

# Which are the links between excess ultra-processed food consumption and food system sustainability?


**1<sup>st</sup> International Electronic Conference on Food Science and Functional Foods**  
**12-25 November 2020**

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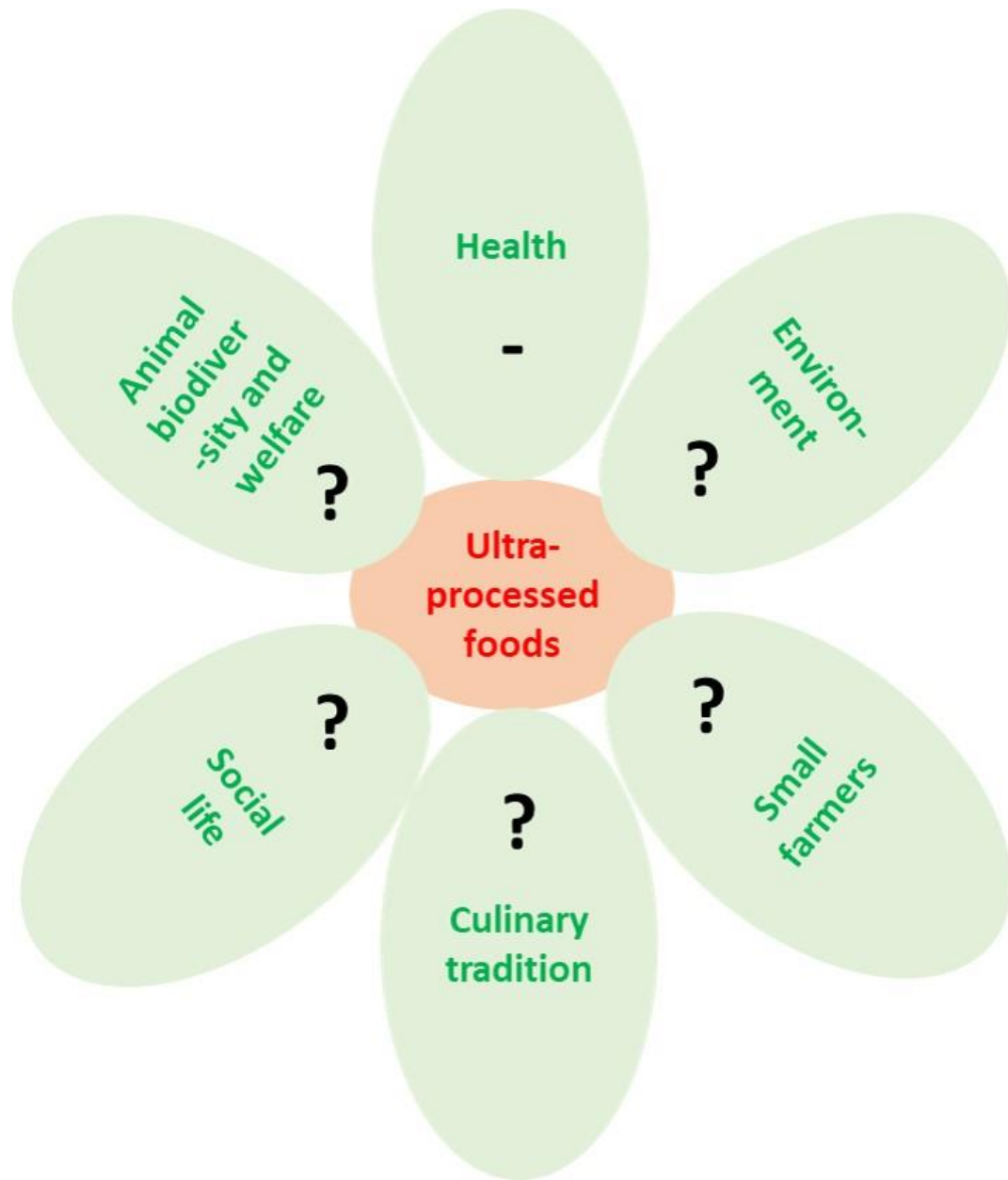


# Introduction & Objective

- Global food systems are no longer sustainable for health, the environment, animal biodiversity and wellbeing, culinary traditions, socioeconomics, or small farmers
- The increasing massive consumption of animal foods has been identified as a major determinant of unsustainability
- However, today, the increasing consumption of ultra-processed foods (UPFs) worldwide is also questioned 
- Up today, more than 50 epidemiological studies have shown that excess UPF consumption significantly increase the risks of several chronic diseases and all-cause mortality

## **Objective:**

Concerning the other dimensions of sustainability (than human health), we attempted, based on the collection of scattered data from scientific literature, to build the interrelations between massive UPF consumption and impacts on food systems



**Excess animal and ultra-processed calories, and monotonous diets threaten all dimensions of sustainability**



# Reminder : What has been the most studied

## A summary of the impacts on health of UPFs

### Cause: UPF matrices

**Degraded and artificialized hyper-palatable, poorly satiating and hyperglycaemic matrices**

- Low nutritional density: "empty" calories
- Hyperglycemic
- Poorly satiating
- High levels of xenobiotics foreign to human body (artificial additives, ultra-processed ingredients, aromas and neofornate compounds)



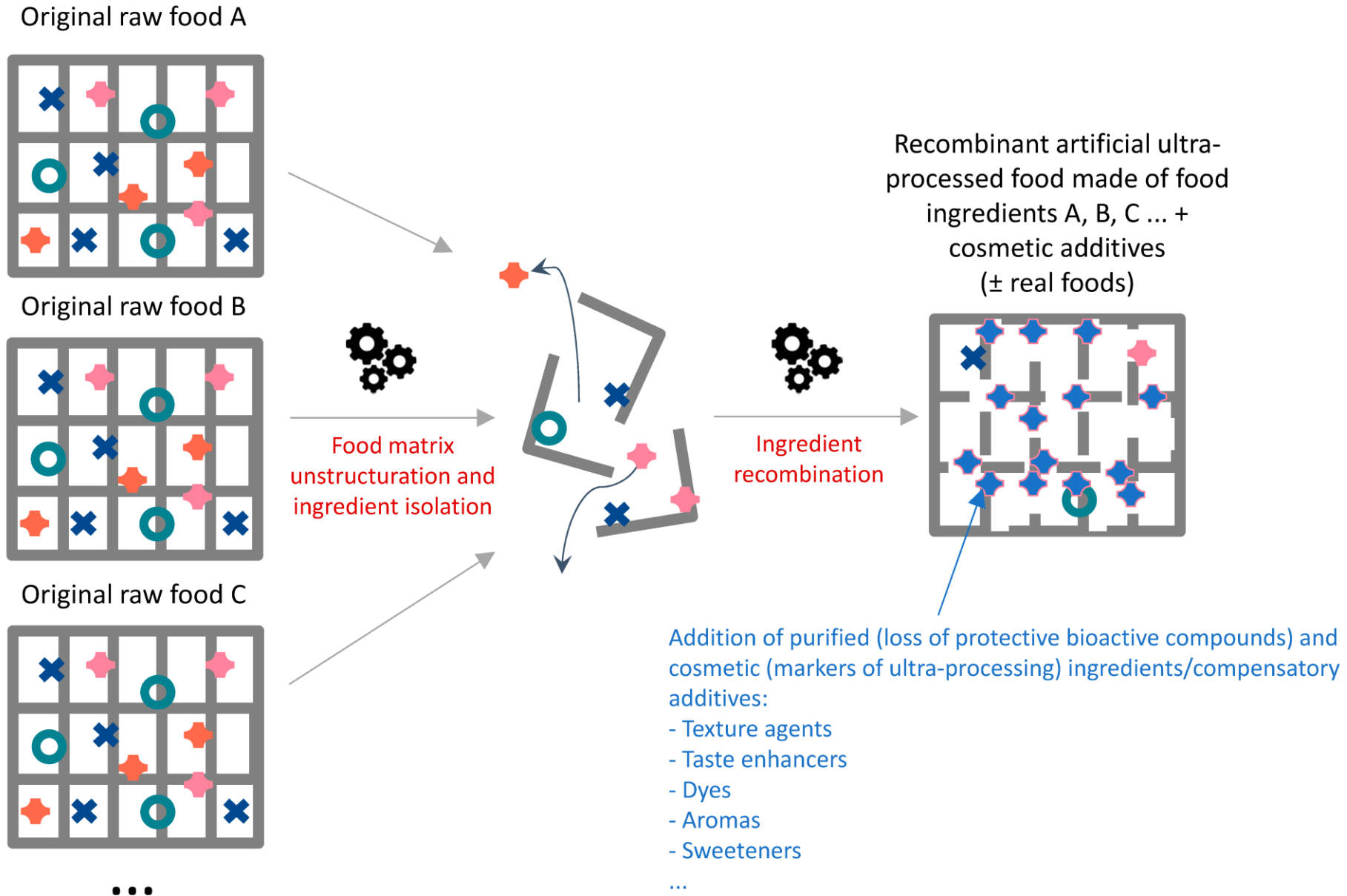
### Effects: human organism

- Excess of « empty » calories, salt, sugars, saturated fats,  $\omega$ -6, additives, xenobiotics
- Poor in protective bioactive compounds
  - High-GI foods (rich in 'rapid' sugars)



**Threats to human health: chronic diseases and nutritional deficiencies**

# Schematic representation of UPFs through fractionation of original raw foods and ingredient recombination with 'cosmetic' additives (Siga Society©).



# Number of food products for the different non-additive ingredients characteristic of ultra-processing

| Ingredients  | Number of Food Products <sup>2</sup> | Percentage of All Products in the Open Food Facts Database <sup>2</sup> |
|--|--------------------------------------|---|
| <b>Ultra-processed carbohydrates:</b>                |                                      |   |
| Glucose-fructose syrup/glucose syrup/(oligo)fructose | >52,154                              | >7.6  |
| Starch   | >22,389                              | >3.2  |
| Dextrose   | >21,340                              | >3.1  |
| Lactose  | >11,232                              | >1.6  |
| Malt (extract)                                       | >8292                                | >1.2  |
| Maltodextrins/dextrins                               | >7756                                | >1.1  |
| Invert sugar   | >4349                                | >0.6  |
| <b>Ultra-processed lipids:</b>                       |                                      |   |
| Refined plant-based oils and fats <sup>3</sup>       | >64,811                              | >9.4  |
| Hydrogenated oils                                    | >99                                  | >0.01   |
| <b>Ultra-processed proteins:</b>                     |                                      |   |
| Milk/whey/casein protein                             | >11,789                              | >1.7  |
| Gluten   | >11,428                              | >1.7  |
| Gelatine   | >3970                                | >0.6  |
| Soy protein  | >1953                                | >0.3  |
| Pea protein  | >1289                                | >0.2  |
| Protein hydrolysate/hydrolysed proteins              | >307                                 | >0.04   |
| Egg white and protein                                | >62                                  | >0.01   |
| <b>Aroma <sup>4</sup>:</b>                           | >72,348                              | >10.5   |

<sup>1</sup> Collected from the French Open Food Fact database, which contains 690,499 products (on 20 June 2020, as described previously [24]); <sup>2</sup> Ingredient lists are not given for all products in the Open Food Facts database: therefore, given values are only minimum values. <sup>3</sup> Refined oils are not strictly characteristic of UPFs in NOVA classification; however, due to the high level of processing that refined oils undergo, they were considered in this analysis, as in the Siga score methodology [13]. <sup>4</sup> Includes artificial and natural aromas.

# Number of food products for the different 'cosmetic' additives characteristic of ultra-processing (1: texturizing agents)

| Additives                                  | Number of Food Products <sup>2</sup> | Percentage of all Products in the Open Food Facts Database <sup>2</sup> |
|--|--------------------------------------|---|
| <b>Texture:</b>                            |                                      |   |
| E322: lecithins                            | >23,640                              | >3.4  |
| E14XX: modified starches                   | >16,405                              | >2.4  |
| E415: xanthan gum                          | >12,015                              | >1.7  |
| E471: mono and diglycerides of fatty acids | >11,828                              | >1.7  |
| E440: pectin                               | >10,172                              | >1.5  |
| E450: diphosphates, pyrophosphates         | >10,644                              | >1.5  |
| E412: guar gum                             | >9177                                | >1.3  |
| E407: carraghenans                         | >8616                                | >1.2  |
| E420: sorbitol                             | >4285                                | >0.6  |
| E406: agar-agar                            | >842                                 | >0.1  |
| E1200: polydextrose                        | >375                                 | >0.1  |
| E421: mannitol                             | >235                                 | >0.03   |

Consulted on the 20th of June, 2020

# Number of food products for the different 'cosmetic' additives characteristic of ultra-processing (2: colouring/flavouring/taste agents)

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| Colour:  |       |      |
|--|-------|------|
| E160c: paprika extract, capsanthin, capsorubin | >5101 | >0.7 |
| E160a: carotenes                               | >4347 | >0.6 |
| E120: cochineal, carmines, carminic acid       | >3560 | >0.5 |
| E150a: plain caramel                           | >3097 | >0.5 |
| E133: Brilliant blue FCF                       | >1450 | >0.2 |

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| Flavour/taste:             |       |       |
|----------------------------|-------|-------|
| E621: monosodium glutamate | >3710 | >0.5  |
| E955: sucralose            | >2436 | >0.4  |
| E950: acesulfame potassium | >2329 | >0.3  |
| E951: aspartame            | >1249 | >0.2  |
| E960: steviol glycosides   | >880  | >0.1  |
| E953: isomalt              | >443  | >0.06 |
| E967: xylitol              | >394  | >0.06 |
| E954: saccharine           | >238  | >0.03 |

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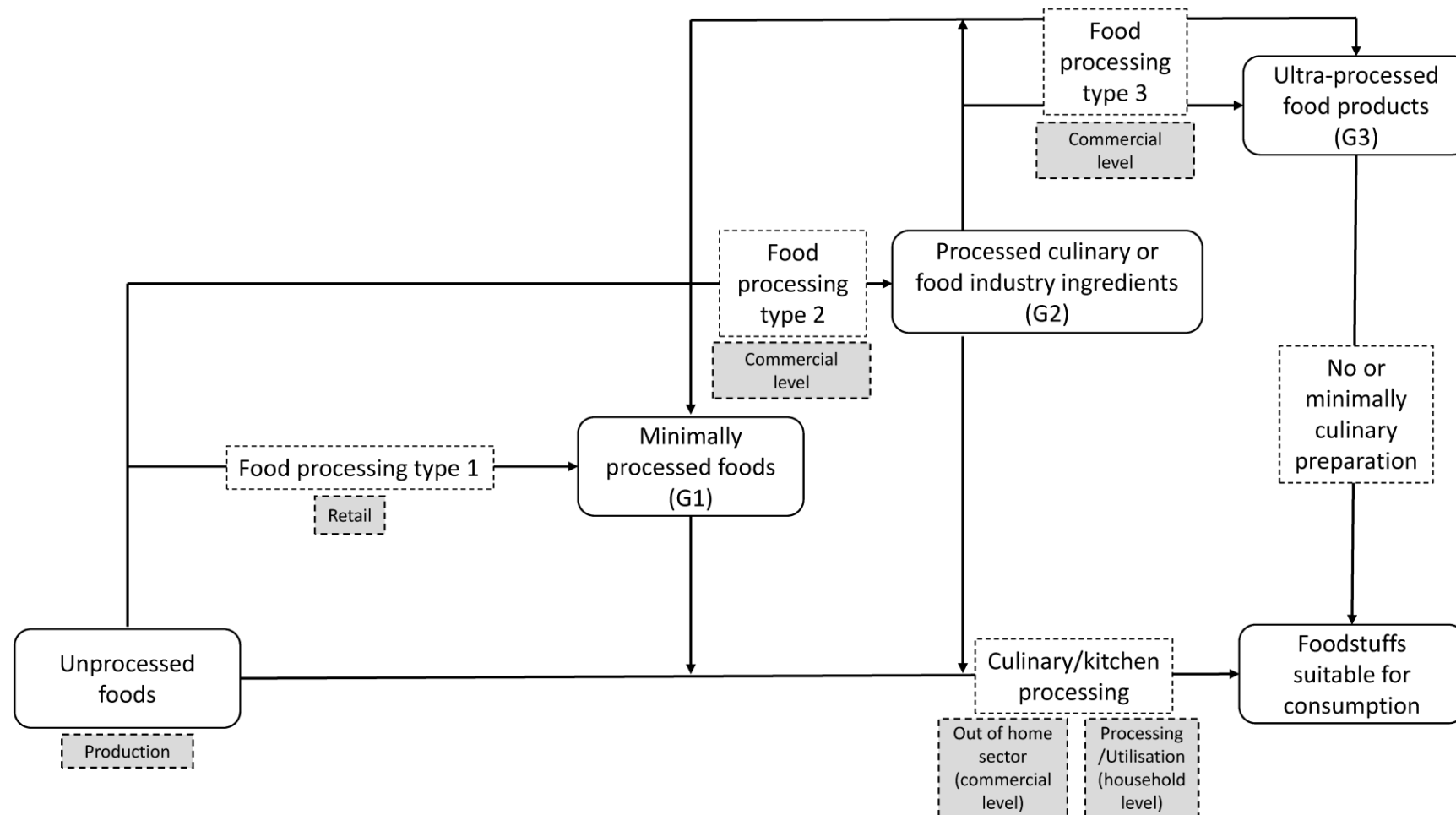
# Intermediate Conclusions

- Mass production of ultra-processed non-additive ingredients, and of numerous additives processed from the cracking of raw foods, **mainly comes from intensive monocultures or livestock of only a few plant/animal varieties**
- **At minimum, their percentage use in foods varies from 0.03 to 12.6 of all foods**, suggesting a high level of consumption, notably due to the rapid increase in worldwide UPF consumption, especially in Latin America



In the following sections, we will therefore analyze how the agricultural system at the basis of these ingredients is linked with sustainability or not, and the impacts of UPF-like product consumption on environmental indicators

# Three types of food processing within the food system

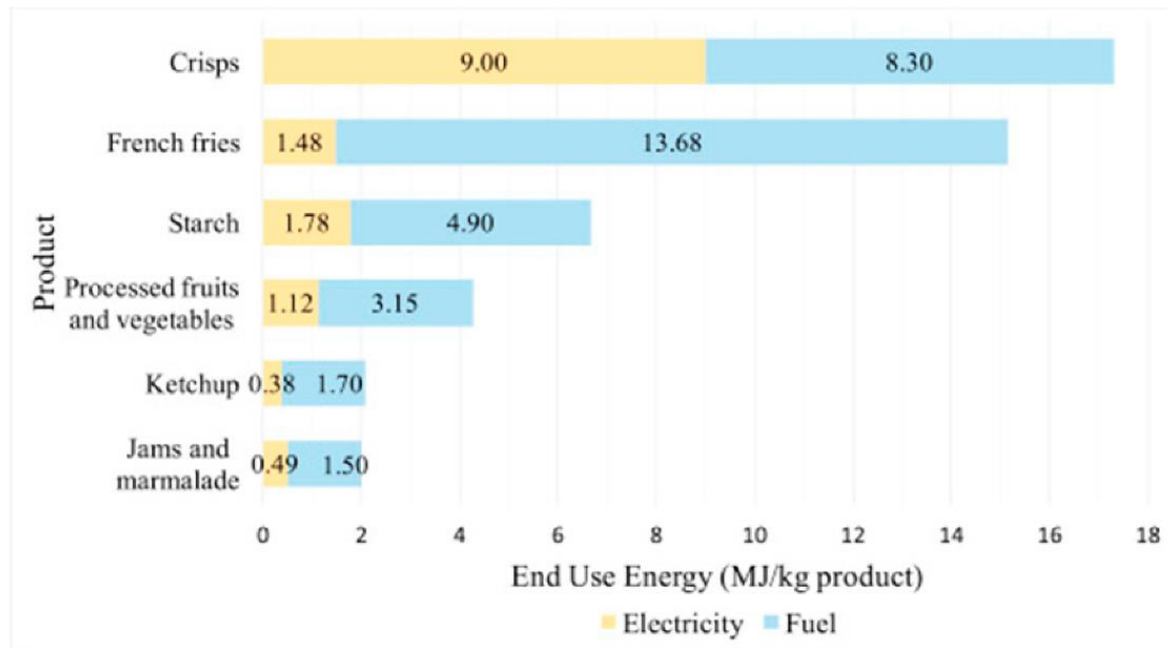


Monteiro, C., *The big issue is ultra-processing*. *World Nutrition* 2010, 1, 237-269.

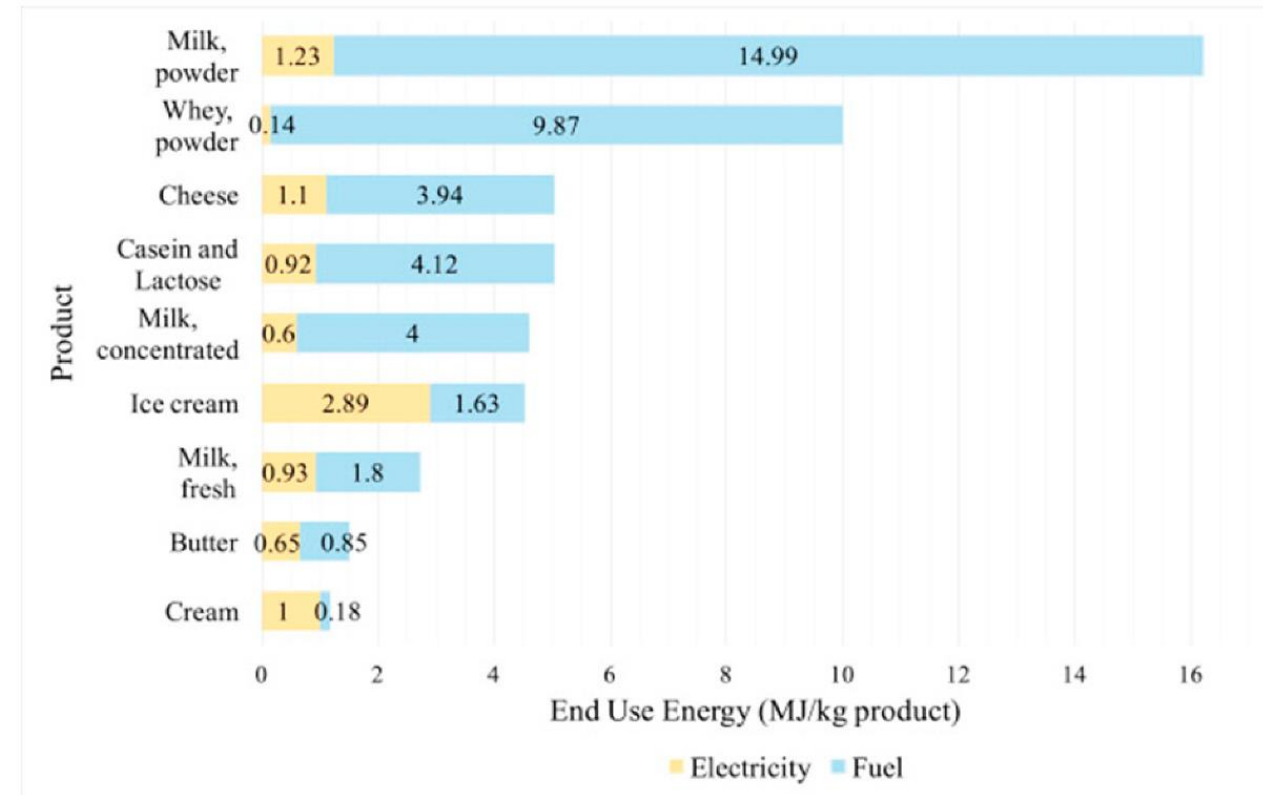
Keding, G.B.; Schneider, K.; Jordan, I., *Production and processing of foods as core aspects of nutrition-sensitive agriculture and sustainable diets*. *Food Security* 2013, 5, 825-846.

# Energy consumed in processing: (A) fruits and vegetables, and (B) dairy products

A)



B)



# Ultra-Processing, Environment and Biodiversity

- The need for cheap oils, sugar and other raw materials for ultra-processed foods creates monocultures and farms producing for export, not for local consumption
- Intensive cultivation of raw materials depends on pesticides and intensive use of fertilizers and water
- The manufacturing and distribution of most ultra-processed foods involves long transport routes, and therefore the excessive use of non-renewable energy and water, and the emission of pollutants
- All of this leads to environmental degradation and pollution, loss of biodiversity, as well as drainage and loss of water, energy and other natural resources.
- Production and consumption also create vast amounts of waste (plastic packaging) - dumped in 'disgusting' and dangerous landfills



*Brazilian dietary Guidelines, Ministry of Health of Brazil, Secretariat of Health Care, Primary Health Care Department (2014)*

*Fardet, A.; Rock, E., Ultra-processed foods and food system sustainability: what are the links? Sustainability 2020, 12, 6280.*

# Intermediate Conclusions on Ultra-Processing, Environment, Biodiversity and Animal Welfare

- UPFs appear associated with a **poor level of biodiversity**, notably due to the few plant and animal varieties that supplied the ingredients used for their production and processing
- Moreover, intensive monocultures are **very demanding in high input energy**, and animal calories found in UPF are associated with **high levels of GHGE**, as well as **deforestation** with feed animals in intensive conditions, that are otherwise **far from respecting their basic needs and wellbeing**
- Fractionating raw foods into massive amounts of ingredients for producing UPFs all around the world appears **more energy demanding than locally consuming raw or minimally processed foods**
- **Plant-based UPFs are clearly not so energy demanding than animal-based UPFs**, but they are not yet associated with a better food system sustainability, especially regarding intensive monocultures

# Ultra-processed foods threaten cultures/traditions, indirectly affecting health and well-being

- Identical brands, packaging, labeling and content worldwide
- Hundreds of new products every year, which leads to a false sense of diversity
- Due to aggressive promotional campaigns, authentic food cultures are considered uninteresting
- All of this suggests to children/young people that the culture and identity of their country, region, ethnicity and traditions including culture and eating habits are boring and traditional dishes tasteless
- Young people in particular are targeted by large manufacturers, acting in concert, leading to a false sense of belonging to a superior, modern and expensive consumer culture



*Source: Brazilian dietary Guidelines, Ministry of Health of Brazil, Secretariat of Health Care, Primary Health Care Department (2014)*

*Fardet, A.; Rock, E., Ultra-processed foods and food system sustainability: what are the links? Sustainability 2020, 12, 6280.*

# Ultra-processed foods threaten social life and the socio-economics, indirectly affecting health and well-being

- Ultra-processed foods are formulated and packaged to be ready to eat without any preparation. This makes eating and sharing food at the table unnecessary
- Ultra-processed foods can be eaten anytime, anywhere, often while being entertained or working, walking a street, driving, or talking on the phone
- These are mostly isolated situations, disguised by advertisements suggesting that such products promote social interaction, which is not the case



Ultra-processed foods fractionate social life



*Source: Brazilian dietary Guidelines, Ministry of Health of Brazil, Secretariat of Health Care, Primary Health Care Department (2014)  
Fardet, A.; Rock, E., Ultra-processed foods and food system sustainability: what are the links? Sustainability 2020, 12, 6280.*

# The Socioeconomic Profiles of the High UPF Consumers

**In France**, a higher consumption of UPFs was independently associated with **being male, being younger, having a lower income level, smoking, being overweight, being obese, and having a lower level of education** (Julia et al., 2018)

**The Spanish SUN cohort** of young university graduates, who have a high level of education, revealed other associated factors, including **sedentary activities (computer, television)** and a high total fat intake together with a low protein and carbohydrate intake (Rico-Campà et al., 2019)

**In the USA**, the highest consumers of UPFs (NHANES cohort, 1988–1994) are more likely to be **younger, male, non-Hispanic White and current smokers** and **are less likely to have less than a high school level of education or to have a household income of more than 350% of the poverty level** (Kim et al., 2019)

**Similar results in the USA** were obtained in the NHANES cohort (2009–2014), showing that **subjects who have an income-to-poverty ratio <3.5, 12 years of education, and low physical activity and who are current smokers present the highest UPF consumption** (Steele et al., 2019)

**In South Korea**, energy drink intake in Korean adolescents, in isolation or in combination with junk food consumption, was shown to have detrimental effects related to **stress, sleep dissatisfaction, mood, and suicidality** (Park et al., 2016)



Surprisingly, however, although social isolation generally increases the risk of type 2 diabetes, socially connected obese participants pose a higher risk of type 2 diabetes than socially isolated obese participants, potentially because the stigmatization of obesity leads to negative social interactions (Atasoy et al., 2019)



# Ultra-Processed Foods and Small Farmers

- Low-price, ready-to-eat, and highly attractive UPFs may lead to a partial or complete substitution of local and traditional foods, especially in emerging and developing countries
  - ❖ For example, in Africa, it has been observed that the [import of chicken wings destroys local companies](#) (Friends of the Earth Europe, 2015)
  - ❖ Indeed, the processing of slaughtering by-products into animal feed is prohibited for European poultry companies, and as a result, these countries export them cheaply to developing countries
- This is only one example among others, e.g., [excess milk in Europe is dried, defatted and exported to Africa](#), where it is cheaper than local milk
- The reason lies in the fact that “[current government subsidies to farmers in the United States and parts of Europe enable developed countries to produce large quantities of cheap staple and ultra-processed foods at 40-60% below the cost of local production of similar goods in developing countries \(Johnston et al., 2014\)](#)”
- In turn, [these less healthy foods as massive imports are considerably less expensive than the locally produced foods, distorting local markets and depressing demand for the more expensive, locally produced, and often times healthier food options](#) (Chicago Council on Global Affairs, 2011)
- Therefore, [the adoption of imported UPFs from developed countries may directly threaten small farmers in developing countries, who are then obliged ‘to put the key under the door’ and to feed the slums...](#)

# Intermediate Conclusions on Ultra-Processed Foods, and Cultural and Socio-Economic Dimensions

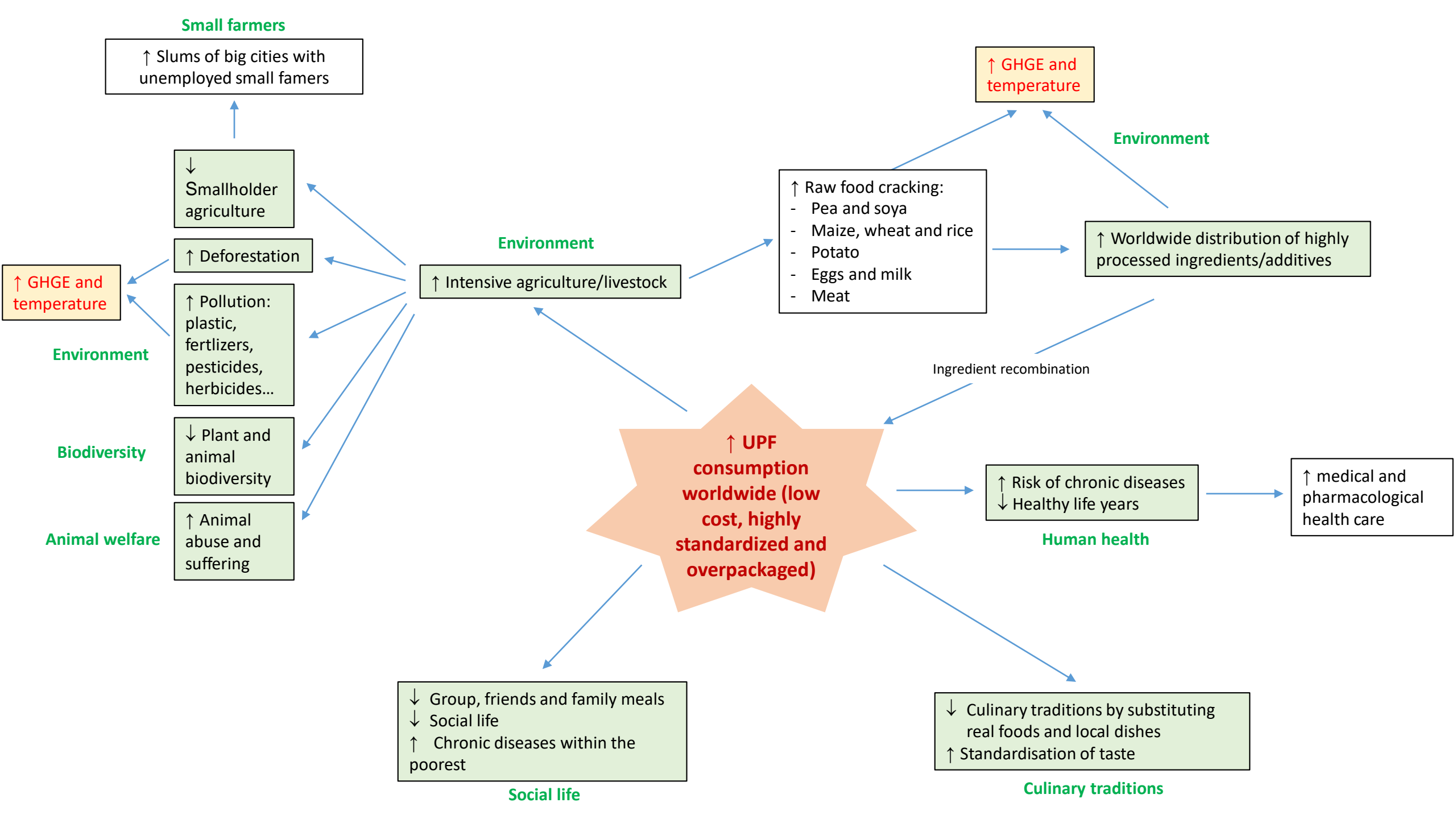
- Overall, **UPFs do not appear associated with a high level of social life, being consumed in isolated situations**, e.g., in front of screens or on the move
- On the contrary, real meals mostly made of real foods are associated with moments of festivity and family sharing
- **Due to their very low cost, some of them may also threaten small farmers and producers in many countries worldwide**, especially in developing countries where local foods may be more expensive
- In our developed societies, **UPFs are generally more consumed by the poorest and less educated people**, contrary to emerging and developing countries where they may appear as outward signs of wealth
- Finally, through the high level of standardization, and their lower cost, **UPFs are progressively replacing some culinary traditions worldwide**, especially among the youngest, such traditions appearing less attractive, with more subtle, risky, and demanding tastes

# Conclusions: A Global Synthesis from Published Data

In this review, we intended to answer to the following issue: “*Are UPFs linked to food system sustainability regarding, beyond human health, the degradation of the other five dimensions of the food system?*”

- UPFs, encompassing other designations such as junk, discretionary, non-core, or sometimes street foods, is an updated concept that explains why **it was difficult to obtain specific information about the potential associations of UPFs with the different dimensions of food systems worldwide**
- Nevertheless, based on the gathered data, **we built the potential links between excess UPF consumption and the alteration of the different dimensions of the food system sustainability**
- More generally, **by combining both the low cost at purchase and increased consumption worldwide, most of UPFs appear potentially associated with intensive agriculture/livestock, a loss of culinary traditions, the progressive disappearance of small farmers/peasants, increased animal suffering, a loss of biodiversity, and social inequalities**





## Conclusions: Non-UPF *Versus* UPF?

- Although present studies suggest that UPFs do not necessarily produce the highest GHGEs, **within a context of overconsumption of animal calories, their contribution to GHGEs could be importantly reduced without negative health effects**
- **It should also be recognized that some non-UPFs may be produced at low cost and/or environmental impact while being highly consumed worldwide**, e.g., refined sugars, oils and cereals, but to the detriment of health outcomes (e.g., obesity or type 2 diabetes)
- **The contribution of some non-UPF food (e.g., palm oil, banana, avocado ...) to the degradation of food system sustainability is already well recognized**, notably through intensive monocultures with large amounts of inputs and loss of biodiversity.

# Perspectives: Better Consideration of the Degree of Processing in Science and Food Policy

- If agriculture is considered to produce too many GHGEs, future evaluations from farm to fork should further analyze the level of contribution of UPF processing, packaging, and transport
- Similarly, when analyzing the associations between food groups and GHGEs, it is important to discriminate the degree of processing of each of the foods included in those groups
- The available data appear sufficient to urgently implement policy regulations for agro-industrials to include nutritional and environmental criteria with regard to processed foods and policy incentives for consumers to shift from UPFs to real raw and mildly processed foods, preferably seasonal, organic and local products

## **The 3Vs rule:**

- On that basis and extended to an ethical and sustainable diet, three golden rules for designing a protective diet food system sustainability have been elaborated in our laboratory, and taking into consideration the neglected dimension of the degree of processing (second rule)
- The 3Vs concept is based on a holistic view in that, through its application, it protects humans, animals, and the environment as a whole. Therefore, if removing the second rule concerning the degree of processing, and based on the data of this review, a diet appears no more fully sustainable

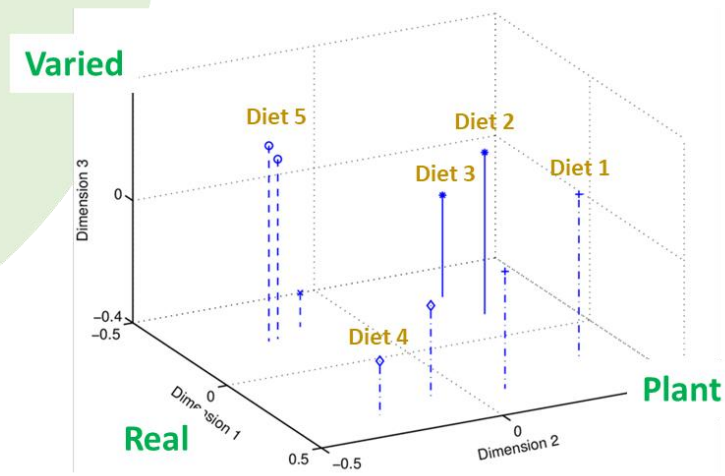
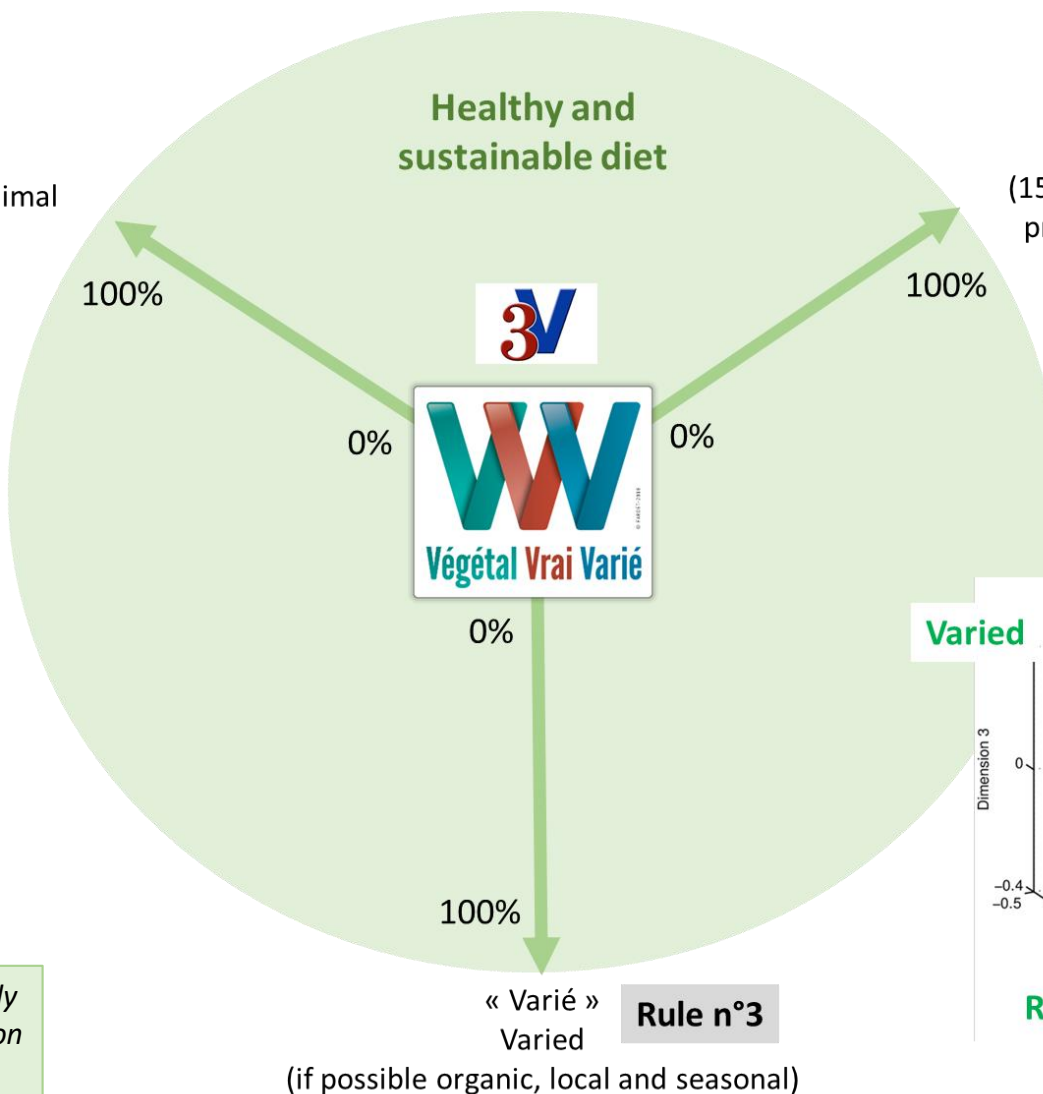


# The 3V's RULE Proposal to Counteract Excess UPF Consumption

**Rule n°1**  
 « Végétal »  
 Plant  
 (15% maximum animal calories)

**Rule n°2**  
 « Vrai »  
 Real  
 (15% maximum ultra-processed calories)

**The diet-health (human & planet) relationship is governed by 3 inclusive and interdependent dimensions or rules**



*Fardet, A.; Rock, E., Reductionist nutrition research has meaning only within the framework of holistic thinking. Advances in Nutrition 2018, 9, 655–670.*

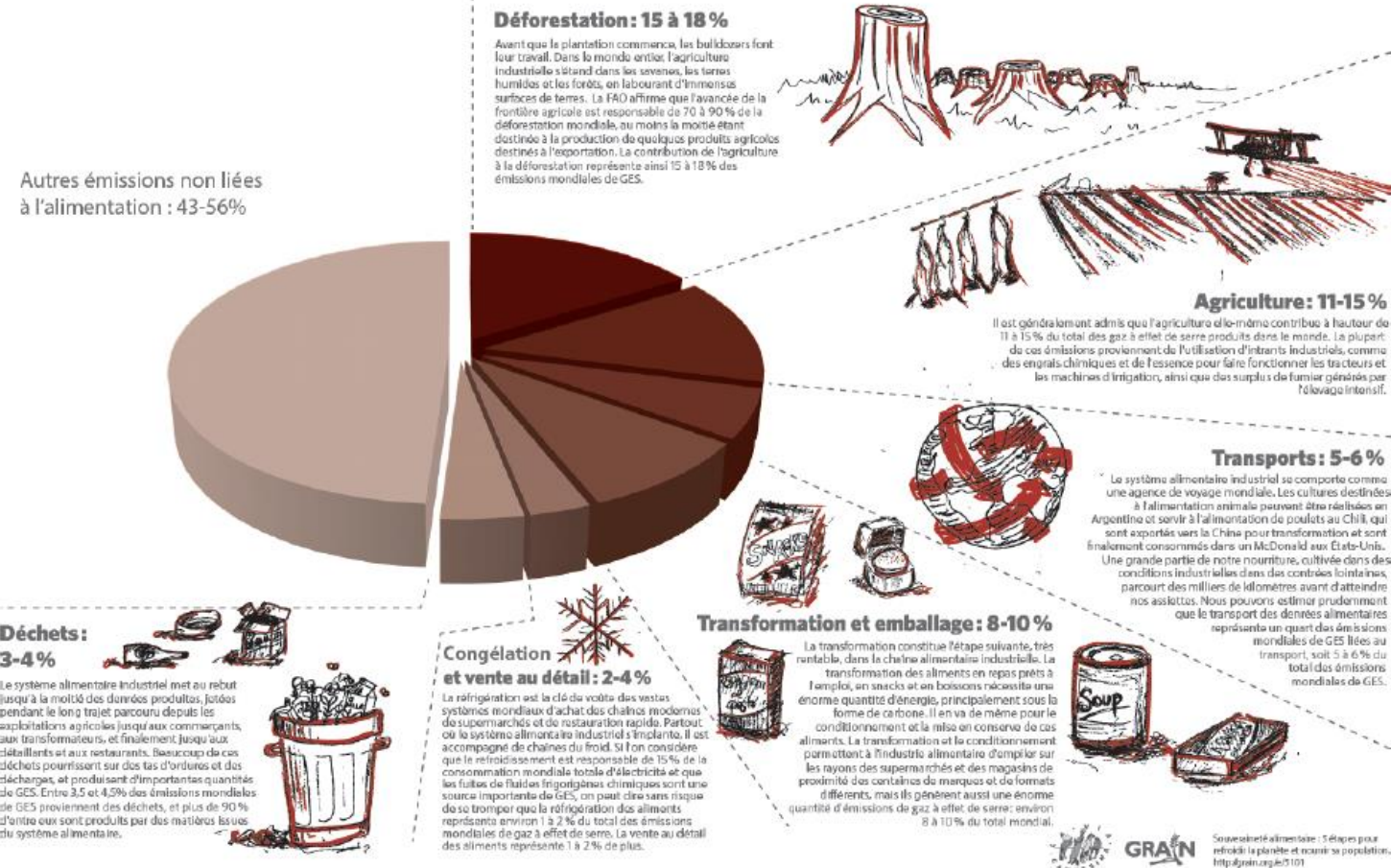
*Fardet, A.; Rock, E., How to protect both health and food system sustainability? A holistic 'global health'-based approach via the 3V rule proposal. Public Health Nutr. 2020, 23, 3028-3044*

# Annexe 1

## Un système basé sur la consommation d'aliments ultra-transformés contribue directement à la crise climatique

### Comment le système alimentaire industriel contribue à la crise climatique

Entre 44 % et 57 % du total des émissions de GES proviennent du système alimentaire mondial



Source : J-C Moubarac  
Grain : organisation internationale qui soutient la lutte des paysans et des mouvements sociaux pour renforcer le contrôle des communautés sur des systèmes alimentaires fondés sur la biodiversité