The SUSFANS visualizer tool for assessing the sustainability performance of EU food systems and diets:

Methods and explanation

SUSFANS DELIVERABLES

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SHORT SUMMARY

SUSFANS proposes a multi-layered index of sustainability metrics for the assessment of the EU food system, food security and dietary habits. Based on a stakeholder-informed scientific attempt to create better insight in and to unveil the complexity of food systems, this report presents one of the core joint results of the SUSFANS research & innovation project. A simple and non-academic interpretation of the highest level of information in the index is provided below.

Performance Metric	Non-technical Interpretation
Policy goal: Balanced and Sufficient Diets for EU citizens	
Food Based dietary guidelines*	How well do Europeans eat compared to recommended diets?
Nutrient recommendations*	How well are the nutrient recommendations met through what food Europeans eat?
Energy Balance	How well do Europeans eat in terms of not consuming too much, avoiding overweight and obesity?
Disease burden	What do European diets mean for diseases such as cancer, diabetes and heart failure, which are major causes of illness and death?
Policy goal: Reduced Environmental Impacts of EU food system	
Climate Stabilization*	Is European food production climate-smart?
Clean air, soil and water*	Is the food produced in Europe produced without polluting the soils, air, and water?
Biodiversity conservation*	Can we avoid adding pressure (due to the food we eat) on the genetic and functional diversity of species on our planet?
Preservation of natural resources	Is the food system in Europe respecting the scarcity of natural resources such as water, soil fertility and fish stock?
Policy goal: Viable EU agri-food business	
Value added and trade*	How does agri-business compare to others, in terms of profitability and competitiveness in international trade?
Jobs and wages*	How does agri-business compare to others, regarding job creation and wages?
Productivity and Innovation*	How does agri-business compare to others, regarding productivity and innovation capacity?
Emission price gap*	How does agri-business compare to others, regarding how far off is the market price because it does not account for carbon emissions?
Policy goal: Equitable outcomes and conditions of EU food systems	
Equity amongst food chain actors and producers	How do food choices made in Europe affect people working to produce that food elsewhere?
Environment for equitable food access	Are the (legal) rights of people to food, health and wellbeing ensured throughout the food system?
Food consumption and nutrition	Are health and nutrition outcomes equitably distributed across the population?
Environmental Justice	Is the environmental burden of food produced globally for European citizens distributed equitably?

Note: * Metrics are quantified for EU28; for other metrics it is work in progress, beyond SUSFANS.

Table of Content

COMMUNICATING AN INTEGRATED APPROACH: THE SUSFANS VISUALIZER

Key to SUSFANS is an integrated approach which builds on the involvement of actors from across the food system. To make such a participatory approach possible, it is vital that the information relating to the different components of the food system are well communicated to both academic and non-academic stakeholders.

1 INTRODUCTION AND BACKGROUND[1]

Goal of this document to give a short introduction into the SUSFANS-visualizer: what does it show (section 2) and how is the data constructed (chapter 3). It also an enclosed descriptive document for the available data (aggregated variables and performance metrics) on the SUSFANS website.

The development of the SUSFANS-visualizer is part of the SUSFANS-project having overall objective to build the conceptual framework, the evidenced base and analytical tools for underpinning EU-wide food policies with respect to their impact on consumer diet and their implications for nutrition and public health in the EU, the environment, the competitiveness of the EU agri-food sectors, and global food and nutrition security.

The visualizer is available on https://www.susfans.eu/susfans-visualizer. Key research outputs from the SUSFANS project are integrated into the visualizer:

- **Concept:** the visualizer as a framework for assessing sustainable food and nutrition security of EU food systems (Zurek et al., 2018).
- **Quantification strategy:** the computation of detailed metrics and performance indicators for 8 out 16 metrics in the visualizer, and explanation of the data and knowledge gaps for the remaining 8 metrics (Achterbosch et al., 2019).
- **Database for quantification of the metrics:** results from the SUSFANS foresight report, with results for the food system at global, EU and national level for EU member states, on the timeline 2010-2050 (Frank et al., 2019). Input data for the visualizer is available here

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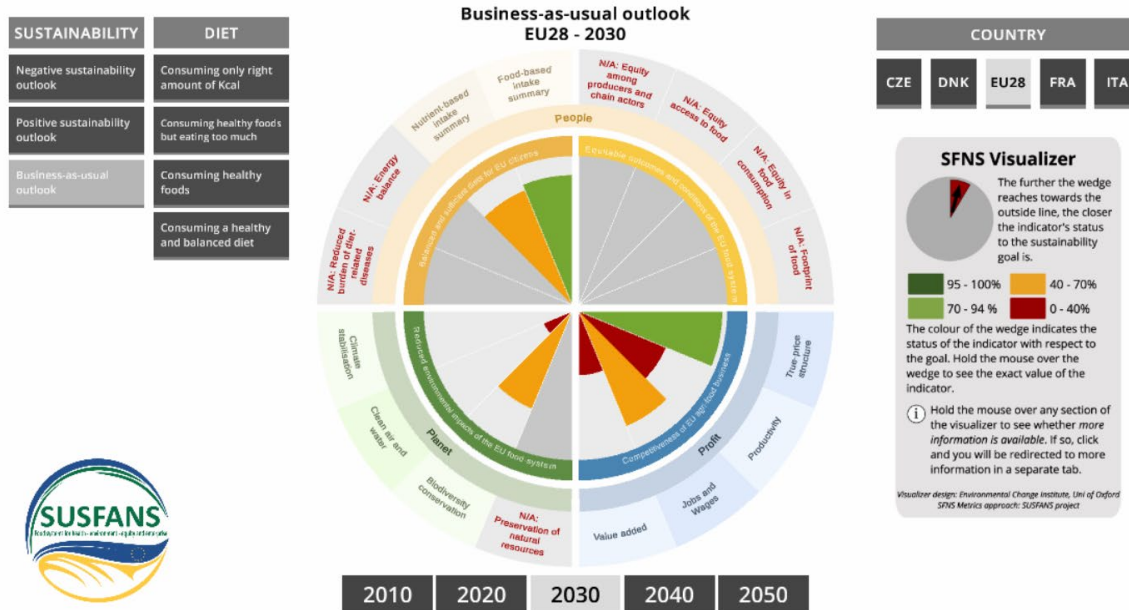[1] Lead authors: Monika Zurel (UOXF) and Aniek Hebinck (UOXF)

Figure 1 SUSFANS-visualizer outlook

The document builds on several SUSFANS deliverables that provide a background on the SUSFANS sustainability metrics (D1.3), the modelling strategy (D1.4), the conceptual approach (D1.5), the quantified scenario drivers (D.10.1), the quantified future challenges (D10.2) and the quantified policy assessment (D10.3) and furthermore as a result of new insights on D6.3 and D10.4.

Three models provide projections for the various variables and metrics: CAPRI, GLOBIUM and MAGNET. For insights in these models, see www.capri-model.org, www.globiom.org and www.magnet-model.org.

Reading guide:
- For a quick impression see section 1 and 2
- For a quick impression with a bit of knowledge how to come from individual data to performance metrics see section 1, 2 and 3
- In depth interest in the figures: see also the Annexes

2 WHAT DOES THE SUSFANS-VISUALIZER SHOW[2]

2.1 Introduction

In this section, we describe briefly, what you see in the SUSFANS-visualizer (figure 1): what the different slices do mean, from which model the data is derived and other issues.

On the left side of figure 1 you can select the sustainability outlook which reflects to the development in GDP, population and other (see D10.1, table 1). A description of de diet scenarios can be found in D10.4, table 3).

The text on the SUSFANS-visualizer for sustainability and diets is different from the text in the deliverables. Therefore, we present here the mappings between the SUSFANS-visualizer names and the naming used in several deliverables (table 1).

Table 1 Outlook and Diet options

Outlook	Description
REF-	Negative sustainability outlook
REF+	Positive sustainability outlook
REF0	Business as usual

Diet Scenarios	Description
DP	consuming healthy foods but eating too much
DEM	consuming the right amount of calories
DPE0	consuming healthy foods with calories at a level of 2010
DPEM	consuming a healthy and balanced diet

2.2 Balanced and sufficient diets for EU citizens

What does a slice mean: It shows the state of the art. In other words, it shows the current score regarding to the optimal situation. For instance, a score of 0.75 means that a country the average diet (nutrients or food) is 75% of the optimal diet.

Model: SHARP data and estimations

Other issues: Only the four countries for which food intake is measured are included in the SUSFANS-visualizer (CZE, DNK, ITA and FRA). A (simple) estimation is made for EU28: adding up country results and dividing by the number of

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[2] Lead authors: Monika Verma (WECR) and Thom Achterbosch

countries with results (there are no results for Italy for the nutrient recommendation score.)

2.2.1   Reduced environmental impacts of the EU food system

What does a slice mean: It shows how much of gap between the target in 2050 and the situation in 2010 is reduced. For instance, a score of 45% for *Climate change* means that 45% of the desired emission reduction between 2010 and 2050 is reached.

Model: CAPRI model results. Of all models, CAPRI has the most complete set of variables covering the environmental individual and derived variables.

Other issues: Only data for 2010, 2030 and 2050 are available. However, 2010 is not visible in the SUSFANS-visualizer as the slices show a reduction relative to 2010.

2.2.2   Viable EU agri-food business

What does a slice mean: It shows how much a country scores relative to the best performer for that indicator in that specific year. For instance, a score of 60% for *Jobs and wages* means that that country performs on a level of 60% of the best performer for that metric in that year.

Model: MAGNET model results

Other issues: There no targets for the metric set.

3 FROM RAW DATA AND MODEL OUTPUT TO PERFORMANCE METRICS[3]

In this section, we give an overview how the performance metrics are structured (figure 2).

Figure 2 shows how an individual variable that measures a single aspect of (EU) sustainability of food and nutrition security can be translated, via a derived variable and aggregated variable, into a performance metric that can be used to assess a set of policy goals.
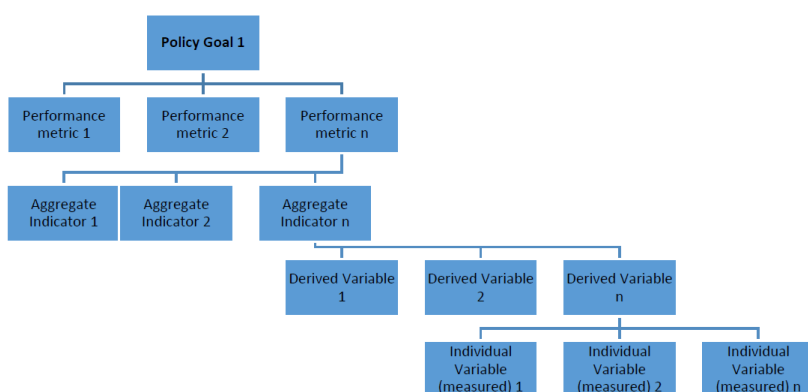

Figure 2 Structure of a SUSFANS Policy goal, Performance metrics and indicators

Hereby we give an example of the structuring of the performance metric of *Clean air and water*. The performance metric of *Clean air and water* is structured by the reduction of emission of nitrogen to air and water and the reduction of the phosphorus surplus (all so-called aggregated indicators). The derived variables are the emissions of nitrogen to air and water and the phosphorus surplus. Individual variables are the emissions of NH_3 and NO_X to the atmosphere, which structure the emission of nitrogen to the air. Annex 1 shows all individual and derived variables behind the metrics in the SUSFANS-visualizer and addresses the models which produce these variables.

Aggregated variables combine one or various derived variables to the level of the policy visions however aggregated variables are most times equal to the derived variables.

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[3] Lead authors: Diti Oudendag (WECR) and Catharina Latka (UBO)

Aggregated indicators evaluate aggregate variables with respect to how much of the path that needs to be covered from the reference situation to the desired level of the policy vision already is achieved.

In our example the aggregated indicator for the emission to air and also for water and phosphorus surplus, are calculated as

$(emission_t - emission_{2010})/(emission\text{-}target_t - emission_{2010})$.

With t = year

To get the value between 0 and 1, the indicators are rescaled (see Annex II for more details).

The performance metric is the weighted average (with weight factor 1) of the three aggregated indicators.

ANNEXES

1 INDIVIDUAL AND DERIVED VARIABLES

1.1 Balanced and sufficient diets

1.1.1 Food based summary score on 7 key foods

1. _Individual variable:_ normalized GENUS food group variable (based on C_QGNS_G)

    a. Create new variable from C_QGNS_G holding the grams/day ("EdFd") for key food groups (aggregating a subset GFOOD items) relevant for diet assessment (= selection of groups already reported for first results of MAGNET for June workshop, see names added to table below)

    b. Normalize the availability of these food groups to a 2000 kcal/day diet using total calories (computed from C_QGNS_G)

2. _Derived variable "adherence to the guidelines for food groups"_: variable based on score of the normalized variables according to guidelines

    a. Compute score for key food groups based on mapping. For example, consumption of 100 g/d of fruits (standardized to 2000 kcal/d) will give a score of '5' for the component 'Fruits'.

   Table 1: guidelines by food groups

	Food group	Guidelines	Maximum score (=10)	Calculation score
1.	Vegetables (VEG)	Eat at least 200 g/d	≥ 200 g	g/200*10
2.	Legumes (LEGUME)	Eat at least 150 g/week	≥ 21.4 g	g/21.4*10
3	Nuts (NUTS)	Eat at least 15 g/d	≥ 15 g	g/15*10
4.	Fruit (FRUITS)	Eat at least 200 g/d	≥ 200 g	g/200*10
5.	Fish (FISH)	Eat at least 150 g/week	≥ 21.4 g	g/21.4*10
6.	Dairy (DAIRY)	Eat at least 300 g/d	≥ 300 g	g/300*10
7.	Red meat (RMEAT)	Eat at **mos**t 500 g/week	≤ 71.4g	max(0,(71.4-g)/71.4*10)

    b. Cap the scores on a maximum of 10. Eating more than the recommended intake for fruits, vegetable, legume, dairy, and fish will not give a higher score. Each component has a maximum score of 10 points. For red meat, the score has a maximum of 10

for zero intake and decreases proportionally with increasing intake of red meat.

1.1.2 Nutrient based summary score

1. *Individual variable:* normalized GENUS nutrient availability (based on C_QGNS_G)

   a. Create new variable from C_QGNS_G by aggregating a subset of the nutrients (keep the upper, median and lower values separate to indicate the spread), see column 3 in table 2 below

   b. Normalize the availability of these nutrients to a 2000 kcal/day diet using total calories (computed from C_QGNS_G)

Table 2: GENUS nutrients corresponding to nutrient measures (partial coverage)

Type of nutrients	Description	GENUS nutrients	NRD9.3 --> NRD8.1	NRD15.3 --> NRD12.1
Qualifying nurients	Protein	Protein	Protein	Protein
	Fiber	Fiber	Fiber	Fiber
	Calcium	Calcium	Calcium	Calcium
	Mono-unsaturated fatty acids	MonoUSF	-	MonoUSF
	Zinc	Zinc	-	Zinc
	Iron	Iron	Iron	Iron
	Potassium	Potas	Potas	Potas
	Magnesium	Magnsm	Magnsm	-
	Vitamin A	VitA	VitA	VitA
	Vitamin C	VitC	VitC	VitC
	Vitamin B1	Thiamin	-	Thiamin
	Vitamin B2	Ribofl	-	Ribofl
	Folate	Folate	-	Folate
Disqualifing nutrients	Saturated Fat	SatFat	SatFat	SatFat

2. *Derived variable "adherence to the DRVs for individual nutrients"*: variable based on score of the normalized variables according to guidelines. Note

that qualifying or desired nutrients have a Dietary Recommended Value (DRV) while disqualifying nutrients have a Maximum Recommended Value (MRV). In case of qualifying nutrients the quantity is capped at DRV (i.e. no additional benefit of consuming more than the recommendation)

    a. Cap qualifying nutrients at DRV values (see table 3 for cut-off values)

    b. Compute the scores by nutrient (see table 3 for DRV and MRV values):

        i. Qualifying nutrients: $100 \times Q_{nutriant\ i} / DRV_{nutrient\ i}$

        ii. Disqualifying nutrients: $100 \times Q_{nutriant\ i} / MRV_{nutrient\ i}$

Table 3: DRV and MRV values for GENUS nutrients

Description	GENUS nutrients	DRV or MRV	Cut-off	Comments
Protein	Protein	DRV	25 g/day	
Fiber	Fiber	DRV	42 g/day	0.66 g/kg bodyweight; assuming average bodyweight of men 68.1 and women 58.5kg
Calcium	Calcium	DRV	805 mg/day	860 mg/day is average, but 750 mg/day for 25 and older
Mono-unsaturated fatty acids	MonoUSF	DRV	39 g/day	15-20% energy intake, as cut-off used 17.5% and converted to grams based on 2000 kcal diet (9 grams per kcal)
Zinc	Zinc	DRV	6.9 mg/day	7.5 mg/day for men and 6.2 mg/day for women
Iron	Iron	DRV	6.5 mg/day	6 mg/day for men and 7 mg/day for women
Potassium	Potas	DRV	3500 mg/day	
Magnesium	Magnsm	DRV	325 mg/day	350 mg/day for men and 300 mg/day for women
Vitamin A	VitA	DRV	530 microgram RE/day	570 microgram/day for men and 490 microgram/day for women

Vitamin C	VitC	DRV	95 mg/day	90 mg/day for men and 80 mg/day for women
Vitamin B1	Thiamin	DRV	0.95 mg/day	1 mg/day for men and 0.9 mg/day for women
Vitamin B2	Ribofl	DRV	1 mg/day	1.1 mg/day for men and 0.9 mg/day for women
Folate	Folate	DRV	250 microgram/day	
Saturated Fat	SatFat	MRV	22 g/day	<10% energy intake, converted to grams based on 2000 kcal diet (9 grams per kcal)

NB: based on Annex III in SUSFANS deliverable 2.2.

1.2 Reduction of environmental impacts

1.2.1 Climate stabilization

1. *Individual variable*:

    CO_2, CH_4, N_2O
    > Models: CAPRI, GLOBIOM, MAGNET

2. *Derived variable*:

    Greenhouse gas emissions in CO_{2eq}
    > Models: CAPRI, GLOBIOM, MAGNET

1.2.2 Clean air, soil and water

1. *Individual variable*:

    NH_3, NO_x
    N emissions to the water
    Phosphorous surplus (not in original metrics table, but P application only)
    Fertilizer application (N and P separately)
    > Models: CAPRI

2. *Derived variable*:

    Reductions of N emissions to the atmosphere (air pollution)
    Reduction of N emissions to the hydrosphere (water pollution)
    Reduction of P surplus
    > Models: CAPRI

1.2.3 Biodiversity conservation

1. *Individual variable*:

The Shannon's entropy index (Hr)
Agricultural land use
> Models: CAPRI, GLOBIOM

2. *Derived variable:*

Change in Shannon's entropy index
Change in agricultural land use

1.3 Viable EU agri-food business

1.3.1 Value-added

1. *Individual variable:*

Sector Value added
Value added of sector and of economy
Value of exports, imports and output of sector
Value of imports, exports and total output of sector
Sector exports of economy and of world
> Models: CAPRI, GLOBIOM, MAGNET

2. *Derived variable:*

Sector value added
Share of sector in economy value added
Self-sufficiency ratio
Sector openness to trade
Sector's export market share
> Models: CAPRI[4], GLOBIOM, MAGNET

1.3.2 Jobs and wages

1. *Individual variable:*

Value of wage payments in sector
Value of wage payments in sector and economy
> Models: MAGNET

2. *Derived variable:*

Growth in wage payments
Growth in sector's share of economy's wage payments
> Models: MAGNET

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[4] CAPRI and GLOBIOM: self-sufficiency ratio, openess and exportshare. The last one expressed in weight.

1.3.3 Productivity

1. *Individual variable:*

   Value of all primary inputs and value of output in sector (TFP)
   Value of labour input, value of output in sector
   Value of all primary inputs and value of output in sector and economy
   Value of labour input, value of output in sector and in economy
         Models: MAGNET

2. *Derived variable:*

   Growth in sectors TFP
   Growth in sectors labour productivity
   Growth in ratio of sector TFP to economy wide TFP
   Growth in ratio of sector's labour productivity to economy-wide TFP
   Models: MAGNET

1.3.4 Emission price gap

1. *Individual variable:*

   Market price
   GHG emissions
   Carbon tax
         Models: MAGNET

2. *Derived variable:*

   GAP in true price and market price
         Models: MAGNET

2 ALGORITHM FOR FILLING THE VISUALIZER

This annex describes how the metric scores are calculated (including some aggregated indicators) for presentation in the SUSFANS visualizer. The following chapters describe the process for calculating aggregated indictors, the targets (where applicable) and the performance metrics as described in D6.3. The targets are based on the targets mentioned in D1.3. In some cased these targets already changed, which is indicated in the text.

2.1 Balanced and sufficient diets

Targets and aggregated indicators

Policy vision: nutritious and healthy diets for the EU population (implemented for the average national consumer by 2050).

Policy targets: policy targets are one for each year (2010, 2020, 2030, 2040, 2050)

Aggregate indicators (SHARP): optimal (or maximum) scores are 5 for the food based intake score for 5 food groups (G7NS) and 900 for the nutrient recommended score based on 9 food groups (NRD9.3). The measured scores are between 0 and 5 for G7NS and between -300 and 900 for NRD9.3. Therefore, these scores are divided by 5 and 1200 respectively to come to the metrics and aggregated indicators. Minimal scores are 0, maximum (optimal) scores are 1.

Aggregate indicators from other models: optimal scores are 10 for the food based intake score (G7NS) and 100 for the nutrient recommended intake scores NRD8 and NRD12. They are divided by 10 and 100 respectively to come to the metrics and aggregated indicators. Minimal scores are 0, maximum (optimal) scores are 1.

The aggregate indicator scores from SHARP and other models are not comparable as SHARP scores are based on food intake while other models use data on food availability. In addition, food products are rather aggregated in the macro models' representations, which limits the interpretability of diet indicators based on results from these models. The respective NRD computations are restricted to the nutrients available in the macro models.

Performance metrics

Food based dietary guidelines

The performance metric is equal to the aggregated indicator for G7NS

Nutrient recommendations

The performance metric is equal to the aggregated indicator for NRD9.3, NRD8 and NRD12.

2.2 Reduction of environmental impacts

Targets and aggregated indicators

Climate stability

Policy vision: net zero GHG emissions from food supply chain in 2100 as described in D1.3. However, in the meanwhile the new EU Long-Term Strategy set the net zero emission goal for 2050 instead of 2100. This is not included in the visualizer yet.

Policy targets: refer to reductions in emissions required to realize the levels associated with the low carbon road map, in 2050 (European, C, 2011). The reductions in this document are defined relative to the emissions in 1990. The policy target is set as a reduction of 80% of total GHG emissions (including emissions other than methane, CO_2 and N_2O and for all sectors) relative to 1990. To be able to get there, sub goals or milestones are set to: 20% reduction by 2020, 40% reduction by 2030, and 60 % reduction by 2040 (new reduction goals would be 25% for 2020, 50% for 2030, 75% for 2040 and 100% for 2050).

Regarding the policy targets/ visions no differentiation is made between the relative changes required from ETS vs non-ETS sectors.

The target emission-reductions are recalculated as emission reductions relative to 2010 (See Annex I). The redefining of emission targets, relative to 2010 instead of 1990, has been done to have the same reference year (2010) for all policy goals. It could also be decided to keep 1990 as a reference year, in which case there will be results and associated metric score available for 2010 as well.

The **aggregated indicator** is calculated as

$(emission_t – emission_{2010})/(emission\text{-}target_t – emission_{2010})$.

With t = year

To get the value between 0 and 1, the indicator is rescaled as follows

- If the aggregated indicator is > 0 and < 1

  Rescaled Aggregated indicator = aggregated indicator

- if aggregated indicator is > 1

Rescaled Aggregated indicator is 1 (more reduction in emission then target)

- if aggregated indicator is < 0

Rescaled Aggregated indicator = 0 (there's no reduction in emission but an increase)

Clean air and water

Reduction of N surplus

No targets are set as they are captured by the reduction of N emissions to atmosphere and water

Reduction of N emissions to the atmosphere

Policy targets: We used the National Emissions Ceilings Directive for the country specific emission reductions (2016). They are defined for NOx and NH3 and are relative to 2005. These target emission reductions are recalculate with respect to 2010. Therefore we used emissions for both gases from the EDGAR databased (Annex II, table) and recalculated the reductions for N relative to 2010 and also the reduction in total N accounted for by the two gases (NH_3 and NO_x). The total N emissions are calculated as the sum of N emissions (N- NO_xNH_3) coming from NO_x (N-NO_x) and those coming from NH3 (N-NH3). Hereby we have to take into account that the emission reductions are national reduction levels and not specific for agriculture. Furthermore, the used database consists of emissions of all sectors. It would be preferable to emission data for 2010 for NH_3 and NO_x.

Step 1: calculate the absolute emissions for the years 2020, 2030 and 2050 using the targets (emission reductions) and the emissions of 2005. NB we did a linear interpolation for the year 2040.

$t \in \{2020, 2030, 2050\}$

$N\text{-}NOx_t = N\text{-}NOX_{2005} * (1\text{-}NOxred_t)$

$N\text{-}NH3_t = N\text{-}NH3_{2005} * (1\text{-}NH3reduc_t)$

Step 2: calculate the sum of the emissions expressed in for the scenario years and for 2010

$N\text{-}NOxNH3_t = N\text{-}NOx_t + N\text{-}NH3_t$

$N\text{-}NOxNH3_{2010} = N\text{-}NOx_{2010} + N\text{-}NH3_{2010}$

Step 3: recalculate the emission reductions for N

$$Nreduc_t = (N\text{-}NOxNH3_{2010} - N\text{-}NOxNH3_t) / N\text{-}NOxNH3_{2010}$$

The **aggregated indicator** is calculated as

$$(emission_t - emission_{2010})/(emission\text{-}target_t - emission_{2010}).$$

With t = year

To get the value between 0 and 1, the indicator is rescaled as

- If the aggregated indicator is >0 and < 1

  Rescaled Aggregated indicator = aggregated indicator

- if aggregated indicator is > 1

  Rescaled Aggregated indicator is 1 (more reduction in emission then target)

- if aggregated indicator is < 0

  Rescaled Aggregated indicator = 0 (there's no reduction in emission but an increase)

Reduction of N emissions to the hydrosphere.

Policy vision: zero emissions (leaching and runoff) in 2030

Policy target: no emissions in 2030.

This results in the emission reductions of 50% by 2020, and 100% by years 2030 onwards.

The **aggregated indicator** is calculated as

$$(emission_t - emission_{2010})/(emission\text{-}target_t - emission_{2010}).$$

With t = year

To get the value between 0 and 1, the indicator is rescaled as

- If the aggregated indicator is >0 and < 1

  Rescaled Aggregated indicator = aggregated indicator

- if aggregated indicator is > 1

    Rescaled Aggregated indicator is 1 (more reduction in emission then target)

- if aggregated indicator is < 0

    Rescaled Aggregated indicator = 0 (there's no reduction in emission but an increase)

Reduction of P surplus

Policy goal: no emissions in 2100.

Policy target: linear interpolation is done to get targets between the reference year and 2100.

This results in the reduction targets of 12% by 2020, 23% by 2030, 35% by 2040 and 46% by 2050.

The **aggregated indicator** is calculated as

$(emission_t - emission_{2010})/(emission\text{-}target_t - emission_{2010})$.

With t = year

To get the value between 0 and 1, the indicator is rescaled as

- If the aggregated indicator is >0 and < 1

    Rescaled Aggregated indicator = aggregated indicator

- if aggregated indicator is > 1

    Rescaled Aggregated indicator is 1 (more reduction in emission then target)

- if aggregated indicator is < 0

    Rescaled Aggregated indicator = 0 (there's no reduction in emission but an increase)

Reduction of toxic substances use

No data available

Biodiversity

Reduction of the contribution of the agrifood chain to loss of Mean Species Abundance (MSA).

Policy goal: no further increase of land used for agricultural production relative to 2010.[5]

Policy target = policy goal.

We assume the same goal to be applicable for 2020, 2030, 2040 and 2050.

Aggregated variable: the aggregated variable cannot be calculated according the formula from page 12 D1.3 as the denominator would be 0. Just the relative difference between the two gives the distance between desired level and current level.

Therefore, aggregated indicator = agri land t / agri land 2010.

Then the derived **aggregated indicator**

- If aggregated indicator < 1
  Rescaled Aggregated indicator = 1

- If aggregated indicator – 1 < 1

  Rescaled Aggregated indicator = 1 - aggregated indicator

- If aggregate indicator -1 >= 1
  Rescaled Aggregated indicator = 0

Agricultural land use diversity

Policy vision: Increase of the Shannon index (LDIV) by two points by 2050.

Policy target: linear interpolation of the Shannon index is done between the reference year and 2050.

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[5] To be able to reach the target of a maximum of 2 degrees temperature increase, area is needed for energy crops and afforestation. Part of this area should come from agriculture (D1.3). Unfortunately energy crops are often considered as agricultural production (also in the models)(pers. P. Havlik).An option would be to return the target in an increase of natural vegetation. However for the moment it is not clear of such targets exists (pers.med. C. Latka)

Therefore targets for the intermitting years are as follows:

Target 2020 = $LDIV_{2010}$ + 0.5
Target 2030 = $LDIV_{2010}$ + 1
Target 2040 = $LDIV_{2010}$ + 1.5
Target 2050 = $LDIV_{2010}$ + 2

Aggregated indicators are then calculated as

$CLDI_t = (LDIV_t - LDIV_{2010})/(Target_t - LDIV_{2010})$

With t = year

And rescaled as below

- If the aggregated indicator is >0 and < 1

    Rescaled Aggregated indicator = aggregated indicator

- if aggregated indicator is > 1

    Rescaled Aggregated indicator is 1 (more increase in Shannon index than target)

- if aggregated indicator is < 0

    Rescaled Aggregated indicator = 0 (there's a decrease in Shannon index instead of increase)

Performance metrics

Climate stability

The performance metric is equal to the rescaled aggregated indicator.

Clean air and water

The performance metric is calculated as the unweighted average of the aggregated indicators for emission to air and hydrosphere and phosphorus surplus.

Biodiversity

The performance metric is calculated as the unweighted average of the aggregated indicators for land use for agricultural activities and the SHANNON-index

2.3 Viable EU agri-food business

Targets and aggregated indicators

Targets for competitiveness are relative and can be best defined as scoring like the best performer on a variable.

The competitive aggregated indicators are calculated according to table 7 in D6.3.

These values automatically range between 0 and 1.

Performance metrics

Performance metrics are calculated as the weighted average of the underlying aggregated indicators (table A2.1) with weight factor 1.

Table A2.1 Structure of performance metrics

Aggregated indicator	Description	Performance metric	Policy goald
A_G7NS	Food based summary score based on 5 key foods	Food based summary score based on 5 key foods	Diets
A_NRD93	Nutrient based summary score based on nine nutrients	Nutrient based summary score based on nine nutrients	
A_EMIS	Reduction of total GHG emissions caused by agri-food chain	Climate stabilization	Environment
A_AIRP	Reduction of N-emissions to atmosphere (NH3, Nox)	Clean air and water	
A_WATP	Reduction of N-emissions to hydrosphere (nitrates, organic N)		
A_PSUR	Reduction of phosphorus surplus		
A_AREA	Reduction of the contribution of agrifood chain to loss of Mean Species Abundance (by no further increase of land used for agriculture)	Biodiversity conservation	
A_LDIV	Agricultural land use diversity (Shannon index)		
OPEN	Growth in sector openess to trade	Value Added	Competitiveness
SSUF	Growth in self sufficiency ratio		
EXPO	Growth n sector's export market share		
OUTA	Growth in sector value added		
OUTE	Growth in share of sector in economy value added		
LFPA	Labour productivity in sector	Productivity and innovation	
LFPE	Labour productivity in sector related to economy		
TFPA	Total factor productivity in sector		
TFPE	Total factor productivity relative to economy		
TPGA	True price structure	True-price structure	
WAPA	Growth in wage payments	Jobs and wages	
WPAE	Growth in sector's share of economy's wage payments		

REFERENCES

Achterbosch, T.J., Verma, M., Leip, A., Zurek, M., Oudendag, D.A., Geleijnse, J.M., Latka, C., Havlík, P., Kuijsten, A., Kuiper, M.H., 2019. A systematic analysis of social, economic and environmental sustainability metrics for the range of activities and world views encompassed in the EU food systems: Deliverable No. D6.3 (No. Deliverable D6.3). SUSFANS, EU Grant agreement no. 633692.

Frank, S., Latka, C., Havlík, P., van Dijk, M., Achterbosch, T., Cui, D., Geleijnse, M., Hebinck, A., 2019. Foresight of EU sustainable food and nutrition security: the interplay between major challenges and policy responses at different spatiotemporal scales (No. Deliverable D10.4). SUSFANS, EU Grant agreement no. 633692.

Zurek, M., Hebinck, A., Leip, A., Vervoort, J., Kuiper, M., Garrone, M., Havlík, P., Heckelei, T., Hornborg, S., Ingram, J., Kuijsten, A., Shutes, L., Geleijnse, J.M., Terluin, I., van 't Veer, P., Wijnands, J., Zimmermann, A., Achterbosch, T., 2018. Assessing Sustainable Food and Nutrition Security of the EU Food System—An Integrated Approach. Sustainability 10, 4271. https://doi.org/10.3390/su10114271