



Integrated metrics to assess sustainable food and nutrition security outcomes of the EU food system

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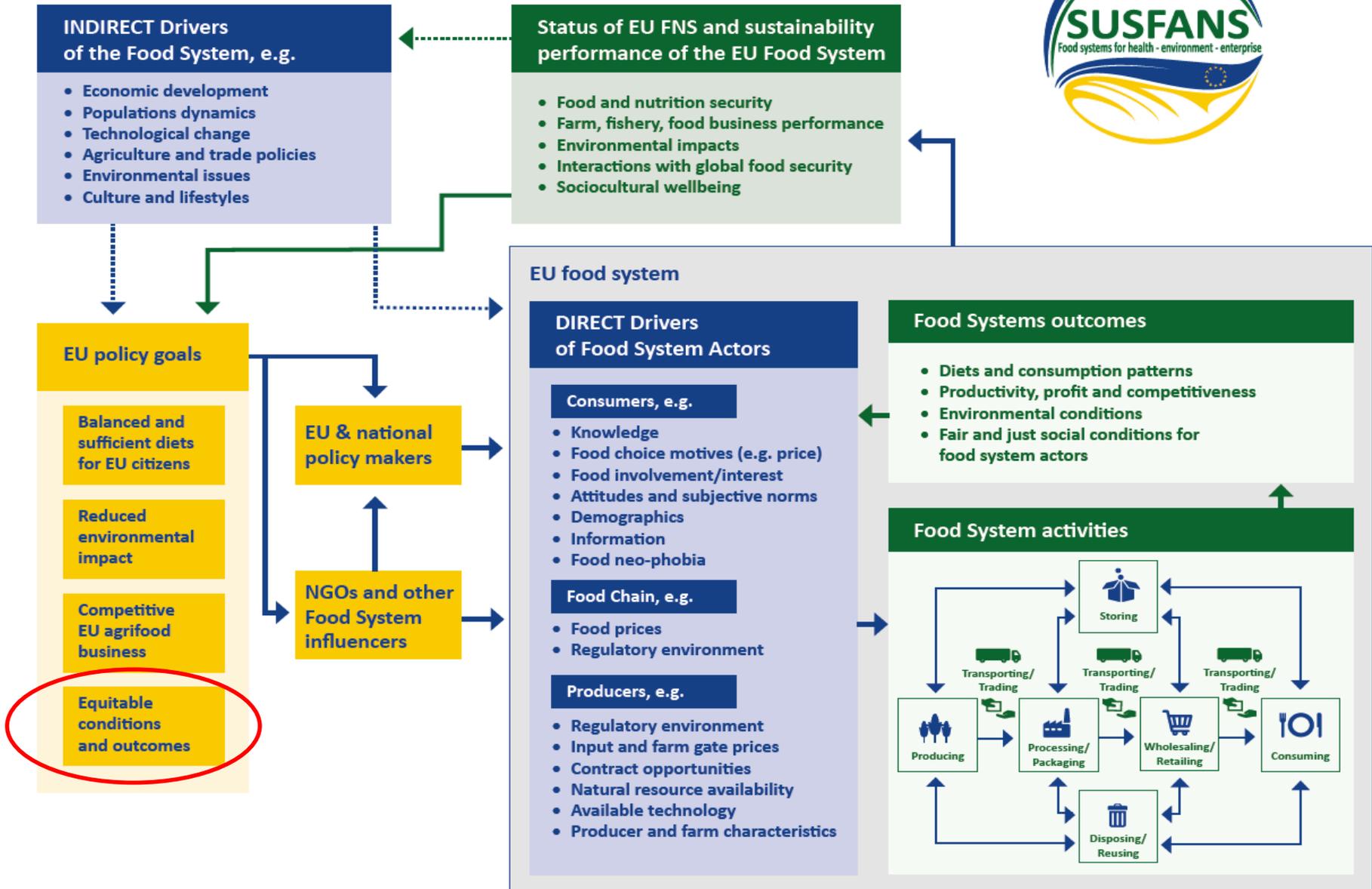


WP1: Conceptual framework and sustainability metrics

To enhance the conceptualization of FNS and to develop metrics for food system sustainability that capture the range of world views across food system actors to enhance food security and environmental outcomes across Europe:

- To develop conceptual and methodological frameworks for the quantitative assessment of sustainable FNS (WPs 2-4) for a range of time frames in the EU;
- To define sets of quantifiable social, economic and environmental metrics tailored to assess the sustainability of food system activities;
- To ensure sustainability metrics are appropriate for short- and long-term modelling of EU FNS;
- To ensure sustainability metrics cover a range of different stakeholder perspectives and world views.

SUSFANS Conceptual Framework for Assessing EU Sustainable FNS





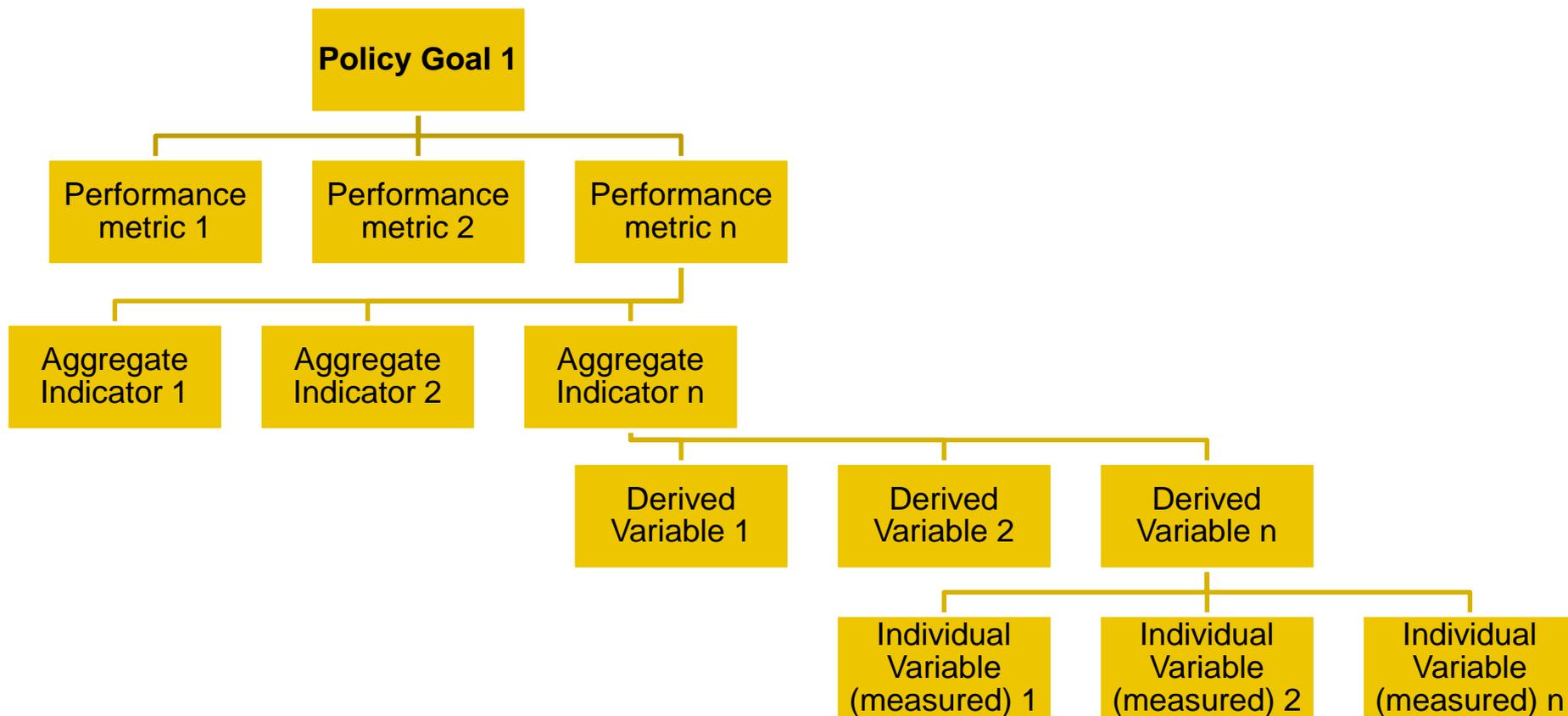
Video explaining the conceptual framework

<http://susfans.eu/wp-1-conceptual-framework-and-fns-sustainability-metrics>



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Metrics on sustainable FNS: How we have defined metrics, indicators and variables so far – the hierarchical approach





Deliverable D1.3 on sustainability metrics

- **Individual Variable:** a measure that can be counted and/or quantified against a universally agreed upon standard (e.g. hectares, kg), usually a measure that can be quantified and/or counted.
- **Derived Variable:** Combines a number of individual variables to come up with a new measure (e.g. Ratio of energy intake vs expenditure, N input vs output) in some cases additional information is used to derive the variable (e.g. conversion of GHG emissions to total CO₂eq).
- **Aggregate Indicator:** Combines one or various derived variables and evaluates them against an objective (e.g. reduction of N surplus, marine biological diversity, food access).
- **Performance metric:** Combines various aggregated indicators and assesses them against achievement of EU targets (e.g. balanced diet for EU citizens, climate stabilization)

Policy	Performance metrics	Aggregate indicators	Derived variable		Individual variable
Goal	(assessable against targets; B derived from C)	(C, derived from D)	(D, derived from E)	Cut-off for D	(E)
Balanced and sufficient diet for EU citizens	Food based summary score based on 5 key foods (0-100): <ul style="list-style-type: none"> Fruits Vegetables Fish Red & Processed meat intake Sugar Sweetened Beverages (SSB) 	n.a.	<ul style="list-style-type: none"> Vegetables Legumes (Unsalted) nuts and seeds Fruits Fish Dairy Red/ processed meat Hard cheese Sugar sweetened beverages Alcohol Salt 	<ul style="list-style-type: none"> ≥200 g/d ≥150 g/week ≥15 g/d ≥200 g/d ≥150 g/week ≥300 g/d ≤500 g/week ≤150 g/week ≤500 mL/week ≤10 g/d ≤6 g/d 	Intake of >1500 food products have been individually assessed in country specific population surveys and have been aligned with FoodEx2 classification system
	Nutrient based summary score (0-100) <ul style="list-style-type: none"> NRD 9.3 NRD 15.3 	n.a.	NRD 9.3 includes protein, dietary fibre, calcium, iron, potassium, magnesium, and vitamin A, C and E, saturated fat, added sugar, and sodium. NRD 15.3 additionally includes mono-unsaturated fatty acids, zinc, vitamin D and B-vitamins (B1, B2, B12, folate), but excludes magnesium.	See protocol D2.2	Energy Protein Mono-unsaturated fat Fibre Calcium Iron Magnesium Potassium Selenium Iodine Zinc Vitamin A Vitamin C Vitamin E Vitamin B1
	Energy balance % of population with normal weight: 100% is 'ideal'		BMI (kg/m2): normal weight: 18.5–24.9 overweight: 25–29.9 obese: >30 ka/m2		BMI (body mass index of each country)

Policy goals	Performance metrics (assessable against targets; B derived from C)	Aggregate indicators (C, derived from D)	Derived variable (D, derived from E)	Individual variable (E)		
Reduction of Environmental impacts	Climate stabilization	Reduction of total GHG emissions caused by the agri-food chain	CO2 eq.	CO2, CH4, N2O (Emissions according to IPCC categories incl. indirect land use change, per unit of product in food consumed (LCA) = C footprints) Use/emissions of cooling agents in fish production (CFCs)		
			Radiative Forcing	Land Cover (e.g. albedo)		
	Clean air and water	Reduction of N surplus	Reduction of N emissions to the atmosphere (air pollution)	Nitrogen surplus	N input (fertiliser, manure, atmospheric deposition, biological fixation, feed) and N output (yield), change of soil stocks. Maybe split of N surplus into emissions to the atmosphere: air pollution and emissions to the hydrosphere: water pollution)	
				Emissions of Nr to the atmosphere (NH3, NOx)	Emissions of NH3, NOx	
		Reduction of N emissions to the hydrosphere (water pollution)	Emissions of Nr to the hydrosphere (Nitrates, Organic N)	Emissions of NH3, NOx Emissions of NO3, other run-off, leaching		
		Reduction of P surplus	Phosphorus surplus	P input and output		
		Reduction of Toxic substances use	Toxic substances use	Use of toxic substances (pesticides, ...)		
	Biodiversity conservation	Reduction of the contribution of the agri-food chain to loss of Mean Species Abundance (MSA)	Land use	Contribution to loss of Mean Species Abundance (MSA) calculated with the GLOBIO model (Alkemade et al., 2009)	Land use Emissions of GHGs, Nr	
				Land use (Shannon)	The Shannon's entropy index (Hr) seafloor area impacted (m2)	
		Reduction in number of threatened species	Protected areas (GLOBIOM) Species rich hotspots (GLOBIOM)	Land use map Land use map		
			Red List Index (RLI)	IUCN Red List threat status (terrestrial and marine) of affected species		
	Preservation of natural resources	Sustainable water use [e.g. maintenance of environmental flows]	Sustainable exploitation of wild-caught seafood resources	Terrestrial water scarcity footprint	Irrigation water use Water use in livestock production Water use in the food chain Water supply	
				distance to optimum exploitation (F/FMSY)	Fishing mortality (F)	
		Sustainable exploitation of wild-caught seafood resources	%PPR relative to total available ecosystem production			primary production required (PPR)

Policy goals	Performance metrics (assessable against targets; B derived from C)	Aggregate indicators (C, derived from D)	Derived variable (D, derived from E)	Individual variable (E)
Competitiveness of EU Food System	Production and trade	Difference of the openness of country i between period t2 and t1 of sector k. Unit % (C1)	Openness of country i for sector k. Unit: % (D1)	$X_{ijkt}, m_{ijkt}, GP_{ikt}$
		Difference of the Self-sufficiency ratio of country i between period t2 and t1 of sector k. Unit % (C2)	Self-Sufficiency ratio of the country i for sector k. Unit: % (D2)	
	Trade - Export flow orientation	Growth export share on the world market for sector k for country i between period t2 and t1. No unit (C3)	Export share of country i of sector k to the world (w) in year t. No unit (D3)	$X_{ijkt}, X_{iwt}, m_{iwt}, X_{kt}, X_{T_{wt}}, m_{T_{wt}}$
	Trade - Trade orientation		Trade balance of country i in period t is the sum of export minus all imports of sector k. Unit: USD (D4)	
		Difference of the normalized trade balance of country i between period t2 and t1 of sector k. No unit. (C5)	Normalized trade balance of country i in period t is the sum of export minus all imports of sector k. No unit. (D5)	
	Trade - Trade specialization	Growth RXA on the world market for sector k for country i between period t2 and t1. No unit (C6)	Revealed Comparative Export Advantage (RXA) indicator for sector k, country i in period t. No unit. (D6)	
			Revealed Comparative Import Advantage (RMA) indicator for sector k, country i in period t. No unit. (D7)	
		Growth RTA of sector k for country i between period t2 and t1. No unit. (C8)	Revealed Net Trade Advantage (RTA) indicator for sector k, country i in period t. No unit. (D8)	
	Production - Economic performance of a sector	Growth RVA of sector k for country i between period t2 and t1. No unit. (C9)	Real value added for sector k in in country i for period t. Unit: USD (D9)	$GVA_{ikt}, P_{it}, GP_{ikt}, V_{aikt}, E_{ikt}, GVA_{ibt}, GP_{ibt}, VA_{ibt}, E_{ibt}$
		Relative growth total factor productivity for sector k in in country i for period t (C10)	Total factor productivity for sector k in in country i for period t (D10)	
		Relative growth real labour productivity for sector k in in country i for period t. Unit: USD VA per USD E (C11)	Real labour productivity for sector k in in country i for period t. Unit: USD VA per USD E (D11)	
	Production - Productivity cross-sector benchmarking	Relative growth ratio real value added for sector k in in country i for period t (C12)	Ratio real value added for sector k in benchmark sector b in country i for period t (D12)	
		Relative growth ratio total factor productivity for sector k in in country i for period t (C13)	Ratio real total factor productivity for sector k in benchmark sector b in country i for period t (D13)	
		Relative growth ratio real labour productivity for sector k in in country i for period t (C14)	Ratio real labour productivity k in benchmark sector b in country i for period t (D14)	

Policy goal	Performance metric	Aggregate indicator	Derived variable	
Equity	Equity among consumers: food system outcomes	Availability	Calorie availability by region (EU, non-EU)	
			Share of nutritious food by region (EU, non-EU)	
			Reduction in share of protein of animal origin by region (EU, non-EU)	
			Domestic food production per capita by region (EU, non-EU)	
		Accessibility	Share of food expenditure in total expenditures by region (EU, non-EU)	
			Food affordability by region (EU, non-EU)	
			Consumption per capita by region (EU, non-EU)	
			Share of calories from fruit and vegetables by region (EU, non-EU)	
		Utilization	Stability	Cereal import dependency ratio by region (EU, non-EU)
				Value of food imports over total merchandise exports by region (EU, non-EU)
		Health: Undernutrition	Market pressure index	Share of population with BMI <18.5
				Share of children < 5 years with stunting
				Share of children < 5 years with iron deficiency
				Share of children < 5 years with vitamin A deficiency
				Share of women at reproductive age with iron deficiency
				Share of women at reproductive age with vitamin A deficiency
				Share of population with insufficient dietary supply adequacy
				Share of population with insufficient protein supply
	Health: Overweight and obesity	Share of population with BMI >25	Share of population with BMI >30	
			National income per capita by region as % of EU national income per capita	
			Household income per capita by region as % of EU household income per capita	
			Share of population with less than 1\$ a day	
			Share of population that has no access to a health care center	
	Equity among consumers: food system conditions	Wealth	Share of population without access to sanitation facilities	
			Share of female population without primary education	
			Share of population living in a political unstable surrounding	
			Share of population without right to social security	
			Share of population that has no access to a safety net (food assistance, pension)	
			Share of population without access to a fresh food shop	
	Political stability	Consumer choices	Share of population whose food preferences are not met by food supply	
			Share of population without access to microfinance	
			Share of farm women without access to saving and credit	
	Equity among producers and chain actors	Access to resources by primary producers	Share of farmers without legal status of ownership of the farm land	
Share of farm women without access to agricultural land				
Access to finance and technology		Share of farmers without access to microfinance		
		Share of farmers without primary education		
		Share of farmers without access to vocational training		
Fair trading practices		Share of farmers who are faced with a monopolist downstream industry	Share of farmers without access to saving and credit	
			Share of farmers without access to microfinance	



Deliverable D1.4: A modelling strategy on the sustainability metrics

Macro-economy

MAGNET
Complete economy
Income effects
Global, countries

Diet & health

SHARP
Product detail
Specific diet needs
EU4

DIET
Consumers preferences
Health & environment
EU3

Agricultural production

**GLOBIOM /
AGRIPRICE4CAST**
Spatial detail
Environmental impacts,
agricultural price volatility
Global, grid

CAPRI
EU detail
Production detail
Global, EU, NUTS2

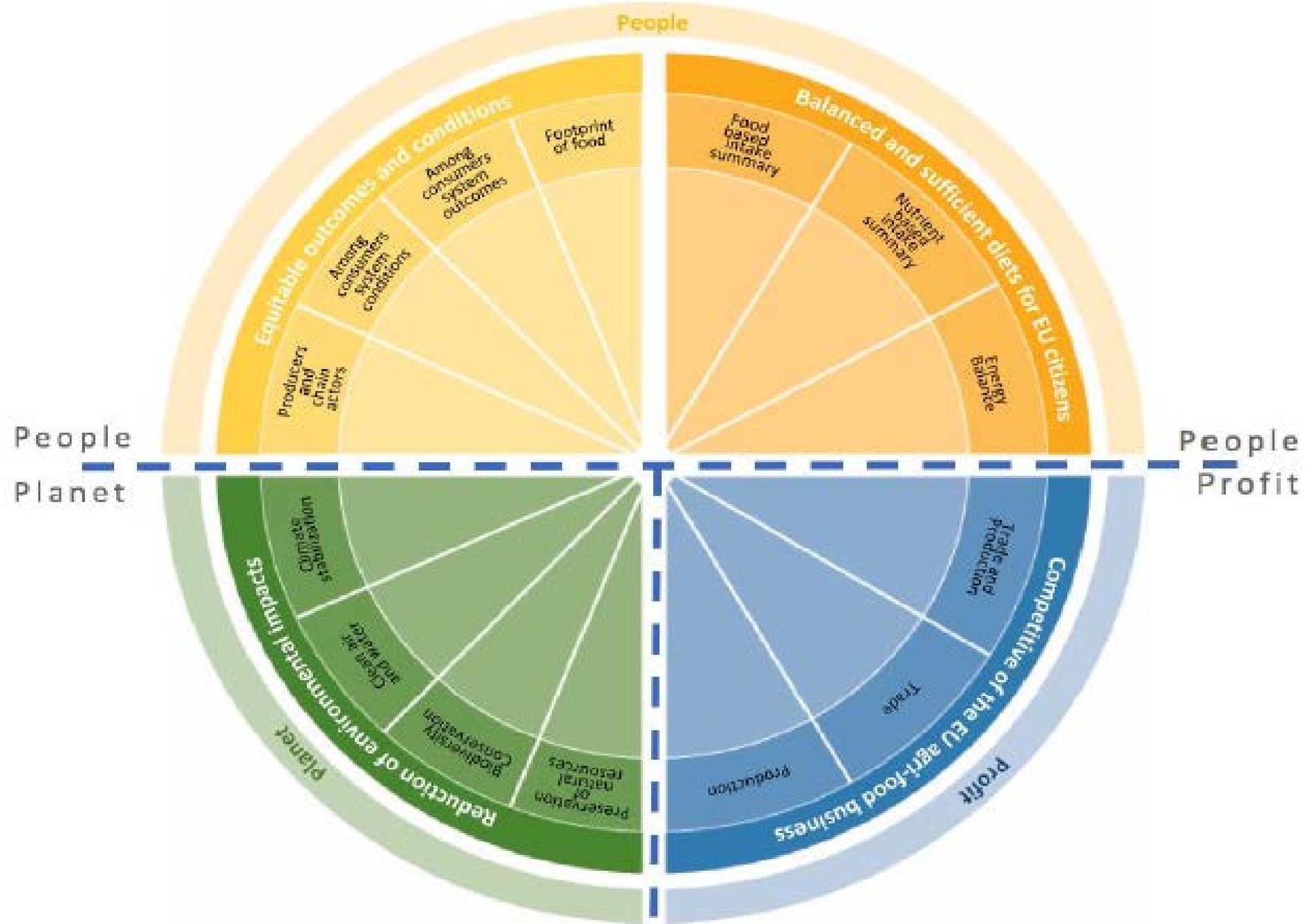
Policy goal	Performance metrics	Models able to assess performance metric¹
<i>Balanced and sufficient diet for EU citizens'</i>	Food based summary score based on 5 key foods (0-100): fruits, vegetables, fish, red & processed meat intake, sugar sweetened beverages)	SHARP, DIET, CAPRI
	Nutrient based summary score (0-100): NRD 9.3 and NRD 15.3	SHARP, DIET, (CAPRI, GLOBIOM partly)
	Energy balance: % of population with normal weight: 100% is 'ideal'	SHARP, DIET
<i>Reduction of environmental impacts</i>	Climate stabilization	GLOBIOM, CAPRI, DIET, MAGNET (SHARP)
	Clean air and water	CAPRI (GLOBIOM)
	Biodiversity conservation	(CAPRI, GLOBIOM, MAGNET)
	Preservation of natural resources	(GLOBIOM)
<i>Competitiveness of EU agri-food business</i>	Production and trade	GLOBIOM, CAPRI, MAGNET
	Trade - Export flow orientation	GLOBIOM, CAPRI, MAGNET
	Trade - Trade orientation	GLOBIOM, CAPRI, MAGNET
	Trade - Trade specialization	GLOBIOM, CAPRI, MAGNET
	Production - Economic performance of a sector	CAPRI, MAGNET
	Production - Productivity cross-sector benchmarking	CAPRI
<i>Equitable outcomes and conditions</i>	Equity among consumers: food system outcomes	MAGNET, CAPRI, GLOBIOM (SHARP)
	Equity among consumers: food system conditions	No model
	Equity among producers and chain actors	No model
	Equity in food footprint	(GLOBIOM, MAGNET, CAPRI)

¹ Model names in brackets signal that model cannot quantify all individual variables composing the performance metric.



An integrated set of sustainability metrics for assessing EU food and nutrition security

- Allows the user to look across all sustainability dimensions/ policy goals at the same time
- Allows the user to assess changes to the food system's performance when introducing innovations
- Visualizes synergies and trade-offs across policy goals for the selected innovations to enable an informed discussion about which innovations to pursue





Thank you!



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GLOBIOM - Contribution to metrics

Balanced and sufficient diet for EU citizens	<i>% of people fulfilling threshold diversity score</i>	Average diet diversity score
	<i>% of people fulfilling food-based dietary guidelines</i>	Kg product per capita per year
	<i>% of people fulfilling nutrient-based dietary guidelines</i>	Accounting of average calorie, protein and fat per capita + undernutrition prevalence
	<i>Acceptance of a sustainable diet</i>	--
	<i>Minimum cost of a healthy diet</i>	Product prices
Reduction of environmental impacts	<i>Climate stabilization</i>	GHG emissions for agriculture and LULUCF
	<i>Pollution</i>	Fertilizer input
	<i>Biodiversity conservation</i>	Spatially explicit protected areas and biodiversity hotspots
	<i>Preservation of natural resources</i>	Water requirement
Competitive EU agri-food business	<i>Overall competitiveness index</i>	Market prices
	<i>Market power for the entire supply chain</i>	--
Food and nutrition security	<i>Global food availability</i>	Calories / Protein / Fat per capita
	<i>Global food access</i>	Food price, international transportation costs, trade barriers
	<i>Stability of FNS</i>	--
	<i>Utilisation in the EU</i>	Food, feed, biofuels, other industrial uses and waste



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WP1: Conceptual framework and sustainability metrics - deliverables

D1.1: The SUSFANS conceptual framework (due June 2016) **DONE**

D1.2: Preliminary report on Task 1.2: Sustainability metrics (due Sep 2016) **DONE**

D1.3: Sustainability metrics for the whole food system: a review across economic, environmental and social/cultural/health considerations (due Mar 2017) **DONE**

D1.4: A modelling strategy for quantifying the sustainability of food and nutrition security in the EU (due Mar 2017) **DONE**

D1.5: An integrated set of metrics for assessing the overall sustainability of FNS in the EU (**due June 2017**)



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