4th International Conference
Organic Rice Farming and Production Systems
Tohoku University Sendai – Japan, September 4 th – 7 th , 2023

9/7 Special topic

Key findings of the French BI0-NutriNet project
on organic food-based diets and sustainability
(diet, nutrition, health and environment)
by

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and the UN Sustainable food systems consortium

I have NO CONFLICT of INTEREST

Towards sustainable diets and food systems …

…In line with the FAO & UN definition of sustainable diets & food systems

An urgent need to face increasing problems:
food security, nutrition-related diseases and ecological damages

Sustainable food production

High food quality-safety

Sustainable food consumption

for

Humankind
&
Planetary Health

The UN
« One Health » concept

The organic food consumers

- Limited but encouraging knowledge was available regarding the **high nutritional value and safety of organic foods** (reports and reviews).

- But until 2010's …… no large scientific studies have been conducted on organic food consumers !

- From **diet sustainability** and **public health** points of view, it was thus crucial to analyze and understand **organic food-related consumer profiles**.

With my colleagues, we thus decided to use the Nutrinet-Santé Cohort study to provide large-scale relevant scientific evidences !

The NutriNet-Santé cohort study (by EREN)

Aims to investigate the relationships between nutrition, lifestyle and health outcomes in a large adult cohort.

- Web-based national **prospective cohort study** since 2009
- Adult volunteers (aged ≥ 18 years)
    To date (2021): 170 000 adults in the cohort
- Follow-up : 2009 + 10 years

- Dedicated secure HTML interface for web-based questionnaires (www.etude-nutrinet-sante.fr)

- Biochemical samples and clinical examination in a subsample
       (> 20 000 subjects for blood and urine)

- Registration of health outcomes and validation

Baseline questionnaires (yearly update)

Diet
(3 x 24h records yearly, FFQs)

Physical activity and sedentary behaviour (IPAQ)

Socio-demographic, economic and lifestyle

Anthropometric data and self-perception

Health
(personal and family)

The **Bionutrinet project** within the French NutriNet-Santé cohort

(with public financial support)

Coordinator : Emmanuelle KESSE-GUYOT, EREN

To describe **organic food consumers** and investigate the **relationships** with food contamination and **pesticide** exposure, **health outcomes,** impacts on **resources** (land, energy use) and **environment** (GHGEs) & socio-economical aspects **.**

- Specific <u>organic food consumption questionnaires</u> (3 & 5 frequency levels)
- State of the art <u>statistical data treatments</u> and modelings.

24 international scientific publications (2013-2022)

Description of consumer's Lifestyle
(n= 54 300)

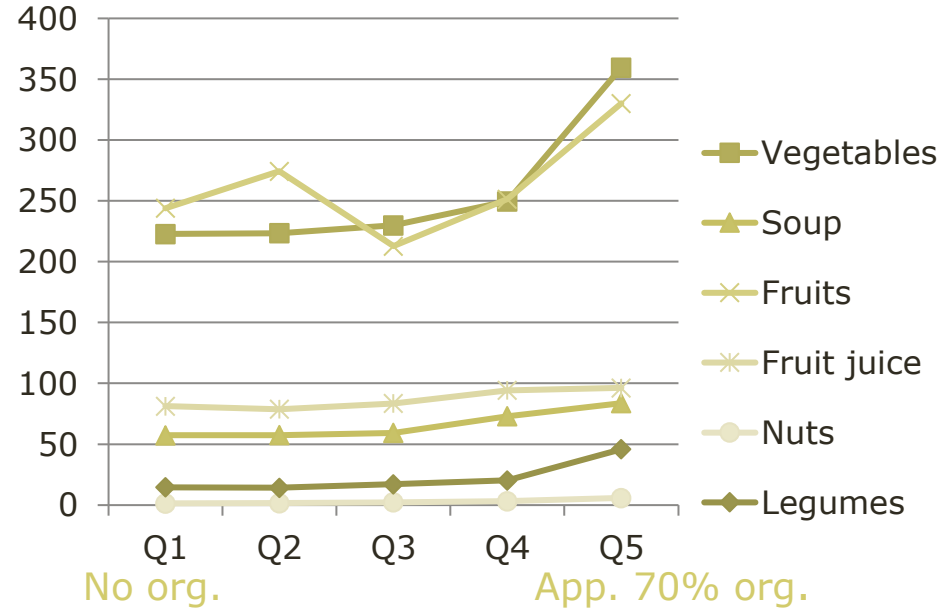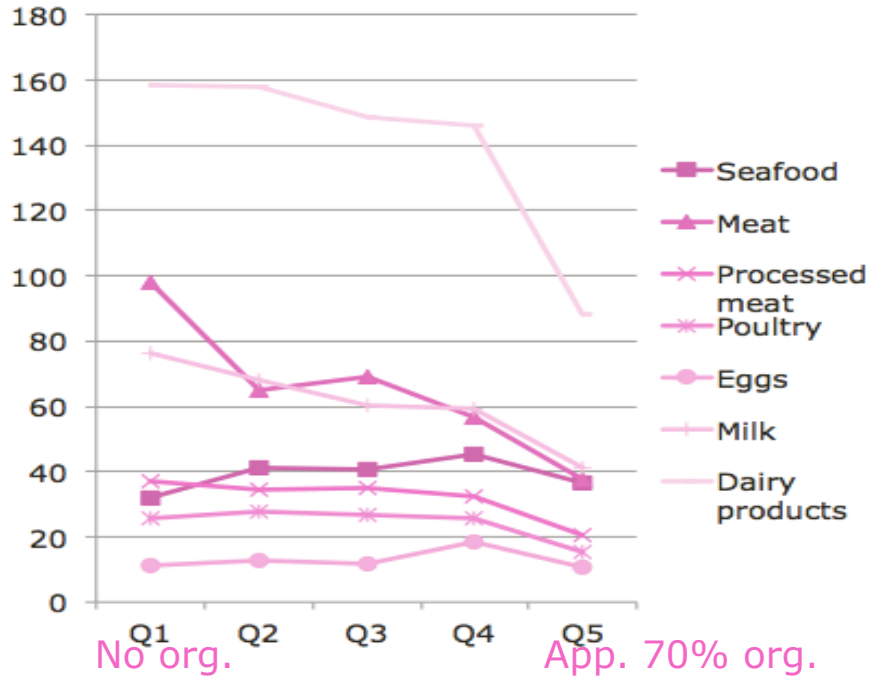*Regular consumption of organic food vs NO is associated with* :

- Being a women
- Less very-low income
- Less report of restrictive diet
- No smoking
- Higher education level
- Higher level of physical activity
- Higher ecological concern

→ **healthier life-style profiles**

Kesse-Guyot, …, Lairon, PlosOne, 2013

ORGANIC DIETS, N=28,245

Baudry, et al. Public Health Nutr, 2016

Organic diet (France)

Dietary intakes (n= 28 400-53 400) :
Intakes of all foods of plant origin increase with the contribution of organic foods to the diet while a reverse trend was identified for meat and dairy products, fast foods, cookies and soda.
-> **Organic consumers have a plant-based diet** *(Confirmed in Germany)*

The **diet quality scores** sig. increased with organic food consumption (mPNNS-GS/RDI, PANDiet/Rec.nutrients):

Nutrient intakes (n= 53 400) : daily intakes of most important nutrients and fibres are sig. higher with the highest organic food consumption (PUFA, PUFA n-3; Vit C, E, B9, B-car; Mg, Fe; Fibres)
-> **Organic consumers have a better/healthier diet.**

Kesse-Guyot et al, PlosOne, 2013; Baudry, et al, Public Health Nutr, 2016

Focus on organic rice consumption (N=28,245)
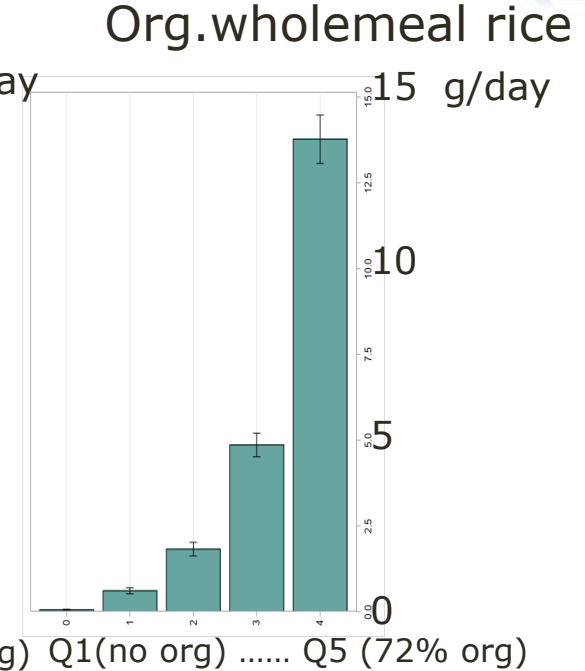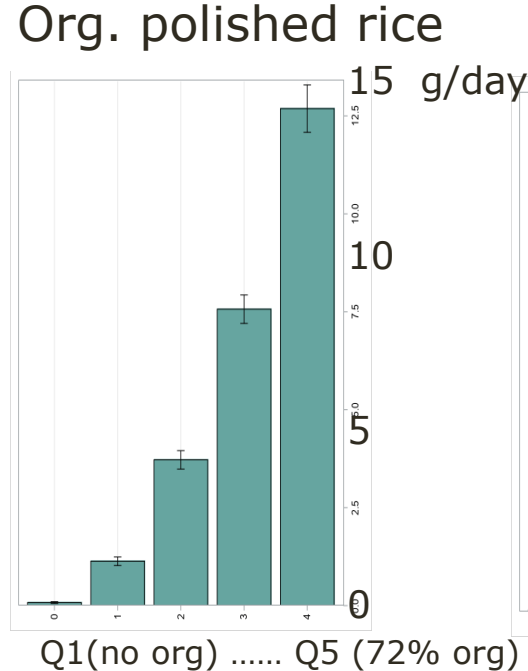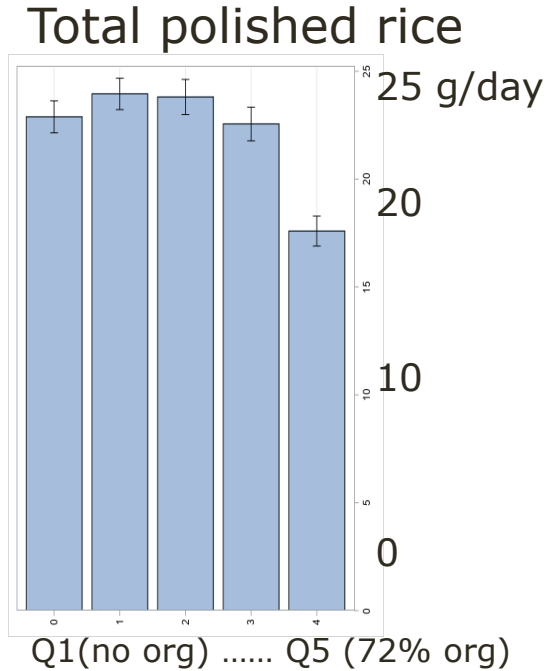
Increasing quintiles (Q sex-specific) of organic food consumption

from Baudry, et al , Public Health Nutr, 2016

Nutrient content of polished and wholemeal rice (/ 100 g boiled)

Item	polished rice	wholemeal rice	*diff (%) W vs P*
Energy (kcal)	136	158	+ 16 %
Protein (g)	2.5	3.5	+ 40 %
Carbohydrates	29	32	+ 10 %
Fat	0.9	1.1	+ 22 %
Calcium (mg)	8.2	20	x 2.40
Iron	0.38	1 max	x 2.63
Magnesium	11.4	50	x 4.38
Zinc	0.4 max	0.6	x 1.5 min
Vitamin B1 (mg)	0.05	0.06	+ 20 %
Vitamin B2	0.01	0.05 max	x 5 max
Vitamin B5	0.1	0.33	x 3
Vitamin B9	5.3	12	x 2.26
Fiber (g)	1.1 max	2.2	x 2 min
Glycemic Index	± 64	± 55	x 0,85

Rice, nutrition and health evidences (T2 diabetes)

- Meta-analysis (n=352 384, 4-22 years): Highest consumption of **white rice** is associated with a sign. increased risk of **T2 diabetes** (+12 %) , especially in Asian (Chinese and   Japanese) populations (+55%). (*Hu et al, Brit Med J, 2012*)

    Observed in the USA *((Sun et al, Arch Intern Med, 2011)*

- Meta-analysis 19 articles (n=700 000, world cohort surveys) : high intake of **white rice** was associated with higher risk of T2D (+ 16%), while **intake of brown rice was associated with lower risk (-19%)**. (*Yu et al, Brit Med J open, 2022*).

    Observed in the USA *(Sun et al, Arch Intern Med, 2011)*

Conclusion: Substitution of white rice for brown rice,
            lower the risk of type 2 diabetes (« a WHO epidemic »).

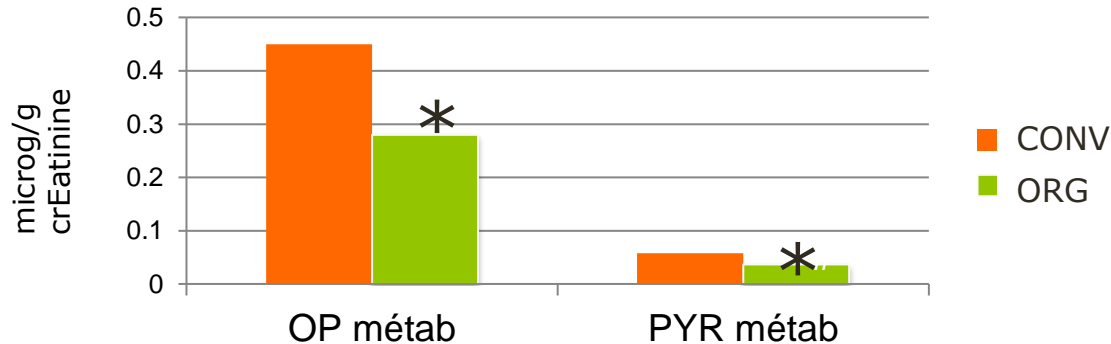# *Organic food consumption patterns in France*

Impact of organic food consumption pattern on **exposure to synthetic pesticides** ?

Pesticide exposure in low and high organic consumers

- Selection (nested-study) of **150 organic consumers** (mean proportion of organic food in the diet=67%) and **150 non-organic consumers** (mean proportion of organic food in the diet= 3%), <u>matched on all characteristics and consumption of food groups</u>.

- Analysis of **pesticide residues** (metabolites) in urine, markers of organophosphates and synthetic pyrethroids exposure.

Baudry et al.
J Exp Sci Env Epid 2018

Findings in line with those from other studies carried out in adults (4) and children (3)

Organic food consumption patterns in France

Impact of organic food consumption pattern on **risks for pathologies**

Organic diet and overweight and obesity 1

A pioneer observational cross-sectional study

n= 54 300 , 77% women, mean age 46y

A high consumption of organic foods is sig. associated with a marked reduction (- 36 to - 62 %) of overweight and obesity in females & males (after adjustments for confounders).

(Kesse-Guyot E,…, & Lairon D; PlosOne, 2013)

Organic diet and overweight and obesity 2

(n= 62 200, 77% women, 3-years follow up)

A first prospective study

After a 3.1 y mean follow-up of 62 200 adults :
the highest level of organic food consumption (Q4: mean 70 % org)
sign. reduces overweight by 23 % and obesity by 31 % (both genders)
(after adjustments for confounder:, lifestyle, diet, exercise, …)

(Kesse-Guyot et al, Br J Nutr, 2017)

A protective effect of consumption of
organic foods on the risk of developing
overweight and obesity

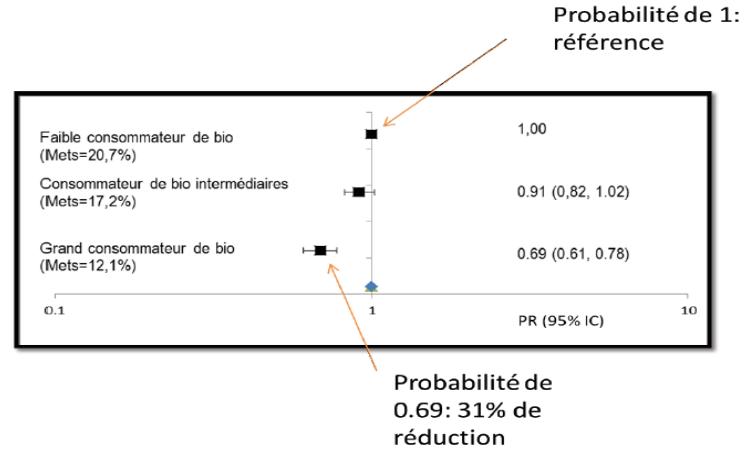*Also observed in Germany (2015)
and USA (2020)*
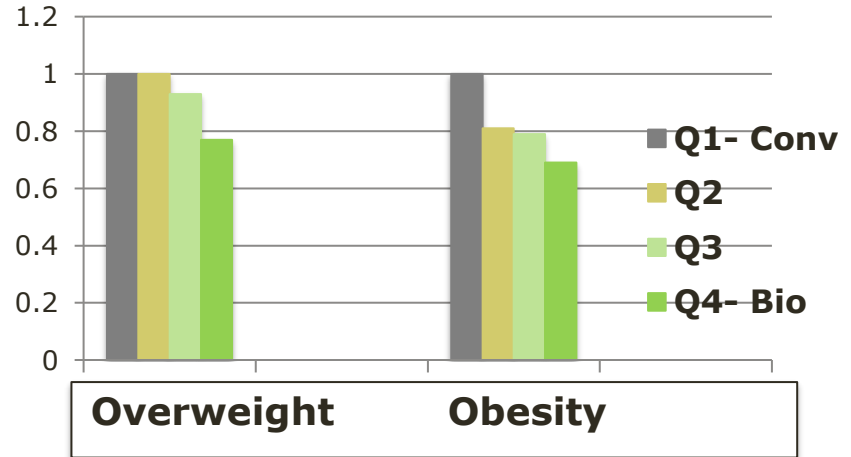
Organic diet and metabolic syndrome (CV risk)

(n= 8 174)

A major CV risk factor (associating central obesity, hypertension, and disregulation of glucose and lipid metabolism)

The highest consumption of organic foods (mean 62%) is sig. associated with a marked reduction by - 31 % of risk of metabolic syndrome (freq. 12.1% vs 20.7%) in both genders.

(Baudry et al, Eur J Nutr 2017)

Probabilité de 1: référence

Faible consommateur de bio (Mets=20,7%) — 1,00

Consommateur de bio intermédiaires (Mets=17,2%) — 0.91 (0,82, 1.02)

Grand consommateur de bio (Mets=12,1%) — 0.69 (0.61, 0.78)

0.1   1   10   PR (95% IC)

Probabilité de 0.69: 31% de réduction

A strong protective effect of consumption of organic food on the risk of developing cardio-vascular risks

Organic diet and Type2 Diabetes
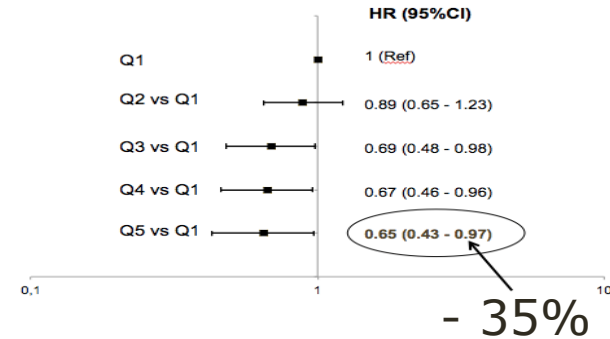## A first prospective study

(**N = 32 800**, mean age = 53 y, 76% women)
After a 4 y follow-up, 293 incident cases of T2D were identified.

The most important organic food consumtion (Q5: > 56% organic foods) is associated with - 35% risk of developing a Type2 Diabetes, especially women, compared to Q1 (about no org).

(after adjustments for numerous confounding factors :
lifestyle (physical activity, smoking status,
alcohol consumption) and nutritional quality of the diet)

Kesse-Guyot et al, J Behav Nutrition…, 2020

	HR (95%CI)
Q1	1 (Ref)
Q2 vs Q1	0.89 (0.65 - 1.23)
Q3 vs Q1	0.69 (0.48 - 0.98)
Q4 vs Q1	0.67 (0.46 - 0.96)
Q5 vs Q1	0.65 (0.43 - 0.97)

- 35%

Observed in USA, Sun et al, 2020 :**T2D risk -20/-24%**

Organic food consumption and Cancers

A prospective study

Follow-up of n= 70 192 ; 78% women, mean age 44 y
Follow-up for 4.6 y ; without known cancer at inclusion.
Data : 1340 novel cancer cases identified
(breast cancer, prostate cancer, skin cancer, colo-rectum cancer,
non-Hodgkin lymphoma, and other lymphoma).

*Org. questionnaire 1 for 16 food groups and organic frequency :
never, occasionally, mostly; making a organic global scoring.*

*Models ajusted for sociodemographic traits,
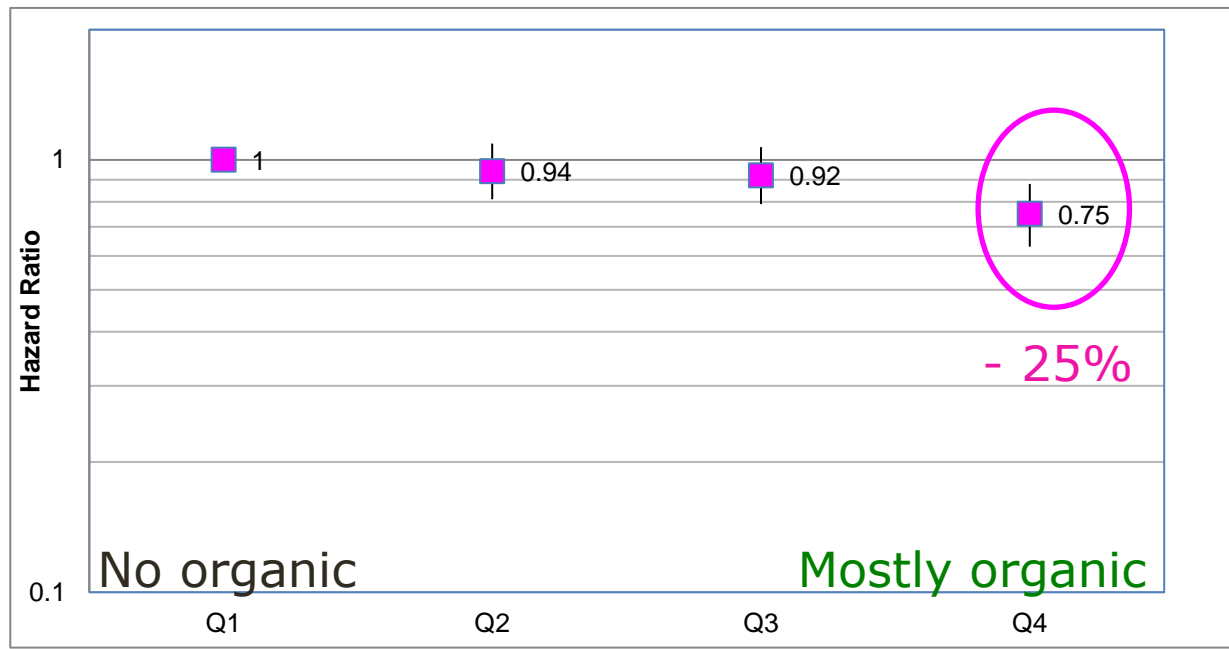life style (ie tobaco, exercice), dietary pattern, BMI, …*

Baudry et al, JAMA Int Med, 2018

Organic food consumption and Cancers: all cancers rates

Q4 (mostly organic) versus Q1 (no organic)
n= 70 192; 78% women, age m = 44 y; follow-up 4,6 y

P-trend=0,001

- 25%

Hazard Ratio

1 — 1 — 0.94 — 0.92 — 0.75

No organic — Mostly organic

0.1

Q1   Q2   Q3   Q4

Models ajusted on sociodemographics, life style, dietary intakes, etc.

Each increment of 15% in the proportion of organic food in the diet
was associated with 8% lower risk of cancers.   *Baudry et al., 2018, JAMA Int Med*

Organic food consumption and Cancers: cancer types

Q4 (mostly organic) versus Q1 (no organic) by types)
n= 70 192; 78% women, age m = 44 y; follow-up 4,6 y

Baudry et al., 2018, JAMA Int Med
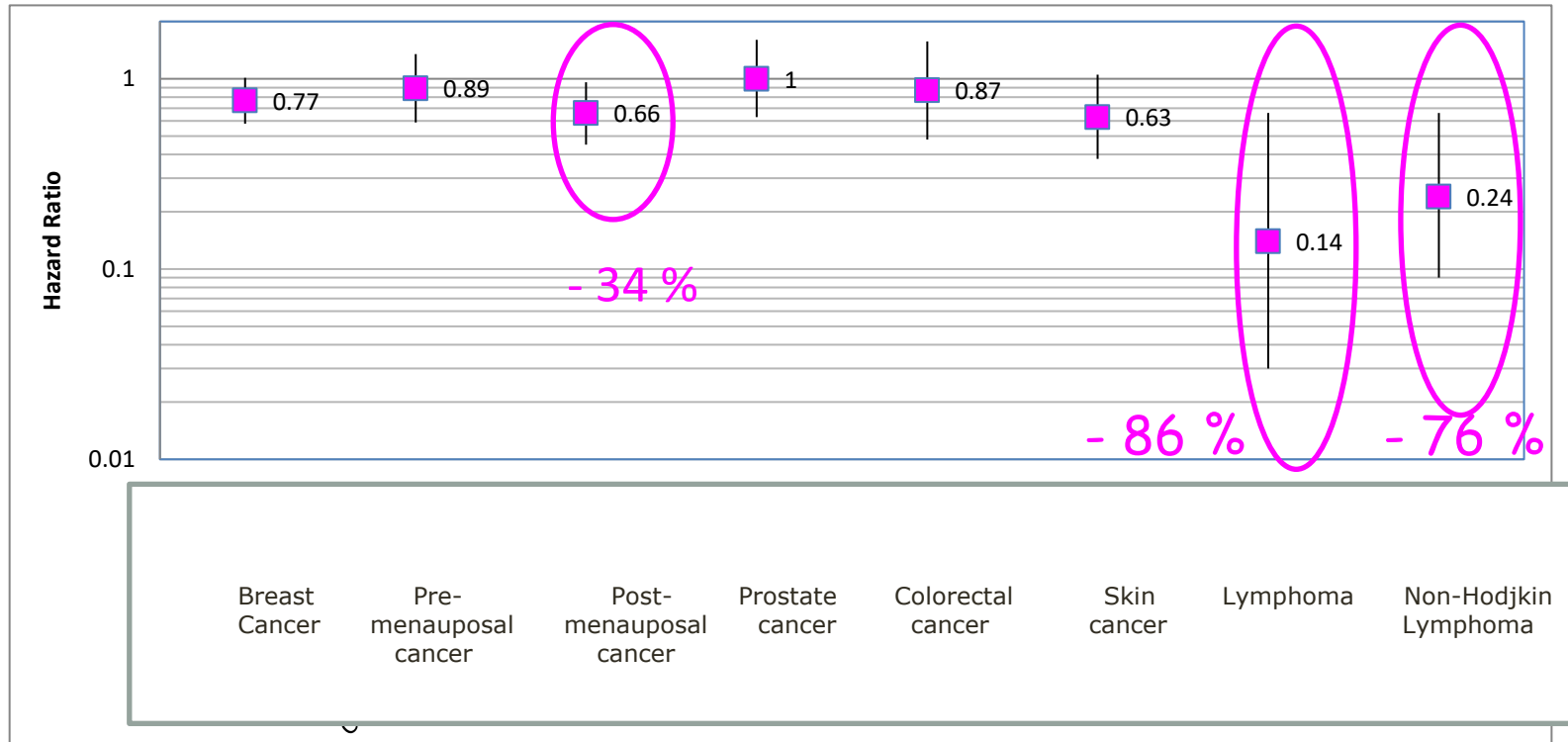
BioNutrinet Study :
Diet Pesticide exposure and breast Cancers

Follow-up of n= 13 149 **postmenauposal women**, mean age 44 y
Follow-up for 4.8 y ; without known cancer at inclusion.

Exposures to 25 dietary active substances used in EU plant-protection products were estimated using a pesticide-residue database accounting for farming practices, from Chemischesund Veterina¨ runtersuchungsamt Stuttgart, Germany.

Non-negative matrix factorisation (NMF) was used to establish exposure profiles.
Models ajusted for sociodémographic traits, life style (ie tobaco, exercice),
dietary pattern, BMI, …

Results
- Lowest exposure to synthetic pesticides mix was associated with – 43% reduction of risk of breast cancer,
- Highest exposure to synthetic pesticides mix was associated with + 73% increase of risk of breast cancer, especially in overweight/obese women (+ 413%).

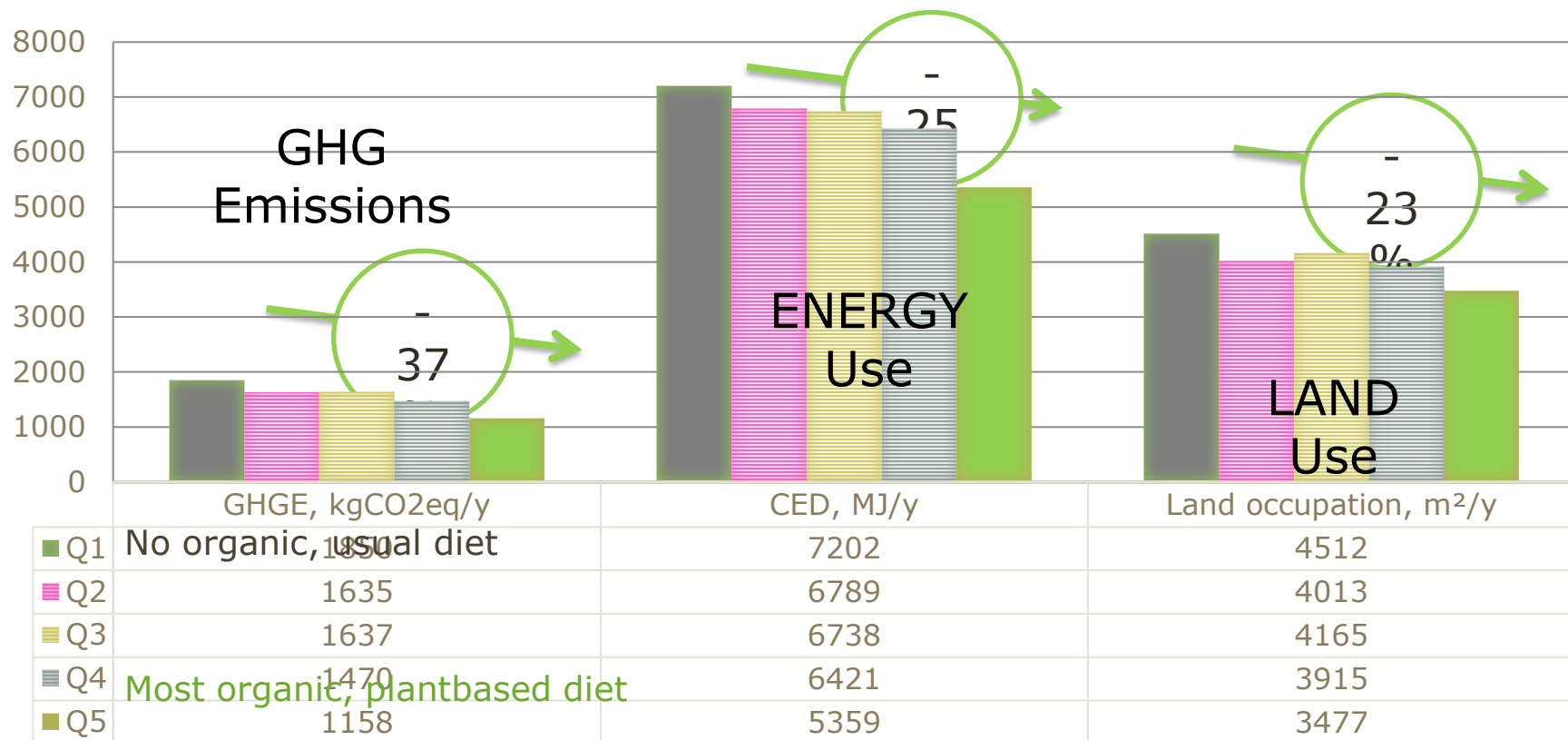*Rebouillat et al, Int J Epidemiol, 2021*

Organic food consumption patterns in France

Impact of organic food consumption pattern on some **ressources and Greenhouse gas emissions**

Organic diet and Planetary health (n= 28 245)

Diet impacts : data at food-diet production level

	GHGE, kgCO2eq/y	CED, MJ/y	Land occupation, m²/y
Q1 No organic, usual diet	1850	7202	4512
Q2	1635	6789	4013
Q3	1637	6738	4165
Q4 Most organic, plantbased diet	1470	6421	3915
Q5	1158	5359	3477

Ajustments on age, gender & energy intake.   *Baudry et al., Am J Clin Nutr 2019*

Organic food consumption : 2023 Conclusions

Present French regular consumers of organic products exhibit :

- specific socio-demographic characteristics (higher **education** level, more physical activity, less smoking; less low income),

- with a healthier dietary pattern (**more plant food-based**) better fitting food-based and nutritional recomendations,

- they consume much less **pesticides**-contaminated foods, and have significantly less pesticide residues in urines,

- they are markedly less **overweight and obese** (men & women: - 31/50%) and have a significantly reduced probability of **cardiovascular risk** (MetS: - 31%), **type 2 diabetes** (-35%) and **cancers** (-25%: 0 to – 86%).

- and have **less impacts** on natural resources (**land, energy**) and **GHGs**.

Thus, they show a better compliance with the sustainable diets concept (cf FAO definition, 2010) and the UN One Health concept.

Kesse-Guyot et al, review in Adv Nutr 2021

THANKS for your attendance

**ENJOY
agro-ecologial transition based on
Organic food system principles : Health, Ecology, Care, Fairness**

A key message ... from numerous available scientific studies

- We know now that adoption of a **plant-based diet**
  is urgent for human and planetary **healths**
  (food and nutr. needs, agric.land, biodiversity, water, GHGe,...),

- We know that conventional plant foods are the food items
  most contaminated by **chemical pesticides** (mean: 45% in EU),

- We know that pesticide exposure is associated with **human diseases and biodiversity losses**, with opposite effects with organic foods and farming

THUS
- The **only sustainable option is to adopt a plant-based diet made of organic foods** (*as recommended in France since 2019*)

Diet and Health : key points for diet Guidelines-PNNS-4

Haut Conseil de la santé publique

AVIS

relatif à la révision des repères alimentaires pour les adultes du futur
Programme national nutrition santé 2017-2021

16 février 2017

Operationally:
recommendations in 2019 :
Santé Publique France

Santé publique France

Fruits and vegetables
Nuts (unsalted)
Legumes
Whole-grain and partly refined grains

Dairies and cheeses(2 P/ j)
Red meat(≤ 70 g/j)
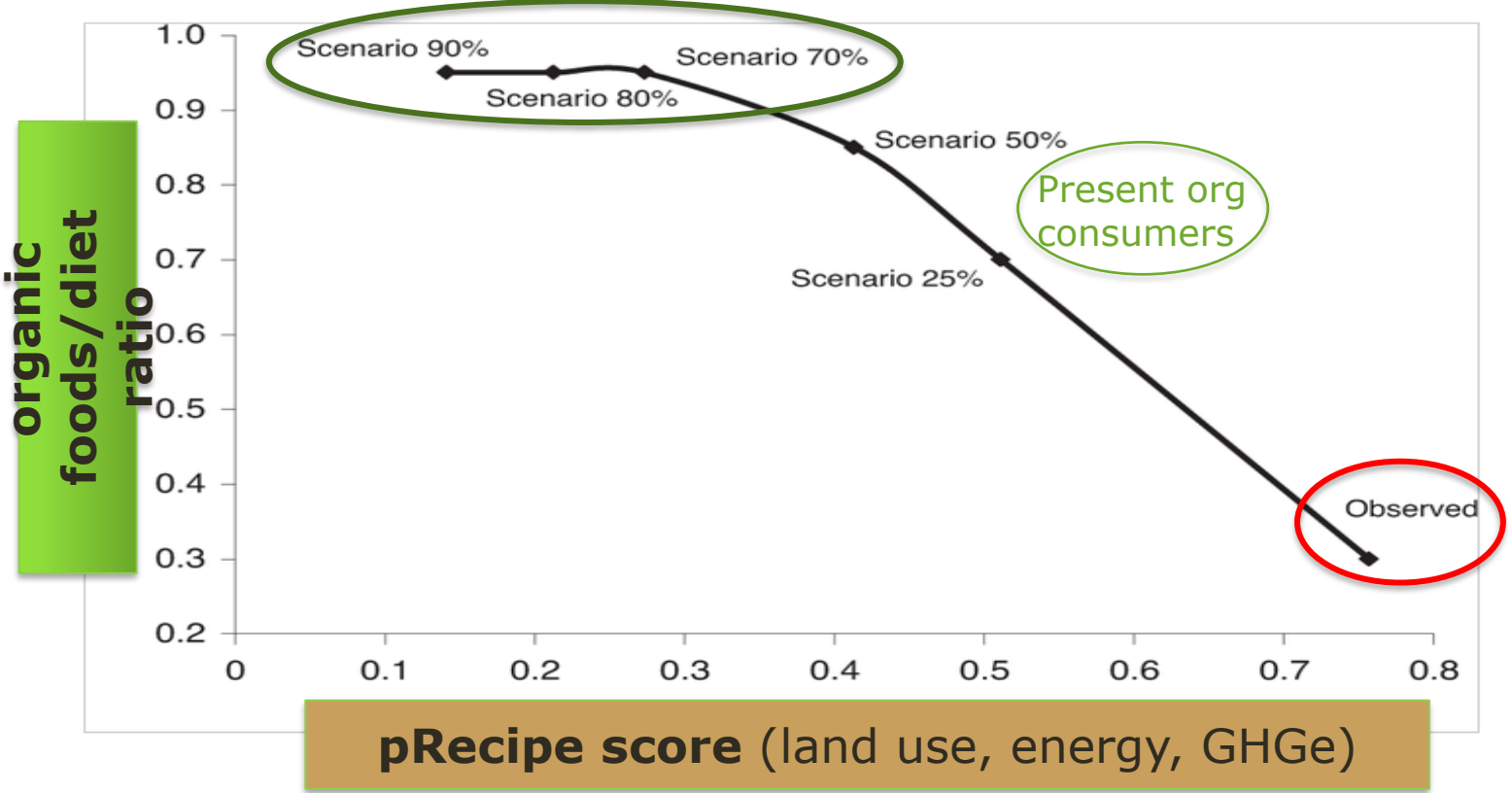*Processed meat* (≤ 20 g/j)
Added fats: favor plant oils
Sugared products, Salt

Fruits, vegetables, cereals, legumes :
« **To favor those organically produced** »,
to reduce exposure to pesticides.

Modeled diets to reduce negative impacts (land use, energy, GHGe) while satisfying mean nutritional needs. (n= 12 166)

Seconda et al, Nature food 2021

Sustainable diets (FAO, 2010)

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. "

BIODIVERSITY AND SUSTAINABLE DIETS
UNITED AGAINST HUNGER

3-5 NOVEMBER 2010 , FAO HEADQUARTERS, ROMA
and FAO publication, 2012.

WORLD FOOD DAY/WORLD FOOD WEEK 2010

INTERNATIONAL SCIENTIFIC SYMPOSIUM
BIODIVERSITY AND SUSTAINABLE DIETS
UNITED AGAINST HUNGER
3 - 5 November 2010, Green Room, FAO Headquarters, Rome