METHODOLOGICAL GUIDE
CALCULATION AND COMPARISON OF CARBON FOOTPRINTS OF A CURRENT DIET AND A RECOMMENDED DIET UNDER ELEMENTS OF NUTRITION AND ENVIRONMENTAL SUSTAINABILITY.

At a global level, the food transition that current societies are experiencing in their dietary patterns is becoming increasingly evident. The production and consumption of food in a country, department or municipality is mediated by various factors, including social, cultural, economic, environmental and political factors.

Estimates show that many of the environmental impacts observed today are based on the way food is produced and consumed. A high burden of greenhouse gas emissions is attributed to the agricultural sector, as is the case with food consumption, mainly related to foodstuffs produced from animal protein and dairy products. These impacts are due to the lack of knowledge of food producers and most of the consuming population around the implications that food practices have on the environment.

One way to determine how sustainable a population's dietary practices are is to compare them with the planetary dietary recommendations based on environmental sustainability recommended by the EAT Lancet Commission. The Commission focuses its dietary recommendations on two main points: the consumption of healthy diets and sustainable food production, both of which have a major impact on human health and environmental conservation (The Eat-Lancet Commission, 2019).

Below are the steps for the calculation and comparison of the carbon footprint of two diets:

1: Current diet based on food consumption (without environmental sustainability criteria) and 2: Recommended diet based on healthy eating and environmental sustainability "EAT-Lancet".

I. Steps for selection of current diet foods (national, departmental or municipal level).

a. Obtaining national databases on nutrition and health from the entity in charge of collecting, processing, analyzing and disseminating the information (Ministry of Health, National Institutes of Health or whoever takes their place).

b. Selection of the component related to food habits, dietary intake or feeding practices.

c. Preparation for database use: Review, cleaning, processing. Selection of data at the level of interest: national, departmental, municipal.

d. Selection of current consumption through descriptive statistics (frequencies/proportion) of individuals who consume a certain food. Also, consider variables such as

grams/kilograms/average liters consumed, number of individuals, age, gender, ethnicity income level among other variables that may be of interest for characterization of the population.

e. Calculate the results of the most frequently consumed foods from the highest to the lowest prevalence (the amount required for analysis) and the average amount in grams for each one.

f. Standardization of units of measurement for each food in order to obtain the same analysis criteria.

g. Review and study of planetary guidelines based on environmental sustainability. Example "EAT-Lancet" diet to be used as the main input for comparison of the carbon footprint of the current diet.

h. For comparing the current diet with an environmentally sustainable diet, consider the 8 food classification groups/categories of "EAT-Lancet". Selected food groups to be considered are: whole grains (rice, wheat, corn and other), tubers or starchy vegetables (potatoes and cassava), vegetables (all vegetables), fruits (all fruits), dairy foods (whole milk or equivalents), added fats (saturated and unsaturated oils), added sugars (all sugars) and protein sources (beef, lamb and pork, chicken and other poultry, eggs, legumes, fish and nuts. Alcoholic beverages, prepared foods and supplements are excluded. Select the most consumed foods in grammage within each category.

This process helps to determine the average intake (grams) per day under the observed scenario and under the EAT-Lancet scenario, so it will be possible to know what percentage of consumption in the current diet is ingested with respect to the recommended diet. In other words, it will be possible to know for each food group what percentage of consumption is above or below the EAT-Lancet. Therefore, the results derived from this process provide information on the foods in which their intake should increase, as well as those in which their intake should decrease, or remain stable according to the EAT-Lancet suggestions. For this, keep in mind that the selection of foods for the current diet should consider the cultural characteristics of each place.

Note: If databases are not available for the location to be analyzed, other sources of information including previous studies of dietary patterns/food consumption and/or available information on food consumption in similar areas that can be used as a proxy for consumption in a given location.

II. Steps to estimate the carbon footprint of the current diet.

a. Collect detailed information on the process and inputs used in the production of each food selected or prioritized according to the place of origin, and its displacement from the farm to the supply centers.
Data can be obtained a) directly in the field, b) through requests to food producing or marketing organizations, c) official documents from ministries or State Secretariats, d) food production guides available on the web, e) academic publications.

b. Classify the required inputs by component of the production to consumption cycle. Example: transport, insecticide, inorganic waste.

c. Estimate the quantity of each input required to produce one unit of each food. Determine the direct and indirect greenhouse gas emissions of each input. For this purpose, academic publications[1] of studies that have quantified these values for the area of interest can be consulted.

d. Estimate the greenhouse gas emission factors for each input. For this purpose, academic publications[2] can be consulted.

e. Apply a conversion factor to the emissions of each greenhouse gas to estimate it in terms of CO2 equivalent.

f. Sum the CO2 equivalent emissions of all inputs. This is the CO2 equivalent emission per unit of product.

g. Estimate the CO2 equivalent emission of each food according to the amount consumed on average per day by each individual in the population studied.

h. Add the CO2 equivalent emissions previously calculated. This is the CO2 equivalent emission generated on average by food consumed per day by each individual in the population studied.

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[1] For example, see see Meul, M., Ginneberge, C., Van Middelaar, C. E., de Boer, I. J. M., Fremaut, D., & Haesaert, G. (2012). Carbon footprint of five pig diets using three land use change accounting methods. *Livestock Science*, *149*(3), 215–223. https://doi.org/10.1016/j.livsci.2012.07.012.
Travassos, G. F., Antonio da Cunha, D., & Coelho, A. B. (2020). The environmental impact of Brazilian adults' diet. *Journal of Cleaner Production*, *272*. https://doi.org/10.1016/j.jclepro.2020.122622

[2] Nemecek, T., & Kägi, T. (2007). Life cycle inventories of Agricultural Production Systems. *Ecoinvent*, *15*, 1–360. http://www.upe.poli.br/~cardim/PEC/Ecoinvent LCA/ecoinventReports/15_Agriculture.pdf
Arrieta, E. M., & González, A. D. (2018). Impact of current, National Dietary Guidelines and alternative diets on greenhouse gas emissions in Argentina. *Food Policy*, *79*(June), 58–66. https://doi.org/10.1016/j.foodpol.2018.05.003

i. Multiply the CO2 equivalent emission generated per day by the number of individuals in question. The result is the CO2 equivalent emission generated on average by food consumed per day by all individuals in the population studied.

III. Steps for estimating the carbon footprint of the diet based on environmental sustainability

j. Adhere to the recommendations of the planetary sustainability-based dietary guidelines. Example: "EAT-Lancet" to the context studied. If the guideline recommends "50g of carbohydrates", estimate what type of carbohydrates and in what proportion they would be consumed in the context studied. For example, the EAT-Lancet diet recommends eating 232g of whole grains per day but does not specify what type of grains. Using information from the current diet, it is possible to identify what type of whole grains are consumed in a given city and in what proportion. Based on this information it is possible to estimate how many grams of each grain would be consumed in an EAT-Lancet scenario.

k. Estimate the carbon footprint of the recommended diet. To do this use the carbon footprints previously calculated for a unit of product in step “g” and follow the procedure up to step "j".

IV. Steps for comparing the carbon footprint of the current diet (without environmental sustainability) with the carbon footprint of the recommended diet (based on environmental sustainability)

l. Calculate the difference in carbon footprint generated on average per day of an individual in the studied population between the observed and EAT Lancet diets.

m. Calculate the difference in the average daily carbon footprint of all individuals in the study population between the two diets.

n. Calculate the difference in the carbon footprint generated on average by each food and/or food category per day of an individual and/or of all individuals of the population studied between the two diets.

The results obtained deliver a quantified estimate of the health and environmental sustainability of food patterns in a given geography (i.e. a municipality, department or country) against a reference point such as the food suggestions of the "Eat lancet" diet based on healthy diets and environmental sustainability.

When the carbon footprint of the observed diet in a country is above that of the recommended diet calculated using EAT Lancet this would indicate that producers,

consumers, governments, food industry and in general the people and entities involved in the entire food system should review their practices of production and consumption of food, since it would be generating an environmentally unsustainable footprint and that brings repercussions not only to the environment but also the health.

The most notable consequences of unsustainable food production are mainly reflected in the degradation of natural resources such as water, land, soil and the impacts caused by climate change. In the same sense, the consumption of unhealthy food also leads to a degradation of our body, which generates impacts associated with overweight, obesity and the growth of chronic non-communicable diseases.

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Behrens et al., 2017; Hartmann & Siegrist, 2017; Ridoutt et al., 2017; The Eat-Lancet Commission, 2019; van de Kamp et al., 2018

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