How to reduce climate impact *while enhancing nutritional value and preserving existing food culture?*

*Experiences from using the **positive deviance** and **diet optimization** approaches on **French** dietary survey data.*
Criteria and metric issues.
Data management and data sources.

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la science pour la vie, l'humain, la terre

Definition of Sustainable diets

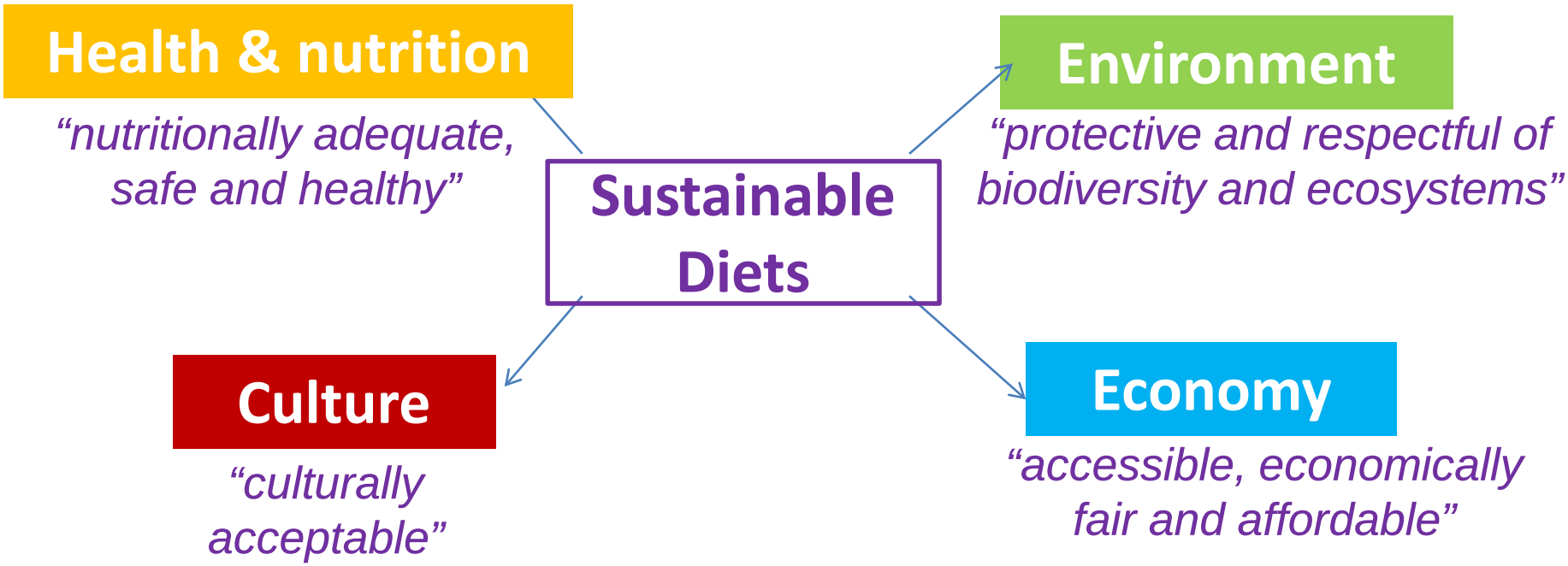
*"**Sustainable diets** are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations.*

***Sustainable diets** are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally adequate, safe and healthy; while optimizing natural and human resources."*

(FAO, 2010)

Holistic and ambitious, but not difficult to implement

Operationalization of the sustainable diet concept

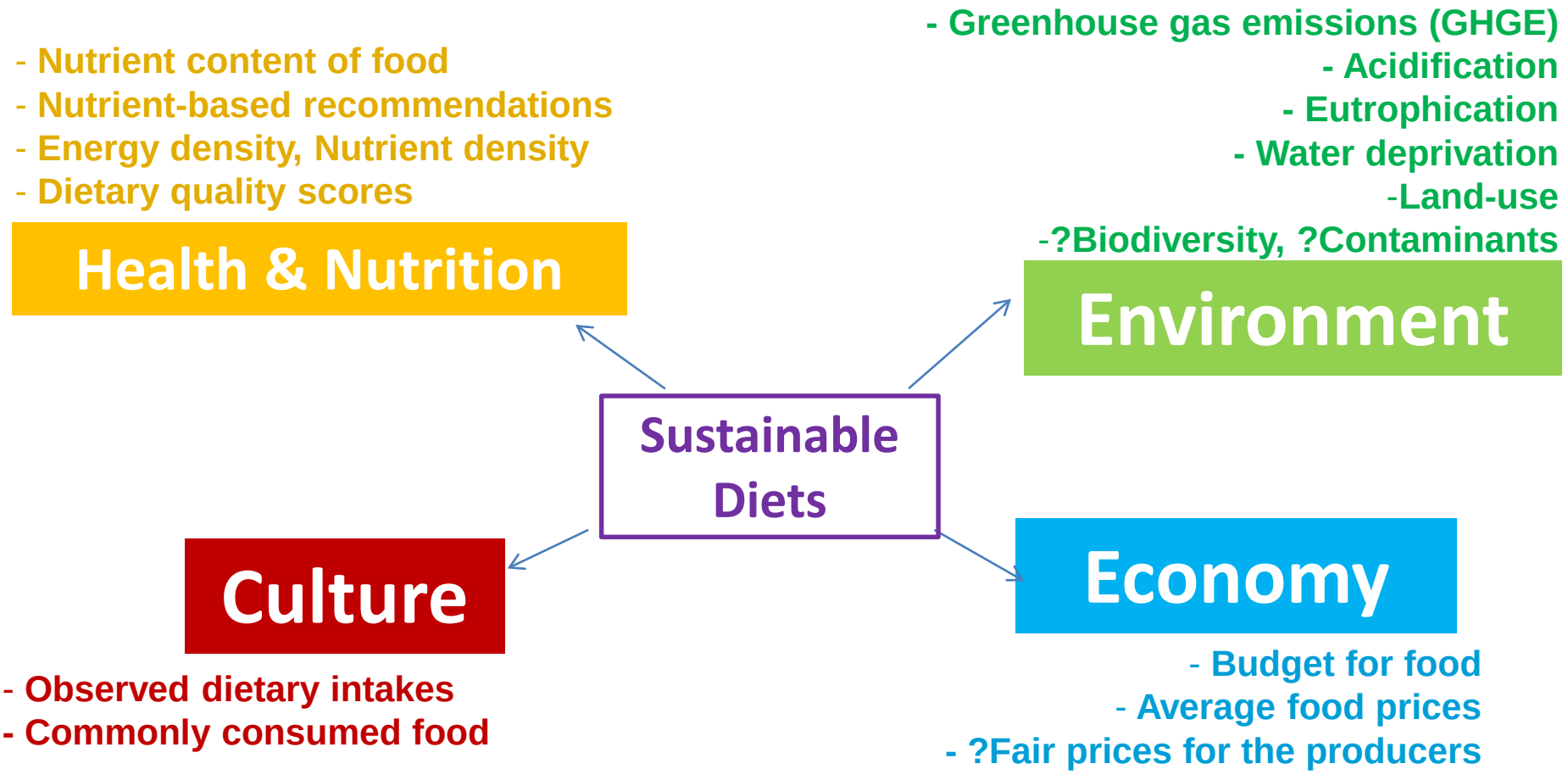


Sustainable diets: respect of the 4 dimensions

Sustainable diets metrics

➔ Indicators needed for each dimension

(Gazan et al, Food Chemistry, 2018)

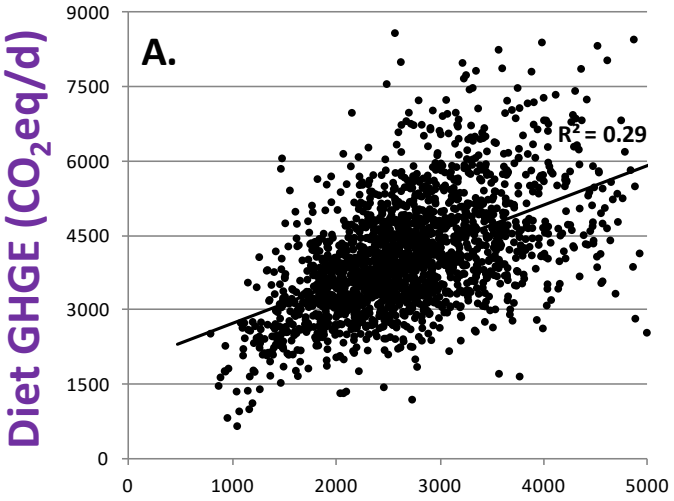


➔ Study of sustainable diets made possible by the compilation of multiple sustainable metrics within a single database

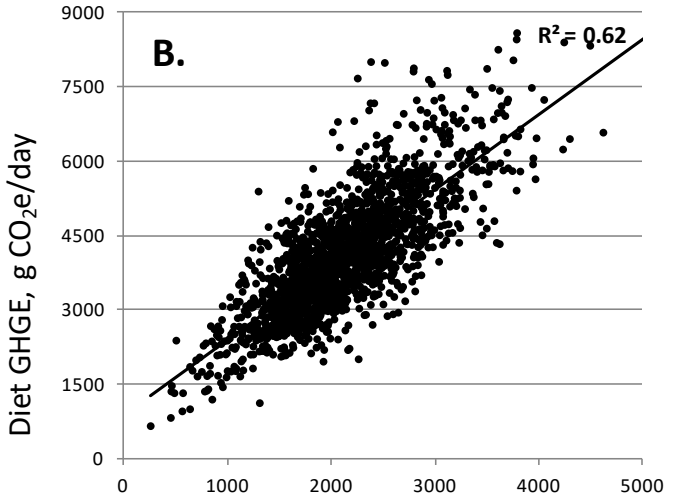
Environmental dimension

GHGE of self-selected diets in France

(Vieux et al, Ecol, Econ 2012)



A. Quantities (g/d)



B. Energy intakes (kcal/d)

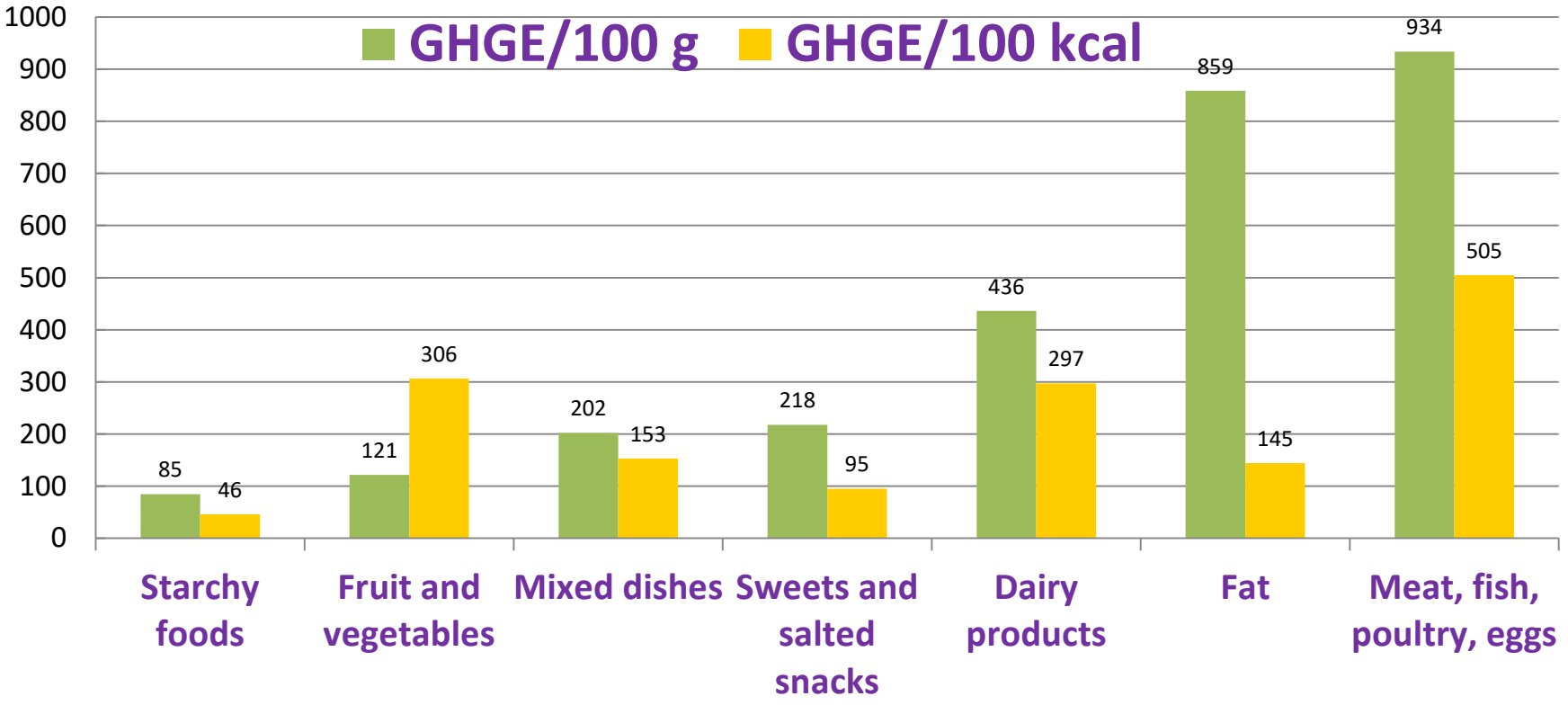
➔ **Strong positive correlation between quantities and GHGE**

➔ **Eat less (and waste less) to impact less**

Environmental dimension

GHGE of food-groups, as consumed in the French diet

(Vieux et al, Am J Clin Nutr 2013)



➔ MFPE: highest GHGE, per 100g or per 100 kcal

➔ Other food groups: ranking depends on the calculation basis

➔ GHGE/100kcal: F&V similar to dairy, HFSS low impact

Studies on sustainable diets in France: insights from 2 research projects

Project Name	Country	National dietary survey (adults)	Environmental data (hybrid methods)
Ocad	*France*	**INCA2** (2006–2007, 7-d records n = 4079)	**- GHGE** **- Eutrophication** **- Acidification** ➔ 402 foods
Sus-Diet	*France, UK, Italy, Finland, Sweden*	**INCA2**(2006–2007, 7-d r, n=4079) **NDNS** (2008-2012, 4-d r., n=4156) **INRAN-SCAI** (3-d r., n = 33) **FINDIET** 2012 (2*48h-r., n=1708) **Riksmaten** 2010 4-d r., n=1797)	**GHGE** ➔ 151 food items from the FoodEx classification system

Nutrition Culture Economy Environment

Methods for studying sustainable diets:

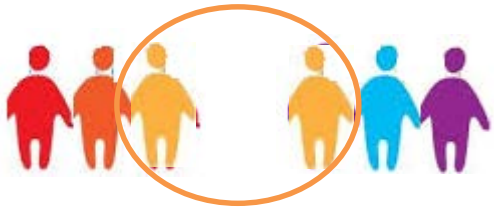
The Positive Deviance approach

➔ identification of more sustainable diets among existing ones:

General Population

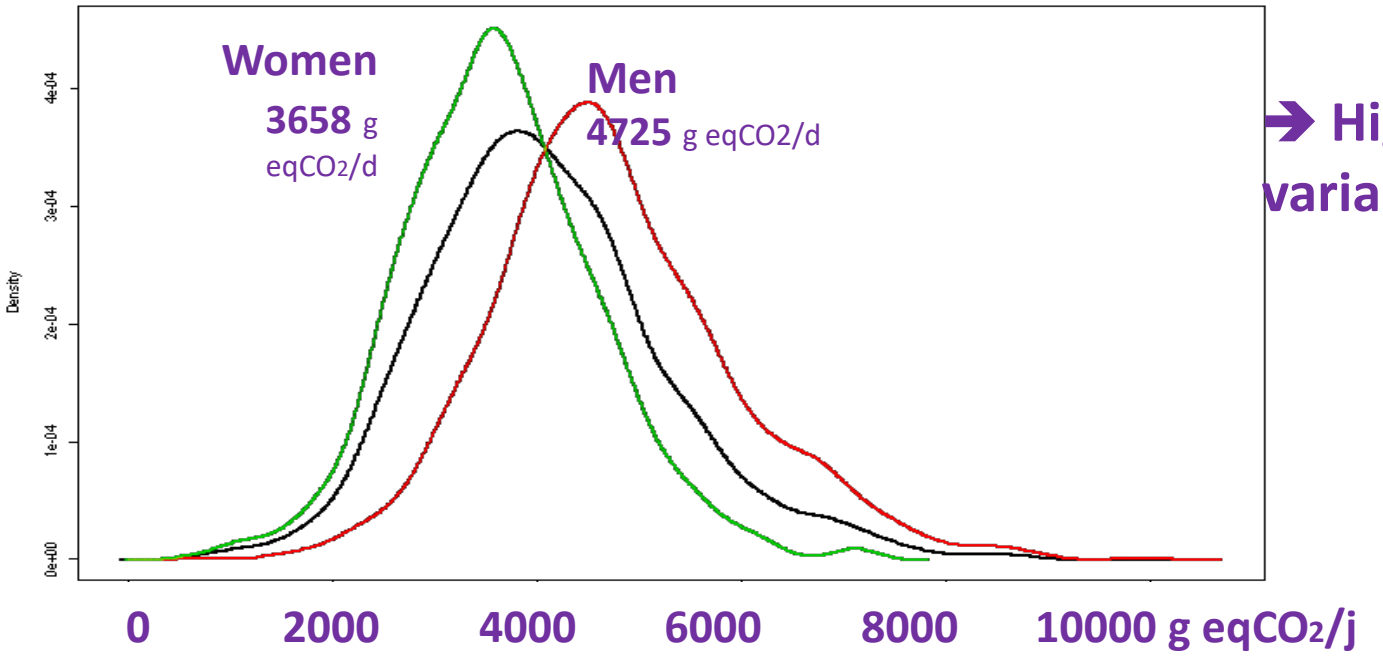
Self-selected diet's:
- Nutritional quality
- Environmental impact
- Cost

Selection of more sustainable diets, i.e. with:
- good nutritionnal quality
- low environmental impact



RESULTS with the positive deviance approach in France (OCAD project)

GHGE of self-selected diets, g eq.CO_2 /d



➔ **High inter-individual variability of dietary GHGE**

(Vieux et al, Ecol Econ 2012)

➔**20% of self-selected diets identified as 'more sustainable':**

- **GHGE reduced by 20%** (vs mean)
- **they eat less** (minus 200kcal vs mean)
- **they eat diferently**

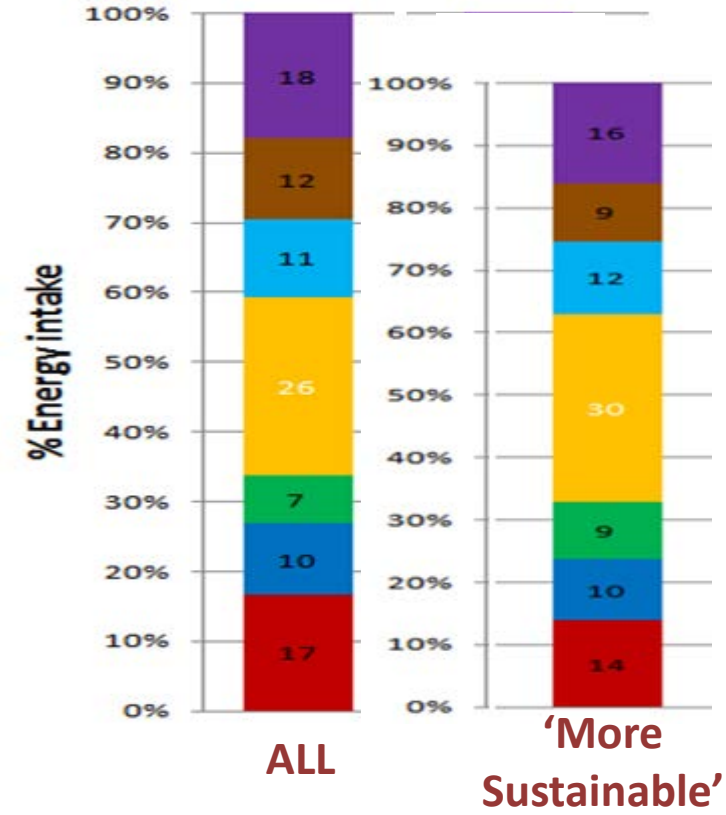
(Masset et al, AJCN 2014)

Nutrition | Culture | Economy | Environment

Diets of 'positive deviants' in France (OCAD project)

(Masset et al, AJCN 2014)

Energy contribution of food groups



- Snacks, sweets, desserts ↘
- Mixed dishes ↘
- Fats, condiments =
- Starchy foods ↗
- Fruit, vegetables, nuts ↗
- Dairy products =
- Meat, fish, eggs ↘

➔ **Higher amount of plant-based products (58% vs 53%*);**

➔ **Lower amount of animal products (dairy excepted)**

➔ **Lower cost (6.2 vs 6.7 €/d)**

*without counting high fat high sugar foods and without counting plants in mixed dishes containing animal products

RESULTS with positive deviance in Europe

(*France, UK, Italy, Finland, Sweden*, SusDiet project) *(Vieux et al, J Clean Prod, 2020)*

➔ **18% of more sustainable diets with GHGE decreased by 21%** (vs population mean)

➔ **Decrease of animal/plant ratio**

(less bovine meat, less processed meat, more F&V, more starchy foods);

➔ **Less soft drinks, less alcoholic drinks**

On average, the daily diet of positive deviants in Europe contains:

1 kg plant-based foods :

400 g F&V,
100 g juice
500 g other plant-based foods (incl. 200g mixt dishes and 20g of nuts)

400 g animal-based foods

100 g meat/fish/eggs (incl. 20g ruminant meat),
50 g mixt dishes
250 g dairy products (incl. 30g cheese).

➔ **To improve diet sustainability, exclusion of entire categories of foods is not a necessity;**

➔ **Moderate meat reduction: 1st step can be achieved right now**

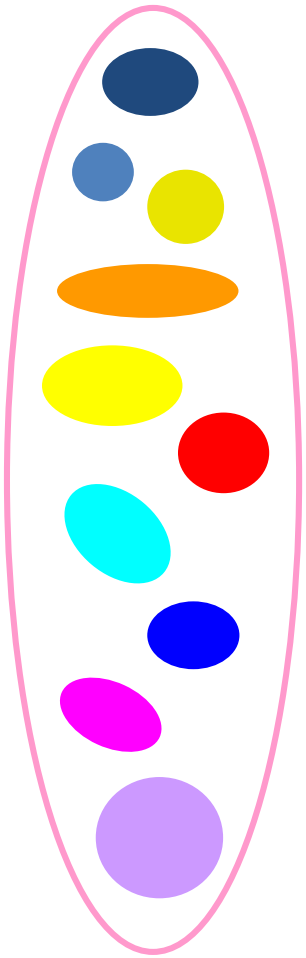
➔ **Next step?**

Nutrition Culture Economy Environment

Identifying tomorrow's sustainable diets

Design of theoretical diets with mathematical optimization

(Gazan et al., Adv Nutr, 2018)



VARIABLES (Foods and their weights)

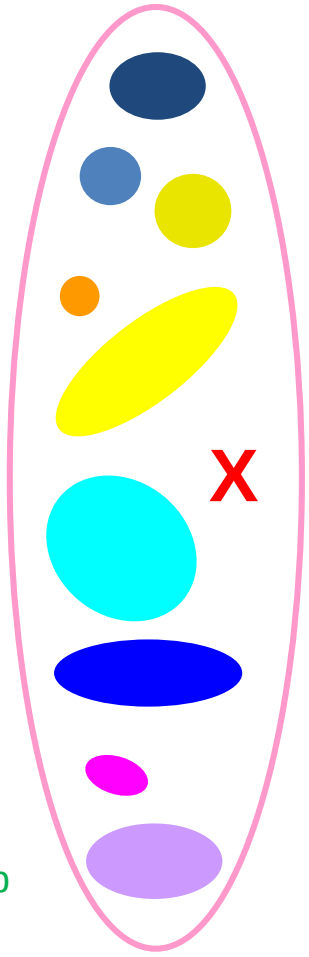
CONSTRAINTS

(Requirements for the modeled diet)

- **Iso Energy**
- **All nutritional recommandations**
- **Environ. impact reduction** (10% steps)
- **Realism and acceptability** (maximum portion sizes, balance between food-groups….), based on observed intakes
- **Cost**

OBJECTIVE FUNCTION

Minimizing departure from the food and food-group content of the observed diet



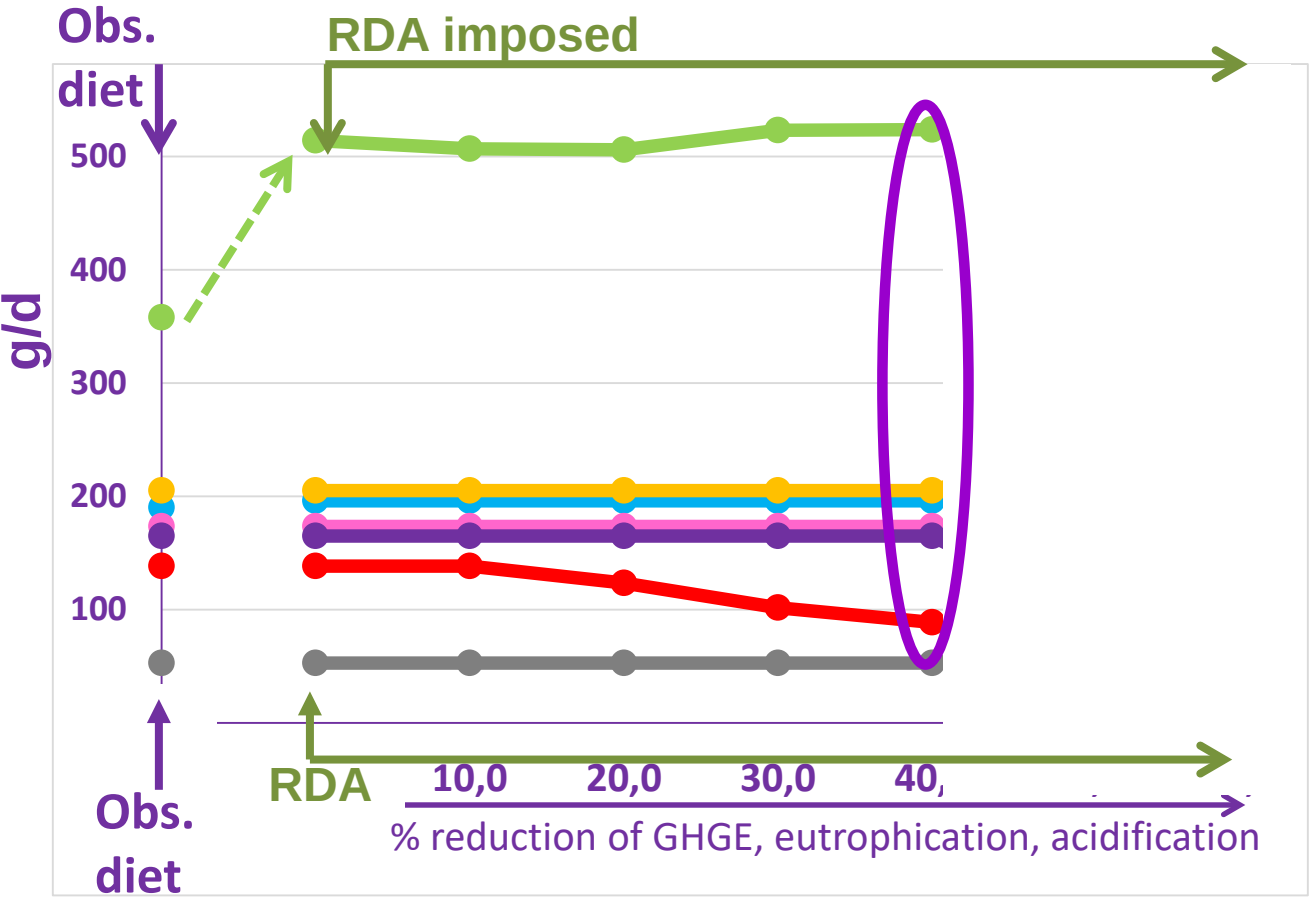
Observed diet

Modeled diet

RESULTS with diet optimization in France

(OCAD project)

Food groups in OBSERVED and nutritionally adequate MODELED diets



(Perignon, Pub Health Nutr, 2016)

- Fruits & vegetables
- Starches
- Dairy
- High fat high sugar
- Added fats
- Meat, fish, poultry, eggs
- Mixed dishes

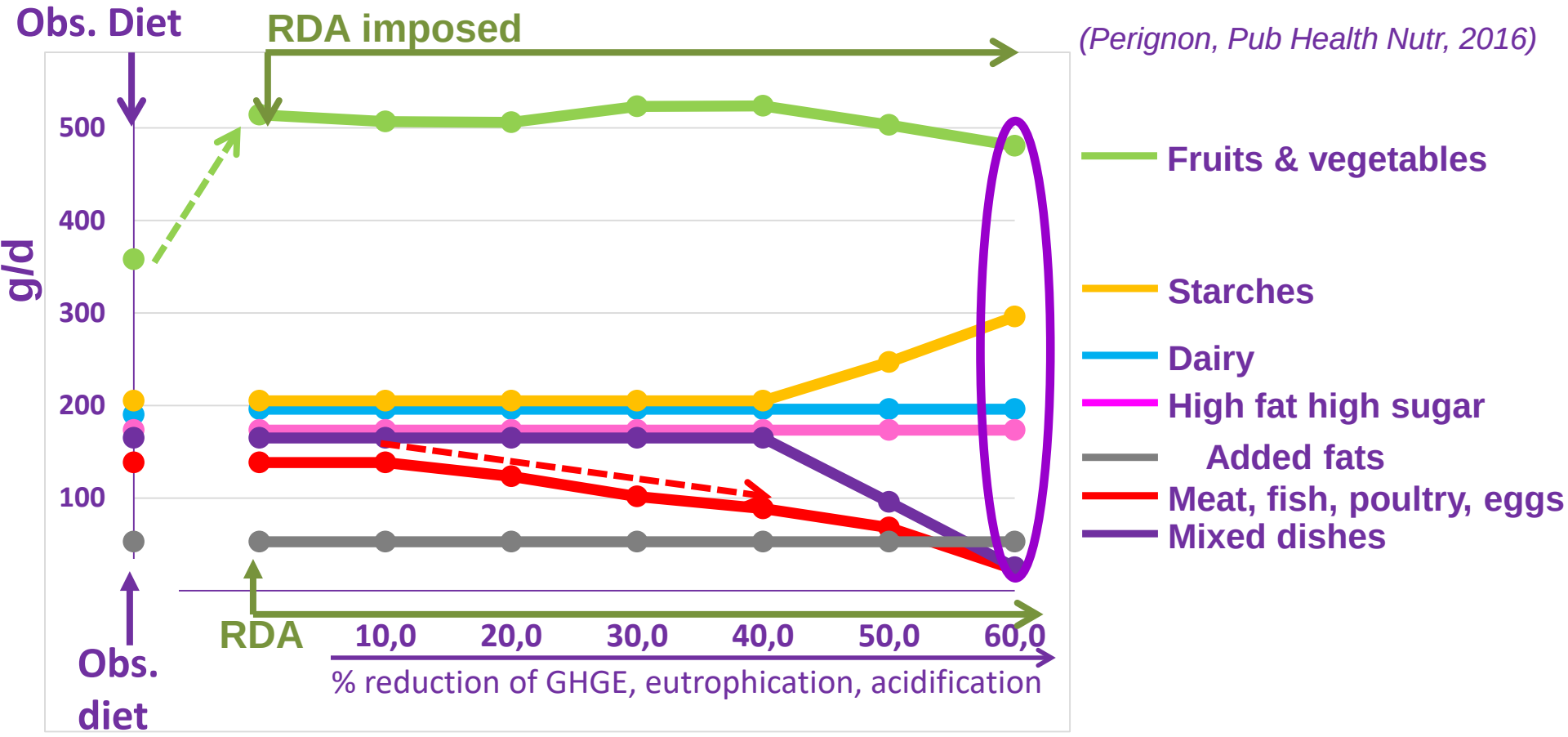
➔ Until 30-40% of environmental impact reduction, nutritional adequacy can be achieved by changing only the quantities of 2 food groups:

➔important F&V increase; ➔moderate M/F/P/E decrease

RESULTS with diet optimization in France

(OCAD project)

Amounts of main food groups in OBSERVED and MODELED diets



➔ **Possible to reduce env. impacts by 60% while achieving nutritional adequacy but requires greater departure from observed intakes :**

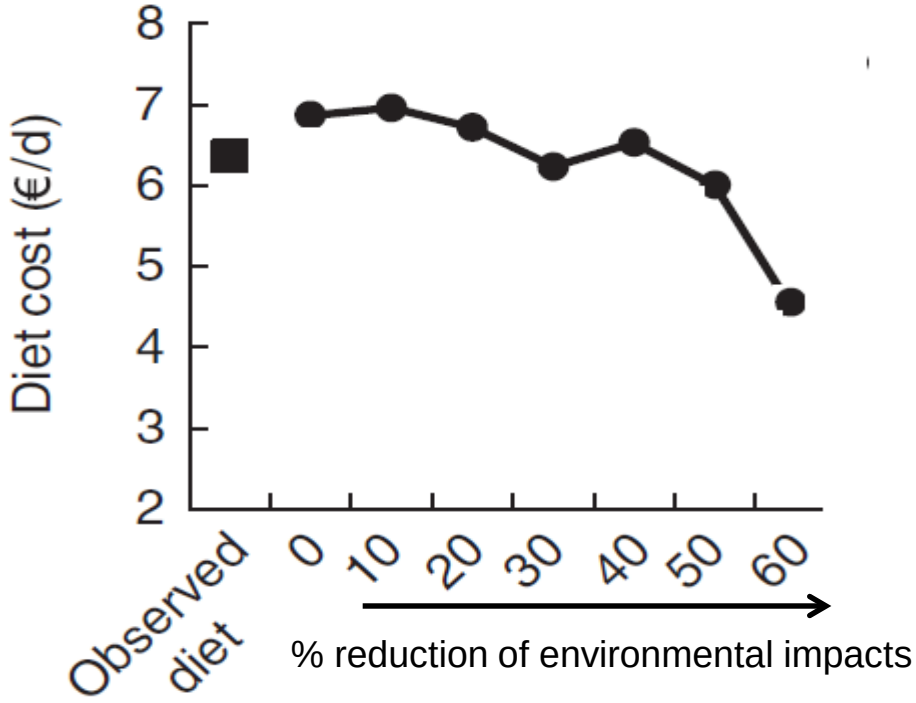
➔ **Dairy** remained stable, **starches** began to increase, **meat** continuing decreasing trend

RESULTS with diet optimization in France:
(OCAD project)

Focus on diet cost

(Perignon, Pub Health Nutr, 2016)

Diet cost (€/d) of OBSERVED and nutritionally adequate MODELED diets



(cost based on mean food prices)

➔ **Cost first increased to fulfill all nutrient based recommendations**

➔ **Then cost progressively decreased with strengthening constraints on environmental impacts**

RESULTS with diet optimization in France:

(OCAD project)

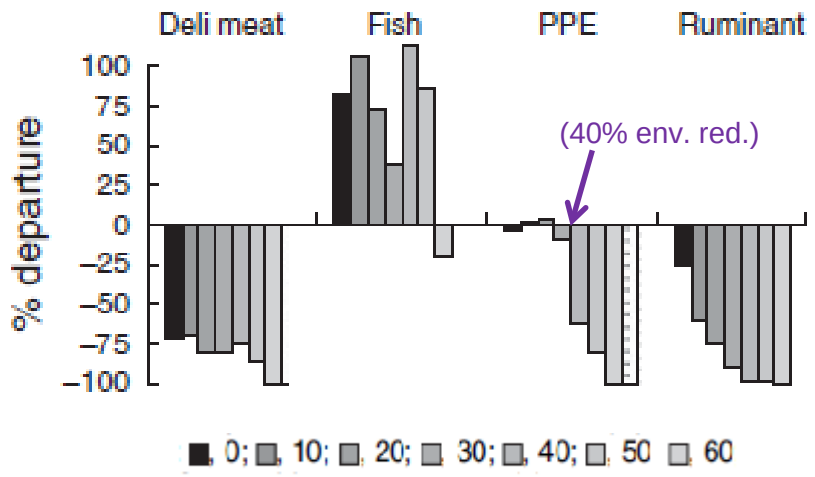
Focus on animal products:

(Perignon, Pub Health Nutr, 2016)

% Departure vs observed amounts in modeled diets

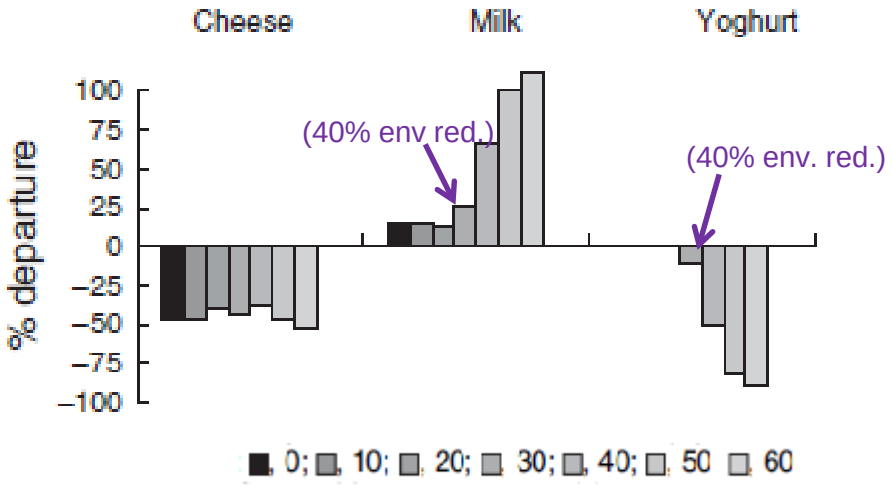
Meat, Fish, Poultry, Eggs

(general decreasing trend)



Dairy products

(general trend = stability)



➔ Delimeat and Ruminant meat decreased (for both nutrition and env.),

➔ Fish increased (for nutrition),

➔ Porc/poultry/eggs first maintained and then decreased for env. reductions >40%

➔ Cheese decreased,

➔ Milk increased,

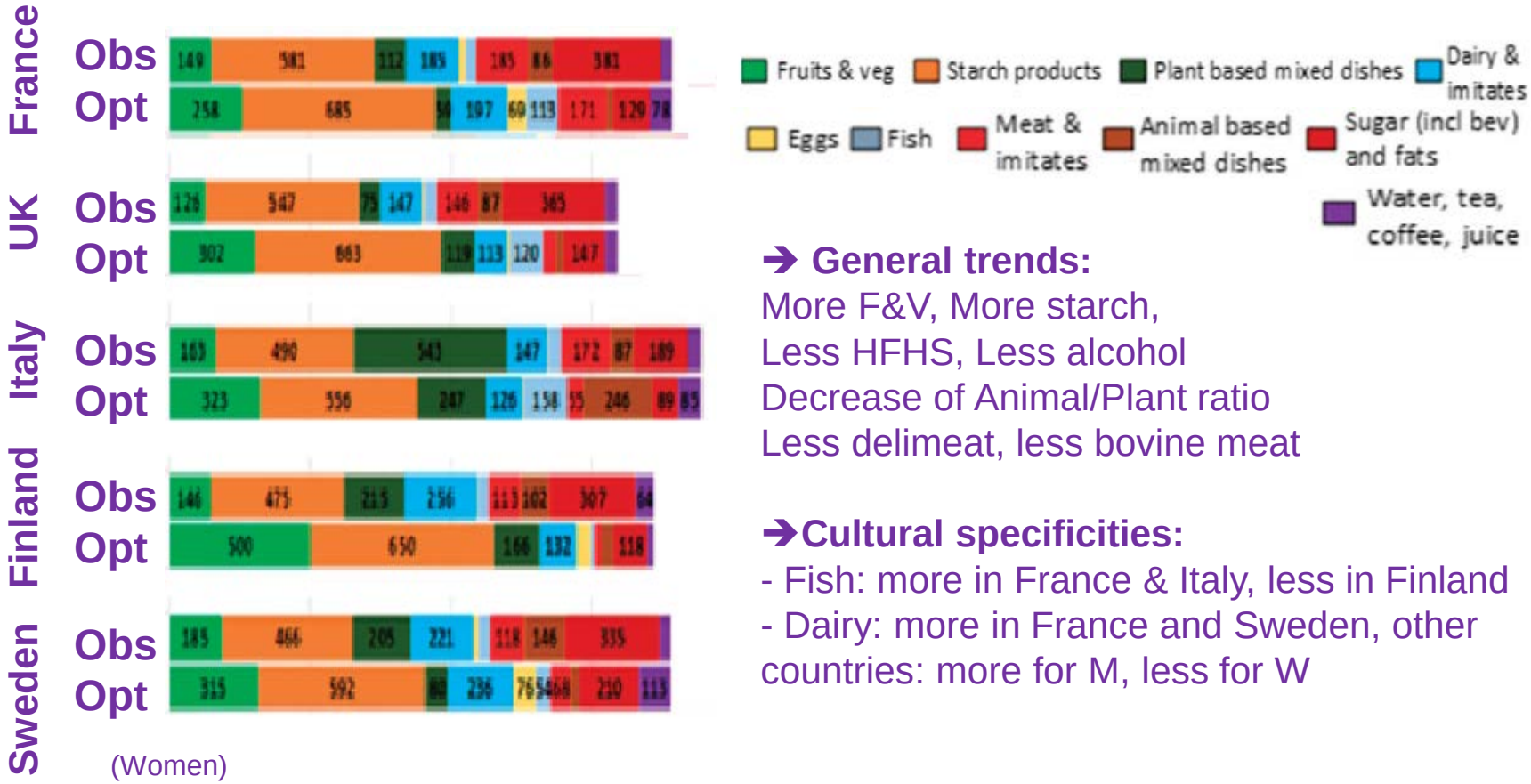
➔ For environmental reductions > 40% : substitution between milk and yoghurt)

RESULTS with diet optimization in Europe

(SusDiet project)

Energy (kcal) provided by different food groups *(Vieux Eur J Clin Nutr, 2018)*

in OBSERVED and MODELED (nutritionally adequate, GHGE -30%) diets



(Women)

➔ **General trends:**

More F&V, More starch,
Less HFHS, Less alcohol
Decrease of Animal/Plant ratio
Less delimeat, less bovine meat

➔**Cultural specificities:**

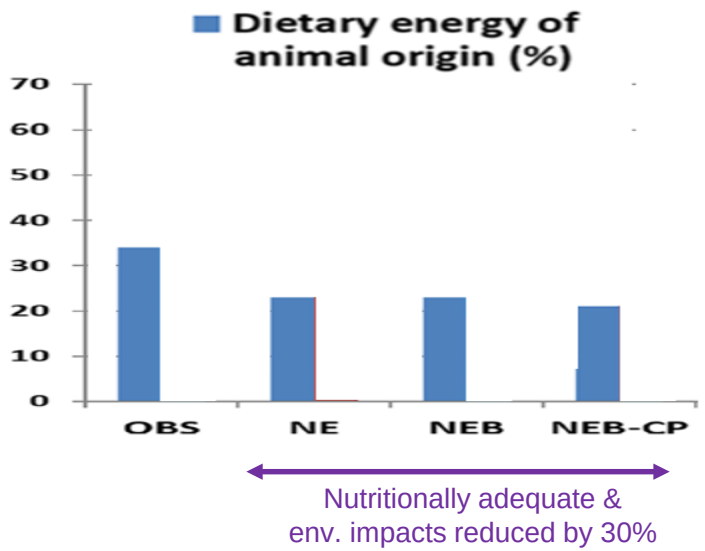
- Fish: more in France & Italy, less in Finland
- Dairy: more in France and Sweden, other countries: more for M, less for W

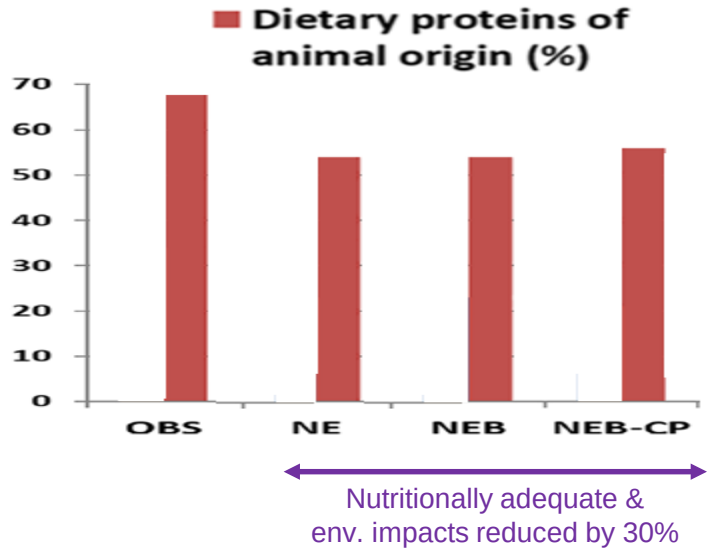
➔Similar trends for different populations

with some country- or sex- specificities

Adressing the limits: taking into account nutrient Bioavailability (NE-B) and Co-Production links (NEB-CP) vs previous model NE (Nutrition + 30% reduction Env. impact)

(Barré, PLOS one, 2018)





➔ **Whatever the model, energy & proteins from animal origin have to decrease**

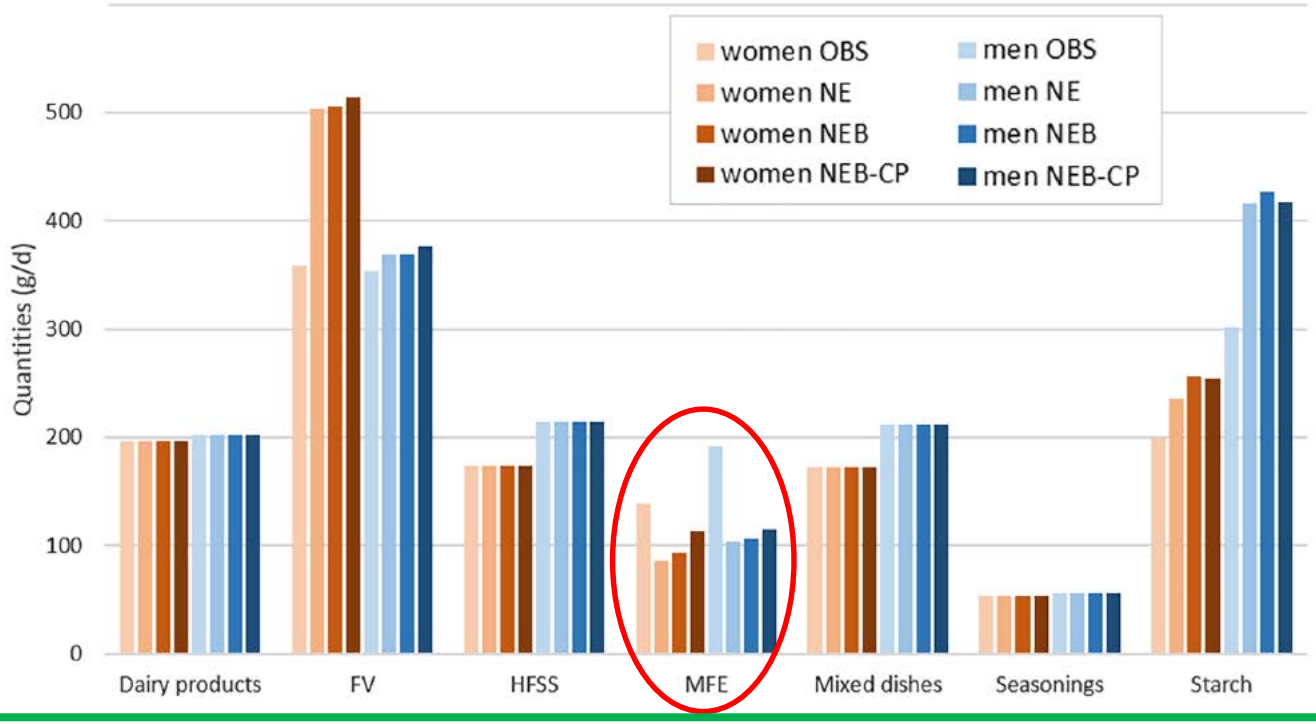
Meat content *(women)*	OBS	NE	NEB	NEB-CP
Total meat[2] plus fish (g/d)	140	54	66	96
Total meat[2] (g/d)	110	25	36	74
Total ruminant meat[3] (g/d)	36	6	5	26

➔ **Meat reduction with all models,**
➔ **But lower reduction when co-production links are considered**

Adressing the limits: taking into account nutrient Bioavailability (NE-B) and Co-Production links (NEB-CP) vs previous model NE (Nutrition + 30% reduction Env. impact)

Food groups content in observed and optimized diets

(Barré, PLOS one, 2018)



Whatever the model:

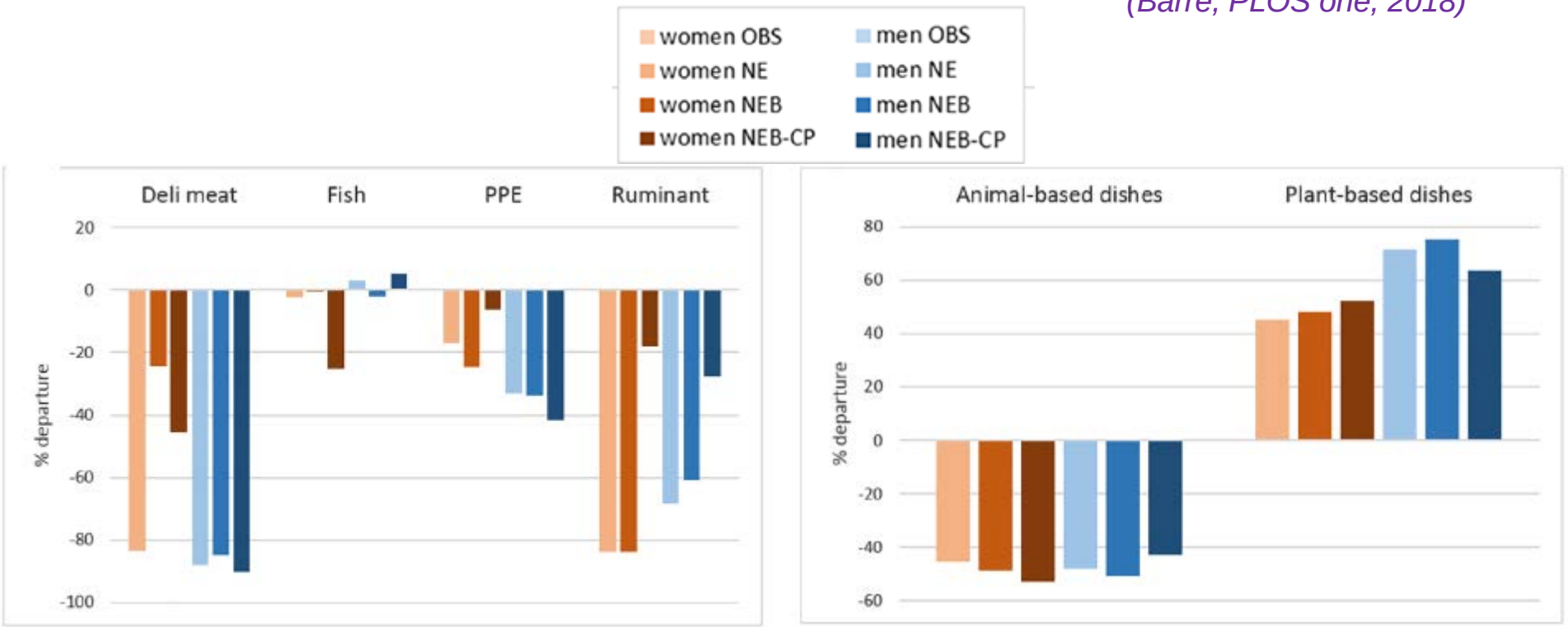
➔ **F&V and Starch increased**

➔ **Dairy stable, High fat/sugar/salt also!**

➔ **Meat/fish/egg decreased**

Adressing the limits: taking into account nutrient Bioavailability (NE-B) and Co-Production links (NEB-CP) vs previous model NE (Nutrition + 30% reduction Env. impact)

(Barré, PLOS one, 2018)



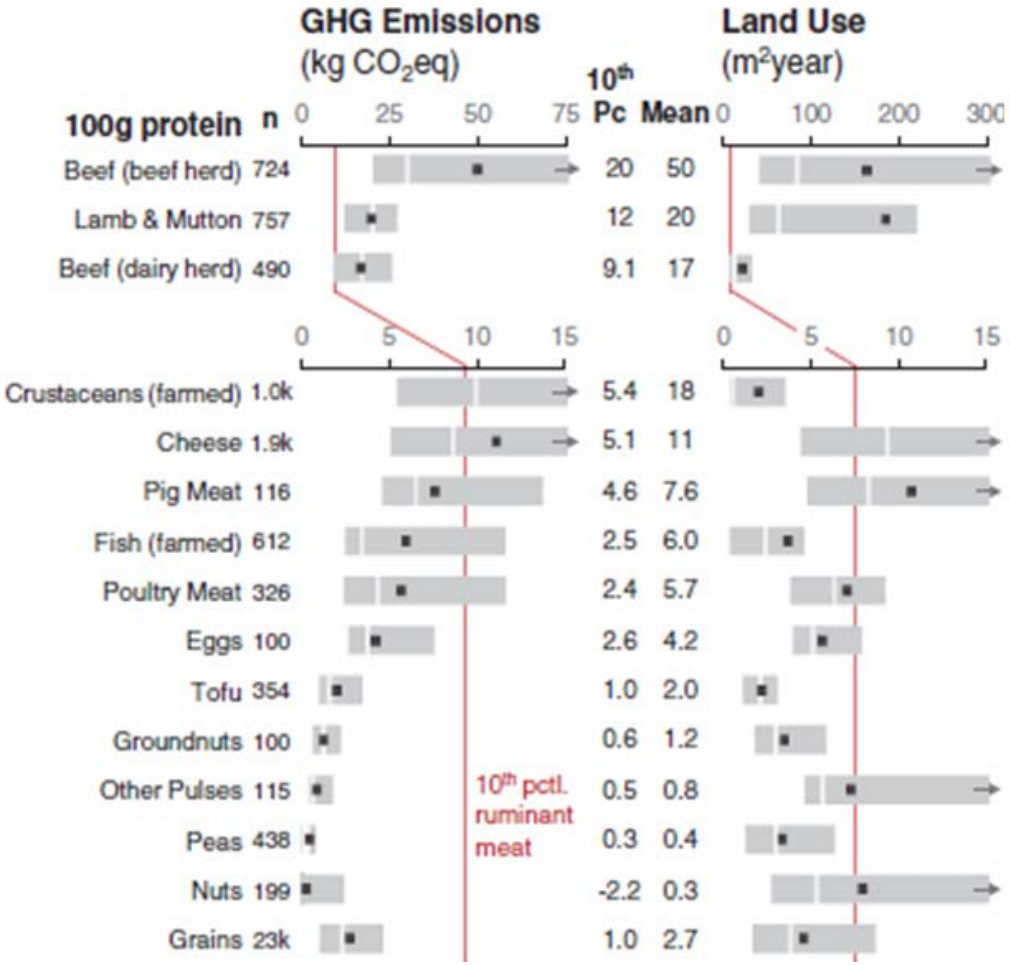
➔ **Whatever the model, meat is decreasing**

➔ **Replacement of animal-based mixed dishes by plant-based ones**

Adressing the limits:

➔ Variability of environmental impacts

Variation in GHGE and land use within and between foods groups
(protein-rich foods)



(Poore and Nemeck, Science, 2018)

✓ **High variation among products**
(impacts of the lowest-impact animal products exceed those of plant products)
➔ Dietary changes needed : promote flexitarism

✓ **High variation among producers**
➔ Need to improve production practices, focusing on the most impacting producers

(Consolidated data from 38,700 farms; 1600 processors, packaging types, and retailers)

Adressing the limits → Food safety

Compatibility with nutritional adequacy?

(Barre et al, J Nutr, 2016)

JN THE JOURNAL OF NUTRITION

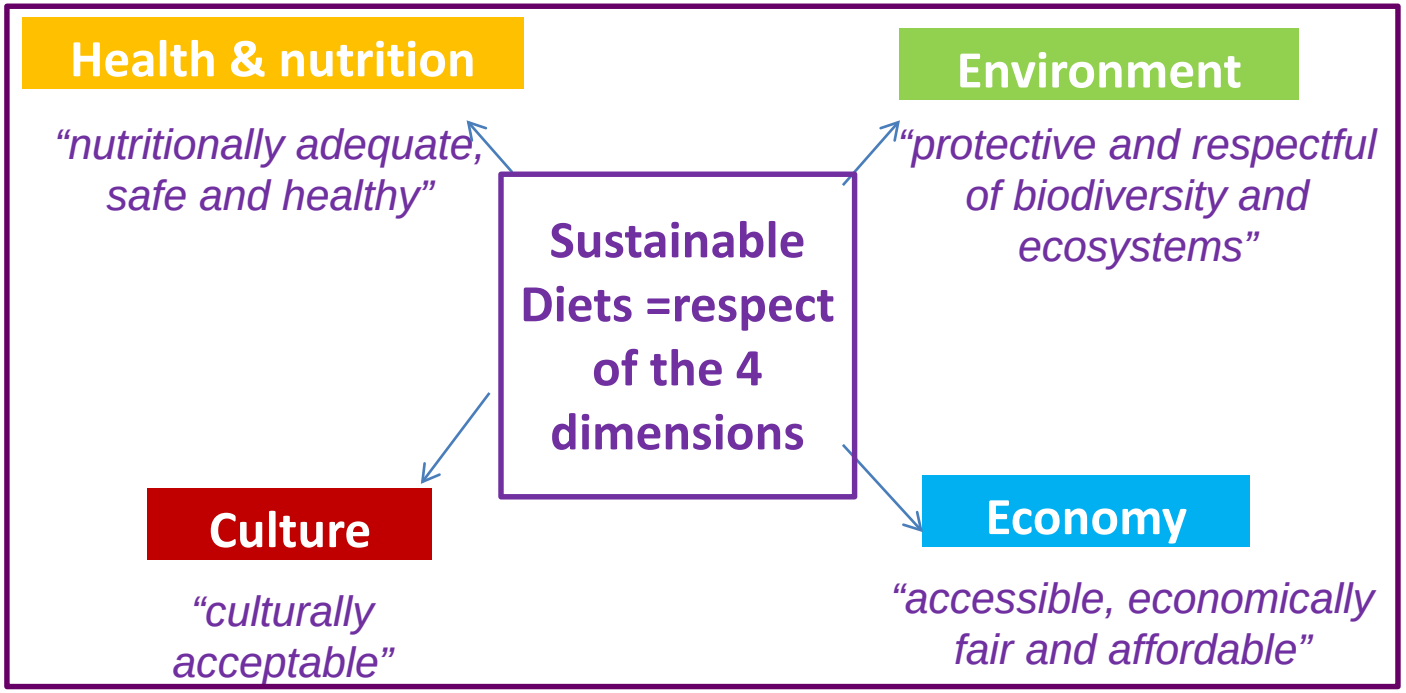
The Journal of Nutrition
Methodology and Mathematical Modeling

Reaching Nutritional Adequacy Does Not Necessarily Increase Exposure to Food Contaminants: Evidence from a Whole-Diet Modeling Approach[1–3]

Tangui Barré,[4] Florent Vieux,[5] Marlène Perignon,[4] Jean-Pierre Cravedi,[6] Marie-Josèphe Amiot,[4] Valérie Micard,[7] and Nicole Darmon[4]*

Conclusions: Based on a broad range of nutrients and contaminants, this first assessment of compatibility between nutritional adequacy and toxicological exposure showed that reaching nutritional adequacy might increase exposure to food contaminants, but within tolerable levels. However, there are some food combinations that can meet nutritional recommendations without exceeding observed exposures.

Conclusions



➔ At 30-40% env. impact reduction: eating less meat common lever

➔ At > 50% env. impact reduction: priority to eggs, milk, fish (within animal products)

➔ **When considering nutrient bioavailability and co-production links : same conclusions**

<u>but studies are needed for other populations (children, elderly, pregnant women…)</u>

➔ **For very high reductions of environmental impacts : cultural acceptability is not ensured, actions on the food supply are required**