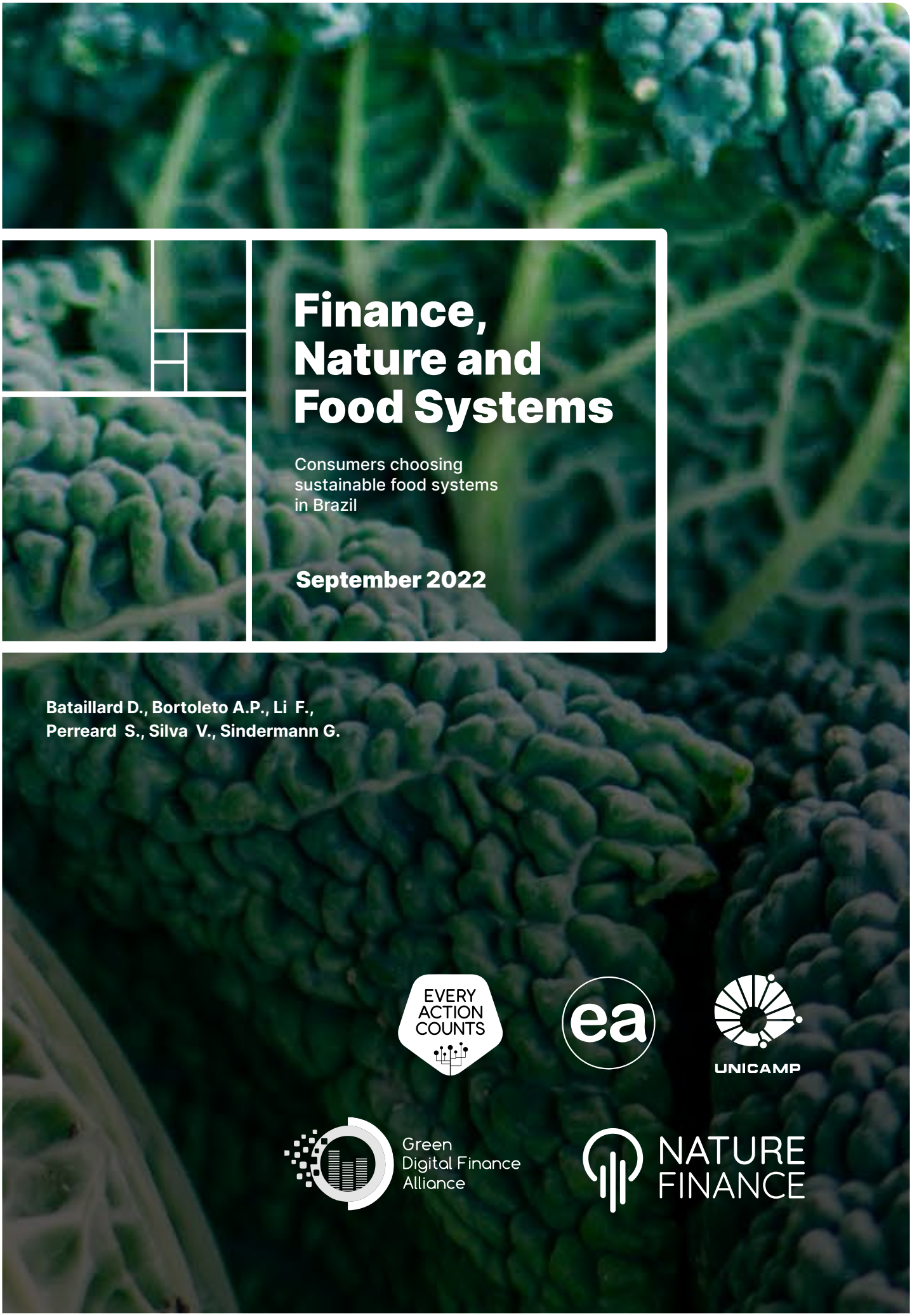

Finance, Nature and Food Systems

Consumers choosing sustainable food systems in Brazil

September 2022

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EVERY ACTION COUNTS

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UNICAMP

Green Digital Finance Alliance

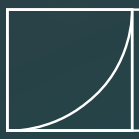
NATURE FINANCE

About NATURE FINANCE

NatureFinance is committed to aligning global finance with nature positive, equitable outcomes.

Our work is shaping the many dimensions, actors and change pathways at the nature-finance nexus to thrive and contribute to development.

How we make change:



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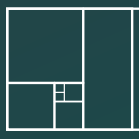

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F4B

NatureFinance is the next phase of impact of the Finance for Biodiversity Initiative (F4B), established with support from the MAVA Foundation. The work also benefits from partnerships with, and support from, the Children's Investment Fund Foundation (CIFF) and the Finance Hub of the Gordon and Betty Moore Foundation.

Our use of Fibonacci sequence imagery is inspired by the association of this unique ratio with the maintenance of balance, and its appearance everywhere in nature- from the arrangement of leaves on a stem to atoms, uncurling ferns, hurricanes and celestial bodies.

Background

NatureFinance (formerly the Finance for Biodiversity Initiative – F4B) is committed to better integrating biodiversity into financial decisions to align finance with nature conservation and restoration. With this aim and given the financialised state of the food system, Nature-Finance decided to advance practical interventions to better align financial flows with the necessity for transformation in how and what food is produced, distributed, and consumed.
To that effect, different projects have been undertaken including development of global models to assess the impact of internalizing nature and climate risks into financial decision-making for food and evaluating how these impacts might play out in a jurisdictional context. Both projects were designed to support development of a policy recommendation paper for the 2022 presidential elections in Brazil.

This report presents the results of one project, combining research and strategy in an approach comprising three levels; Level 1 – a global modelling exercise to demonstrate the impact of incorporating nature and climate risks into financial decision-making around food, Level 2 – application of those findings in the jurisdictional context of Brazil and Level 3 - testing and analysing the incorporation of climate and nature pricing in food-related financial actions.

This report focuses on the role of consumers in fostering necessary food system transitions. Indeed, consumers as key stakeholders, need to be placed at the centre of just and effective food system transformation. When empowered by transparency and education, they can be instrumental in reducing harmful environmental impacts and can become key influencers by making changes in their own lives and as drivers levers for broader change.

The 'Every Action Counts' (EAC) coalition, launched in June 2021 by the Green Digital Finance Alliance, initiated this project. Its 14 members with a combined customer base of 2.7bn convene around a shared mission to empower 1 billion people by 2025 with green awareness and green action opportunities. EAC members are leading global financial insti-tutions and retail platforms that create novel digital solutions with the goal to empower individuals to decouple consumption and investment choices from environmental degradation, to adopt green actions, to reduce their own emissions more actively, and generally reduce the negative impact of their daily lives on nature.

EAC teamed up with leading organizations in their field: Latin America institution, The University of Campinas (Unicamp), for scientific investigation of Brazilian citizens' behaviours around food consumption, and environmental research organization EA – Environmental Action for modelling environmental impact reduction potential. Together EAC, Unicamp and EA investigated the potential reduction of greenhouse gas emissions via the application of nudging strategies on e-commerce platforms. These strategies relate to changing accessibility, availability, and presentation of food options, and to the use of prompts, and did already successful influence more sustainable food choices, such as plant-based pro-teins or meat substitutes.

The goal of this study was to provide proven strategies to e-commerce providers on how to effectively support their customers in the transition towards healthier and more sustainable food, while at the same time showing policymakers that a transition towards more sustainable food systems can be facilitated.

Executive Summary

With food demand likely to double over the next four decades, food consumption is already driving climate change and is the principal force behind biodiversity loss (Willett et al., 2019; Alexandratos, 2012), among other environmental impacts. Brazil is the world's fifth-largest agricultural producer with a total production of 1,080 million tonnes in 2019 (FAO, 2021) and with the largest forecasted increases in output over the next four decades of any country worldwide. At the same time, Brazil is one of the most biodiverse countries on the planet and the second most deforesting country with 62.8 million hectares from 2011-2021 (following Russia on first place with 76 million hectares; World Resources Institute Research, 2021).

In 2020, Brazil submitted to the UNFCCC its new Nationally Determined Contribution (NDC) under the Paris Agreement to reduce its total net Greenhouse gas emissions by 37% in 2025, 43% in 2030 and net zero emissions in 2060 (MRE, 2020). Brazil represents 4.7% of the world's GDP from agriculture, forestry and fishing value-added, and it is responsible for 7.41% of the greenhouse gas emissions from global food production (FAO, 2021). To deliver on its commitment to the Paris Agreement, Brazil therefore needs to provide a healthy diet to its population through a sustainable food system.

Facilitating Brazilians to shift their food choices and food behaviours can be a powerful tool to achieve it. However, policy design for behavioural change is complex and requires a thorough understanding of the factors influencing food choices. A reciprocal relationship between food production and food choice directly influences food consumption behaviour that, in return, also affects product development and supply. Moreover, food decision making involves choosing between available options, each with benefits and costs, such as environmental conservation or a healthy diet.

This research proposes a novel approach to reduce the impact of food systems, taking new lenses to look at the well-known challenging issue of reducing the impact of food consumption, by harnessing, thanks to nudge strategies, the power of consumers in supporting the creation of a sustainable food system. The overall goal of the research reported herein is thus to 1) estimate the potential climate and nature-related impact of nudging strategies on changing food-related behaviours using real-world experiments to ultimately understand the potential for mitigating the environmental impacts that nudge strategies could achieve if used at scale, and 2) translate the learnings into recommendations for public policy makers to activate and leverage nudge strategies opportunities. This research is unique in that it examines the impact of various nudging strategies on environmentally friendly food options in a set up that is close to real-life and testing combined nudging strategies to evaluate the most effective combinations. Although nudging strategies have already been successful in influencing food decisions, previous research has only examined them in specific situations (e.g., one type of food product, food labelling or choosing recipes in restaurants). As part of this report's research, participants had to first choose from a set of recipes and subsequently select ingredients from various food groups and types of production. This research tailored nudging strategies to the Brazilian context, building on surveys of Brazilian consumers to understand better their consumption perceptions, behaviours, and influences using geographical and sociodemographic data.

This research demonstrates the effectiveness of specific nudges in reducing CO2 emissions and translated into recommendations for e-commerce platforms and policymakers, as well as for further experimentation on choice architecture and nudging strategies.

Three top insights from the research:

- Nudging strategies can help consumers shift their food choices and behaviors simultaneously towards more sustainable food products and healthier diets.
- Labelling is a powerful tool for engaging consumers in making better decisions, particularly labels with simple messages that consumers can easily understand.
- Nudges are more effective when used in combination, particularly when it comes to switching to alternative proteins and plant-rich diets in Brazil, which is an effective lever for reducing greenhouse gas emissions.

Three public policy recommendations deriving from the study:

- Develop a comprehensive labelling policy capable of translating relevant data on environmental and other impacts of food products based on a consistent methodology for inferring them;
- Plan a food consumption educational program to be implemented where consumers typically make their food choices; and
- Engage all stakeholders from the food systems in the design, implementation, and deployment of this new policy.

Figure 1 | Theory of change and goals of this study

THEORY OF CHANGE

A

Robust understanding of food choices and its environmental consequences is central to addressing the gap between environmental mitigation policies and consumers' diets.

B

Food consumption choices have a reciprocal relationship with food supply. Food supply influences food consumption behavior and food choice, which itself influences new food product development and food supply.

GOALS

- Understand Brazilians' food consumption behavior: food choices and the current contextual situation where food choices are made.
- Green nudging experiment: conduct an experiment in Brazil to investigate the effectiveness of nudging strategies in changing food choice that contribute to mitigate the negative outcomes.
- Environmental impact of Brazilian food consumption: understand which of the main foods consumed in the country have the highest impact on the environment.
- Impact reduction potential: (a) identify different levers and their potential to reduce greenhouse gas emissions within the Brazilian context, (b) understand which nudges would help consumers to activate the levers and lower the environmental impacts of their food choices.
- Draft recommendations to e-commerce platforms and design a food policy tailored to the Brazilian context.

Figure 2 | Key findings for each goal and recommendations

KEY FINDINGS

KEY FINDINGS – GOAL 1: UNDERSTAND BRAZILIAN'S FOOD CONSUMPTION BEHAVIOR

- The weekly food consumption of Brazilians is composed of a high level of animal protein intake with rare consumption of milk and meat substitutes.
- Brazilians purchase few fruits and vegetables.
- Brazilian population waste less food than in other Latin Americas countries.
- Brazilians with higher incomes shop more frequently than those with lower incomes.
- Due to socioeconomic disparities in Brazil, classes with the highest income shop online more frequently.
- Most Brazilians consider food labelling important.
- Price remains a significant predictor of individuals endorsing organic, healthy food products or those with less impact on the natural environment.

KEY FINDINGS – GOAL 2: GREEN NUDGING EXPERIMENT

- The Nudging strategy based on defaults is effective with consumers with high environmental and nutritional awareness who can take advantage of the pre-selected option.
- Transparency on the purpose (avoid emissions and other impacts) of the default increased the pre-selected choice among consumers with higher environmental awareness.
- More availability and visibility of eco-friendly products can positively motivate consumers to overcome differences in price ranges.
- Label wording must be carefully chosen and needs to be linked with an educational process where consumers usually make their decisions.
- Food categorization with vegan and vegetarian words should be used parsimoniously.
- Nudging strategies are context-dependent and need to be tailored to each food category to avoid biases from standard misconceptions by consumers.

KEY FINDINGS – GOAL 3: ENVIRONMENTAL IMPACT OF BRAZILIAN FOOD CONSUMPTION

- Brazilians' beef consumption contributes the most to CO2 eq. emissions and greatly exceeds the negative environmental impacts of all other food sources.
- Brazilians' rice consumption contributes the most to freshwater withdrawal and degradation.

KEY FINDINGS – GOAL 4: IMPACT REDUCTION POTENTIAL

- Switching to alternative proteins and plant-rich diets in Brazil is the most efficient lever to reduce greenhouse gas emissions.
- Reducing food waste at home and preferring food that has been sustainably produced are also two efficient lever to reduce GHG emissions.
- Consuming domestically produced food does not present a remarkable reduction of greenhouse gas emissions at the Brazilian level.
- The placement nudge is the one that reduce the most the CO2 emissions, followed by the default nudge.

KEY RECOMMENDATIONS

E-Commerce Platforms

- Implement choices preselection for eco-friendly consumers.
- Apply of a simple process of education for food labelling.
- Combine multiple nudges will increase their efficiency.
- Ensure similar visibility of eco-friendly products as non-eco-friendly ones on e-commerce platforms.

Policy Makers

- Develop a comprehensive labelling policy to account for avoided emissions and other impacts of food products.
- Design an educational program on food consumption to be implemented where consumers usually make their food choices

Contents

1 Introduction

Agriculture has a significant and steadily increasing impact on environmental resources. This trend is expected to continue, due not only to population growth but also because rising affluence leads to higher calorie per capita consumption, as well as greater consumption of animal products (Tilman & Clark, 2014). Helping people adapt their food consump-tion and nutritional value intake to reduce environmental impact can significantly improve the sustainability of food production. However, many barriers make it difficult for policy-makers to moti-vate individuals to adopt environmentally friendly and healthier diets. Although, in general, people do see a strong connection between the environment and food, they are more likely to be concerned about plastic packaging, transport, and quantities, rather than the effect that different types of food have on the environment. Generally, people indicate that their food preferences are influenced by factors with different degrees of importance, including taste, health, cost, mood, culture, and quality, while the environment is not usually considered (Macdiarmid et al., 2016).

Policy design for behaviour change is complex and requires a thorough understanding of factors influencing food-related behaviours. Understanding the reciprocal relationship between food choice and food supply is also important, as this influences food consumption behaviour and, therefore, food choices. It follows that a cycle exists whereby, food choices influence product development and food supply. Furthermore, food decision typically involves a decision among available options each with benefits and costs, for example, to environmental conserva-tion or to a healthy diet. One strategy that individuals use is heuristics, an efficient cognitive process to preserve mental capacity for other tasks where either mental shortcuts or a practical method is applied in decision-making to save time and energy (Gigerenzer, 2008). Heuristics achieve this accuracy by successfully exploiting evolved mental abilities and context-situational structures where decisions are made (Gigerenzer and Brighton, 2009).

Decision-making is often biased by where an individual looks for information, how s/he conducts their searches (i.e., for a product), and other factors like time exposure. These contextual factors build the choice architecture through which individuals make decisions. In the case of consumption, the predominant choice architecture encourages or discourages certain food choices. Therefore, there is an appeal to change the choice architecture and nudge individuals in a particular direction (i.e., to specific choices). Nudging means influencing individuals' behaviour through corresponding cues to minimise the cognitive effort required for (or resistance to) selecting the promoted option (Thaler and Sunstein, 2021). In other words, nudging makes the target choice easier by operating within individuals' heuristics processes.

According to Thaler and Sunstein (2021), libertarian paternalism is at the core of the nudge theory. It preserves the freedom of choice alongside proven authority to guide individuals in a particular direction, typically one that is beneficial for their welfare. Nudge theory enables positive change for individuals and aligns with wider societal interests without the imposition of legislation. This is relevant for food policies that aim to improve public health and environmental conservation. To proactively address common ethical concerns towards nudging, several factors must be considered before applying a particular nudging strategy, for example, whether individuals are aware of the existence of the nudge and whether using heuristics processes is beneficial to society's welfare. For this reason, an ethical framework is needed for the responsible deployment of these techniques.

2

Brazilian food consumer profile

2.1 Brazil under a microscope

Brazil is the fifth largest country in the world, with an estimated population of 211,755,692 (IBGE, 2022) and a 2021 per capita GDP of USD 7,518 (The World Bank, 2021). Economic inequality, ethnic and gender disparities, and poverty are still notable in Brazilian society. As Salata (2020) notes, 55% of the race effect (interference of the skin color in social dynamics, also known as systemic racism) and 65% of the social origin effect on a person's income occur indirectly, primarily through education. In 2019, the Brazilian Institute of Geography and Statistics conducted a national survey showing that individuals with higher income and higher education consume more fruits and vegetables, less traditional Brazilian foods (e.g., beans), and more ultra-processed food (e.g., soft drinks). Brazilians with lower incomes consume more rice and beans and less industrialised food. A recent study also shows that fruit and vegetable consumption was more prevalent among more educated individuals, making groups that have less education more vulnerable to malnutrition and health problems (Crepaldi et al., 2021). In 2020, the cost of a healthy diet was USD 3.08 per person per day (The World Bank, 2020), while 62.7% of the Brazilian population earned less than USD 640 per month (USD 21 per day).

Brazil is among the ten highest-grossing economies for food-related revenue, almost USD 250 billion in 2020, which represents 11% of the country's GDP (Statista, 2022b). In 2021, meat product most consumed in Brazil was poultry, with more than 40.76 kilograms con-sumed per capita per year. Beef and veal are also widely enjoyed by Brazilians, with an es-timate per capita consumption of 25 kilograms annually (Statista, 2022e).

This volume represents a marked decreased since 2019, when 34 kilograms per capita were consumed; the decrease is attributed to rising beef prices. On the other hand, in 2021 rice consumption increased to 35.2 kilograms per inhabitant while beans consumption remained stable at 15.2 kilograms per person (EMBRAPA, 2021). Finally, consumption of fresh dairy products increased by approximately 3% between 2018 and 2021, reaching nearly 75 kilograms per person per year (Statista, 2022d).

Since 2018, Brazil has been one of Latin America's leading markets for organic products with a share of 0.5% in total agricultural area (FAO, 2021). The organic industry's revenues have correspondingly seen constant annual growth rate of 15% in recent year. In 2018, nearly 1.2 million hectares of organic farmland was under production with 2019 revenues of reaching USD 1 billion (Statista, 2022). Plant-based protein production has increased by 70% since 2015, with 2020 revenues of USD 82.2 million. Clean or cultured meat production (i.e., meat grown in a lab from animal stem cells) is experimental in Brazil and still lacks a specific regulatory framework (Tunes, 2019). In 2021, the Brazilian food and beverages industry generated approximately USD 179 billion in net revenue, thus, organic and plant-based protein productions represent about 0.55% and 0,045% of the market share respectively. Ac-cording to a recent national survey, 46% of Brazilians have decided not to eat beef at least once a week, and 14% have declared themselves vegetarians (IPEC, 2021).

In 2020, Brazil submitted its new Nationally Determined Contribution (NDC) to the UNFCCC as part of the Paris Agreement. Based on the reference year of 2005, Brazil committed to reducing total net GHG emissions by 37% by 2025, 43% by 2030 and aimed to reach net zero emissions by 2060 (MRE, 2020). However, deforestation in the Brazilian Amazon has risen sharply since 2019, with an estimated 1,120 km^2 being deforested in June 2022 within the Amazon Legal territory, the highest value for June since 2016 (INPE,2000).

Brazil has the world's second-largest forest area, with 496,620 ha (12% of total forest area). Between 2001 and 2011, Brazil lost 62.8 million ha of forest area, with 74% of the loss likely to be permanent. Deforestation peaked in 2016-17, owing primarily to forest fires in the Amazon, and was generally initiated to prepare land for agriculture and pasture (Tyukavina et al., 2017). These fires have the potential to spread into nearby forests, which have already been degraded by human activity. They have been steadfast in recent years, with official data indicating that clear-cut deforestation in the Amazon is at its highest in over a decade (World Resources Institute Research, 2021). Between 2010 and 2014, an annual average of 544.73 million tonnes of CO2 eq. emissions was attributable to Brazilian deforestation for food production higher than the US (109.65 million tonnes) and China (193.17 million tonnes; Pendrill et al., 2019). Moreover, Brazil shares 7.41% of greenhouse gas emissions from global food production but only shares 1.26% of global greenhouse gas emissions for 2,73% of the global population (Crippa et al., 2021). In 2020, Brazil emitted 2.20 tonnes per capita and since 1750 has emitted a cumulative 16.24 billion tonnes of CO_2 eq. (Friedling-stein et al., 2021). To minimize its emissions and better respect Paris Agreement commitments, Brazil must shift food consumption to a diet that better sustains the environment, with the added benefit of likely improving citizen health and wellness.

2.2 Understanding Brazilian's food-related behaviours

Understanding food-related behaviours is essential for closing the gap between environmental mitigation policies in place or planned to be introduced and the average consumer's diet in Brazil. To achieve the first goal of this study, a survey was conducted in Brazil (N=2190), nationally representative across age, gender, income, and education. In June 2022, participants were asked about their food-related behaviours and related predictors, food consumption choices, food shopping preferences, and how often they consumed and wasted different types of food over the last year.

a. Weekly food consumption

Figure 3 shows that the average respondent consumes mostly rice, beans, poultry, beef, and dairy products. Consistent with 2019 IBGE data, a high level of animal protein intake was observed. The findings also indicate low levels of milk substitutes consumption (36% of respondents) and meat substitutes (less than 24%), with most respondents never or rarely ever consuming these products (46% for milk substitutes and 60% for meat substitutes).

Figure 3 | Weekly Food type consumption [% per meal].

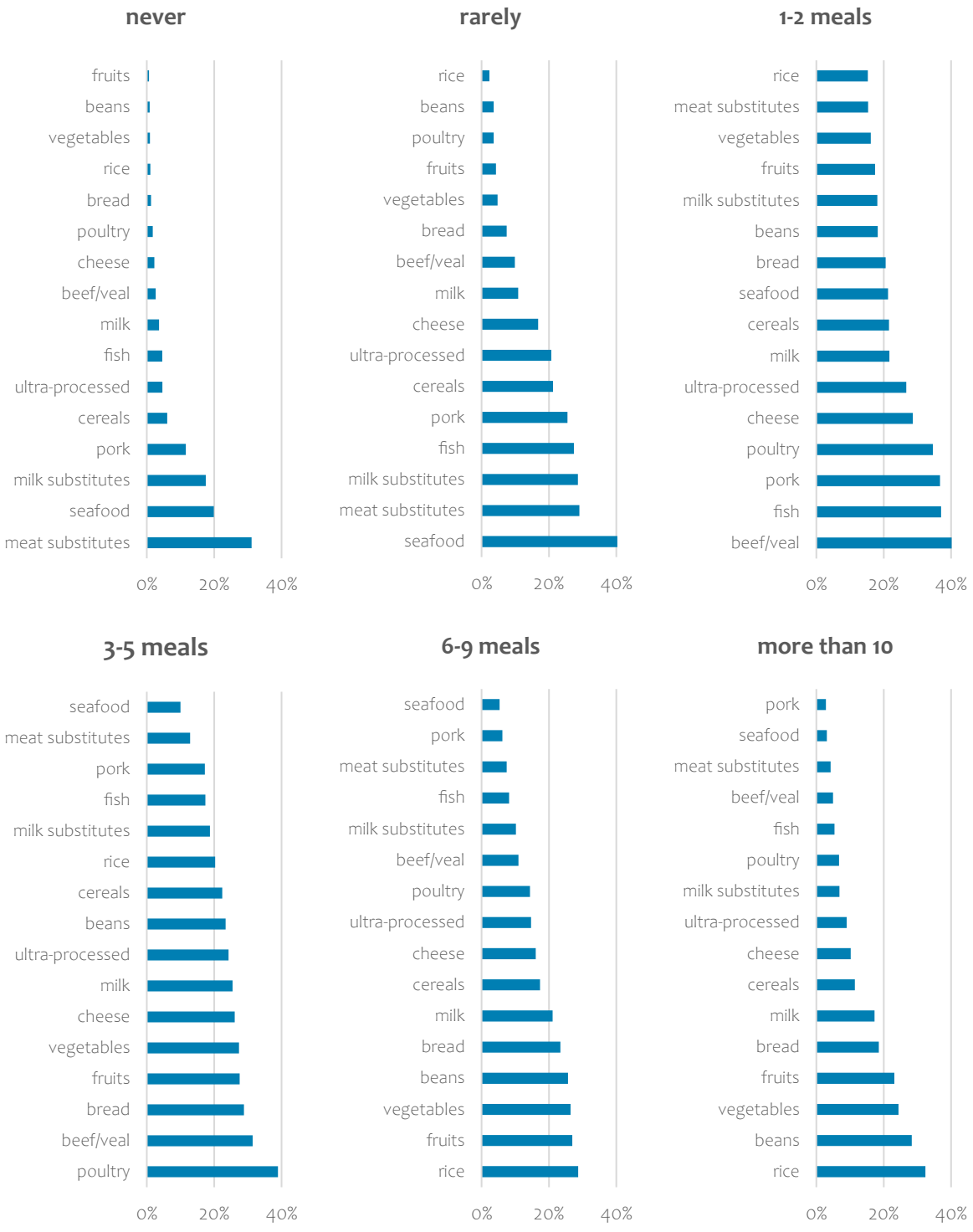


Figure 4 shows daily consumption (at least once per day) of rice, fruits, and beef by educational level and social class. Individuals with no education or who have completed studies through high school levels consume rice more frequently (12.1%), fruits (10,8%), and beef (7.25%). However, individuals with a lower income (DE) are less likely to consume fruits (7.1%) and rice (6.9%) regularly than individuals with higher incomes (Table 1). The frequency of beef consumption also decreases as income increases. A low intake of fruits has been observed here as in previous nationwide Brazilian surveys.

Even at the highest income levels, Brazilian purchases of fruits and vegetables occurs below the WHO recommended level of 400 grams per day (Levy-Costa et al., 2005). This finding is likely due to the higher cost of fruits (USD 0.46 per person per day) compared with other food groups (The World Bank, 2020). Moreover, individuals with higher income levels (above B2 class) have more dietary variability, so the frequency of each food category tends to be less than three times a week.

Figure 4 Daily consumption of rice, fruits, and beef per education level [at least one meal per day]

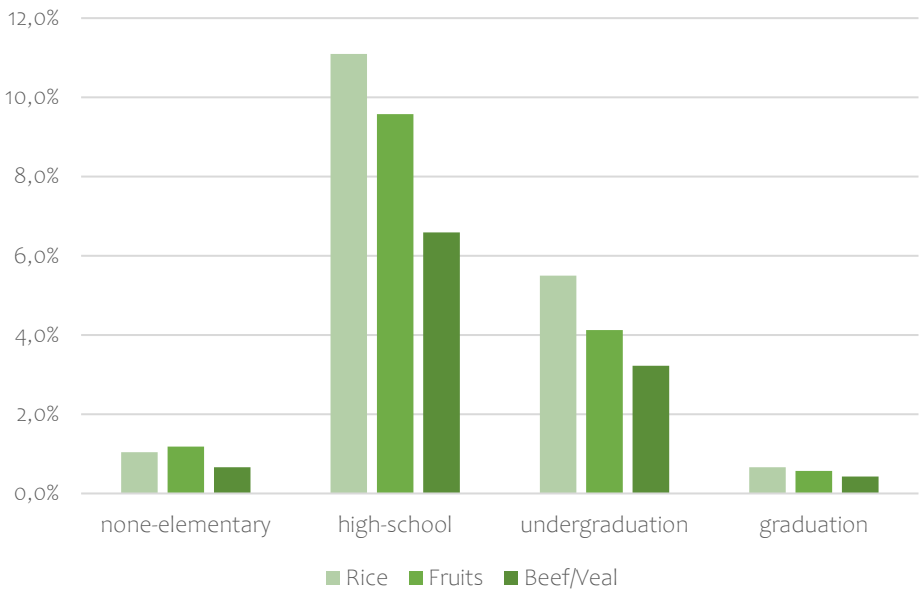


Table 1 Consumption frequency of rice, fruits, and beef per social class* [at least one meal per day]. *IBGE social class classifica-tion by average income: A = USD 4,550; B1 = USD 2,160; B2 = USD 1,150; C1 = US$ 640; C2 = USD 380; DE = USD 173

	At least once a day			Less than three times weekly		
Social Class	Rice	Fruits	Beef/Veal	Rice	Fruits	Beef/Veal
A	0,0%	0,0%	0,0%	12,2%	12,3%	12,2%
B1	0,0%	0,0%	0,0%	22,2%	22,2%	22,0%
B2	0,0%	0,0%	0,0%	4,6%	5,7%	12,1%
C1	3,7%	2,4%	1,8%	5,0%	6,3%	9,9%
C2	7,8%	6,0%	3,9%	1,8%	1,9%	3,6%
DE	6,9%	7,1%	5,2%	0,0%	0,0%	0,0%

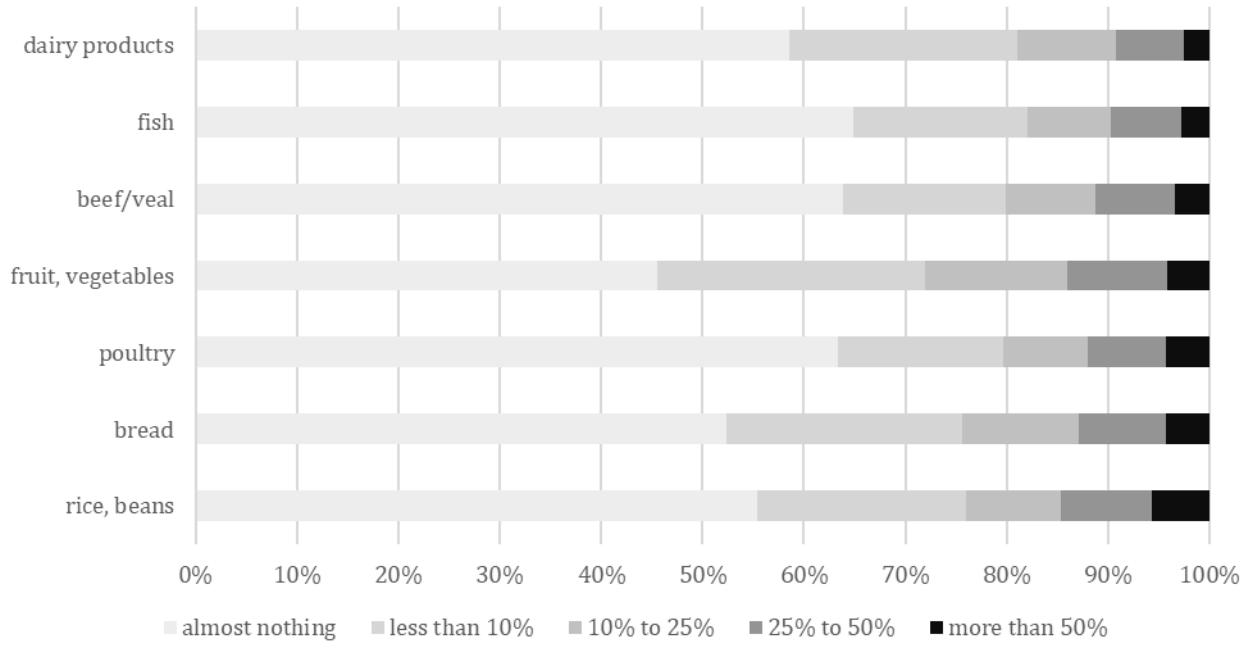
It is important to consider that self-reported details on food consumption is subject to under-reporting (Prentice et al., 2011). A study done by Lopes et al. (2016) compared energy intake in eighty-three adults with energy expenditure from double-labelled water and found the rate of under-reporting of energy intake to be about 30%. This suggests that, for most foods, differences between reported and actual consumption and wastage data might still be higher, although it is impossible to infer the degree of this for each food item.

b. Food Waste

In Brazil, annual food waste per capita is 41.6 kilograms (around 50% of total per capita municipal waste), with rice topping the list at 22% of all food wasted, followed by meat at 20%. The share of fruits and vegetables in Brazilian households' food waste is around 8% (Por-pino et al., 2018). Most of the waste in Brazil is food loss, meaning that it happens throughout the supply chain, particularly prior to the point of consumption (e.g., in supermarkets, grocery shops, and street markets). Another study by EMBRAPA (2018) revealed that each family discards on average 128 kilograms of food per year. Again, the most discarded products annually are rice (22%), beef (20%), beans (16%), and poultry (15%).

Around 5% of individuals surveyed waste more than 50% of purchased food (Figure 5). In this study's research, the most highly discarded food products (more than 25% of wastage) were reportedly fruits and vegetables (28%), bread (24.3%), rice and beans (24%), poultry (20.3%), and beef/veal (20.1%). On average, 12% waste more than 25% of their food, less than other Latin American countries. According to FAO (2014), households in Latin America usually waste 28% of their food regularly. These figures are consistent with Henz and Porpino (2017), where food waste in Brazilian restaurants and households are reported at 15% and 20%, respectively. A study conducted in 2020 shows that 31% of Brazilian households now freeze meal leftovers versus 28% before the Covid-19 lockdown while 58% of households only buy food that they will eat without wastage (Canatella, 2021). This indicates that only half of the population buys food that is later wasted.

Figure 5 | Food waste generation per type of food [%]



c. Food Shopping preferences

Regarding their food shopping frequency, 11% of the survey respondents shop every day and 43% shop once a week. Figure 6 shows that higher-income residents are more likely to shop more frequently. While 37% of the respondents do not shop for food through online outlets at all, 6% and 19% shop every day and once a week though online markets, respectively.

Figure 6 | Food shopping frequency [% per social class]

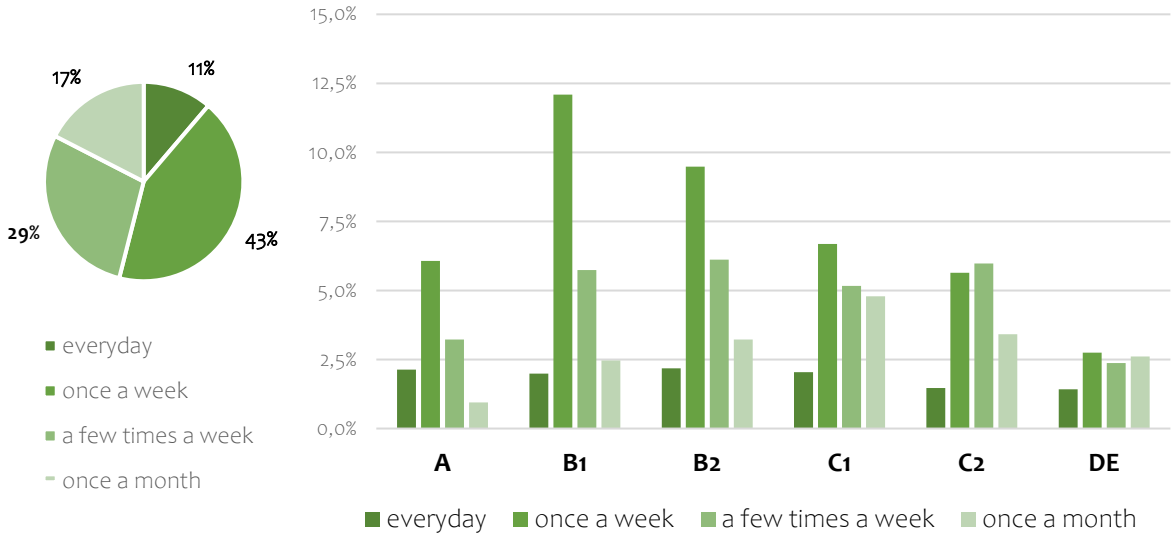
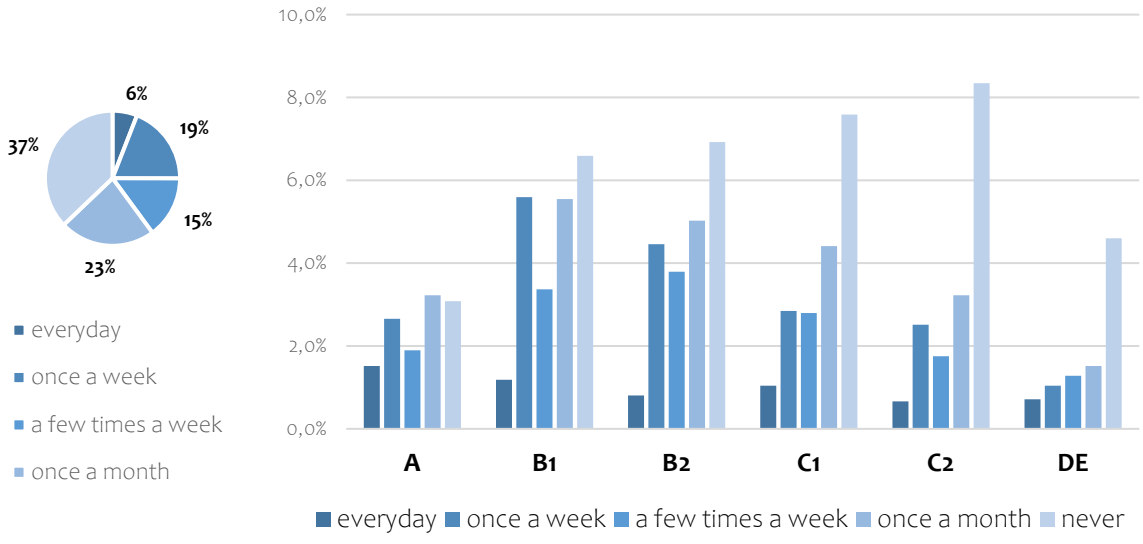


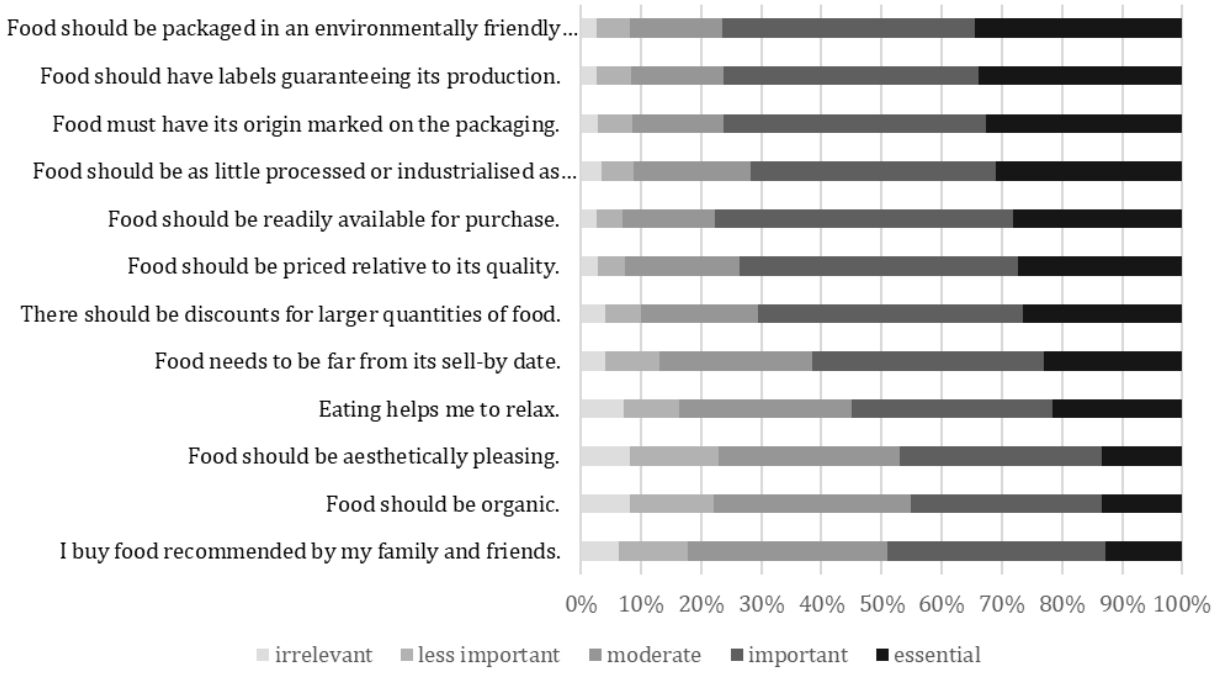
Figure 7 | Online shopping for food frequency [% per social class]

Online shopping is more frequent among respondents from classes B1 and B2, while it is less frequent among those from classes C and D-E (Figure 7). Problems with delivery (e.g., time) and food quality were the main complaints among respondents who had shopped online for food. According to Statista (2022a), Brazilians prefer to pay their online orders with credit cards more than any other payment method. In 2021, this means of payment was used in over two-thirds of online purchases in Brazil, and likely indicates that there is a bar-rier to online shopping for those from classes C and D-E since who have restricted access to credit cards and lower credit card spending limits.



Food choices relevance regarding price, familiarity, sensory appeal, convenience, ethical concern and food quality are presented in Figure 8. 53.1% of the respondents believe it is less important that food be organically produced, while 71.7% think it is important to buy less processed or industrialised food. Labelling is also an important factor for 76.2% of re-spondents (i.e., food should have labels guaranteeing its production), and 32.6% think having the food origin marked on the packaging is essential. Concerning food prices, 73.5% of respondents agree that price should correspond with food quality.

Figure 8 | Food shopping choices relevance [%]



d. Food related behaviours

The food-related behaviours scale applied in this study covers food consumption, preparation, packaging, and waste. Table 2 presents the ranking starting from the most common behaviour to that which is less common among respondents. The easiest and most practised behaviour in Brazil is 'checking the fridge/freeze/pantry before shopping for a food product' (91.9%), a social behaviour established during the 1980s when inflation was over 1500% (The World Bank, 2022) and Brazilians were forced to carefully plan their shopping list. Shopping list creation is the third most common behaviour at 82.1%. 64.1% of respondents declared that buying seasonal food is one of their food-related behaviours and 56% bought organic food overpackaged options.

Regarding food preparation, cooking at home (78.8%) is popular among respondents in a similar range as reheating food leftovers (75%).

As mentioned, most food waste generated in households consists of small portions of leftovers that were stored in the fridge. 58.2% of respondents admitted to discarding meal leftovers, consistent with the 43% measured in 2018 EMBRAPA research. Another reason cited for excessive food waste is strict supermarket standards and consumer demands that determine food's aesthetic cosmetic appearance, such as the banana's curvature and colour (Devin and Richards, 2018). Results show that 37.8% of respondents consumed fruits and vegetables with slight blemishes.

Table 2 | Food-related behaviours frequency [%]

Rank	Food-Related Behaviours	Category
91,9%	I check my fridge/freezer/pantry before shopping.	food consumption
88,5%	I know how to store my food to keep it fresh.	food waste
82,1%	I write a shopping list for the supermarket.	food consumption
82,0%	I check the expiry date on food before going to the supermarket.	food diet
79,8%	I buy refillable products.	food preparation
78,8%	I cook at home for myself or my family.	food waste
75,0%	I recook food leftovers.	food waste
64,2%	I purchase more food than I can consume.	food waste
64,1%	I buy seasonal food.	food consumption
62,3%	I separate my waste for the recycling collection.	food waste
58,4%	I use food packaging to store food in the fridge.	food packaging
58,2%	I dispose of any leftovers from a meal.	food waste
56,0%	I buy organic food that is over-packaged.	food preparation
45,3%	I talk with others about my diet.	food packaging
43,7%	I remove the food packaging before storing it in the fridge or pantry.	food preparation
43,3%	I cook multiple recipes for a single meal.	food waste
39,6%	I cook large quantities of food and freeze the surplus.	food waste
37,8%	I consume fruits and vegetables with slight blemishes (e.g., stains).	food consumption
33,8%	I buy ready-to-eat frozen food.	food consumption
31,8%	I buy food close to its expiration date when it is cheaper.	food consumption
29,1%	I peel fruits or vegetables before consumption.	food preparation
18,3%	I dispose of food as soon as the expiration date has been exceeded.	food waste
11,6%	I clean my fridge to throw away spoiled food.	food preparation

e. Predictors of food consumption behaviour
Behaviour predictors are variables that indicate patterns or trends in food consumption. In this study, price, personal norms, perceived behaviour control, specific knowledge and environmental awareness were inferred predictors for specific food behaviour.

Price remains a significant predictor for individuals to consumption of organic, healthy food products or products with a lower impact on the natural environment. 83.5% declared that they pay attention to good deals on food products; however, only 26.1% stated it is more important to keep meat prices as low as possible rather than ensure animal welfare is pro-tected during production. 58.1% agreed that helping the natural environment is a good reason to pay more for products. In the case of personal norms, 57.1% are willing to change their diet to protect the environment, while 79.9% admitted feeling responsible for reducing their food waste.

Specific knowledge in food consumption refers to nutritional values, recommendations, and labelling regarding food production, origin, and socio-environmental impacts. 22% of respondents said that nutritional information is hard to find, and 56% admitted having difficulties understanding this type of information. The most recognisable food labels are those for organic products (65%), Agriculture Minister seal of approval (80%) and gluten-free (55%). The Brazilian Federal Government is responsible for administration of the first two labels, which were implemented more than 30 years ago. Only 44% reported familiarity with the vegan label. Regarding the new nutritional label that was approved by ANVISA in 2020 and put in force in October 2022, 85.6% declared it easy to understand and agreed that it will help make healthier food choices (86%). Only 6% claimed to be highly knowledgeable about nutrition and consumption, while 69% declared to have little knowledge in these topics.

Perceived behavioural controls refer to the degree to which a person believes that he or she has control over a given behaviour. 72.1% of the respondents agreed that they would purchase more organic food if they could afford it, while 55% felt they did not have time to do more about their food consumption. Only 25.2% think buying food online is easy; and 54.7% indicate that acting environmentally friendly is not inconvenient.

For this study, a seven-level scale was developed to infer how concerned respondents are about the impacts of their actions on the natural environment. 75.4% agreed that super-markets should be environmentally responsible for the food they sell, and 66.3% indicated that environmental conservation should be more important than the food price. Figure 9 shows the level of environmental concern calculated for the Brazilian population based on the survey results. On a scale of 0 to 7 (highest level of concern), 54.9% have a score of 1, while only 3.2% show a score over 5 for environmental concerns. 60% of those who shop online for food daily (5.93%) scored over 5 for environmental concerns. This result repre-sents the challenge of engaging Brazilians in future environmental policies without a fo-cused plan on educating individuals to be more aware of environmental impacts of their food-related behaviours.

Figure 9 | Level of Environmental Concern for the Brazilian Population
(Seven is the highest score, meaning the person has the high-est environmental concern)

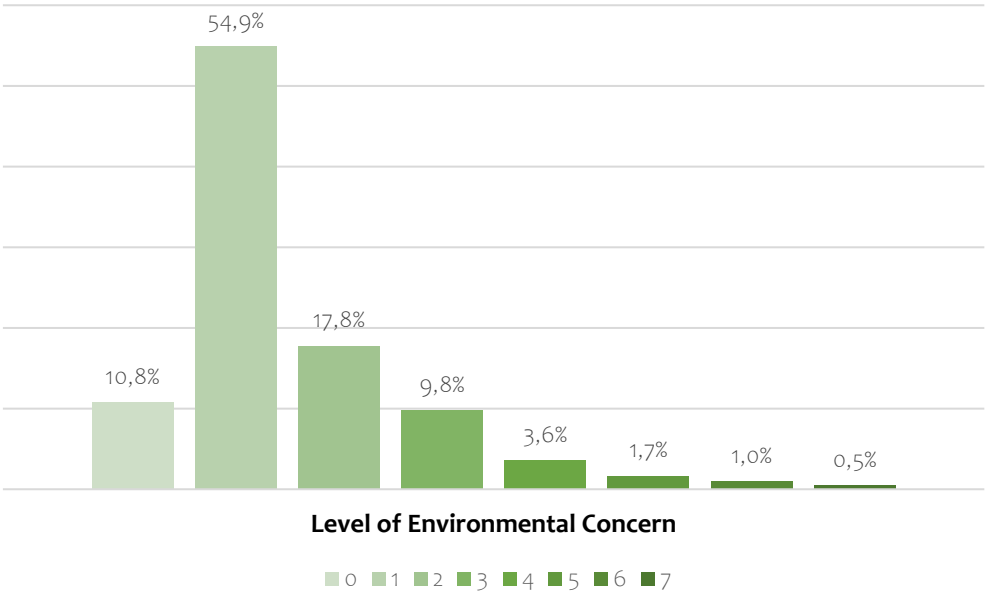


Figure 10 | Key findings of survey conducted to understand Brazilians food consumption behaviour

KEY FINDINGS GOAL 1

UNDERSTAND BRAZILIAN'S FOOD CONSUMPTION BEHAVIOR

- The weekly food consumption of Brazilians is composed of a high level of animal protein intake with rare consumption of milk and meat substitutes.
- Brazilians purchase few fruits and vegetables.
- Brazilian population waste less food than in other Latin Americas countries.
- Brazilians with higher incomes shop more frequently than those with lower incomes.
- Due to social-economic disparities in Brazil, classes with the highest income shop online more frequently.
- Most Brazilians consider food labelling important.
- Price remains a significant predictor of individuals endorsing organic, healthy food products or those with less impact on the natural environment.

3

Can we nudge consumers toward a climate and nature positive outcome?

3.1 Nudging for sustainable food consumption

What individuals eat is very personal, and its follows that encouraging people to make more sustainable food choice requires well-designed and motivating policies and method. The most common policy approach used to influence food choices is provision of nutrition information. This typically includes general guidance on the broad parameters of what con-stitutes a healthy diet and, in some cases, nutritional information on food products or at the point of food purchase. Although seemingly straight-forward, providing nutritional information has proven to be complex and occasionally controversial. Given the numerous food choices most people make daily, it is not surprising that many consumers find acquir-ing, recalling, and applying nutrition informa-tion to food choices a demanding task and perceive it as excessively difficult and burdensome.

Additionally, when a task is seen as less critical, or motivation is low, individuals may make less effort to apply available information. At the same time, even when information strategies are effective in commu-nicating information, knowledge may not always triumph in the face of competing preferences such as taste, convenience, culture, and other food attributes. Many consumers consider taste and price more important than or at least as important as nutrition or health in grocery purchasing decisions (De Cosmi et al., 2017; Negri et al., 2012).

Behavioural economics studies have shown that when faced with making buying decisions, consum-ers rely on simple heuristics, or mental shortcuts, to make dealing with information more manageable (Kahneman, 2011). For food choices, examples of "rules of thumb" (i.e., an approximate method for doing something based on practical experience rather than scientific facts) that might be applied could be "vegetables are healthy," "organic food is environmentally friendly," or "the diet version of a product will also be lower fat". Although they are helpful, these rules of thumb may not be effective; for example, a product labelled "diet" could contain a large amount of total fat or sugar. Nudging strategies rely on shifting food choices based on purposeful choice architecture to direct individuals towards preferable options. Thaler and Sustain (2021) defined a nudge as "any aspect of the choice archi-tecture that predictably alters people's behaviour without forbidding any options or significantly changing their economic incentives." In other words, nudge strategies are related to changes in the accessibility, information availability and presentation of food options along with the use of prompts to encourage a particular choice.

In contrast, no food options are eliminated, and economic incentives are not included. Some nudge strategies include contrast, availability, placement, defaults, descriptive norms, prompts, semiotics, and presentation. Nudge strategy success has already been shown to motivate food decisions towards more sustainable food consumption, such as plant-based or meat substitutes (Bacon & Krpan, 2018; Ensaff et al., 2015, Vennard et al., 2019; Visschers & Siegrist, 2015).

3.2 Green nudging experiment

To estimate the potential impact of nudging strategies on changing food-related behaviours, a green nudging experiment was design for implementation in a simulated real-world situation. The overall goal was to understand the potential for mitigating the environmental impacts that nudging strategies could achieve if used at scale. The survey data from the previous section was analysed and applied to tailor the experiment to the Brazilian context.

a. Methodology

Most nudge strategies are highly context-dependent (Johnson, 2019). Although the tech-nique used might be the same, the behaviour domain, the target population and effectively the entire choice architecture will contribute to altering a particular nudge strategy's success or failure.

This experiment aimed to investigate the effects of two specific nudging strategies with Brazilian test participants to evaluate the effect on the proportion of vegan and vegetarian diet recipes and plant-based and organic food products chosen in an online environment. The two nudging strategies studied were, 1) default effect and 2) attraction effect. Building on previous studies, it was decided to vary the price range, price difference, as well as label-ling to examine a comprehensive set of real-life circumstances more thoroughly. This also allowed for identification of limiting conditions related to price and labelling in the attrac-tion condition.

The default effect can occur when people encounter a choice between two options where one option is pre-selected. The decision-maker is free to choose whichever option s/he wants and bypass the pre-selected option. Setting sustainable options as the default may increase the likelihood that individuals accept the default option, and in this case, preferred option. In many cases default can be interpreted as a trusted choice and empowered with the pre-selected option the purchaser might make this endorsed selection due to a lack of time or willingness to find an alternative. The attraction effect, also known as the decoy effect, emerges when options (usually two) are accompanied by an additional option, which is clearly substandard to the available alternatives. Typically, the third, substandard option is inferior in all aspects to one of the preferred options, while with the second op-tions it has some inferior characteristics and some superior. Several other nudges were also tested for combined effect. These included presentation nudge (picture vs. words), semiot-ic nudge (use of labels), availability nudge (overweigh information that is recent and readily available), and descriptive or social norm nudge (educational process).

A digital survey was built simulating a purchase environment, where recipes and product choices were indicative of the efficiency of nudging on sustainable consumption. Participants were presented with two sets of recipe choices and three sets of choices either two or three options for three different types of food products. In all choice sets, eco-friendly and healthy products were represented by official labels like organic production, certified vegan product, healthy diet, low-carbon product, and/or animal fairness. All choice sets had one non-eco-friendly product with no label, whereas the opposite choice was interpreted as an eco-friendly choice (nudged choice). The digital survey was realised on N=2109 Brazilian citizens who were asked to complete to four different tasks:

Choice Task 1: Participants were asked to imagine a hypothetical situation where they must plan and cook a dinner for a group of three friends. First, they had to choose a food category (a. salad, b. pasta, c. meat, or d. vegan or vegetarian).

Choice Task 2: Each participant then had to choose a recipe for the category they selected in Task 1. Each category included a vegan/vegetarian recipe option (except for meat).

Choice Task 3: After choosing the recipe, participants went through a focused training to learn about the particular labels used by the functional supermarket.

Choice Task 4: The last task was to choose three ingredients to use in cooking the chosen recipe, with three different conditions being applied:

• Control condition: two options per ingredient, one eco-friendly and the other non-eco-friendly. Both possibilities were displayed equally with the differences being price, size, and labelling.

• Default condition (Intervention Group 1): two options per ingredient, one pre-selected eco-friendly and healthy option with the possibility to change for a cheaper non-eco-friendly food product.

• Attraction condition (Intervention Group 2):
a) one cheaper non-eco-friendly option and two eco-friendly options with different prices, and
b) two non-eco-friendly options with different prices and one eco-friendly option with a median price.

Non- and eco-friendly food options were presented equally to participants, meaning that pictures were the same without differences in packaging, colours, or marketing. Brands were also omitted, and price anchoring was maintained to avoid biases.

b. Results

As shown in Figure 11, few participants chose a vegan or vegetarian meal category for the dinner party in the Choice Task 1 (Choice 1). However, in Choice Task 2 (Choice 2), a signifi-cant portion of participants chose vegan or vegetarian recipes in the salad and pasta categories. This result implies a significant negative impact with items being referred to as vegan or vegetarian as compared to wording about food category such as salad, pasta or meat. The proportion of vegan and vegetarian recipes at the end of the experiment had increased after participants selected vegan or vegetarian ingredients when given the choice between plant-based or meat, poultry and fish recipes in Choice Task 4 (Figure 12). Again, a significant negative effect ($p<0.001$) of vegan labelling and framing was also inferred by the statistical analysis. This corroborates what previous studies (Demartini et al., 2022) have shown, namely that the absence of vegetarian and vegan framing (labelling or wording), regardless of the alternative intervention, may make vegan and vegetarian choices more likely.

Figure 11 Nudging choice 1 represent the participants' choice for each recipe category (nudging choice 1), and nudging choice 2 represents the participants' choice for a set of three recipe choices in each category

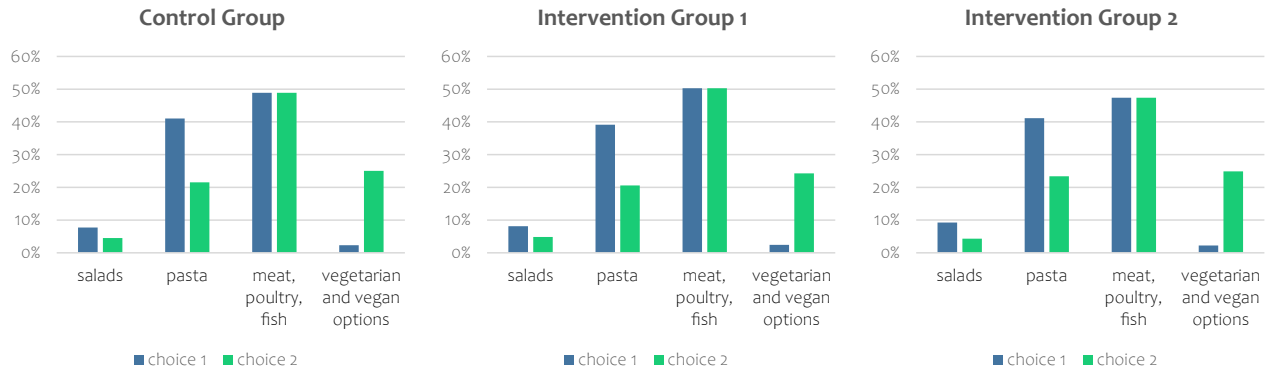
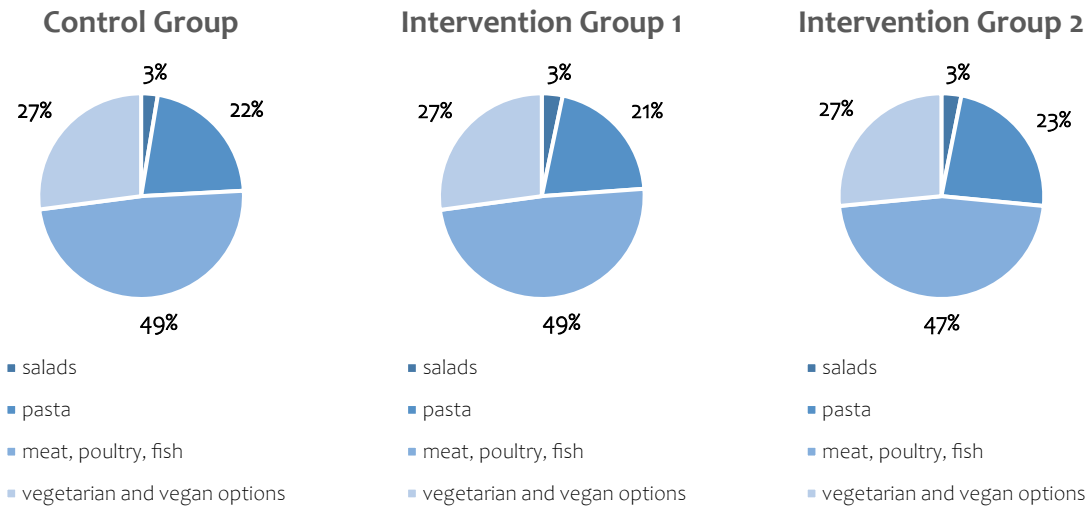
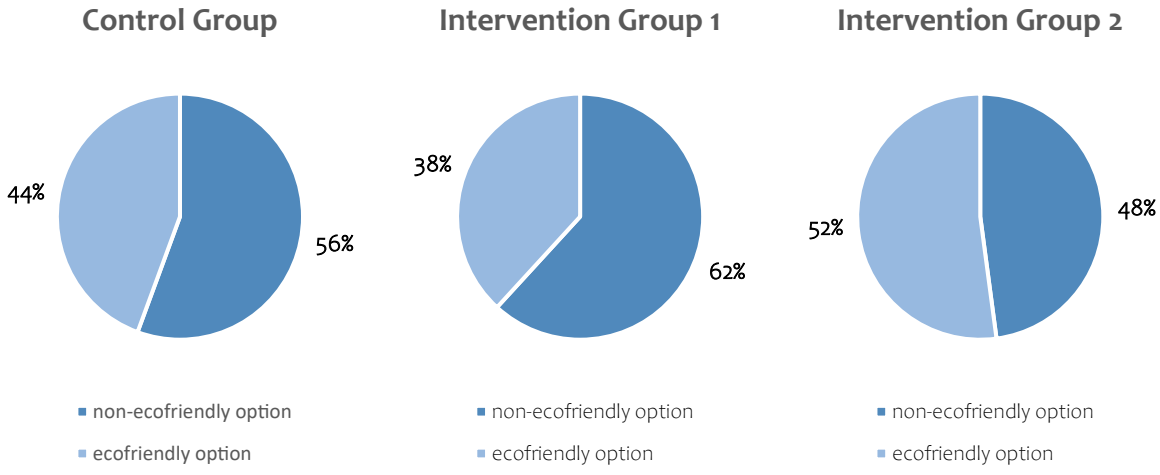


Figure 12 Final distribution of the participants' choice for each recipe category after choosing the ingredients (plant-based dairy and meat).



For the effectiveness of the two nudge strategies, overall, when compared with the control group, the attraction effect was more effective than the default effect in influencing the choice of an eco-friendly option, particularly when participants were exposed to two choices of eco-friendly food products (Figure 13).

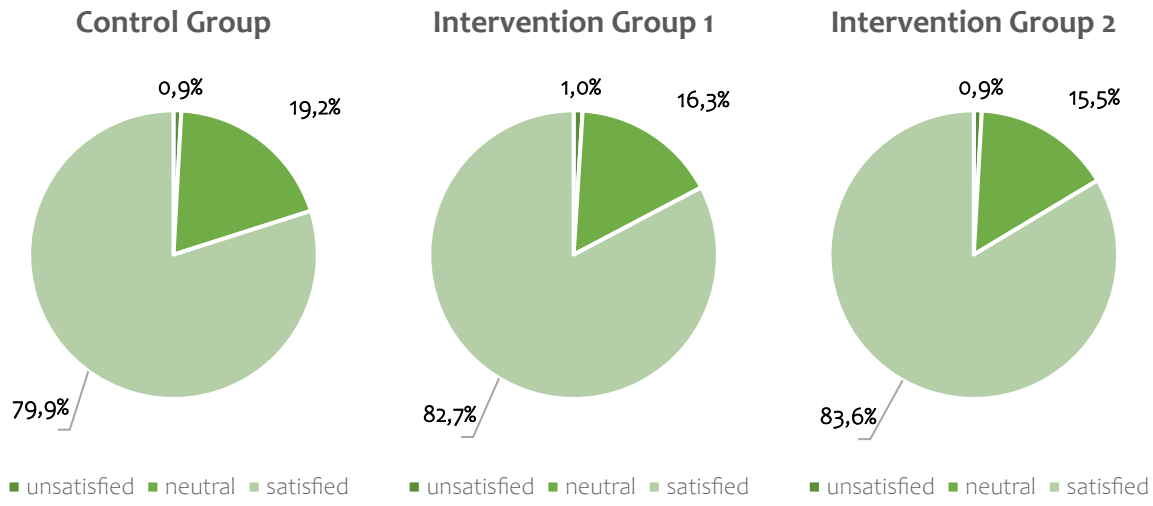
Figure 13 Representation of the overall choice of food ingredients in the three experimental groups. The Control Group had two options: one eco-friendly and the other non-eco-friendly. Intervention Group, 1 for the default condition had two options, one pre-selected eco-friendly and an option non-eco-friendly. Intervention Group, 2 for the attraction condition had three options, one eco-friendly and (a) two eco-friendly options or (b) only one eco-friendly option



The magnitude of the nudging effect differs when each ingredient option is considered for each intervention group, default, and attraction nudges. In the case of plant-based meat (vegan label), the default effect was higher than the attraction effect (which included the organic option). For organic meat (organic label), the attraction effect was higher than the default. The price range difference significantly impacted all three groups, and the vegan label was used to describe plant-based meat.

When choosing recipes, taste appeared to be an important factor. Food decisions are often hedonic rewards, and highly palatable foods typically win when a choice is available. Figure 14 shows the level of shopping satisfaction for the three groups. Thus, it is proposed that for a nudge strategy to be effective and for consumers to select it, their taste perception of the food needs to be satisfied before selection.

Figure 12 | Shopping satisfaction distribution of the participants' overall choices



c. Conclusion

Overall, the attraction effect, in other words, the effect of adding a third option, can influence our perception of the original two choice. This makes it a promising nudging strategy; increasing the probability that an eco-friendly choice will be made in a fictitious online supermarket, especially when the price is high or when there is a large price range. Although the default effect nudge did not motivate eco-friendly choices at a group level, it was efficient among those with strong environmental awareness. The results have also demonstrated the success of combined effect with multiple nudges being engaged, particularly on intervention Group 2. This combined effect proved effective with overcoming differences in price. Additionally, label wording must be carefully chosen and ideally linked with an educational process; otherwise, standard rules of thumb may be applied by consumers, particularly those associated with emotions, taste, price, conven-ience, and other food attributes.

Food categorisation with vegan and vegetarian words should be applied sparingly. Results show negative effects with both word and label compared to other eco-friendly options and labelling that do not contain these terms. The absence of vegan and vegetarian words, regardless of the nudging strategy, may make non-animal choices more likely. Nudges are highly context-dependent, so overall choice architecture contributes to the success or failure of their deployment. The availability of options presented similarly with visibility to the consumer may increase the effectiveness of nudging strategies. More specifically, plant-based protein or protein substitutes need to be visible for consumer comparison. Moreover, each food category (fresh, protein, dairy, vegetables, and fruits, processed and ultra-processed) has specific characteristics (perceived health values, sizes, branding, marketing, etc.) that can positively or negatively influence different nudging strategies. Nudging strategies need to be tailored to these food categories differently to avoid biases.

Figure 15 | Key findings of the green nudging experiment

KEY FINDINGS GOAL 2

GREEN NUDGING EXPERIMENT

- The Nudging strategy based on defaults is effective with consumers with high environmental and nutritional awareness who can take advantage of the pre-selected option.
- Transparency on the purpose (avoid emissions and other impacts) of the default increased the pre-selected choice among consumers with higher environmental awareness.
- More availability and visibility of eco-friendly products can positively motivate consumers to overcome differences in price ranges.
- Label wording must be carefully chosen and needs to be linked with an educational process where consumers usually make their decisions.
- Food categorization with vegan and vegetarian words should be used parsimoniously.
- Nudging strategies are context-dependent and need to be tailored to each food category to avoid biases from standard misconceptions by consumers.

d. Ethics considerations

As mentioned, the use of nudges is not without ethical concerns. However, some nudges are effective not because people are unaware of what the nudge is but because being aware of the nudge makes salient the advantages of the choice and the disadvantages of the alternative choice. This might lead purchasers to assume that the designated option is recommended, and provides an easy way out of having to make an otherwise difficult decision. Several dimensions are ethically relevant when considering the implementation of the nudge strategies presented in this study. For example, for the default nudge, individuals must have an easy way to opt out of the preselected choice and its benefits must outweigh any anticipated psychological, social, or financial harms. Additionally, attempts must be made to mitigate any injustice or harm brought by the default to vulnerable or marginalised populations.

More transparency can have a positive impact. The case for transparency is based on the premise that people respond positively to nudges when they know what they are intended to do. This encourages them to slow down and carefully think about their decisions as they proceed through multiple reference points. Transparency also ultimately results in consumers being less influenced by the way the choices are presented. Disclosure can also enhance consumers' perceptions of ethicality and attitudes toward the nudge-setter by giving them the ability to make decisions in their own best interests. There is evidence from previous studies showing that nudges can be equally effective when the intention behind them is disclosed (Blumenthal-Barby & Burroughs, 2012) and there is public approval of nudging for health and environmental reasons (Bruns, et al., 2018). These considerations are relevant as acceptability may influence implementation of nudges at the government and retailer levels.

Moreover, policymakers and other consumer advocates can encourage consumers to articulate their preferences regarding food consumption premises before they choose in situations in which marketers are likely to set defaults to benefit themselves. In this case, accountability may thus provide a useful tool for consumer protection. For these reasons, the required ethical framework for the responsible deployment of these techniques may not diminish the desired effect of the respective policies.

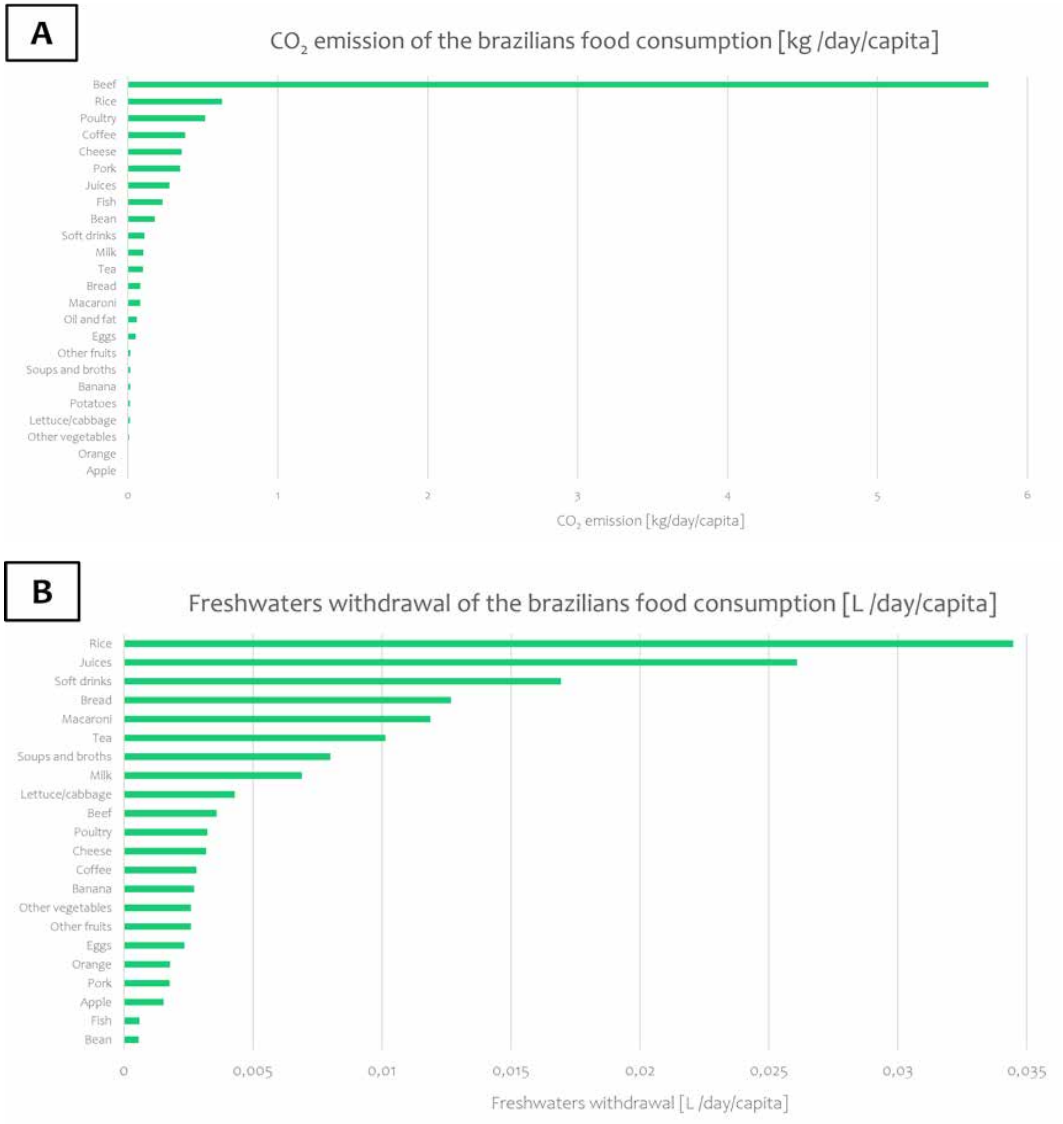
4

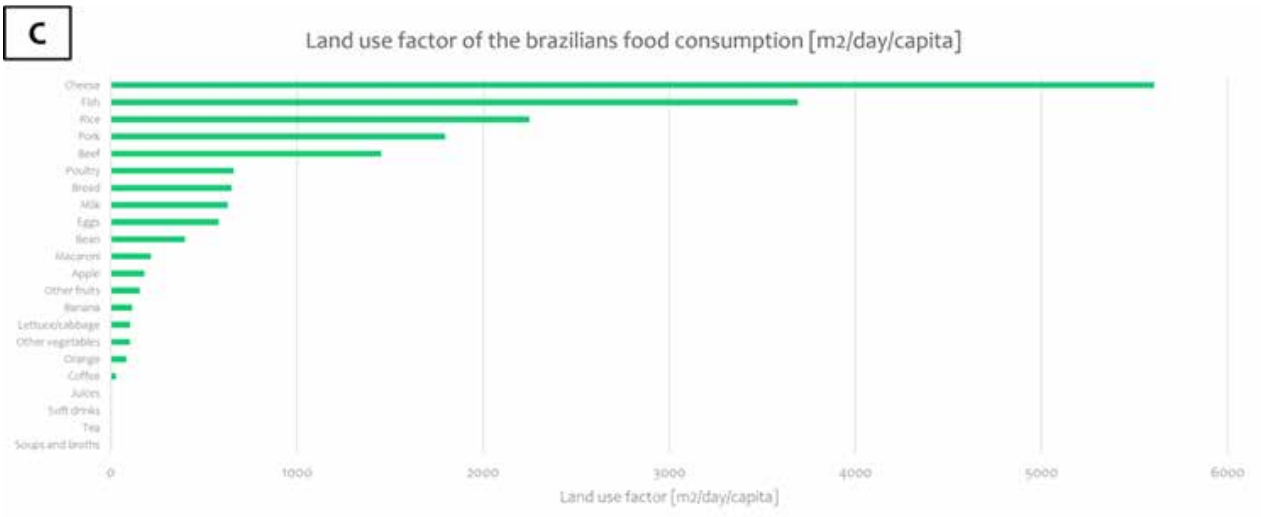
What is the impact reduction potential?

4.1 What is the environmental impact of domestic Brazilian food?

In assessing the environmental impact of a typical Brazilian's diet, the contribution of each food to degradation in the following key areas was determined; climate change, land use and deforestation, and freshwater (Figure 16). Understanding the most significant contributors to environmental harm was essential to establish the levers and actions that would put Brazil on a path to more sustainable consumption.

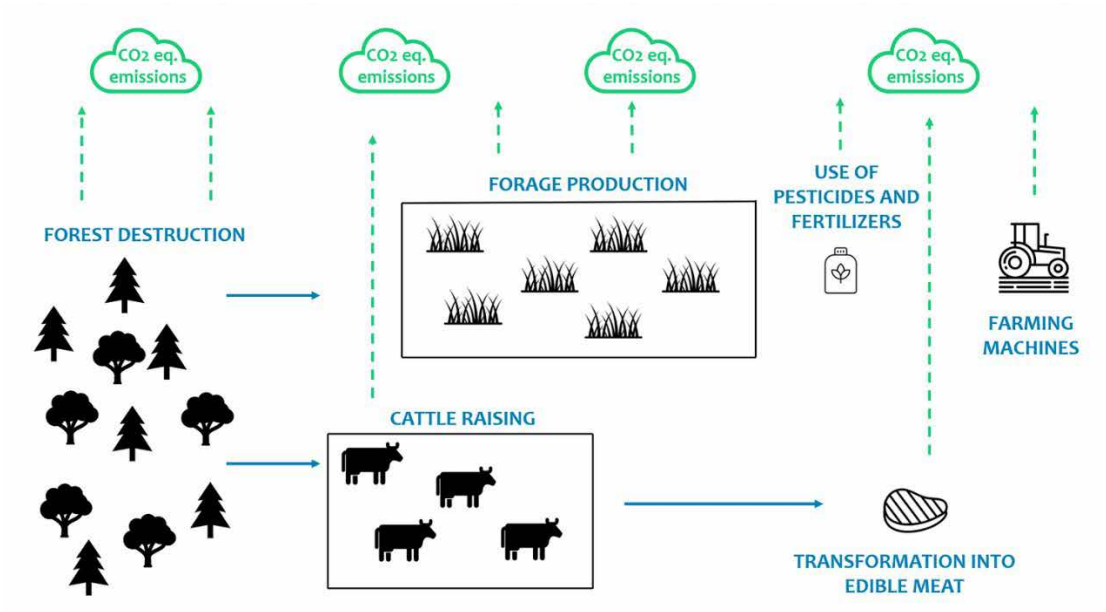
Figure 16 Environmental Impact of the Brazilian citizens food consumption for all socio-economic classes (A, B and C). A) Represen-tation of the CO_2 emission impact, expressed in [kg CO_2 eq./day/capita], B) representation of the freshwater withdrawal, expressed in [L/day/capita] and C) representation of the land-use factor expressed in [m2/day/capita]





Beef contributes the most to CO_2 emissions and greatly exceeds the negative environmental impact of all other food sources (Figure 16). Assessing the impact of beef requires accounting for: a) land use for direct rearing and fodder production; b) fertilizer use in feed production; c) emissions from manure and gas released directly by cows during digestion; d) processing of livestock into consumable meat; and 3) emissions from farm and processing machinery (Cusack et al., 2021; Garnett et al., 2016); as well as 4) transport.
The combination of these elements also supports the understanding of high land use levels required for beef production (Figure 17).

Figure 17 | Representation of contributors to emissions from meat production



Where beef has the biggest impact on CO_2 emissions, rice contributes the most to freshwater withdrawal and degradation (Figure 16). Indeed, although some regions are cultivating upland rice, a large part of Brazil continues to grow flooded rice, which requires a lot of wa-ter and releases a great amount of the greenhouse gases methane, CH_4, and nitrous oxide, N_2O (Nunes et al., 2016; Surendran et al., 2021).

Figure 18 | Key findings of the environmental impact of Brazilian food consumption

KEY FINDINGS GOAL 3

ENVIRONMENTAL IMPACT OF BRAZILIAN FOOD CONSUMPTION

- Brazilians' beef consumption contributes the most to CO2 eq. emissions and greatly exceeds the negative envi-ronmental impacts of all other food sources.
- Brazilians' rice consumption contributes the most to freshwater withdrawal and degradation.

4.2 Consumption change as levers for a green transition

Studies have shown that consumers can be instrumental in reducing harmful environmental impacts when they make changes in their own lives, with these individual changes then becoming levers for broader change. For example, changes such as switching to alternative proteins and plant-rich diets, prioritizing food that has been sustainably produced, reducing food waste at home, and consuming domestically produced food are all personal behaviours that when done en masse, become levers for more system-wide shifts (Guertin-Armstrong, 2019; Project Drawdown, 2020; Sun et al., 2022). Getting Brazilians to adopt the necessary changes will require the involvement of players from across the food system including policymakers, brand owners, retailers, and e-commerce platforms. For this reason, it is key to identify different levers, quantify their relative effectiveness if scaled, and understand which nudges would empower consumers to activate those levers and thus lower the environmental impact of their food consumption (fourth goal if this study).

4.2.1 Available levers for a consumer-driven green transition

Four levers have been identified:

a. Switching to alternative proteins and plant-rich diets
Switching to a plant-rich diet is not only favourable for the environment (de Boer & Aiking, 2011) but also human health, primarily by reducing obesity levels (Bodirsky et al., 2020).

To achieve a plant-rich diet, several alternative protein sources exist with plant-based meat substitutes, dairy substitutes, insect-based meat substitutes, and lab-grown meat being the most well-known, although consumption of larger quantities of protein rich vegetables, legumes, grains and nuts that do not mimic meat nor dairy is favoured by long term plant-based diet followers (Akhtar & Isman, 2018; Grossmann & Weiss, 2021; Thavamarni et al., 2020; Verbecke et al., 2015).

Project Drawdown (Hawken & Wilkinson, 2017) calculated the potential for climate change mitigation through broader adoption of plant-rich diets globally. If 50% of the global population adopts a plant-rich diet by 2050, a cumulated reduction of 78.33 gigatons of CO2 equivalent would occur between 2020 and 2050 (via reductions in emissions from agricul-ture production, land conversion, and sequestration to the ecosystem). In other studies, switching to a healthy diet (for personal health and the environment) is shown to reduce greenhouse gas emissions by 25% (Candy et al., 2019; de Boer et al., 2016; Willet et al., 2019). These notable reductions correspond with high current levels of meat and dairy consump-tion, which respectively represent 32% and 14% of greenhouse gas emitted from human food consumption, and are ideal targets for emission reduction.

b. Prioritizing sustainably-produced food
The current practices for producing food are detrimental to soil health, ecosystems, and biodiversity (Galli et al., 2020; Mbow et al., 2019). Achieving a sustainable food system for a growing population is challenging and the necessary transformation will require an agricultural revolution (i.e. regenerative agriculture that enhances and sustains the health of the soil by restoring its carbon content, Annex 2), modification of industrial-scale production, and critically, the active involvement of policymakers and government (Galli et al., 2020; Van der Goot et al., 2016).

Knowing that animal proteins production is anathema to sustainable food production (Cu-sack et al., 2021; Garnett et al., 2016), reducing the impact on the environment means reducing animal proteins production and consumption. However, modelling a shift from traditional food production to regenerative food production for non-animal products is complicated and requires the integration of many players and efforts. For this reason. and be-cause Brazil is a great producer and consumer of rice, this study further focused on improving rice production. Project Drawdown (2019) proposed a set of practices to reduce methane emissions from rice production. Improved rice production practice includes changes to water management (alternate wetting and drying), fertility management, use of aerobic cultivars, no-tillage methods and direct seeding. These practices would not only make rice production more sustainable, but also help to meet growing demand.

c. Reducing food waste at home and by retailers
When food is wasted, all resources, energy, and money that went into producing, processing, packaging, and transporting it are lost. The food system needs to change to minimize food waste, especially knowing that roughly 30% of food produced is lost (occurring along the food supply chain from harvest/slaughter/catch through to production) and wasted (occurs at the retail and consumption level) globally (Food loss and waste together reach 40% in Brazil; IPCC, 2019; Mbow et al., 2019). In Latin countries the food waste at home was estimated to reach 28% (FAO,2014).

Even if Brazil wastes less food (16%) at home than other countries (Henz & Porpino, 2017), there is a great potential for improvement as studied in Project Drawdown (2019). Indeed, if the world reduces its food waste by 50% by 2050, 88.50 gigatons of cumulated CO_2 eq. (2020-2050) would be spared, making this the third most effective solution for greenhouse gas emission reduction.

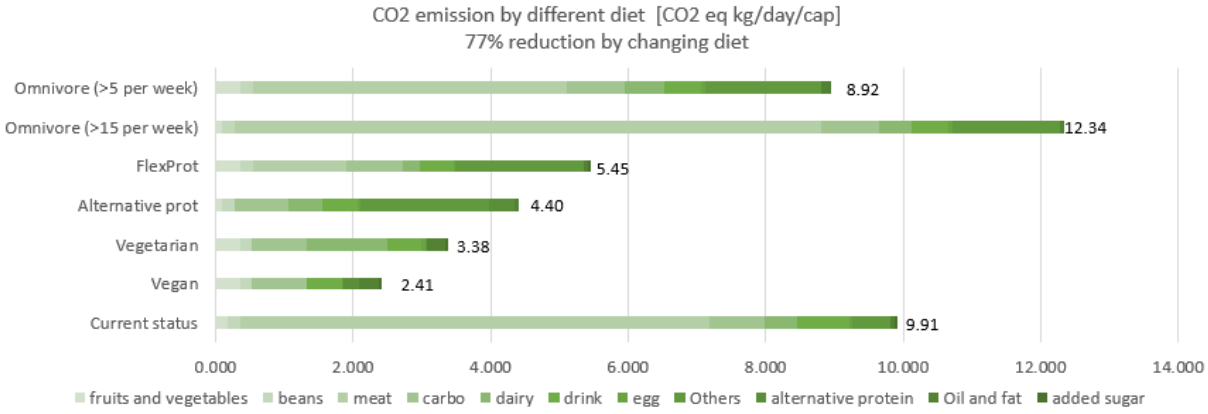
c. Consuming domestically produced food
According to current beliefs, domestically produced food is most often linked to sustainability via the concept of "food miles," which suggests that transport-related emissions are so important that they can be used to determine a product's "carbon footprint", while by extension, domestically produced food is more sustainable because it does not require as much transport. While this statement is logical, current environmental analysis shows that land use, production processes, and storage impact a product's carbon footprint more than the distance the food has travelled (Ritchie & Roser, 2020).

4.2.2 Effectiveness of available levers

Which levers are the most effective?
By setting for each lever the maximum value (100% of plant-based diet, 0% of food waste, 100% of domestically produced food, 100% sustainable rice production), the maximum emission reduction potential of each lever was determined. This effort was essential to determine which levers would be the most effective within the Brazilian context, and as such, which food behaviour nudges should be applied for greatest impact.

a. Switching to alternative proteins and plant-rich diets
The most effective lever would be a broad shift to plant-based diets, which has the potential of reducing CO_2 emissions by 77%. This high level of reduction could be seen if the whole population was eating a healthy 2500kcal diet that was fully plant-based (Figure 19). As shown in Figure 19, reducing the intake in animal-based foods (such as switching to a vege-tarian or a flexitarian diet) would contribute to lower CO_2 emissions, which is consistent with a previous study (Hemler & Hu, 2019).

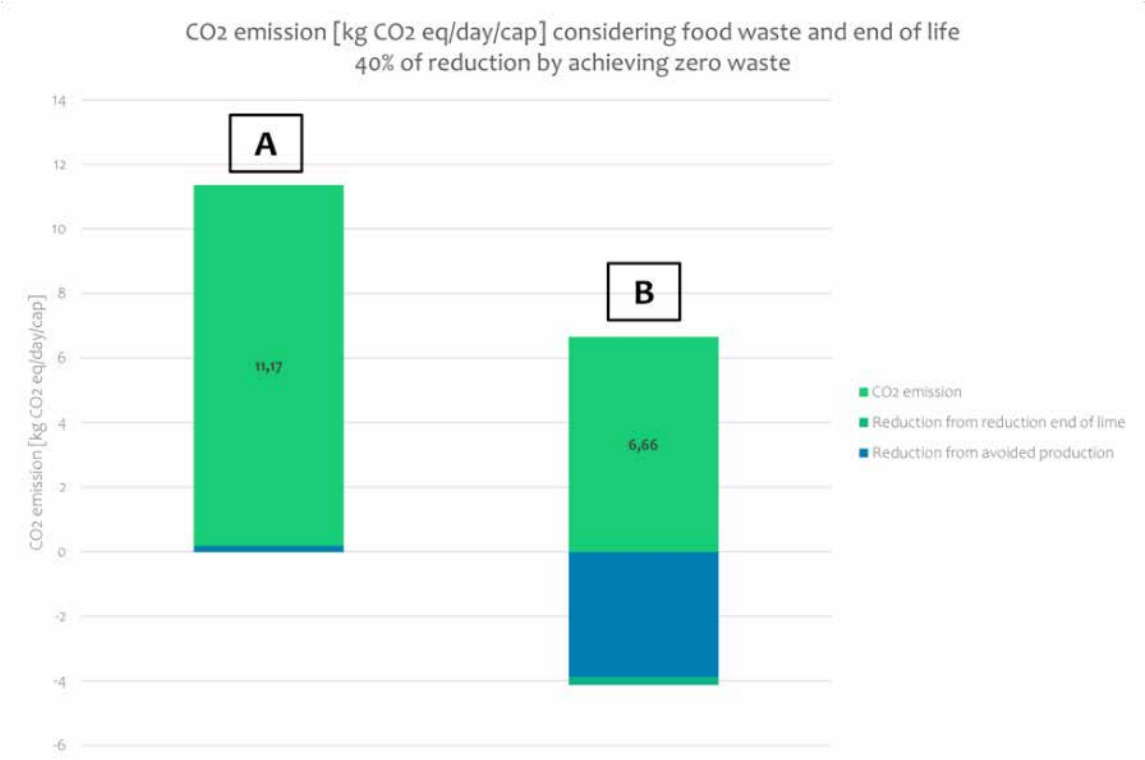
Figure 19 | CO_2 emission expressed in [CO_2 eq. kg/day/capita] when each diet is followed by 100% of the population



c. Reducing food waste at home and by retailers

Eliminating all food waste has the potential to reduce 40% of food-related CO2 emissions (Figure 20). This is particularly interesting because with the food that is saved and improvement in the food system, Brazil could feed the 3.4 million residents, who currently suffer from malnutrition (FAO, 2022).

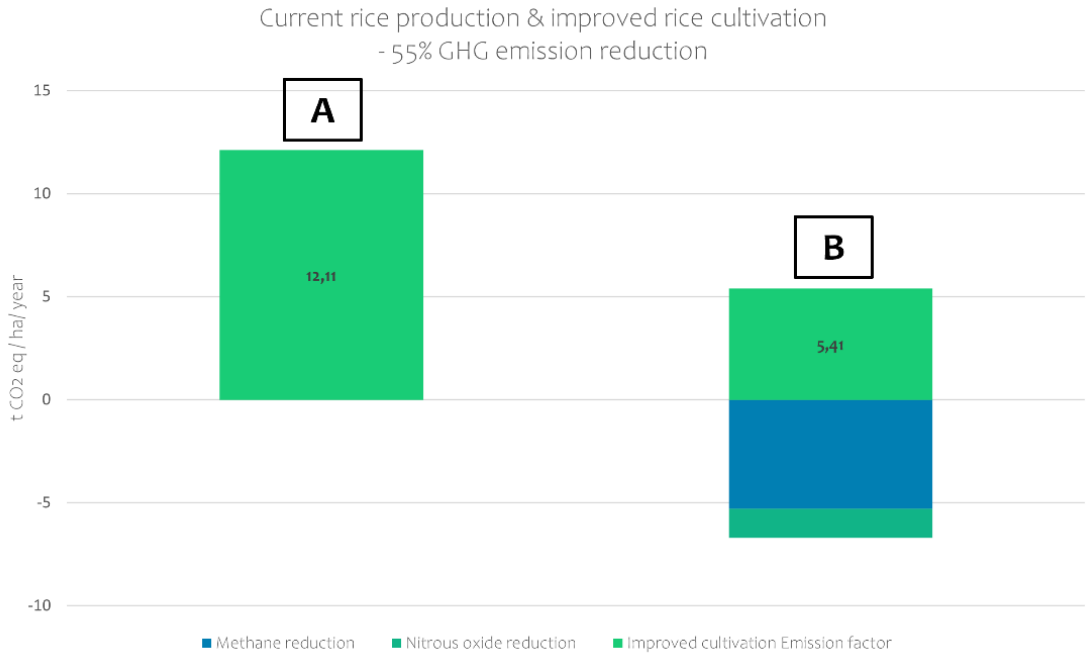
Figure 20 | CO_2 emissions expressed [kg CO_2 eq./day/capita] with A) the actual food waste versus B) 0% of Food Waste



d. Prioritizing sustainably produced food

Changing the current practice for rice production in Brazil provides another opportunity to greatly reduce the country's food-related emissions. If rice production hypothetically transi-tioned to methods that are 100% sustainable, a 55% reduction of rice-related CO_2 emissions could be seen (Figure 21), saving 10'224 tons of CO2 equivalent every year (Annex 3). Although this reduction would equate to a low 0.84% reduction of daily consumption CO_2 equivalents, this level is interesting from a consumer empowerment perspective, because choosing items that are more sustainably produced is already recognized by consumers as a way that they can positively influence their impact on nature. This is shown by the consumer perception that eating organic is a way to improve both their health and that of the planet. Applying nudges on regeneratively grown food, like labelling or education thus proves one powerful way to use consumer power to influence the demand for more sustainably produced food.

Figure 21 | CO_2 emissions expressed [t CO_2 eq./hectare and per year] for A) the current rice production versus B) improved rice cultivation

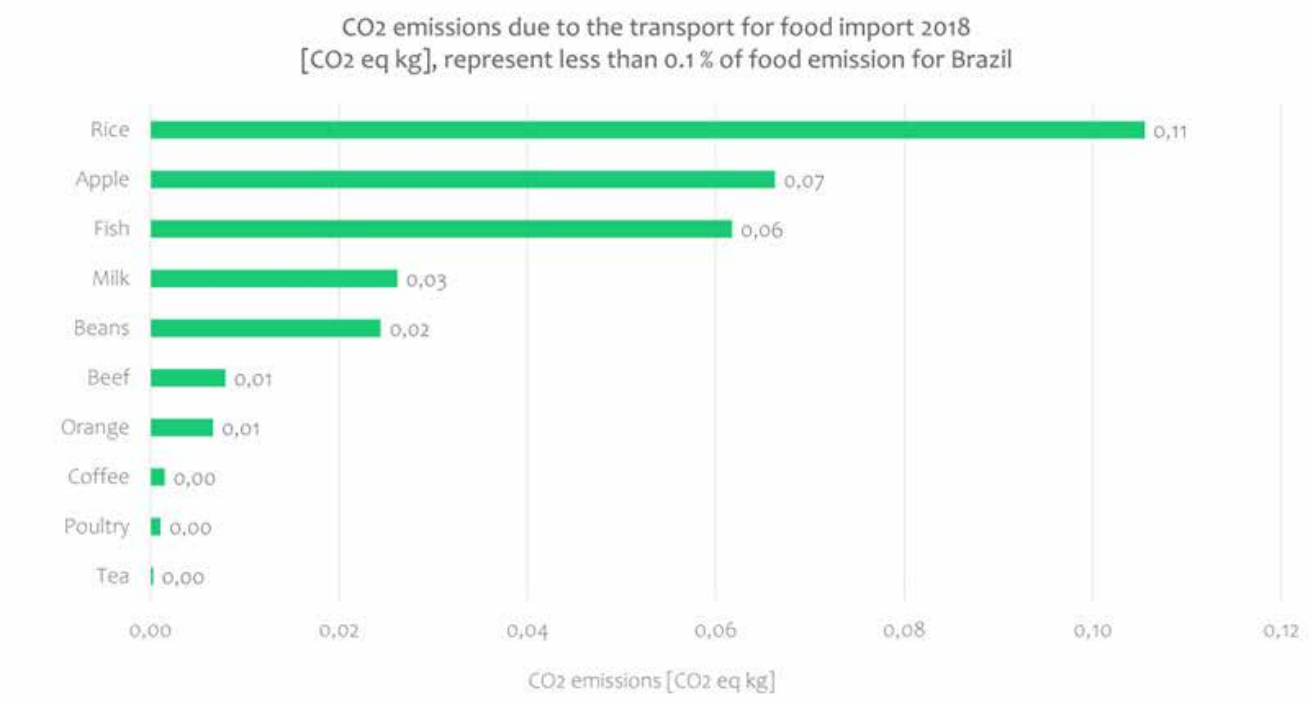


e. Consuming domestically produced food

If all food was domestically produced in Brazil, the emissions reduction would be 0.1%, which does not present a remarkable reduction of greenhouse gas emissions (Figure 22). This can be explained by the fact that the Brazilian diet already consists mainly of foods that are domestically produced (FAOSTAT,2020). As a result of the low reduction potential and the already high proportion of locally produced food consumed in Brazil, it was decided that no nudge is recommended for this lever.

However, it is important to note that consuming domestically produced food has other advantages beyond the potential reduction of emissions from transportation; indeed, food sovereignty means increased resilience, with individuals being better connected to their land and culture.

Figure 22 | CO_2 emission due to the transport for food import 2018 expressed in [CO_2 eq. kg]



4.3 Impact of reduction potential from green nudging

4.3.1 Consumer-driven scenarios for emissions reductions

Several scenarios were modelled (Figure 23) to assess the potential in emission reductions coming from shifts in Brazil's food consumption behaviours. These scenarios incorporated expectations for a growing population in the coming years (Annex 5).

a. Baseline

The Baseline Scenario represents the current aggregate Brazilian consumption and was modelled based on the current mix of diets across the population (IBGE, 2021).

Like any large and diverse country, the Brazilian population has a very broad mix of diets. To picture the diversity of diets in Brazil and how those might evolve in the future, a segmentation of consumers by types of generally preferred diets has been developed. The following list defines the segments based on their diets. For each of them, usual types and amounts of products consumed have been modelled, including animal products consumed like dairy, meat and alternative protein:

• Omnivore: An omnivore diet integrates animal products in larger quantities.

• Flexitarian: The flexitarian diet follows a vegetarian diet with occasional consumption of meat or fish.

• Alternative proteins: The alternative protein diet follows the vegetarian diet with the addition of protein sources coming from insects and lab-grown meat.

• Vegetarian: Under a vegetarian diet, no products that have directly caused the death of animals are consumed (no meat, fish, poultry, or seafood).

• Vegan: Under a vegan diet, no animal products are consumed (no meat, dairy, eggs or honey).

Recent surveys (IBOPE, 2018) estimate the number of vegetarians in Brazil to be 30 million (about 14% of the population). The other segments have been modelled to equal the known total emissions of the current average Brazilian diet, that is 75.3% omnivores, 7% flexitarians, 14% vegetarian and 3.3 vegan (Annex 6). Alternative protein diet has not been integrated into this mix, due to the extremely low portion of the population who currently consumes insects, and the lack of availability of lab-grown meat.

b. EAT diet

The EAT report (The Eat-Lancet Commission, 2019) was oriented around the principle that humanity is facing an immense challenge, providing a growing world population with healthy diets produced via sustainable food systems. This report introduced the concept of a "Planetary Health Diet" that highlights the role that diets play in the health of both humans and the planet.

The EAT Lancet Commission (2019) provided scientific targets for a planetary health diet, with an intake of 2500 kcal/day (Appendix: Table 3). The EAT diet was the basis, or end goal, for the modelling in this study. Because it prioritizes both the health of humans and the planet, and its recommendations are fully aligned with the Ministry of Health of Brazil (2015) "Dietary guidelines for the Brazilian Population", the EAT diet is the basis or end goal for the modelling done in this project, which we will com-prising of different scenarios. The following two scenarios have been used for comparison purposes:

- Objective 1: 50% of the population adopts EAT diet
- Objective 2: 100% of the population adopts EAT diet

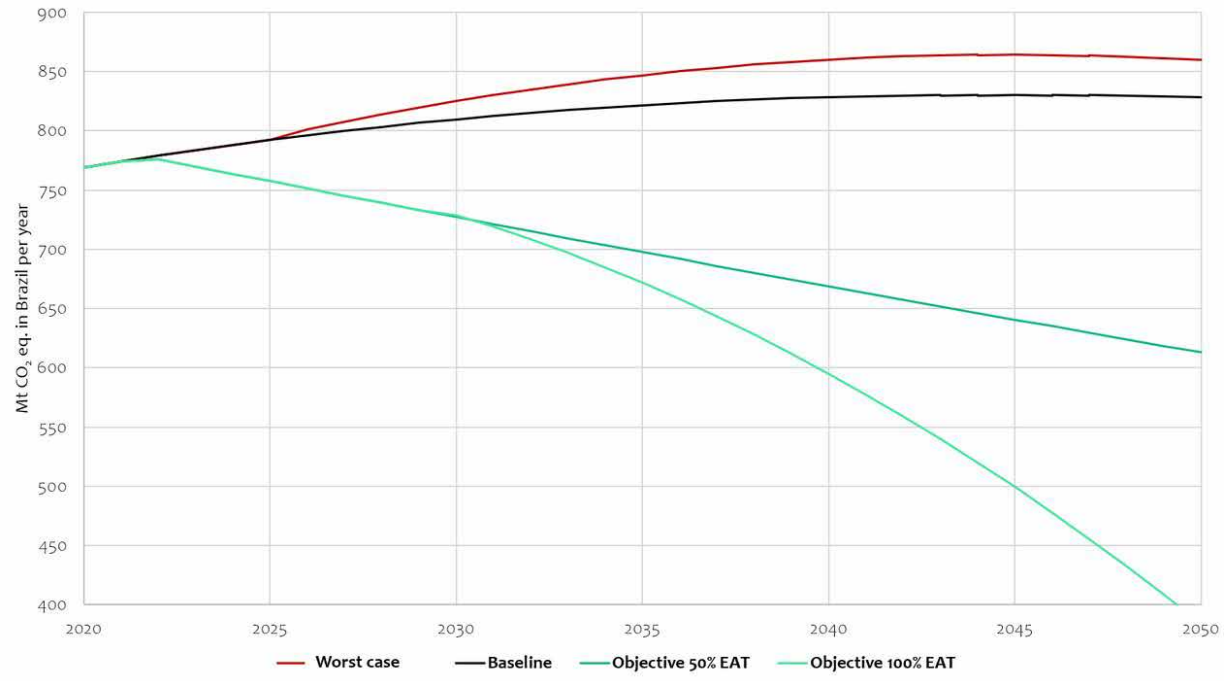
If 50% or 100% of the Brazilian population was eating in alignment with the EAT diet, Brazil would save a cumulated 3.58 gigatons / respectively 5.35 tons of CO2 eq. emissions be-tween 2023 and 2050, or a 14.20% / respectively 21.23% per year compared to current average diet.

If the total population of Brazil was eating under the EAT diet, the food-related emissions would total 1'053 kilotons of CO_2 eq. per day. To make this figure more understandable, this would equate to 25% of the population eating a vegan diet, 25% a vegetarian diet, 26% a flex-itarian diet, 20% an alternative protein diet, and 4% an omnivore diet (Annex 7).

c. Pessimist baseline

Based on literature (Bodirsky et al., 2020), a pessimistic (worst-case) scenario was generated by assuming that the number of omnivores, or people that are eating animal protein ~15 times a week is going to increase in the future.

Figure 23 Representation of the CO_2 emissions evolution through 2050 expressed in [Mt CO_2 eq.] for the worst-case(pessimist), Base-line, Objective 1: 50% EAT diet, Objective 2: 100% EAT diet



d. Nudges

The last scenarios are directly linked with the fourth objective of the study which is to evaluate the potential reduction if nudging strategies are applied to the actual food consumption in Brazil.

4.3.2 Emissions reduction potential from green nudging strategy

Based on research results, three nudging strategies were modelled in a simulation of future scenarios, to evaluate what would happen if the nudges were applied at scale. The three nudges evaluated were (1) default nudging on plant-based protein; (2) semiotic and descriptive nudging on label logos and educational information; (3) placement nudging on making target options more prominent than non-environmental options. These were applied either jointly or separately to determine how close the nudges would bring Brazil to the ultimate objective, that is Objective 2 where 100% of the population transitions to an EAT diet equivalent. The more realistic target laid out in Objective 1 where 50% of EAT diet equivalent. Because these nudge strategies are particularly relevant to e-commerce plat-forms, the modelling considered the portion of Brazilians who are shopping on e-commerce platforms (Figure 24) with an expected 4% annual increase in the use of these platform (Annex 8).

Figure 22 Explanation of the scenarios modelling: Nudge strategies are particularly relevant to e-commerce platforms; therefore, the modelling considered the portion of the Brazilian population who are shopping on e-commerce platforms, and among them, those who environmental protection matters.

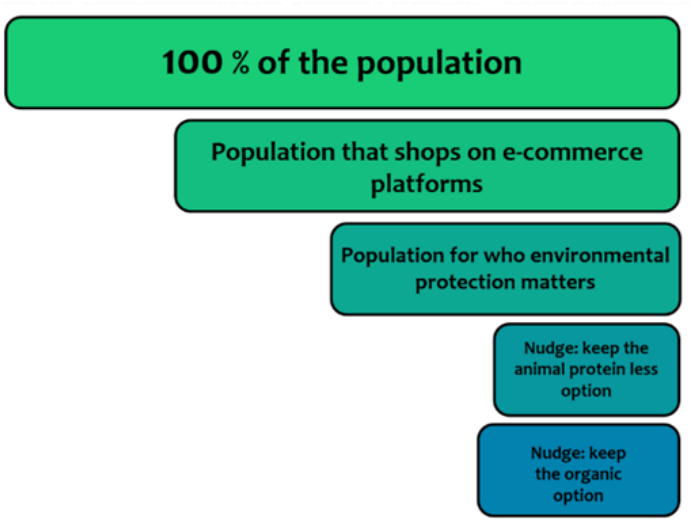
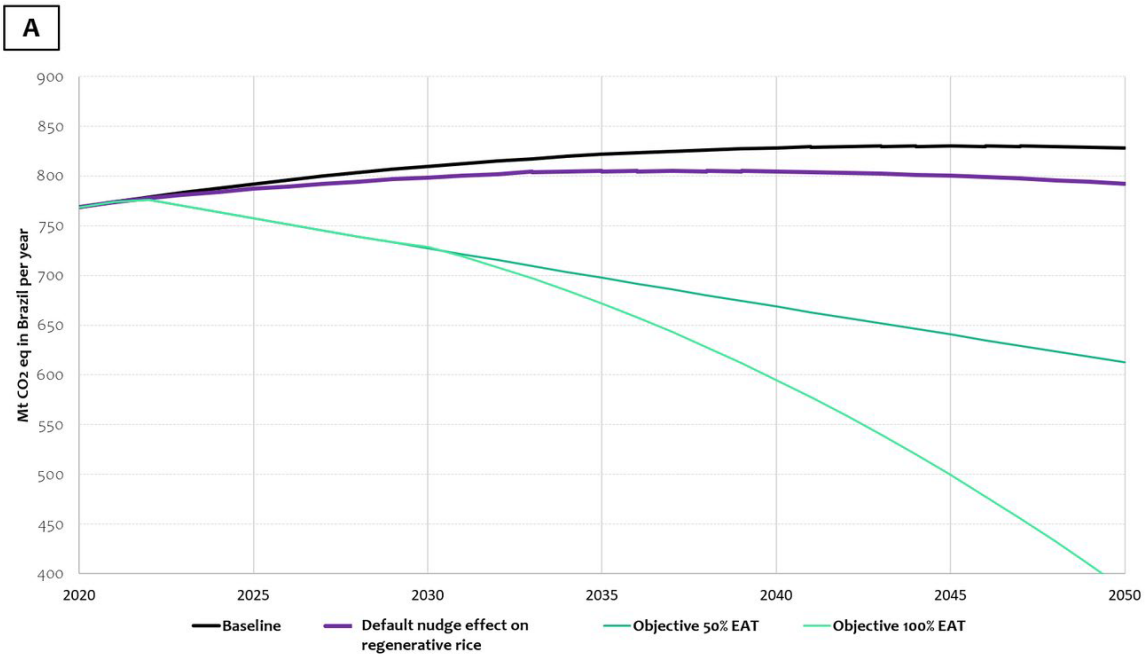
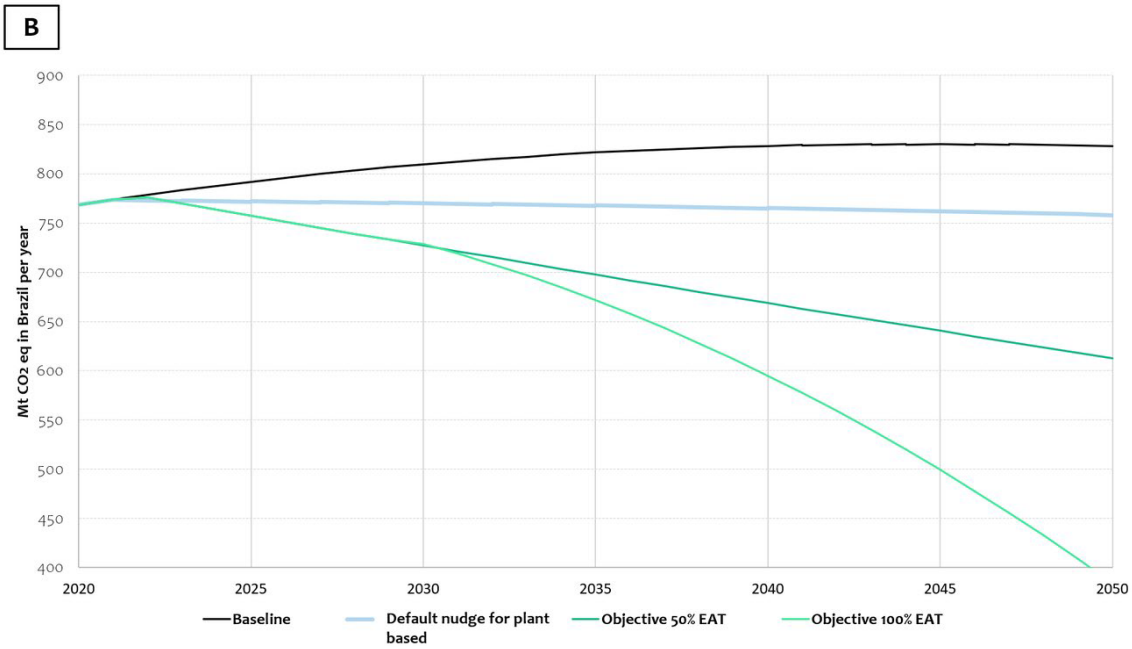


Figure 25

Representation of the CO_2 emissions evolution through year expressed in [Mt CO_2 eq. per year] for the scenario (Baseline, Objective 1: 50% EAT, Objective 2: 100% EAT) and if nudges are applied: A) Default nudge effect on regenerative rice B) Default nudge for plant-based C) Placement nudge D) All nudges together





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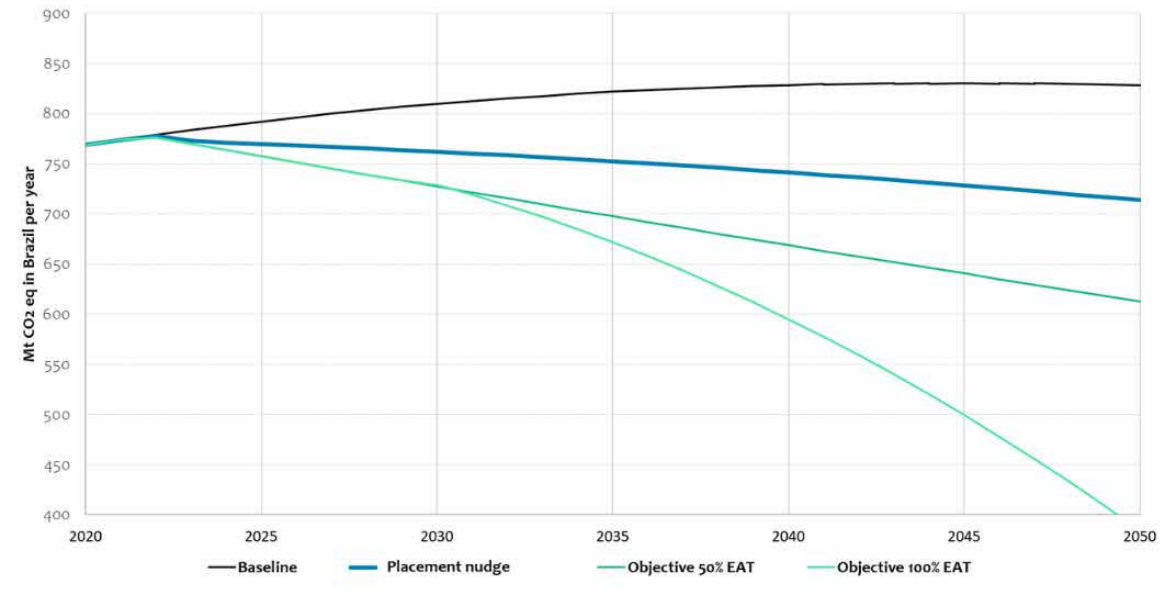
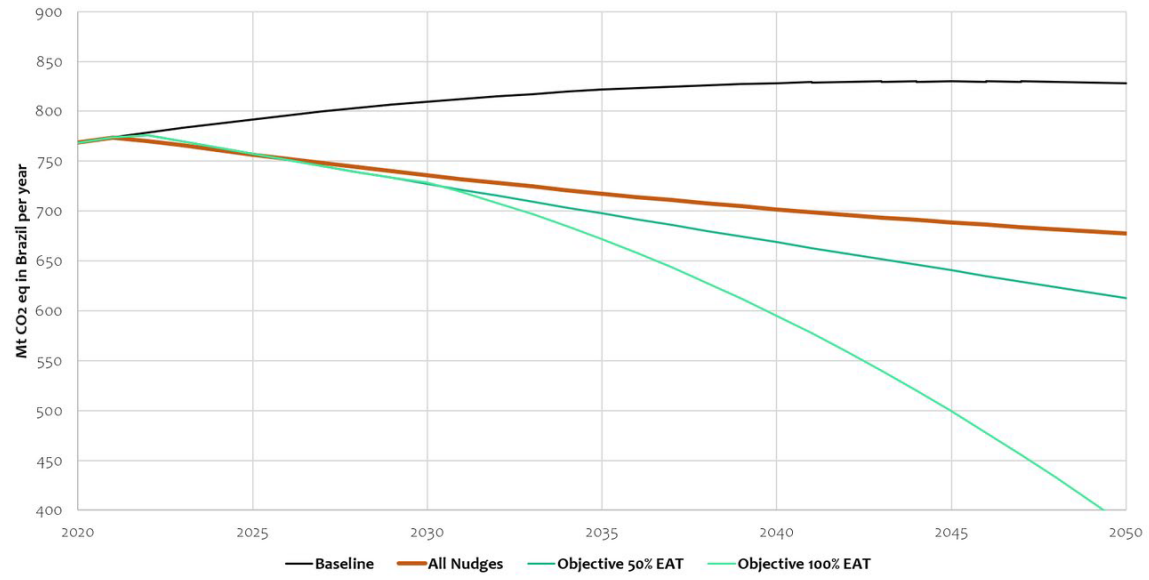

900
850
800
750
700
650
600
550
500
450
400
Mt CO2 eq in Brazil per year
2020
2025
2030
2035
2040
2045
2050
Baseline
Placement nudge
Objective 50% EAT
Objective 100% EAT

D


900
850
800
750
700
650
600
550
500
450
400
Mt CO2 eq in Brazil per year
2020
2025
2030
2035
2040
2045
2050
Baseline
All Nudges
Objective 50% EAT
Objective 100% EAT

Regarding the results of all nudges separately, the placement nudge is the one that reduce the most the CO_2 emissions (7.85% or 1.97 gigatons of CO2 eq. from 2023-2050, Figure 25.C). Next is the default nudge for plant based (5.7% or 1.44 gigatons of CO_2 eq. from 2023-2050) and the default nudge effect on regenerative rice (2% or 0.504 gigatons of CO_2 eq. from 2023-2050, Figure 25.B and 25.A respectively).

If all the nudges tested in this study (the placement nudge and default nudge on plant-based and on "regenerative rice") were applied by all e-commerce platforms, meaning that all consumers shopping online in Brazil were exposed to the nudges, it would allow to reduce the impact of food consumption by a cumulated 2.41 gigatons of CO_2 eq. (2023-2050). That would bring us to 54.75% of our Objective 2 of 100% of EAT diet equivalent, and 80% of Objective 1 of 50% of EAT diet equivalent (Figure 25.D).

While this is not enough, and while the assumptions taken are clearly too optimistic, we should keep in mind that out of all possible nudging strategies, this potential reduction only represents two that we have tested and modelled in this study. There remain many options to be evaluated.

Figure 26 | Key findings of the impact reduction potential

KEY FINDINGS GOAL 4

IMPACT REDUCTION POTENTIAL

- Switching to alternative proteins and plant-rich diets in Brazil is the most efficient lever to reduce greenhouse gas emissions.
- Reducing food waste at home and preferring food that has been sustainably produced are also two efficient lever to reduce GHG emissions.
- Consuming domestically produced food does not present a remarkable reduction of greenhouse gas emissions at the Brazilian level.
- The placement nudge is the one that reduce the most the CO2 emissions, followed by the default nudge.
- Nudges are more effective if they were applied together.

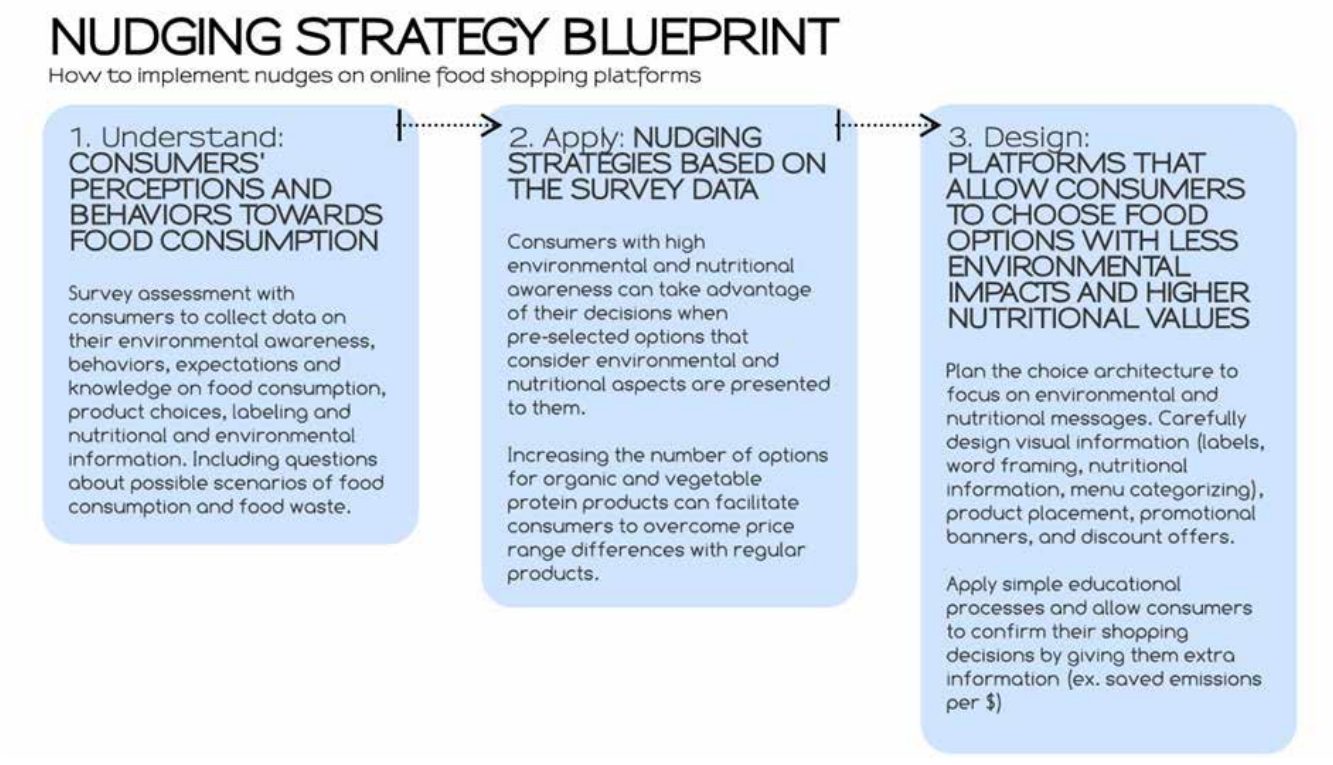
5

Recommendations for implementation

5.1 Private sector: implementation Blueprint for a green nudging strategy on online shopping platforms

Linked with the key learnings exposed in the nudging experiment conclusions, the following actionable recommendations can be made for food e-shopping platforms. Figure 27 shows retailers can implement this study's learning by following a step-by-step recommendation.

Figure 27 | Step by Step Recommendation for Implementing Nudging Strategies



a. Firstly, implementing choices preselection for eco-friendly consumers (high environmental concern score). Pre-selecting eco-friendly choices for consumers who have an eco-friendly profile. Indeed, consumers have repeatedly given sign that they would like to be supported in the shopping choices towards what they wish to improve (93% support national awareness campaigns on food choices); in the case of consumers who would like to improve their environmental impact but do not have the time to make the necessary research, an opportunity arises if consumers are asked in their personal e-shopper profile setup, whether they care for the environment, and whether they give the permission to the e-shopping platform to make recommendations that would lower their environmental footprint.

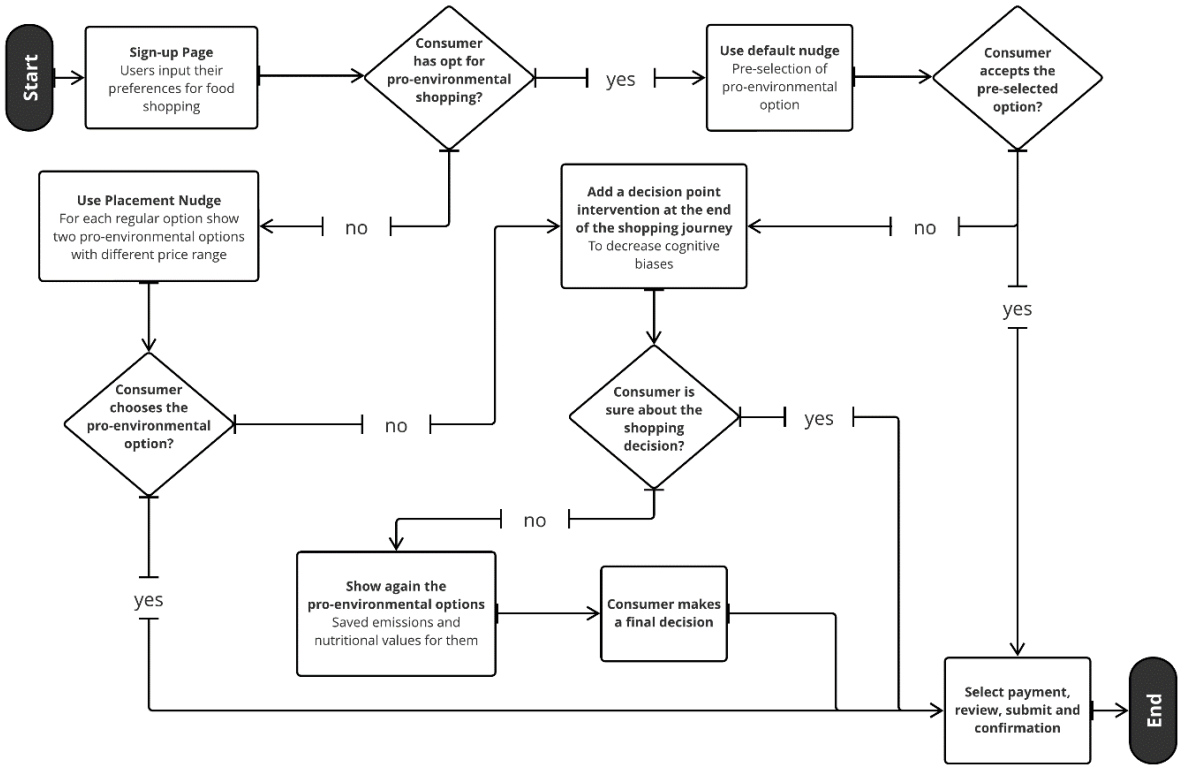
b. Secondly, the application of a simple process of education for food labelling. The effectiveness of labelling is tied to a good understanding and awareness of what the label guarantees to the consumer; as a result, rewarding consumers online with points to spend on their shopping basket if they listen to a short clip explaining what lies behind a specific label and the benefits of the products carrying such label, will increase the understanding of the label and its effectiveness.

c. Thirdly, combining several nudges will increase their efficiency. For example, combining a placement nudge (making environmentally friendly options more prominent than non-environmental options) with a social reference nudge (for ex-ample, positive consumer feedback visible next to the products) may increase the likelihood of an eco-friendly product being chosen.

d. Finally, online shopping platforms should ensure similar visibility of eco-friendly products as non-eco-friendly ones. Showing plant-based / eco-friendly alternatives next to the animal product / non-eco-friendly product that consumers looked for will give visibility of plant-based products to consumers who might otherwise not have searched for it and increase the likelihood of the product being tested.

These recommendations need further tailoring to different social contexts and jurisdictions where shopping decisions initially occur. Figure 28 shows a blueprint tree as an example of how to implement the nudging strategies within the consumer journey.

Figure 28 | Blueprint tree for Implementing Nudging Strategies



5.2 Food policy recommendations

The survey also asked participants about their support for public policies and retail initiatives that could support their decisions toward more sustainable food choices. 92% supported the increase in the share and diversity of organic food, and 86% agreed on the importance of promoting products with high animal wel-fare standards by supermarkets. In the case of public policies, 82% agreed to establish food waste taxes for food production and distribution and 65% on taxing sugary drinks to subside healthy food products. Respondents also supported subsidies for farmers with higher animal welfare standards (84%), for farms involved in organic production (83%) and for fostering organic food and local farmers' markets (89%). But even more strongly, 93% supported implementing awareness campaigns about the environmental impacts of food products. Respondents also clearly stated that they expect the government to step up and help them on their journey, with 79% of respondents replying that the government should do more to mitigate food production emissions and 65% stating that monetary incentives are necessary to help the population to change their behaviour to protect the environment.
The nudging experiment results also indicate that simple informational designs can facilitate information acquisition to decrease biases (e.g., food price ranges, food taste perception) toward sustainable food choices. Results also support the demand for policies to go beyond the traditional approach of encouraging better food choices based on providing only nutritional information.

Firstly, individuals learn better in the place where they make their decisions. Educational programs on food consumption must take place where consumers shop for food, so they can visualise the options and the labels and get used to the actual choice architecture. This approach can avoid the counter-productive "rule of thumb" effects or vicious nudging strategies (e.g., take one for the price of two). A study by Bem Lignani et al. (2010) shows the importance of educational programs on food consumption. They analysed changes in self-reported food intake among Brazilian families that benefitted from conditional cash transfer implemented in the Program Bolsa Família by the Brazilian Federal Government. Families increased consumption of all food groups analysed; however, increases in fruit and vegetable consumption were smaller than those for cereals (mainly rice), beans, meat and milk. Processed foods and high-density, energy-rich foods demonstrated the most significant increase.

Secondly, better decisions do not necessarily depend on complex rational pro-cesses. Previous studies show (e.g., Barcellos et al., 2011) that attitudes towards the environment and nature may influence citizens' specific positions towards animal farming, but these positions' influence on consumers' behaviour is usually weak. Heuristics are shortcuts individuals use when making decisions between alternatives, so they can quickly make decisions without knowing all the information about each food alternative. Nudging strategies can facilitate these heuristic processes. Results show that labelling is a powerful tool that can easily communicate to consumers the one cue or characteristic that differentiates the food options. However, it is necessary to ensure that consumers use a valid label (i.e., valid cue) as the reason behind their decision.

The survey has shown a strong recognition by respondents of governmental labels (72.5% on average), and 56% also declared they trust the information written on food certification labels. Thus, developing a comprehensive policy involving all societal actors is suggested to facilitate food consumption choices that can effectively contribute to mitigating environmental impacts (e.g., climate change, bio-diversity loss). It primarily involves designing a label that can easily convey this message and does not repeat information already delivered by current and well-established labels (e.g., organic product label). Legislation and regulation must also be implemented to avoid any message bias after employing the label. And most important, it must be combined with an educational program to ensure the understanding by consumers of its underlying bene-fits to the environment and their health.

The new Brazilian regulation on nutrition labelling of package food products, approved by the National Agency of Sanitary Surveillance in October 2020 and put in force in 2022, facilitated the understanding of nutritional information by imposing the label to be placed on the front panel of packaged foods using simple and straightforward icons to emphasise high contents of saturated fat, added sugar and sodium. According to ANVISA (2020), these three nutrients were chosen because they represent the most critical ones to consumers' health, and there is robust scientific evidence pointing in this direction. Additionally, ANVISA considered Brazilian consumers' concerns about these nutrients. The table of nutritional information has also gone through significant changes. From now on, it will be mandatory to use a black font and white background. It will also be mandatory to place the nutritional information table close to the ingredients list. It will not be permitted to cover, break, or display the table in areas of difficult reading or areas that may be deformed by the package's nature.

The same approach can be applied to certain features that can characterise a food product as less harmful to a certain environmental impact, such as climate change or biodiversity loss. These features can be designed based on life-cycle sustainability assessment (LCSA), which refers to evaluating environmental, social, and economic in decision-making processes towards more sustainable products throughout their life cycle (Zamagni, 2012). This approach suggests a policy aiming to lead consumers to make more conscious food consumption decisions considering relevant information on environmental burdens. A new framework must be established to legitimate the information, its content, and how it will be displayed to consumers. A key finding of our study shows that word framing is a significant factor to decrease consumers' bias or misconceptions toward environmentally friendly food products. In this direction, all food system societal actors (i.e., production, processing, distribution, retail, and consumption) must be involved in designing, implementing, and operating this policy. To conclude, this food labelling educational policy should aim to promote a sustainable food system in Brazil. Sustainable food systems are those systems that aim at achieving food and nutrition security and healthy diets while limiting negative environmental impacts and improving socio-economic welfare.

5.3 Further market testing of Green nudging strategies

The current study allowed to test the effectiveness of several nudging strategies, including the attraction and the default nudge. The study also raised some questions and invited us to investigate further the potential of using a nudging strategy to positively influence con-sumption by reducing food products' environmental impacts. The list below proposes a non-exhaustive list of recommendations for future nudging research:

• Test nudging strategies in affordance to explore the features of a product and people's inherent associations with it. Since taste and wording associations were found to be significant, exploring them may represent opportunities for action. Social ref-erence nudge may be another strategy to be tested to overcome these associations.

• Test semiotic nudging strategies in brand, packaging and marketing.

• Test the combined effect of multiple nudges since it can increase the impact on sustainable choices.

• Test this research's outcomes for choice architecture interventions on similar real shopping situations.

• Measure the adoption of nudges in food consumption impact on consumers' experience, satisfaction, and perception of value to infer its longevity effect.

• Future simulations should consider the possibility of product acquisition and payment since there is a possibility of social desirability when participants do not have to pay for their choices.

• Further research should evaluate how subjects respond to different types of transparency for different types of nudges and should also investigate the link between transparency and the different underlying working mechanisms of defaults and other types of nudges.

• Further research needs to explore unintended consequences (i.e., rebound effects), where individuals may compensate for nudged food choices with less preferable additions (e.g., snacks, drinks), which may undermine positive outcomes.

Thus, future studies should design experiments to run on or to simulate existing e-commerce platforms to mirror the context in which consumers are already used to shopping. Minor changes to the choice architecture (i.e., online environment) may be necessary to implement the nudging strategies.

Experiments may also require financial incentives, enabling participants to play their role as consumers since they will be able to buy and receive the food selected during the experiment. The product list should be short to avoid unnecessary complexity and to facilitate tracking the consumer journey during the experiment. The number of participants is directly related to the statistical power effect needed; however, representative samples of a specific population are always advised for studies aiming at designing policy recommendations and blueprints to be implemented by retailers.

6
Conclusion

The overall NatureFinance study, of which this consumer-focused work is a part of, looks at four normative outcomes: nature, climate, jobs and access to nutrition. The other studies indicate that a 'policy driven internalization of nature and climate risk' are more efficient from a resource and equity point of view compared to a 'financial risk-driven' transition. Consumers play a critical role in this process and Brazilian consumers' behavior regarding food choices will have a strong impact on the country's ability to become carbon neutral and to halt its biodiversity loss.

This study provides critical insights on green nudging efficacy and recommendation for necessary policy decisions, to support elected candidates in their climate and food-related work.

Insights on green nudging efficacy:

• Insight 1: Nudging strategies can help consumers shift their food choices and behaviours toward more sustainable food products and healthier diets.

• Insight 2: Labeling is a powerful tool for engaging consumers in making better decisions, particularly labels with simple messages that consumers can easily understand.

• Insight 3: Nudges are more effective when used in combination, particularly when it comes to switching to alternative proteins and plant-rich diets in Brazil, which is an effective lever for reducing greenhouse gas emissions.´

Public policy recommendations:

(a) develop a comprehensive labeling policy capable of translating relevant data on environmental and other impacts of food products based on a consistent methodology for inferring them;

(b) plan a food consumption educational program to be implemented where consumers typically make their food choices; and

(c) engage all stakeholders from the food systems in the design, implementation, and deployment of this new policy.

Brazil is at a crossroad. It has developed a large-scale agricultural system, recognized world-wide for its role in domestic economic growth and expanding exports. However, the success of this sector is associated with widespread damage to Brazilian ecosystems as well as environmental degradation. To achieve a sustainable and equitable agricultural system, Brazil must reconcile its increas-ingly productive current system, with environmental conservation and new patterns of food consumption behavior. Brazil has the unique opportunity to lead in this venture by combining modernized agriculture, ecosystems' preservation policies and promoting sustainable food behavior.

Our study offers a contribution to the understanding of sustainable food consumption in Brazil. Firstly, by investigating the variation in consumption preferences, perceptions, sociodemographic data, and environmental burdens of food consumers choices. Secondly, in revealing nuances of nudging strategies in describing how they positively impact consumers' food choices and may mitigate GHG emissions.
To date, few solutions and actions have been approved and implemented in Brazil to mitigate climate change, biodiversity loss and other environmental impacts related to food consumption. Yet, our findings suggest that improvement is possible with consumers in the driving seat, steering towards a sustainable future. However, the needed transitions must be supported by policymakers, retailers, and the financial sector. Consumers have shown that they care for the environment and their health, and that they are willing to modify their diets, if the Brazilian system supports these changes.

A 'Policy-facilitated' transition will improve economic and social incomes while speeding up decarbonization of the food system, allowing ecosystem restoration and benefits for nature, compared to a so-called 'financial risk driven' transition where protecting financial systems is prioritized (Finance, Nature and Food Transitions, 2022). Considering this finding, it needs to be a priority to issue policies that build on nudging strategies to empower consumers to improve their diet for their own health and for that of the planet. This would generate benefits for climate, nature, jobs and food affordability by responding to pressing demands from citizens for their government to support them in making better food choices.

In addition to building on the successfully proven nudges from this study, we recommend combining improved labelling with matching education, and to make eco-scores on all products mandatory, like the nutritional label policy already in place in Brazil. While solely educating consumers about the relative impact of each type of food would be cumbersome for manufacturers, retailers, and consumers themselves, the recommended policy approach provides complements basic education with easy-to-understand information and the needed transparency to simplify the consumer journey.

This step towards transparency would simultaneously provide a new competitive edge for companies to show their environmental performance, further fostering innovation within the food system for a faster transition to operating towards sustainability.

Ultimately, nothing is designed nor decided yet, and room for maneuvering remains. One thing is for sure, however, a just and effective food system transition can only happen with the support and involvement of consumers.

Figure 29 | Key recommendations of this study

KEY RECOMMENDATIONS

E-COMMERCE PLATFORMS
- Implement choices preselection for eco-friendly consumers.
- Apply of a simple process of education for food labelling.
- Combine multiple nudges will increase their efficiency.
- Ensure similar visibility of eco-friendly products as non-eco-friendly ones on e-commerce platforms.

POLICY MAKERS
- Develop a comprehensive labelling policy to account for avoided emissions and other impacts of food products.
- Design an educational program on food consumption to be implemented where consumers usually make their food choices.
- Involve all societal actors of the food system in both steps to guarantee policy effectiveness and acceptability.

Glossary

Attraction nudge	It describes how, when individuals are choosing between two alternatives, the addition of a third, less attractive option (the decoy) can influence their perception of the original two choices.
CO2 eq.	It represents the carbon dioxide equivalent which is a metric measure that converts all greenhouse gases to their equivalent amount of carbon dioxide.
Control group	A standard group to which comparisons are made in the experiment. The control group is not subjected to interventions.
Default nudge	It is the outcome a decision-maker gets under the status quo. It's the pre-set option that is made available when individuals do nothing and requires no effort on their part.
Descriptive nudge	Refers to the perception of the prevalence of a behavior (what most people do, what is done).
Food loss	Food loss occurs along the food supply chain from harvest/slaughter/catch up to, but not including the sales level.
Food waste	Food waste occurring at the retail and consumption level, meaning at the household level or in restaurant.
Improved rice production	Improved rice production is defined as a set of practices to reduce methane emissions from paddy rice production using alternate wet and dry periods and other strategies (Project Drawdown, 2019).
Intervention Group	The group in an experimental study that receives the intervention being tested. Also called an experimental group or investigational group.
Rules of thumb	An approximate method for doing something based on practical experience rather than scientific facts.
Nudge	Any aspect of the choice architecture that predictably alters people's behavior without forbidding any options or significantly changing their economic incentive (Thaler and Sustain 2021).
Placement nudge	It works on the basis that options further away or less prominent will reduce their selection.
Presentation nudge	Presentation (picture vs. words) of a food product is likely to be a particularly effective cue in increasing hedonic-related evaluations of healthy food items among low-HC individuals.
Rebound effect	The rebound effect (or take-back effect) is the reduction in expected gains from new technologies or approaches that increase the efficiency of resource use or choice selection, because of behavioral or other systemic responses.
Regenerative agriculture	Regenerative agriculture enhances and sustains the health of the soil by restoring its carbon content. This improves productivity and removes carbon dioxide from the atmosphere (Project Drawdown, 2020)
Semiotic nudge	To stimulus-response compatibility is an aspect of semiotics, i.e., to nudge through conveying in language, signage, symbols, stories, metaphors, etc., and generally any other visual carrier of meaning.
Social reference nudge	It uses comparison to how others perform to boost individual performances in experiments with one group reference point.

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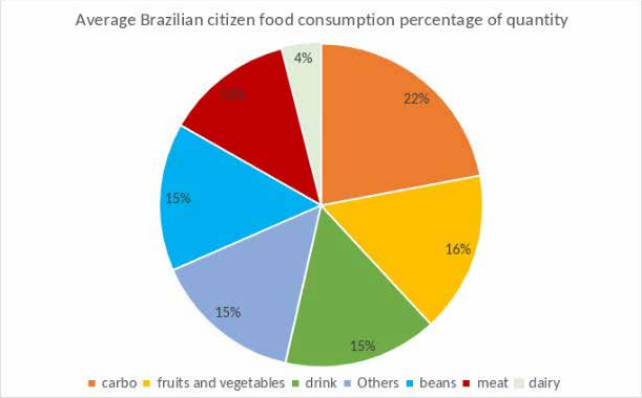
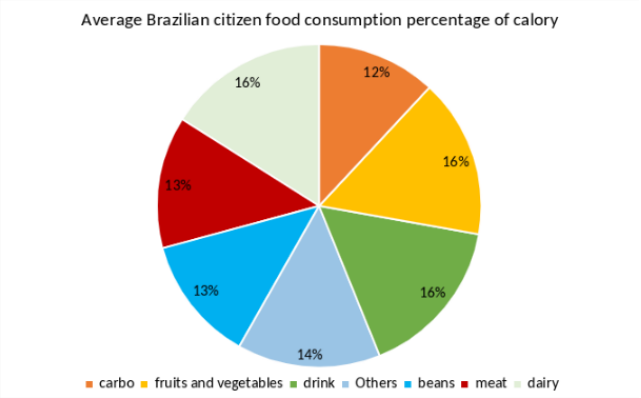
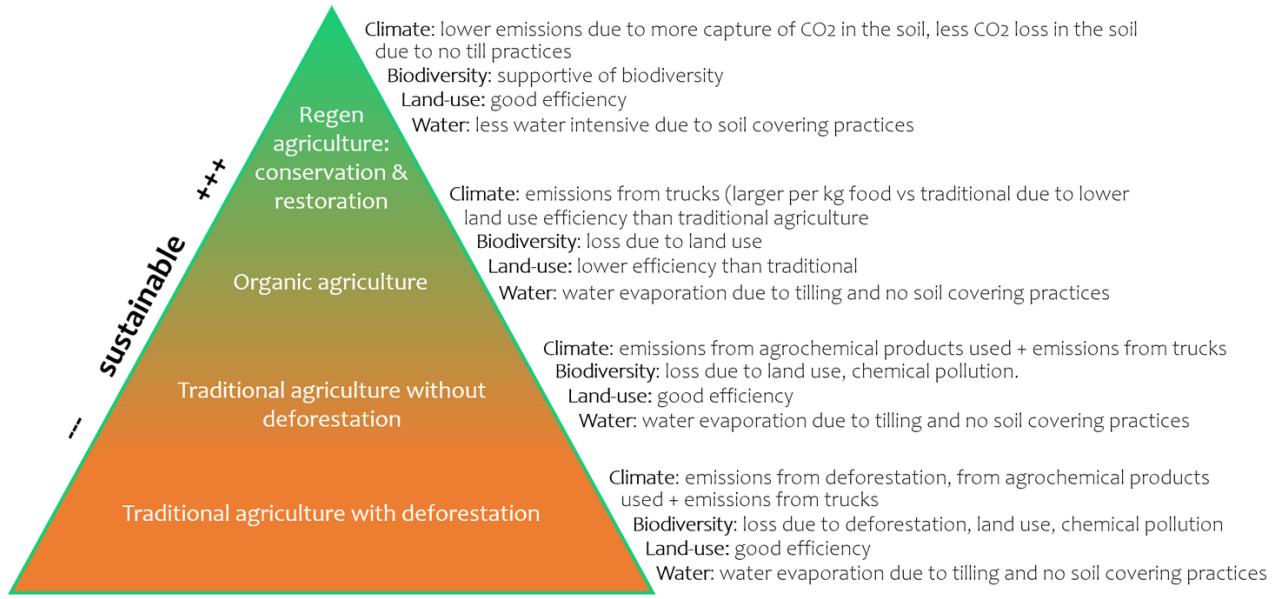
Appendix

Annex 1 | Average Brazilian food consumption percentage of A) quantity and B) Calory. Calculations are based on (IBGE, 2021)

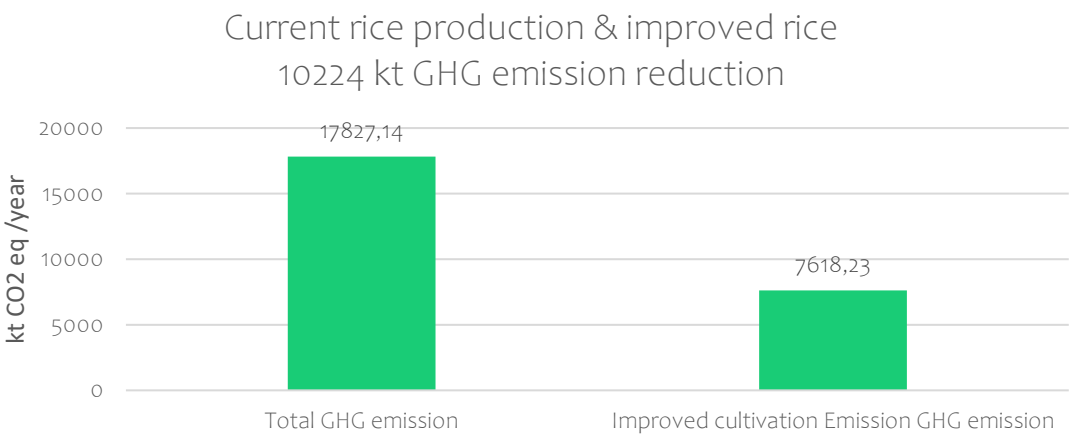




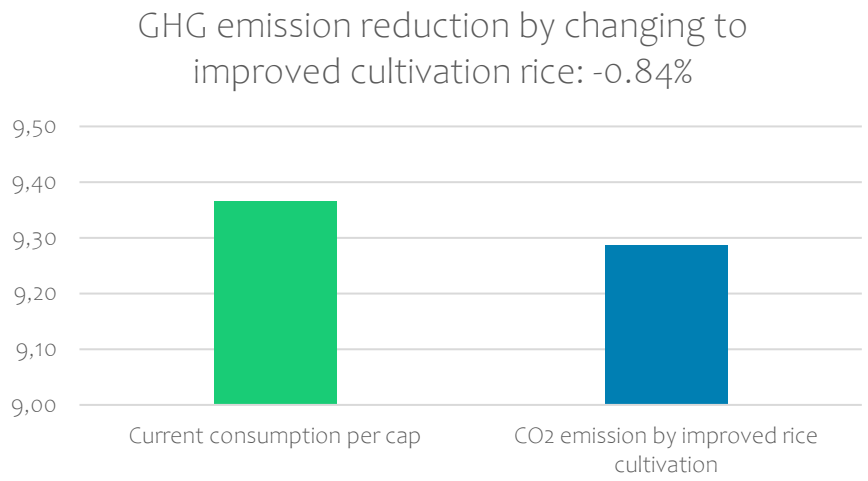
Annex 2 | Different types of agriculture and their impact on climate, biodiversity, land-use and water



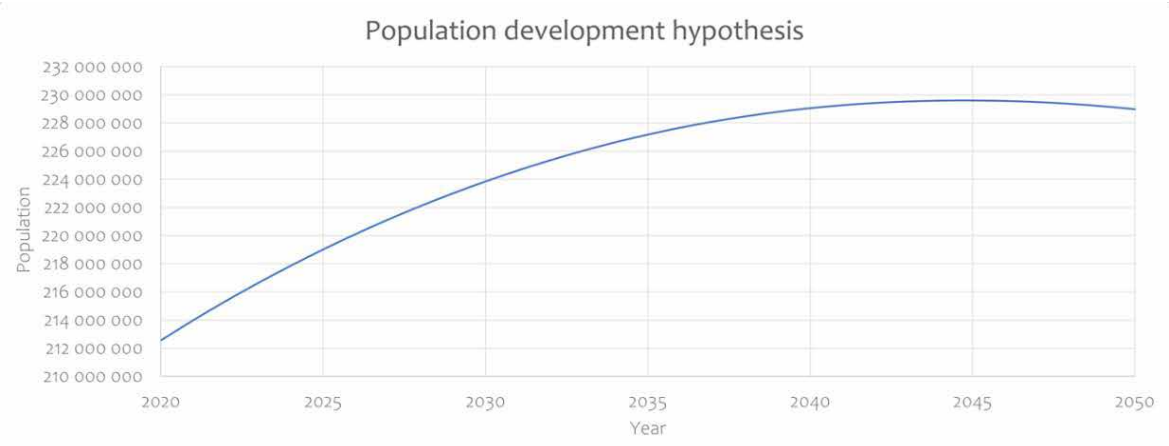
Annex 3 | Improved rice production GHG emission reduction potential



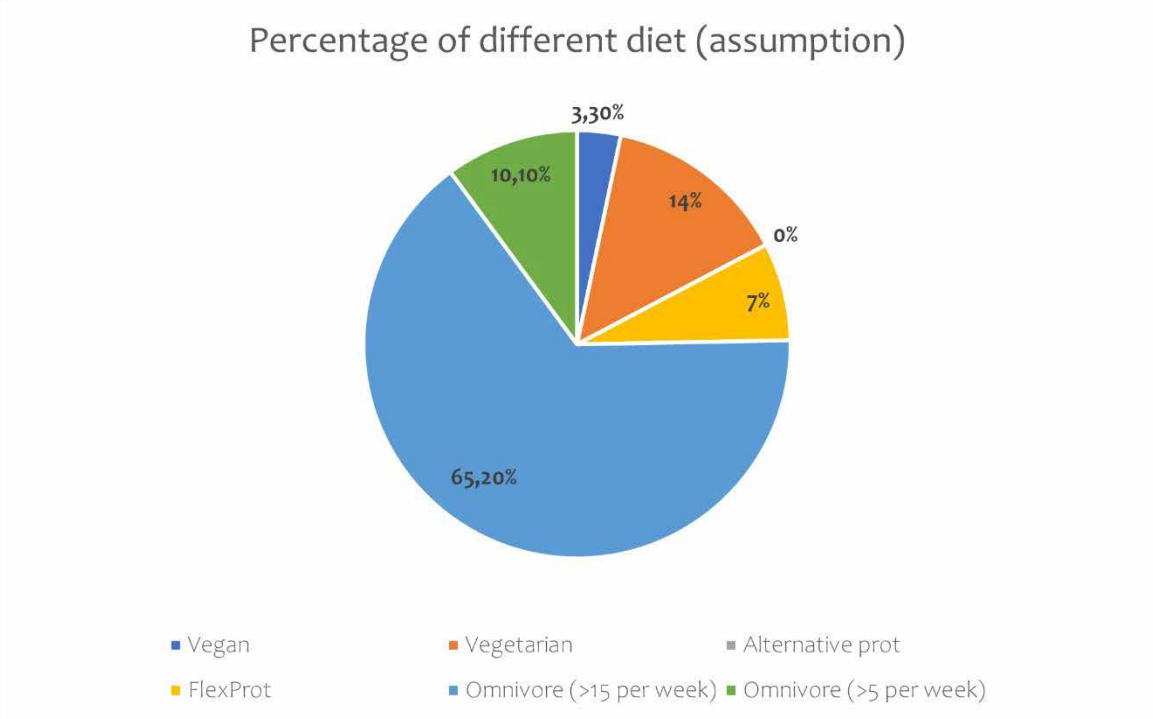
Annex 4 | Total CO_2 equivalent emissions of daily food consumption per capita, with current rice pro-duction vs with improved rice production practices



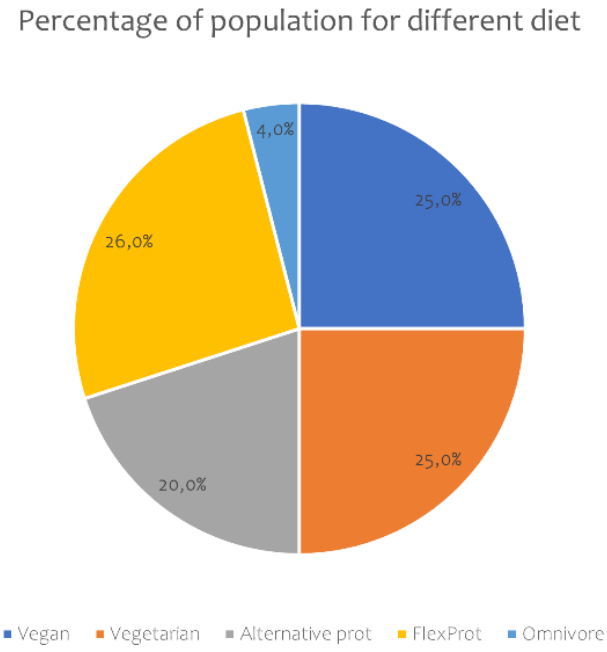
Annex 5 | Population development hypothesis based on https://www.populationpyramid.net/brazil/2007/



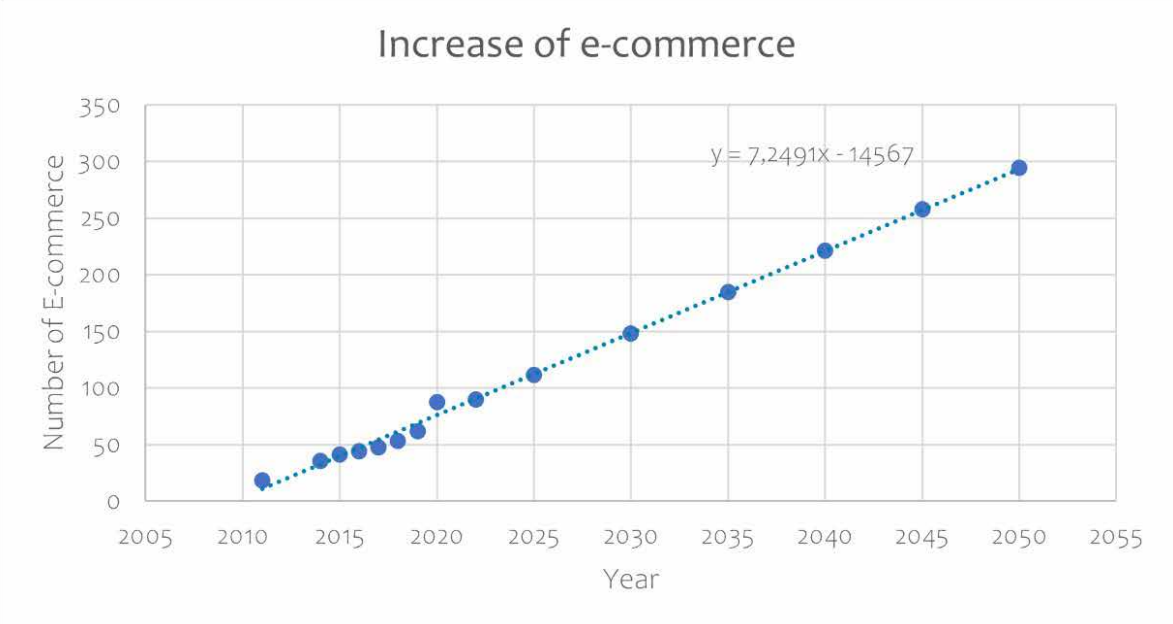
Annex 6 Percentage of each diet in Brazil. Based on the survey from IPOBE (2018) and assumptions



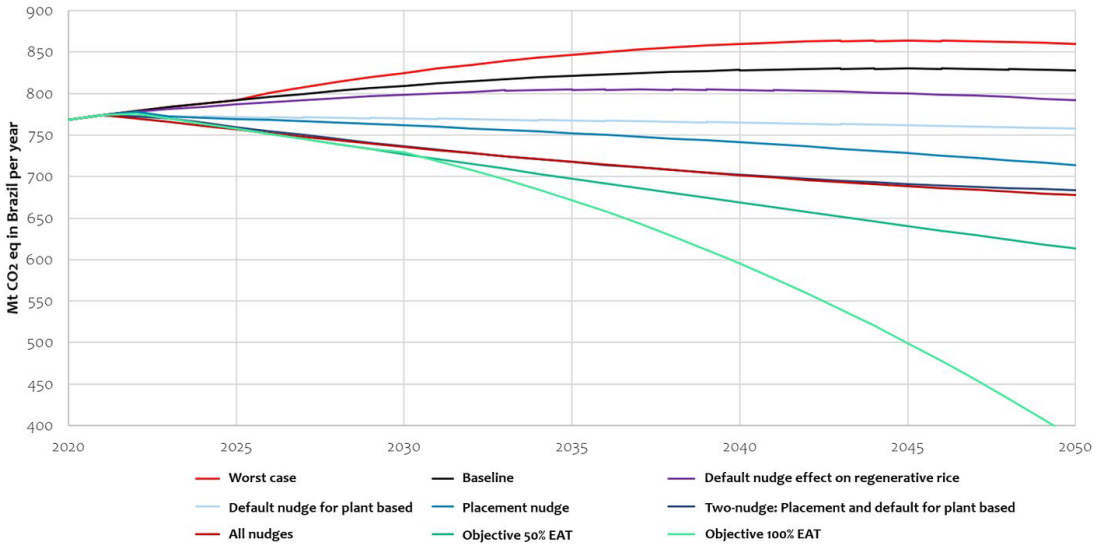
Annex 7 Percentage of the population for different diet if Brazil follows the recommendations from The Eat-Lancet Commission (2019)



Annex 8 Increase of E-commerce, based on data from Webshoppers 43 Ebit|Nielsen & Bexs Banco

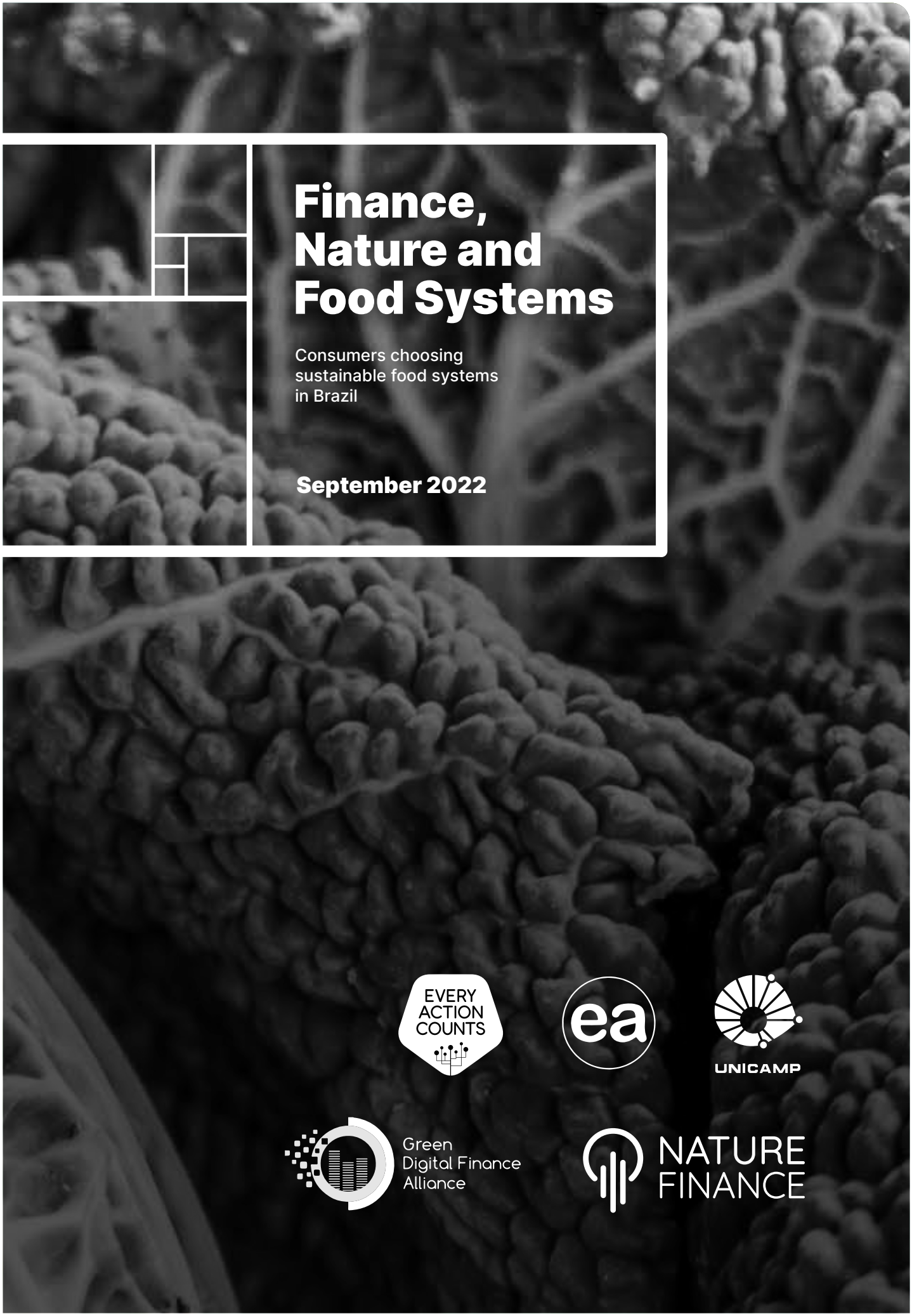


Annex 9 Representation of the CO_2 emissions evolution through year expressed in [Mt CO_2 eq.] for the scenario (Baseline, worst case or pessimist, Objective 1: 50% EAT, Objective 2: 100% EAT) and if nudges are applied (either separately and together).



Annex 10 | Scientific targets for a planetary health diet, with possible ranges, for an intake of 2500 kcal/day (The Eat-Lancet Commission, 2019).

	Macronutrient intake grams per day (possible range)	**Caloric intake kcal per day**
Whole grains		
Rice, wheat, corn and other	232	811
Tubers or starchy vegetables		
Potatoes and cassava	50 (0–100)	39
Vegetables		
All vegetables	300 (200–600)	78
Fruits		
All fruits	200 (100–300)	126
Dairy foods		
Whole milk or equivalents	250 (0–500)	153
Protein sources		
Beef, lamb and pork	14 (0–28)	30
Chicken and other poultry	29 (0–58)	62
Eggs	13 (0–25)	19
Fish	28 (0–100)	40
Legumes	75 (0–100)	284
Nuts	50 (0–75)	291
Added fats		
Unsaturated oils	40 (20–80)	354
Saturated oils	11.8 (0-11.8)	96
Added sugars		
All sugars	31 (0–31)	120



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September 2022

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