, although not necessarily in the same sectors. While reductions reach about -40% compared to the current situation for both ruminants and monogastrics in S2, S3 and S4 go further in terms of reductions. In S4, following the agroecological narrative of the scenario, the specialised beef and dairy herd are replaced by a single double purpose herd. As a result, the total population of ruminants decreases by 40% but the population of milk-producing cows is maintained (although in more extensive and less productive systems). Monogastric populations see drastic reductions in this scenario, with only 20% of animals remaining compared with the current situation. S3 presents intermediate reduction levels between S2 and S4, with the objective of preserving grasslands and extensive ruminant systems while decreasing monogastric productions.

On the other side, driven by market competitiveness, S1 is the only scenario where certain livestock sectors see a growing trend, in particular the egg, poultry and dairy sectors. However, following recent trends, the pork and in particular the beef sectors decrease.

Table 13 : *Agricultural areas per crop (ha/year) in Belgium in the current situation and in four scenarios in 2050.*

Plant-based sector	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Cereals	316.426	316.426	290.041	290.041	290.041
Forage crops	190.108	177.498	173.938	173.938	173.938
Fruits	19.655	19.655	17.954	35.909	35.909
Open-air vegetables	55.055	55.055	100.754	151.130	151.130
Greenhouse vegetables	3.690	3.690	3.369	3.369	3.369
Legumes	5.188	5.188	14.292	23.820	47.640
Oil-rich crops	9.792	9.792	17.997	8.998	8.998
Grassland	565.836	496.937	518.731	518.731	518.731
Potatoes	91.227	91.227	83.535	41.767	25.060
Sugar Beet	56.798	56.798	52.092	41.674	26.046
Total	**1.313.775**	**1.232.266**	**1.272.703**	**1.289.378**	**1.280.863**
Evolution vs. current	-	*-6%*	*-3%*	*-2%*	*-3%*
New land for biodiversity	-	*0*	*41.072*	*24.397*	*32.912*

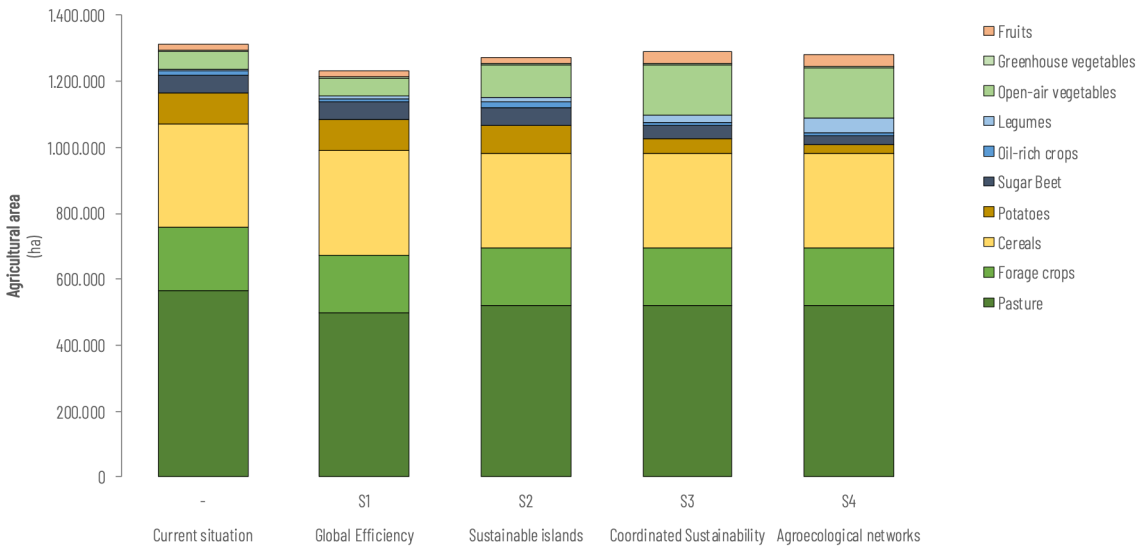


Figure 6 : *Agricultural areas per crop and total agricultural land use (ha/year) in Belgium in the current situation and in four scenarios in 2050.*

Table 14 : *Animal populations in the Belgian livestock sector (heads/year) in the current situation and in four scenarios in 2050.*

Animal sectors	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Suckler cows	364.132	268.357	182.066	182.066	0
Dairy cows	511.753	546.183	358.227	255.876	511.753
Pigs	11.061.925	9.865.489	7.482.144	5.138.835	3.083.301
Broilers	220.130.041	326.373.655	129.028.896	72.127.954	43.276.773
Laying hens	8.776.068	10.305.611	6.143.248	4.388.034	2.632.820
Ruminants	**875.884**	**814.540**	**540.293**	**437.942**	**511.753**
Evolution vs. current	-	-7%	-38%	-50%	-42%
Monogastrics	**239.968.034**	**346.544.755**	**142.654.288**	**81.654.824**	**48.992.894**
Evolution vs. current	-	+44%	-41%	-66%	-80%

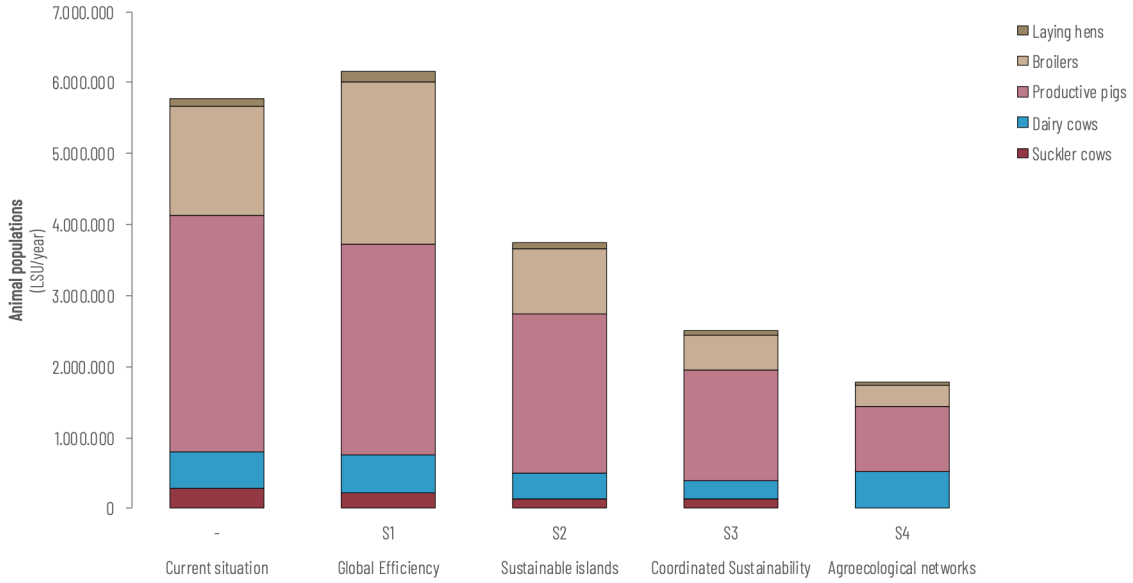


Figure 7 : *Animal populations in the Belgian livestock sector (LSU/year) in the current situation and in four scenarios in 2050.*

Note : To facilitate comparison across categories, animal populations are expressed in livestock units (LSU) rather than in number of heads. LSU conversion factors referenced by Eurostat are used[4]: dairy cows=1 LSU; suckler cows=0,8 LSU; pigs=0,3 LSU; broilers=0,007 LSU and laying hens=0,014 LSU.

[4] Eurostat reference for livestock unit conversion factors : https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Livestock_unit_(LSU)

Farming systems

Following the hypotheses set in Table 11, the share of organic farming increase in all scenarios, in both animal and crop productions, reaching around 50% in scenarios S2 and S3. Despite this common share, both scenarios are rather contrasted as the remaining 50% are produced by either intensive systems in S2 (land sparing), or extensive farming systems in S3 (land sharing). The share of organic farming is lower in S4, but the remaining 70% are produced by extensive farming practices, following the idea of a (decentralised) agroecological network. Scenario S1 remains the closest to the current situation, although organic farming reaches around 20% (Figure 8).

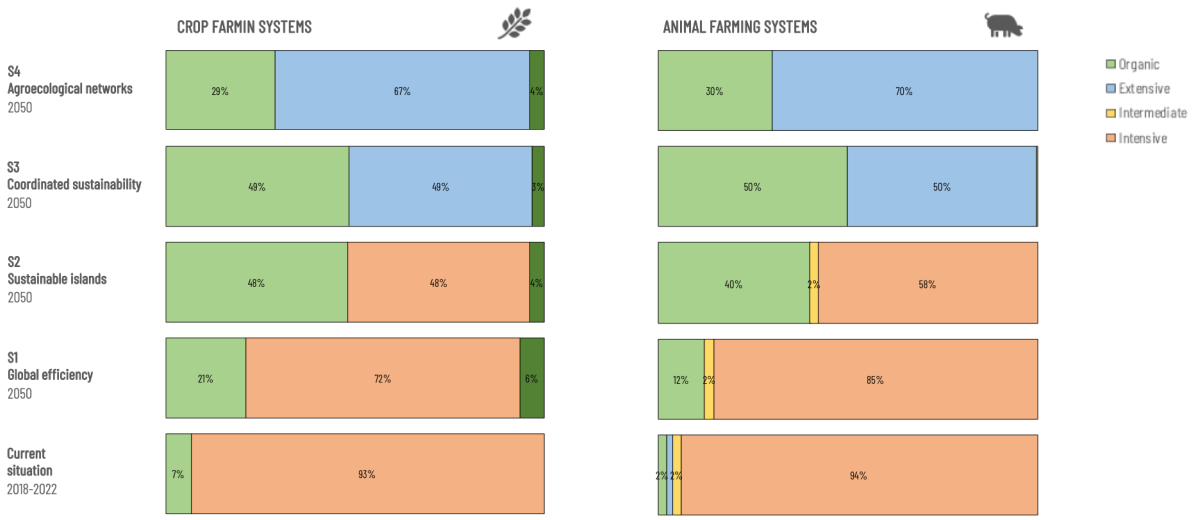


Figure 8 : *Shares of farming systems in the plant based sectors (% ha) and in the livestock sectors (% animals) in Belgium in the current situation and in four scenarios in 2050. The dark green areas on the left-hand figure are agricultural land that is freed up compared to the current situation. In all scenarios but S1, this land is used for biodiversity conservation.*

Concentrate feed demand

Following the evolution of animal populations (in particular that of monogastrics) and of farming systems, the demand for concentrate feed (expressed in ha) varies according to the scenarios (Table 15).

In S2, despite a decrease in animal populations, the total demand for concentrate feed remains about unchanged, mainly due to the important presence of intensive farming systems. As the animal populations are less affected in scenario S1, the demand for concentrate feed even slightly increases in this scenario. The greatest reduction in concentrate feed demand occurs in S4, given the 80% reduction in monogastric populations, while S3 leads to a reduction in concentrate feed demand of about 25%.

The demand for soybean meal, an important source of protein in animal feed but with potential impacts in terms of deforestation of biodiversity-rich ecosystems (Jennings & Schweizer, 2019) represents around 300.000 ha in the current situation and in S1. It decreases to 250.000 ha in S2, 150.000 ha in S3 and 100.000 in S4.

Table 15 : *Demand for concentrate feed (ha/year) of Belgian livestock production in the current situation and in four scenarios in 2050.*

Animal sectors	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Cereals	404.457	441.852	432.520	365.450	206.366
Soybean meal	326.765	342.456	251.236	154.372	109.498
Other concentrates	134.200	149.299	183.026	135.713	66.817
Total	**865.422**	**933.606**	**866.783**	**655.534**	**382.681**
Evolution total	-	*8%*	*0%*	*-24%*	*-56%*
Evolution soybean	-	*5%*	*-23%*	*-53%*	*-66%*

Note: Only the land use of primary products is considered here (i.e. agricultural crops grown specifically for animal feed production). Coproducts from industrial process (e.g. brans, oil cakes, etc.). Soybean, although it also leads to the production of oil (similarly to rapeseed and sunflower) is here considered to be grown primarily for animal feed, and thus considered as a primary product.

Environmental outcomes of agricultural production

N cycle

The evolution of the N cycle is assessed through several indicators (Table 16) : ammonia (NH_3) emissions, N emissions from animals through manure productions, organic and synthetic nitrogen fertilisation needs for crops, and organic nitrogen self-sufficiency (ratio between available manure and organic nitrogen needs for fertilisation).

Ammonia emissions decrease in all scenarios : by about a quarter in S1, by half in S2 and S3, and by two thirds in S4. N emissions from manure follow the same trend across scenarios, with the smallest reduction in S1 and the strongest one in S4, while S2 and S3 present intermediate situations.

In terms of fertilisation needs, the need for synthetic N decreases as the share of organic farming increases in the scenarios, while the need for organic N (mainly form animal manure) stays relatively stable across scenarios.

As a result, the self-sufficiency for organic N evolves positively in S2, S3 and S4, from a strong surplus in the current situation (around 200%), to 120% in S2 and nearly balanced situations in S3 and S4 (around 100%). As for the other indicators, S1 leads to minor changes compared to the current situation and maintains a manure surplus, with an organic N self-sufficiency of 185%.

Table 16 : *Nitrogen cycle indicators of Belgian agriculture in the current situation and in four scenarios in 2050.*

N cycle indicators	**Unit**	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
NH_3 emissions	Kt N-NH_3/year	30	23	16	15	11
Evolution	*%*	-	*-23%*	*-46%*	*-50%*	*-63%*
Manure production	Kt N/year	243	217	153	133	119
Evolution	*%*	-	*-11%*	*-37%*	*-45%*	*-51%*
Organic N needs	Kt N/year	124	117	126	127	121
Evolution	*%*	-	-6%	2%	2%	-2%
Synth N needs	Kt N/year	126	98	63	41	55
Evolution	*%*	-	-22%	-50%	-67%	-56%
Organic N self-sufficiency	%	196%	185%	121%	105%	98%

GHG emissions

The greenhouse gas emissions of the Belgian agricultural sector decrease in all scenarios (Table 17). S1 leads to a minor decrease of less than 10%, while S2 reduces emissions by 30% and S3 and S4 by 40%. Around three quarters of emissions are attributed to animal production in the current situation, a share which stays the same in S1, decreases to 70% in S2 and to 62% in S3 and S4, thus emphasising the difficulty to reduce animal emissions, even in scenarios where livestock decreases significantly.

Scenarios S3 and S4 show counterbalancing effects in this regard. On the one hand, the important reduction in monogastric populations in S4 significantly reduces demand for concentrate animal feed, in particular soybean, and its potential impacts on climate (and biodiversity). On the other hand, as S4 maintains more ruminant animals than S3, this also maintains relatively high GHG emissions (in particular in terms of methane emissions). Overall, these counterbalancing effects explain why S3 and S4 remain close in terms of GHG emissions.

Table 17 : *Annual greenhouse gas emissions (kt CO2e/year) of the Belgian agricultural sector in the current situation and in four scenarios in 2050.*

Production type	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Animal sectors	11.096	10.079	7.298	5.494	5.500
Crops	3.802	3.555	3.138	3.352	3.428
Total	**14.898**	**13.634**	**10.355**	**8.798**	**8.863**
Evolution vs. current	-	*-8%*	*-30%*	*-41%*	*-41%*
Share animals	*74%*	*74%*	*70%*	*62%*	*62%*

Biodiversity impact

Beyond biodiversity areas and demand for soybean, biodiversity is also assessed through a damage score indicator (Table 18), which gives an indication of the potential impact on biodiversity (in terms of potential disappearance of species) of different land use categories (here arable land, grassland and soybean), in different countries (here Belgium and Brazil), and according to different management intensities (e.g. light use, minimal use or intense use).

Results highlight the importance of soybean (considered here to be grown in Brazil) in terms of total biodiversity impact, as over 80% of the current biodiversity impact of Belgian agricultural production is attributed to this crop (via the demand for animal feed). Scenario S3 and S4 are the ones where the biodiversity impact decreases the most (respectively -50% and -59%), driven by the lower demands, and thus impact of soybean in these scenarios. Biodiversity impact also decreases in S2, although to a lesser extent (-27%), while it remains unchanged in S1.

Table 18 : *Biodiversity impact (Damage score, or potentially disappeared species) of the Belgian agricultural sector in the current situation and in four scenarios in 2050.*

Land use categories	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Arable land (BE)	0,07	0,06	0,06	0,06	0,06
Grassland (BE)	0,05	0,04	0,04	0,04	0,04
Soybean (BR)	0,54	0,55	0,38	0,23	0,17
Total	0,66	0,66	0,49	0,33	0,27
Evolution vs. current	*-*	*0%*	*-27%*	*-50%*	*-59%*
Share soybean	*82%*	*84%*	*79%*	*69%*	*61%*

Note: The damage score indicator, gives an indication of the potential impact on biodiversity (in terms of potential disappearance of species) of different land use categories (here arable land, grassland and soybean), in different countries (here Belgium and Brazil), and according to different management intensities (e.g. light use, minimal use or intense use).

Summary of production-side outcomes

Table 19 provides a comparative overview of the production-side outcomes of the scenarios.

In general, the global efficiency scenario (S1), driven by international markets and highly specialised farming systems, leads to the minor changes compared to the current situation, following recent trends. Environmental outcomes remain high, with only ammonia emissions showing a decrease of about 25%.

The sustainable islands scenario (S2) could probably considered as the next step in terms of environmental ambition. It pursues environmental sustainability through strong efficiency gains and technological innovation, which coexist with a significant presence of organic agriculture and setting quite some productive land aside for biodiversity conservation following a land sparing approach. Across environmental indicators, this leads to impact reductions which range between -30% and -50%, while maintaining a (limited) N surplus.

Scenarios S3 and S4 present somewhat similar outcomes, with impact reductions comprised between -40% and -60% and balanced N situations. They both pursue a strong extensification

of farming practices and are more aligned with the land sharing paradigm. Scenario S3 aims for a coordinated sustainability approach, which maintains current livestock sectors, although they are all significantly downsized. Scenario S4 is probably the most ambitious in terms of overall systemic change. Agroecological principles are generalised and monogastric populations are strongly reduced, while ruminant populations are slightly higher than in S3, but switch to double purpose breeds producing both beef and milk. The strong reductions in monogastrics lead to significantly lower demands for animal feed, and in particular soybean, thus contributing to lower biodiversity impacts.

Table 19 : *Compared outcomes of production-side scenarios of Belgian agriculture in terms of land use, animal populations, N cycle, GHG emissions and biodiversity impact.*

Outcomes of Belgian agriculture	**Unit**	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Agricultural area	ha	1.313.775	1.232.266	1.272.703	1.289.378	1.280.863
Evolution		-	*-6%*	*-3%*	*-2%*	*-3%*
New land for biodiversity	ha	-	0	41.072	24.397	32.912
Ruminants	Nb animals	875.884	814.540	540.293	437.942	511.753
Evolution		-	*-7%*	*-38%*	*-50%*	*-42%*
Monogastrics	Nb animals	239.968.034	346.544.755	142.654.288	81.654.824	48.992.894
Evolution		-	*44%*	*-41%*	*-66%*	*-80%*
Organic N self-sufficiency	%	196%	185%	121%	105%	98%
NH3 emissions	Kt N-NH_3/year	30	23	16	15	11
Evolution	*%*	-	*-23%*	*-46%*	*-50%*	*-63%*
GHG emissions	*Kt CO2e/year*	14.898	13.634	10.355	8.798	8.863
Evolution	*%*	-	*-8%*	*-30%*	*-41%*	*-41%*
Biodiversity impact	*Damage score*	0,66	0,66	0,49	0,33	0,27
Evolution	*%*	-	*0%*	*-27%*	*-50%*	*-59%*

4.3.2 Consumption-side scenarios

Evolution of the Brussels demand

Population

The consumption-side scenarios consider an evolution of the Brussels population, which is expected to be very limited by 2050. According to official statistical projections by Statbel, the resident population would remain constant at 1,25 millions inhabitants (Table 20). Importantly, as pointed out in previous reports (see Q1), Brussels also has a significant daily flow of incoming commuters, estimated at around 400.000 persons per day. Unfortunately, the food demand of these commuters is not assessed here as no information regarding their demand is available (in particular what and how much they consume). The scope of the analysis presented here is thus limited to the resident population.

Table 20 : *Brussels resident population considered for the consumption-side assessment in the current situation (2024) and in the scenarios (2050).*

	Current situation	**Scenarios**
	2024	2050
Brussels resident population	1.249.597	1.252.677
Evolution	-	<1%

Diets

In terms of dietary patterns, the scenario exercise considers three distinct diets: the current Brussels diets (Sciensano, 2024), the Belgian nutritional recommendations (food-based dietary guidelines ; FBDG) (Conseil Supérieur de la Santé, 2025) and the updated EAT-Lancet diet (Rockström et al., 2025).

Both the Belgian nutritional recommendations and the EAT-Lancet diet imply lower consumption levels of animal products (Figure 9a). The consumption of meat for instance goes from 141 g/cap/day in the current Brussels to 88 g/cap/day in the Belgian FBDG and 45 g/cap/day in the EAT-Lancet diet. The total consumption of dairy products also decreases significantly, from over 500 g/cap/day when all dairy products are taken into account (milk, cheese, yoghurt, etc.; expressed in milk equivalents), to 375 g/cap/day in the Belgian FBDG and 255 g/cap/day in the EAT-Lancet diet. In parallel, the consumption levels of fruits, vegetables and legumes would see significant increases in both alternative diets, while the EAT-Lancet diet also significantly increases the consumption of plant-based unsaturated oils (40 g/cap/day, compared to 6 g/cap/day in the current diet and 15 g/cap/day in the FBDG).

These shifts among food categories lead to rebalancing the shares of animal and plant-based products in the protein intake (Figure 9b). While animal products currently represent around two thirds (68%) of total protein intake, the Belgian FBDG lead to a balanced situation (50% of protein coming from animals and from plants), while the EAT-Lancet diet turns the situation around, with two thirds of protein intake coming from plant-based sources.

With regards to the scenario exercise, the shares of the three diets are redistributed in the scenarios (Figure 10). In S1 and S2, a significant share of the Brussels population stick to their current diet, while the EAT-Lancet diet is adopted by respectively 10% and 30% of the population. Scenarios S3 and S4 see more radical changes, with the entire population shifting to either the EAT-Lancet diet in S3 or the Belgian nutritional recommendations in S4 (Figure 10).

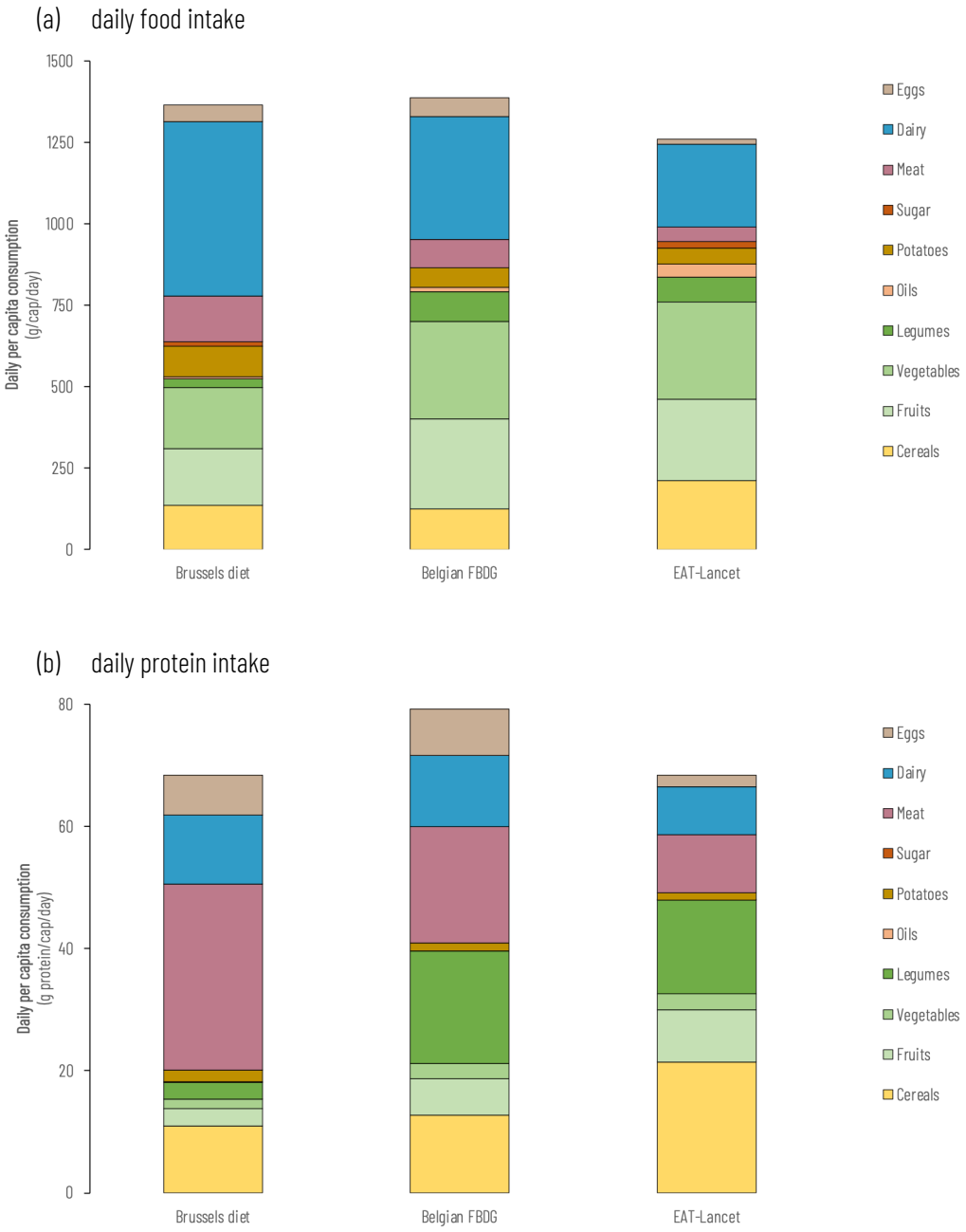


Figure 9 : *Comparison of (a) daily food intake (g/cap/day) and (b) daily protein intake (g protein/cap/day) of different foodstuffs in the three diets considered in the scenario exercise : current Brussels diets, Belgian food-based dietary guidelines (FBDG) and EAT-Lancet diet.*

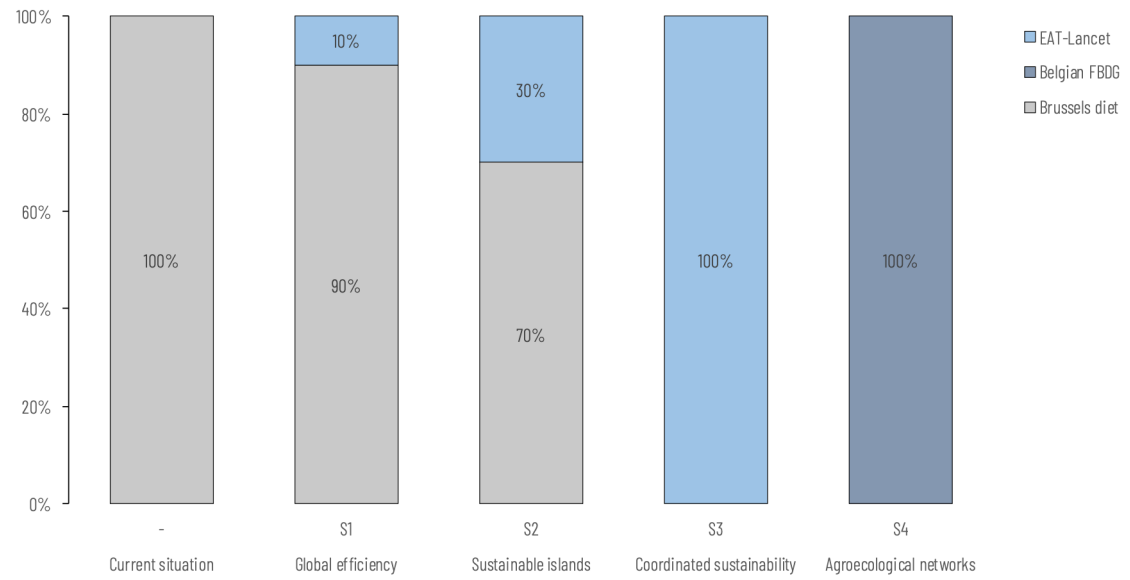


Figure 10 : *Shares of different diets in the food demand of the Brussels resident population in the current situation and in four scenarios in 2050.*

Farming systems

Next to changing dietary patterns, the demand of Brussels food residents also evolves in terms of farming systems (e.g. demand for organic products). The hypotheses set on the shares of different farming systems (intensive, extensive, organic) in the food demand are aligned with those set on the production side (see Table 11). The demand for organic products reaches 20% in S1, 30% in S4 and 50% in S2 and S3. While the remaining demand is met with intensively-produced products in S1 and S2, extensive farming meets the remaining demand in S3 and S4 (Figure 11).

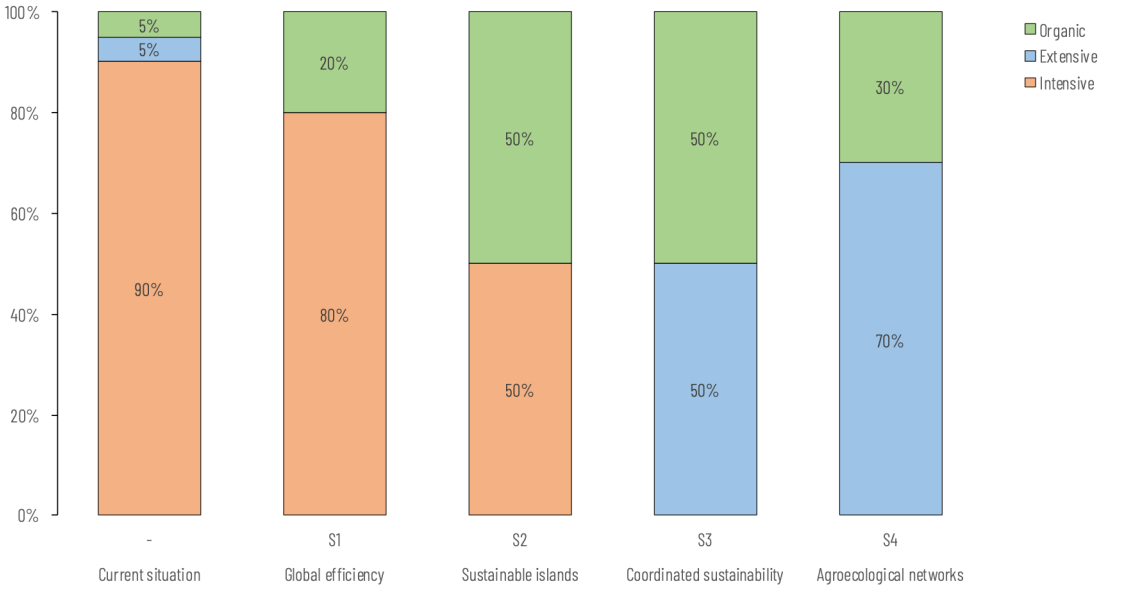


Figure 11 : *Shares of farming systems in the food demand of the Brussels resident population in the current situation and in four scenarios in 2050.*

Environmental footprint of Brussels food demand

Land use

The land use of food demand represents the agricultural land that is required to answer Brussels' demand for food, according to the diets of the population and taking into account waste, losses and processing factors throughout the supply chain. Currently, the demand of the Brussels population represents around 150.000 ha per year, of which 82% are attributed to the consumption of animal products. The greatest contributors in terms of areas are grasslands (55.000 ha), cereals (38.000 ha) and soybean (23.000 ha). Soybean (for animal feeding purpose) alone represents 15% of the land use in the current situation, while fruits, nuts, vegetables and fruits together represent 14% (Table 21).

All scenarios lead to increases in the agricultural land use that is required to answer the Brussels food demand (Table 21 and Figure 12). The increase is the smallest in S1 (+3%) as the scenario implies little changes compared to the current situation and relies on productive farming systems. As the demand in other scenarios evolves towards more extensive, in particular organic products, the associated land use increases due to the lower yields of organic and extensive farming systems. This trend is to some extent counterbalanced in S3 (+8% in total land use) and S4 (+10% in total land use) due to the lower demand for animal products, and the reduction in food waste (30% reduction in S3 and 60% reduction in S4). As the demand for animal products does not decrease as much in S2 and food waste reductions are smaller (30% reduction), this scenario leads to the highest increase in total land use (+19%).

In relative terms, i.e. expressed per capita rather than for the entire population, the land use for food represents 0,13 ha/cap/year in the current situation, with a significant share attributed to animal products (0,10 ha/cap/year). This increases across the scenarios, following the same trends as for total land use (Table 22).

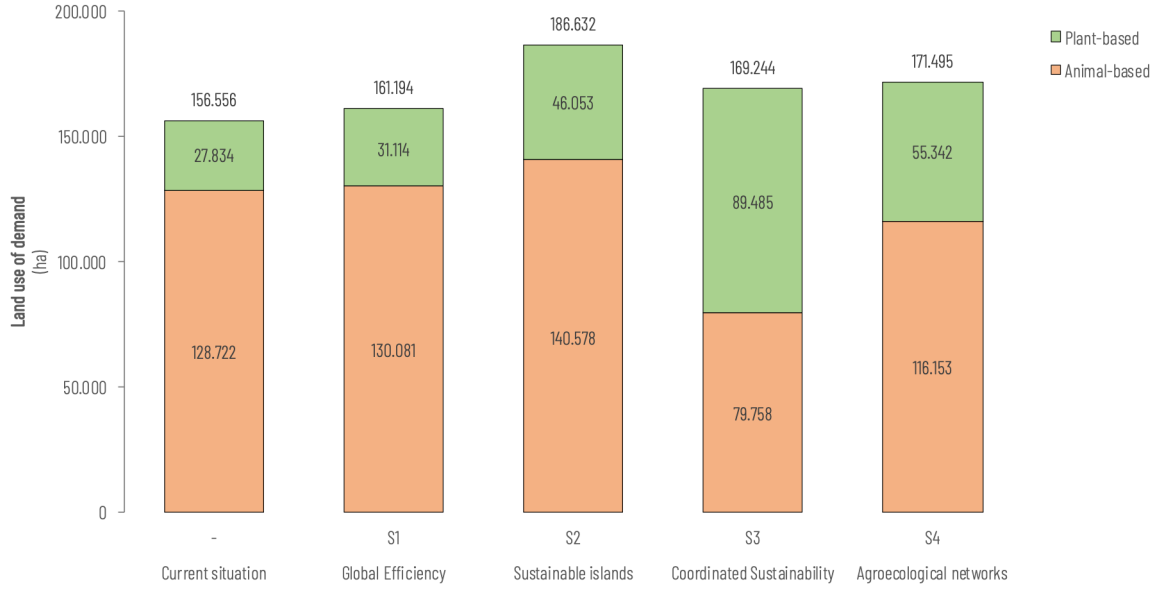


Figure 12 : *Land use of Brussels residents' food demand (ha/year), per type of product (plant-based and animal-based), in current situation and in four scenarios in 2050.*

Table 21 : *Land use of Brussels residents food demand (ha/year), per agricultural sector, in current situation and in four scenarios in 2050.*

Sector of origin	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Cereals	38.215	38.511	44.648	35.768	36.890
Fruits	5.667	6.366	8.918	16.307	10.934
Greenhouse vegetables	247	248	295	422	373
Open-air vegetables	3.863	3.816	4.483	6.338	5.599
Legumes	9.964	11.169	15.659	19.021	23.676
Oil-rich crops	2.618	4.365	9.095	25.691	8.603
Potatoes	1.178	1.122	1.177	820	850
Sugar Beet	571	632	800	1.086	0
Soybean	23.297	21.828	20.050	10.650	14.256
Forage crops	15.439	13.140	7.725	4.307	6.698
Grasslands	55.497	59.997	73.783	48.835	63.617
TOTAL	**156.556**	**161.194**	**186.632**	**169.244**	**171.495**
Evolution vs. current	-	*+3%*	*+19%*	*+8%*	*+10%*
Share animals	*82%*	*81%*	*75%*	*47%*	*68%*

Table 22 : *Relative land use of Brussels residents food demand (ha/cap/year), per type of product (plant-based and animal-based), in current situation and in four scenarios in 2050.*

Sector of origin	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Plant-based	0,02	0,02	0,04	0,07	0,04
Animal-based	0,10	0,10	0,11	0,06	0,09
TOTAL	**0,13**	**0,13**	**0,15**	**0,14**	**0,14**

Greenhouse gas emissions

The GHG emissions associated with the current Brussels food demand amount 1.000 kt CO_2e/year, of which 88% are attributed to the demand for animal products (Table 23 and Figure 13). The evolution of GHG emissions in the scenarios is mainly driven by the demand for animal products. Given the relatively little changes in dietary patterns, emission reductions in S1 and S2 are limited to -6% and -10% respectively. Alternatively, as S3 and S4 fully shift to alternative diets, emission reductions are more significant, reaching -24% in S4 and -34% in S3. Overall, dietary changes, in particular the demand for animal products, have greater impacts than farming systems in lowering GHG emissions.

When expressed in relative terms, i.e. emissions per capita rather than for the entire population, the food demand of an average Brussels resident leads to the emissions of 802 kg CO_2e/cap/year in the current situation, with a significant share attributed to animal products (712 kg CO_2e/cap/year). These emissions decrease across the scenarios, following the same trends as for total emissions (Table 24).

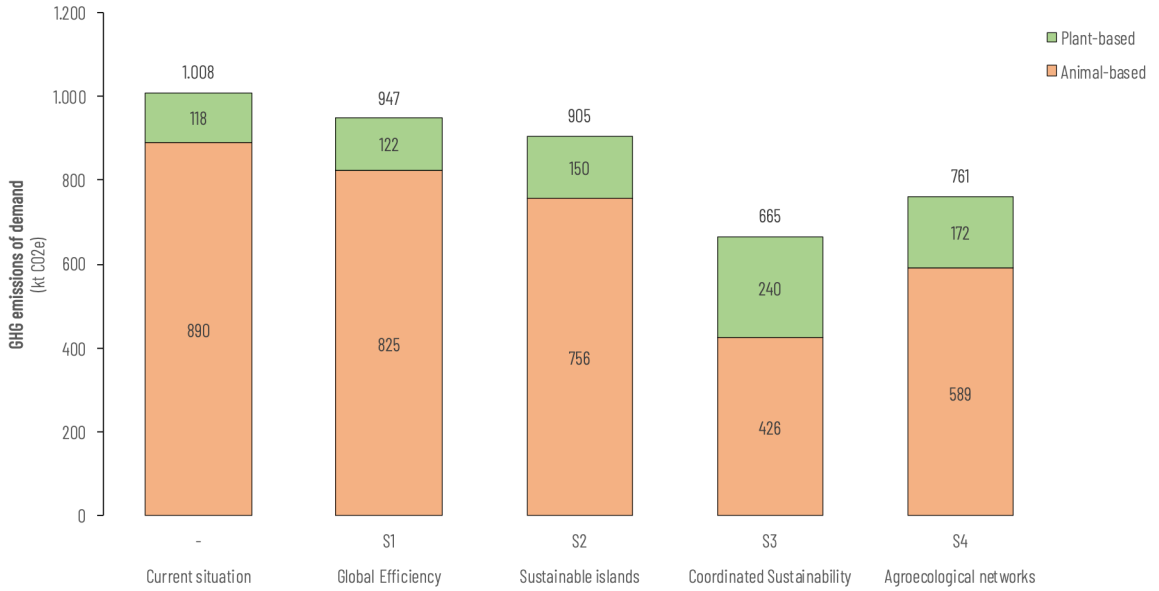


Figure 13 : *Greenhouse gas emissions of Brussels residents' food demand (kt CO_2e/year), per type of product (plant-based and animal-based), in current situation and in four scenarios in 2050.*

Table 23 : *Greenhouse gas emissions of Brussels residents food demand (kt CO_2e/year), per type of product, in current situation and in four scenarios in 2050.*

Sector of final product	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Cereals	27	26	28	36	20
Fruits	15	16	20	33	22
Greenhouse vegetables	55	55	66	94	84
Open-air vegetables	5	5	6	8	7
Legumes	3	4	8	20	21
Oil-rich crops	7	10	18	46	16
Potatoes	5	4	3	2	2
Sugar Beet	1	1	1	2	0
Bovine meat	340	311	268	113	214
Pork	120	112	98	12	62
Poultry	46	46	57	67	37
Eggs	63	59	46	14	57
Dairy	321	298	287	218	220
TOTAL	**1.008**	**947**	**905**	**665**	**761**
Evolution vs. current	*-*	*-6%*	*-10%*	*-34%*	*-24%*
Share animals	*88%*	*87%*	*83%*	*64%*	*77%*

Table 24 : *Relative greenhouse gas emissions of Brussels residents food demand (kg CO_2e/cap/year), per type of product (plant-based and animal-based), in current situation and in four scenarios in 2050.*

Sector of origin	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Plant-based	94	97	120	191	137
Animal-based	712	659	603	340	470
TOTAL	806	756	723	531	608

Biodiversity impact

Beyond the land use demand for soybean, the evolution of the impact on biodiversity of the Brussels food demand can also be assessed through the damage score indicator. The results show that soybean (considered here to be grown in Brazil) is the main driver of the potential biodiversity impact of the Brussels food demand, highlighting again the significant potential impact of this crop on biodiversity. The scenarios that are less reliant on soybean (as their demand for animal products is lower) are the ones that decrease their impact on biodiversity the most. This is particularly the case of S3 (-43%), followed by S4 (-31%), S2 (-14%) and S1 (-7%) (Table 25 and Figure 14).

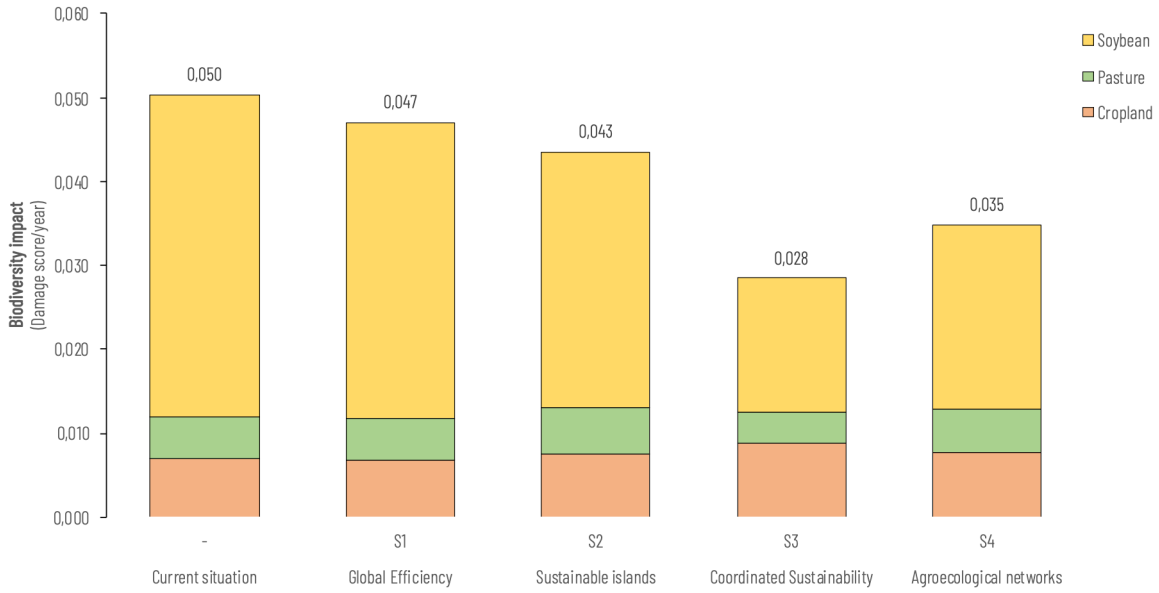


Figure 14 : *Biodiversity impact of Brussels residents' food demand (damage score), per type of land use (cropland, pasture, soybean), in current situation and in four scenarios in 2050.*

Table 25 : *Biodiversity impact of Brussels residents food demand (damage score ; potentially disappeared species) in current situation and in four scenarios in 2050.*

Sector of final product	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Cropland	0,007	0,007	0,007	0,009	0,008
Pasture	0,005	0,005	0,006	0,004	0,005
Soybean	0,038	0,035	0,030	0,016	0,022
TOTAL	**0,050**	**0,047**	**0,043**	**0,028**	**0,035**
Evolution vs. Current	*-*	*-7%*	*-14%*	*-43%*	*-31%*
Share soy	*76%*	*75%*	*70%*	*56%*	*63%*

Recap of consumption-side outcomes

Table 26 provides a comparative overview of the consumption-side outcomes of the scenarios in terms of land use, greenhouse gas emissions and biodiversity impact. The comparison across consumption-side scenarios is similar to that of production-side scenarios.

The global efficiency scenario (S1) predominantly maintains the current diet (90% of the population), slightly increases the demand for organic products and sees no evolution in terms of waste reduction, leading to land use, GHG and biodiversity footprints which are very close to those of the current situation (less than 10% difference).

The sustainable islands scenario (S2) is slightly more ambitious in terms of dietary changes, but also pushes the demand for organic products quite significantly (50% of demand) and reduces food waste by 30%. As current dietary patterns remain dominant (70% of the population), this limits the reduction in footprints (-10% for GHG emissions and -14% for biodiversity impact), while the land use increases by 19%.

In the coordinated sustainability scenario (S3), the population sources half of its food through labelled organic production, while the other half comes from extensive farming systems. Diets fully shifts to the EAT-Lancet diet, dividing their consumption of meat by three, in particular that of high-emitting products such as beef. This leads to reducing the GHG footprint by 34% and the biodiversity footprint by 43%, while the land use demand increase by 8%.

Finally, in the agroecological networks scenario (S4), along with meeting the demand with organic (30%) and especially localised extensive products (70%), the population is considered to adopt the Belgian nutritional recommendations, decreasing their consumption of meat by about half. While being less ambitious than the EAT-Lancet diet, this leaves some room for the extensive production taking place in the scenario, for instance of bovine meet through the double purpose herd. This scenario reduces the GHG footprint by 24% and the biodiversity footprint by 31%, while the land use demand increases by 10%.

Table 26 : *Compared outcomes of demand-side scenarios (footprint of Brussels demand) in terms of land use, GHG emissions and biodiversity impact.*

Outcomes of Brussels demand	**Unit**	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Land use of demand	*Ha*	156.556	161.194	186.632	169.244	171.495
Evolution	*%*	-	*+3%*	*+19%*	*+8%*	*+10%*
GHG emissions	*Kt CO2e/year*	1.008	947	905	665	761
Evolution	*%*	-	-6%	-10%	-34%	-24%
Biodiversity impact	*Damage score*	0,050	0,047	0,043	0,028	0,035
Evolution	*%*	-	*-7%*	*-14%*	*-43%*	*-31%*

4.3.3 Comparison of Belgian production and Brussels demand

Table 27 and Table 28 link the production-side scenarios and the consumption-side scenarios by looking at what the Brussels food demand represents compared to total agricultural production in Belgium (i.e. the ratio between the Brussels food demand and Belgian agricultural production). Results are presented either in terms of amounts (volumes) of agricultural products (kt/year; Table 27) or in terms of land use (areas) of agricultural crops (ha/year; Table 28).

For the majority of products and scenarios, the Brussels food demand represents less than 10% of Belgian production. This is particularly the case for export-oriented crops such as potatoes and sugar beet, even in scenarios where their productive areas are decreased (S3 and S4). Two crops and products do stand out however: legumes and oil-rich crops.

Legumes are particularly relevant in the context of the protein transition as an alternative source of protein replacing animal products for human food. As the legume production in Belgium is very limited, the share of the Brussels demand in total Belgian production is relatively high, reaching nearly 50% in the current situation, where consumption is still low. In the scenarios, this percentage is comprised between 33% (S4) and 64% (S3), resulting from the combined effect of changes in dietary patterns, which can be counterbalanced by increases in productive areas (as in S3 and even more in S4). Beyond their role for human food, legumes are a source of protein for animal feed. Taking this into account significantly increases the share of Brussels demand compared to Belgian production, as shown in Table 28 (which considers the total areas for legumes, both for human food and animal feed), with percentage values higher than 100% for the current situation, S1 and S2.

The case of oil-rich crops, which reaches percentage values above 200% in S3, is closely related to the characteristics of the EAT-Lancet diet, where the consumption levels of unsaturated plant oils are very high compared to the current diet and the nutritional recommendations (see Figure 9a).

All in all, the Brussels land use demand for food corresponds to 12% of Belgium's agricultural land. As Brussels represents 11% of the total Belgian population, this implies that Belgium could potentially be close to self-sufficient (not accounting for actual export flows and other uses of production). Additional calculations allow to estimate that the Brussels food demand represents 12% of total Belgian land use demand and GHG footprint.

Table 27 : Share of Brussels demand on Belgian production, expressed in amounts of agricultural products (kt/year), in the current situation and in four scenarios in 2050.

Agricultural sector	**Scenario 0** Current situation	**Scenario 1** Global efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated sustainability	**Scenario 4** Agroecological networks
Cereals	3%	3%	5%	7%	4%
Fruits	14%	14%	18%	12%	11%
Greenhouse vegetables	5%	5%	7%	10%	9%
Open-air vegetables	7%	7%	4%	4%	3%
Legumes	47%	65%	41%	64%	33%
Oil-rich crops	26%	44%	46%	267%	88%
Potatoes	1%	1%	1%	2%	3%
Sugar Beet	1%	1%	1%	2%	0%
Beef	6%	6%	8%	4%	7%
Pork	4%	4%	4%	1%	9%
Poultry	7%	4%	10%	17%	16%
Eggs	14%	11%	16%	8%	53%
Dairy	7%	6%	9%	9%	5%

Table 28 : Share of Brussels demand on Belgian production, expressed in areas of agricultural crops (ha/year), in the current situation and in four scenarios in 2050.

Sector of origin	**Scenario 0** Current situation	**Scenario 1** Global efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated sustainability	**Scenario 4** Agroecological networks
Cereals	12%	12%	15%	12%	13%
Fruits	29%	32%	50%	45%	30%
Greenhouse vegetables	7%	7%	9%	13%	11%
Open-air vegetables	7%	7%	4%	4%	4%
Legumes	192%	215%	110%	80%	50%
Oil-rich crops	27%	45%	51%	286%	96%
Potatoes	1%	1%	1%	2%	3%
Sugar Beet	1%	1%	2%	3%	0%
Soybean	-	-	-	-	-
Forage crops	8%	7%	4%	2%	4%
Pasture	10%	12%	14%	9%	12%
TOTAL	12%	13%	15%	13%	13%

4.3.4 General overview of scenario results

Summarising the quantitative results of the scenario assessment, Table 29 and Table 30 provide a comparative overview of both the consumption-side outcomes and the production-side outcomes of the scenarios, considering the main sustainability indicators and themes that were defined in paragraph 4.2.2 : impacts on human health (S1), risks to food security (S7), land use (E1), climate (E2) and biodiversity (E3). Looking at the relative evolutions of each scenario (Table 30) confirms conclusions pointed out earlier in the text.

First, the global efficiency scenario, which is close to a "business as usual" scenario leads to minor changes compared to the current situation and is thus not the most promising for the sustainability of Brussels food system and Belgian agricultural production. Second, the Local Eco-intensive scenario constitutes a first step in terms of improving the sustainability outcomes of the Brussels food system. Finally, the local agroecology and coordinated sustainability scenarios lead to stronger decreases of impacts, with reduction levels which are somewhat similar despite some nuances. In particular, S3 reaches greater reductions on the demand-side given the greater dietary changes. S4 on the other hand greatly reduces its impact on biodiversity by significantly lowering its dependence on soybean meal.

Table 29 : *Compared outcomes of production-side scenarios (outcomes of Belgian agriculture) and demand-side scenarios (footprint of Brussels demand).*

Compared scenario outcomes	**Unit**	**Scenario 0** Current situation	**Scenario 1** Global Efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated Sustainability	**Scenario 4** Agroecological networks
Impacts on human health (S1)						
Population meeting dietary recommendations	%	<9% [1]	10%	30%	100%	100%
Consumption of plant-based protein	% protein intake	32%	35%	42%	66%	50%
Land use (E1) and risks to food security (S7)						
Agricultural area in Belgium	ha	1.313.775	1.232.266	1.272.703	1.289.378	1.280.863
Evolution	*%*	-	*-6%*	*-3%*	*-2%*	*-3%*
Land use of Brussels demand	ha	156.556	161.194	186.632	169.244	171.495
Evolution	*%*	-	*+3%*	*+19%*	*+8%*	*+10%*
Brussels land use demand vs. Belgian agricultural area	%	12%	13%	15%	13%	13%
Climate (E2)						
GHG emissions of Belgian agriculture	Kt CO_2e/year	14.868	13.456	10.184	8.844	8.933
Evolution	*%*	-	*-9%*	*-32%*	*-41%*	*-40%*
GHG footprint of Brussels demand	Kt CO_2e/year	1.008	947	905	665	761
Evolution	*%*	-	*-6%*	*-10%*	*-34%*	*-24%*
Biodiversity (E3)						
Biodiversity impact of Belgian agriculture	Damage score	0,66	0,66	0,49	0,33	0,27
Evolution	*%*	-	*0%*	*-27%*	*-50%*	*-59%*
Biodiversity impact of Brussels demand	Damage score	0,050	0,047	0,043	0,028	0,035
Evolution	*%*	-	*-7%*	*-14%*	*-43%*	*-31%*

Note: [1] The share of the population meeting dietary recommendations in the current situation is not known across the whole diet, as data on compliance with recommendations is specific to individual food products. The lowest compliance level has been found for nuts and seeds, with only 8,8% of the population meeting the recommendations. Hence, the share of the population in compliance with all recommendations cannot be higher than this share (and is probably lower).

Table 30 : *Production-side and consumption-side scenarios outcomes in 2050 in terms of healthy diets (absolute percentages), land use, GHG emissions and biodiversity impact (relative percentage evolutions against current situation).*

Indicator	**Scenario 0** Current situation	**Scenario 1** Global efficiency	**Scenario 2** Sustainable islands	**Scenario 3** Coordinated sustainability	**Scenario 4** Agroecological networks
Population meeting recommendations	<9%	10%	30%	100%	100%
Plant-based protein intake	32%	35%	42%	66%	50%
Agricultural area in Belgium	-	-6%	-3%	-2%	-3%
Land use of Brussels demand	-	3%	19%	8%	10%
GHG emissions of Belgian agriculture	-	-9%	-32%	-41%	-40%
GHG footprint of Brussels demand	-	-6%	-10%	-34%	-24%
Biodiversity impact of Belgian agriculture	-	0%	-27%	-50%	-59%
Biodiversity impact of Brussels food demand	-	-7%	-14%	-43%	-31%

5 Discussion

5.1 General approach and scope of assessment

As explained in paragraph 2.2, the methodology adopted in this report led to the production of exploratory scenarios following a mixed quantitative and qualitative approach and targeting multiple scales : the food consumption of Brussels residents and the food production of Belgian agriculture. The approach brings advantages and limitations.

Starting with the design of qualitative scenarios allowed to develop detailed and societal narrative storylines of the Brussels food system. The scenario design phase took the results of previous project phases as a starting point, in particular the outcomes of the barrier analysis (Q3) and the tree main clusters that were identified : (i) an insufficient demand for sustainable food ; (ii) high prices and costs of sustainable food, and (iii) the limited availability of sustainable food. This continuity fosters consistency across the project and its findings, and may facilitate appropriation of the results for the actors involved. The qualitative narrative approach allowed to develop scenarios that cover a wide range of variables, focussing on two key factors in particular (agricultural practices and market-related aspects, as in Therond et al. (2017)), but also covering complementary societal considerations, as also included in the sustainability framework developed in Q2.

As a second phase, a quantitative assessment of the four scenarios was performed with the help of a modelling tool of the Belgian agriculture and food system, simulating both the outcomes of Belgian agriculture and the footprint of Brussels food demand. In this sense, the approach can be considered to fall under an *agricultural capacity* approach, estimating the potential food self-sufficiency or local foodshed size required to meet a certain food demand (Schreiber et al., 2021). Inevitably, the quantitative assessment constitutes a simplification of the much more detailed qualitative scenarios developed initially.

For instance, the scope of the quantitative consumption-side assessment is limited to Brussels residents, although considerable flows of incoming commuters are known to increase the daily population (and food demand) of the city. While the demand of this additional flow was not assessed as their eating behaviours are unknown, considering them in the assessment would provide a more accurate picture of the overall footprint of Brussels food demand, as done for instance in the case of Antwerp (Veldscholten & Papangelou, 2026). Additionally, compared to the adopted sustainability framework, the scope of the modelling tool did not allow to cover all sustainability themes and indicators, which would require to find additional data to expand the scope of the tool. Nonetheless, as actors have pointed to a lack of data and an interest in having quantitative figures, we believe both sides of the mixed qualitative-quantitative approach to provide valuable elements of discussion in the context of the project's needs.

In terms of scale of analysis, the assessment highlights the interdependencies between Brussels and Belgium, not only confirming the actual reliance of Brussels on Belgian production, but also emphasising that both should evolve together in future scenarios. How to translate this interdependency in concrete and coherent actions at both scales remains a key question, which will be investigated further in the final report.

5.2 Assessment of city footprints

The outcomes of the scenarios highlight and confirm the challenge of reducing the footprint of both a city's food demand and of agricultural production. Below we compare with the literature the results of the demand footprint for two indicators: land use and GHG emissions.

First, in terms of land use, a study by the EU Joint Research Centre (JRC) estimated the per capita land footprint of EU demand (European Commission. Joint Research Centre., 2024). According to the calculations, the land footprint of EU consumption amounts 0,26 ha cropland/capita/year and 0,27 ha grasslands/capita/year. These estimates are significantly higher than the ones presented in this report for the Brussels population, which amount 0,13 ha/capita/year (Table 22). Two main elements can explain these differences. First, the scope of the JRC study goes beyond food demand only, and includes the total amount of land directly and indirectly needed to fulfil the consumption of a country or region in one year, including for food and feed, but also timber, energy and textile. Second, our modelling considers all production (except that of soybean) to occur in Belgium. As Belgian agriculture is quite productive and characterised by high yields, this is likely to lead to comparatively lower land use demands. This is exemplified in scenarios S2, S3 and S4, where the shift to organic and extensive farming practices has an increasing effect on land use demand (although this effect is partly compensated by lower consumption levels of animal products).

Second, in terms of GHG emissions, we can compare the carbon footprint of the Brussels demand to existing data. In particular, a recent study estimated the carbon "hoofprint", i.e. the emissions associated with the consumption of meat (in particular beef, chicken and pork), in all cities from the USA (Goldstein et al., 2025). According to their results, depending on the practices of producing regions, the per capita carbon hoofprint varies between 450 and 1800 kg CO_2e/cap/year. Our estimates for the current situation are comprised within this range, although at the lower end of it with 533 kg CO_2e/cap/year when considering only meat (out of a total of 806 kg CO_2e/cap/year[5] ; Table 24). Again the highly productive character of Belgian production could be an explanation to this. In the perspective of decreasing impacts, Goldstein et al. (2025) find that halving food loss, switching to lower-emission types of meat (e.g. replacing 50% of beef with chicken) and adding one meat-less day per week could decrease the total hoofprint by about 50%. Similarly to our results, this confirms the importance of switching to alternative diets and reducing the consumption of meat to reduce emissions.

The objective of the scenario exercise was to delineate alternative configurations of the Brussels food system, which ideally would all be sustainable. The quantitative phase of the exercise aimed to assess this sustainability through a series of indicators, following the sustainability framework and baseline established in Q2. Upon completion of the scenario exercise, we cannot provide a definite assessment on whether the scenarios are sustainable or not. This is due to the limited scope of the quantitative assessment, to the absence of absolute thresholds which would need to be set for each indicator, as was also noted in the conclusions of Q2, and to the trade-offs that appear between scenarios and sustainability themes. Nevertheless, the scenario results outlined above allow to draw some conclusions on ways to improve the sustainability of the system, confirming the importance of certain levers such as dietary patterns, farming practices and food waste.

[5] As a comparison, the personal carbon budget to align with the Paris Agreement is of 2 tonnes CO_2e/year. For Brussels citizens, their current food consumption thus represents 43% of that budget.

6 Conclusion

This report presents the scenario exercise performed in the context of the Brufo2050 project. Adopting a mixed qualitative-quantitative approach, the exercise proposes four scenarios based on two critical factors, the evolution of farming systems (from intensive to extensive) and the evolution of supply and market structures (from diverse and localised to homogenous and globalised) :

- Scenario 1 : “Global efficiency” (intensive and globalised)
- Scenario 2 : “Sustainable islands” (eco-intensive and localised)
- Scenario 3 : “Coordinated sustainability” (extensive and globalised)
- Scenario 4 : “Agroecological networks” (extensive and local)

After providing a narrative description of each scenario, a second phase of the exercise consisted in quantitatively assessing the outcomes of each scenario both in terms of food demand, for Brussels, and in terms of agricultural production, in Belgium. Three main indicators allow to compare outcomes across scenarios: land use, GHG emissions and biodiversity. The results confirm the importance of shifting towards alternative diets to significantly reduce impacts across all three indicators. While moving towards extensive farming systems may lead to higher land use and GHG footprints, these effects are outweighed by the effects of dietary shifts. Additionally, while biodiversity can be favoured either by more extensive systems or by setting land aside for nature conservation, the results also highlight the role of soybean (mainly consumed by monogastric productions) and its indirect impacts on biodiversity.

While methodological uncertainties remain, the scope of the scenario outcomes show how challenging it can be to significantly reduce impacts, both at production and consumption level, confirming the importance of well-known levers such as lowering our consumption of animal products or decreasing waste across supply chain stages. Given that Brussels is highly reliant on neighbouring and international regions for its food supply, increasing its sustainability requires actions to be taken both within the scope of the Brussels region (e.g. in terms of governance, accessibility, education, etc.), but also outside (e.g. mainly in terms of availability and production). Departing from this, the next step, which is tackled in the following and final project report (Q5), consists in identifying the actions that should be taken, across all scenarios, to increase the sustainability of the Brussels food system. As such, the purpose of the scenario exercise is mainly to provide us with a space of possible options, rather than identifying a single scenario we should aim for, an approach also highlighted in the case of the future of the Belgian livestock sector (Riera et al., 2026). As explained in greater depth in the Q5 report, the scenario exercise presented in this document provides us with an analytical framework centred on the future to guide further reflections on which actions should be taken to increase the sustainability of the Brussels food system and overcome its barriers.

7 References

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Appendix

7.1 Sustainability framework and indicators

Table 31 : *Sustainability framework used in the context of the project. socio-economic and environmental themes and indicators defining a social foundation and environmental ceiling. Based on Q2 report.*

Dimension	Theme	Selected indicators
Socio-economic (social foundation)	S1. Impacts on human health	S1.1 Prevalence of overweight and obesity
		S1.2 Protein consumption from plant-based sources
		S1.3 Proportion of the population meeting dietary recommendations (by food group)
	S2. Poor working conditions and violations of labour rights	S2.1 Number of jobs in the Brussels agri-food sector
		S2.2 Employment contract types in the agri-food and agricultural sectors in BCR
		S2.3 Employees with atypical working hours in agri-food sector in BCR
	S3. Lack of a decent income	S3.1 Average income in agrifood industry in BCR
		S3.2 Turnover of the food industry
	S4. Socio-economic inequalities	S4.1 Poverty risk rate in Brussels
		S4.2 BIM beneficiaries
		S4.3 Income disparity in food spending
	S5. Barriers to food democracy	S5.1 Public engagement and awareness on sustainable food system issues
		S5.2 Equitable access to diverse and sustainable food outlets
		S5.3 Policy framework and support for socially vulnerable groups in the food system
	S6. Degradation of social cohesion	S6.1 Urban food production and community gardening
		S6.3 Number of sales points in short supply chains (SSC)
	S7. Risks to food security	S7.1 Affordability of food and food price inflation
		S7.2 Geographic accessibility to diverse food retailers and "food deserts"
		S7.3 Food insecurity and reliance on food aid
		S7.4 Brussels' food self-sufficiency level
Environmental (environmental ceiling)	E1. Land use	E1.1 Land use of Brussels food demand
	E2. Climate	E2.1 Carbon footprint (GHG emissions) of Brussels food demand
	E3. Biodiversity	E3.1 Damage score (potentially disappeared species) of Brussels food demand
		E3.2 Reliance on soybean (potentially imported deforestation) of Brussels food demand