METHODOLOGICAL GUIDELINE

Assessing the carbon footprint and climate risk of most consumed food products in Cali, Colombia: Methodological development of a decision support tool

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This document is a methodological support complementing the combined methodology proposal. It lists all the steps to be followed to implement it. The initial proposal used Cali as a case study. Nevertheless, this type of methodology can be adapted at different levels: national, regional or other.

STEP 1. Identification of target food products

1. **Set the subject**
   Are you studying a diet? A meal? Identified products?

2. **Set the scale**
   Are you focusing on a national level? Municipal level? Regional level ? Community level? (This decision can depend on the availability of data)

3. **Revision of existing data on consumption patterns**
   Already existing information can be found in:
   - National statistic surveys on consumption patterns
   - Academic research on food consumption
   - FAO food balance sheets. This option might not be the best as the balance sheets give a measure of food consumption from a food supply perspective and does not rely on real food consumption surveys.

4. **Identification of the geographic production areas of targeted products**
   Existing data on food production origins can be found in:
   - National statistics on food production regions
   - Academic research
   - Statistics given by the main retailers of the city: wholesale markets, supermarkets etc.
   - At the country level: FAO food balance sheets give all the imports and exports of products between countries.

Identifying the main origin of a product consumed in a given area can be an arduous task. In a city, food products are distributed through numerous retailers, some of which have their own integrated supply chain.

STEP 2. Carbon footprint assessment

This step follows the PAS 2050 2011 Standard Norm for carbon footprint "Specification for the assessment of the life cycle greenhouse gas emissions of goods and services" (British Standards Institution, 2011) which proposes a methodology and specific system boundaries for the analysis of greenhouse gases in the life cycle of goods and services. This standard is based on the Life Cycle Analysis (LCA) methodology. Other standards and norms to assess carbon footprint exist and could be chosen.

1. **Delimitating the boundaries of your system under study**
   Draw the system boundaries of the life cycle of the target products to clearly define what will be included and excluded from the calculation. The system boundaries define all the processes that are included in the analysis, as well as the geographical and temporal boundaries of the study and the environmental flows taken into account.

2. **Set production scenarios**
   As the study cannot encompass the totality and diversity of production processes, one specific scenario has to be given to each item in order to communicate with the best transparency about what will be assessed in the carbon footprint analysis. The carbon footprint is not representative of the whole production of a product in a Region, but accounts for the scenario described. The scenarios are "theoretical farms" or estimates that are built in order to make this assessment possible.

   Example of production scenario: "Tomatoes produced in open air in the El Valle Region, under conventional practices, transported 97km from farm to the Cali's wholesale market."

3. **Choosing the functional unit**
   The Functional Unit is the unit of measurement used to evaluate the service provided by the product. The most common functional unit used when assessing the carbon footprint of a food product is kg of product.

4. **Life Cycle Inventory**
   1. Identify and list each activity operated in the life cycle and quantify its consumption in energy, inputs, fossils fuels as well as the generated waste. Data on life cycle of products can be found in:
   - Secondary information delivered by institutions and official actors from the sectors. One easy way to have detailed information on production practices is through production costs analysis made by local institutions or farmers federations.
   - Academic research: already existing carbon footprint assessments
   - Experts knowledge

   2. Write the inventory analysis. The analysis explains how the collected data is used in the LCA model and reveals the assumptions that were made and choices that were taken.

5. **Life cycle impact assessment**
   1. Find direct and indirect emission factor for each consumption in energy, inputs, fossil fuels in the life cycle of the product. Emission factors can be found in the LCA data base Ecoinvent.
   2. Convert all the emission factors in carbon equivalent (CO_2eq) and calculate the overall carbon footprint. The equivalence between other GHG and Co_2eq is given by IPCC.

STEP 3. Modeling of the expected changes in terms of crop-specific climatic suitability in the regions where food products are cropped.

The Ecocrop methodology is based on a database of environmental parameters of a wide range of plants created by FAO called Ecocrop database, first modeled in 2001 by Hijmans et al. This model determines geographically and theoretically the areas where climatic parameters are optimal for a specific crop (niches) and focuses on two climatic parameters: rainfall and temperature, using a gridded data of temperature and rainfall (minimum, maximum, and mean monthly temperatures, and total monthly rainfall). The algorithm determines climatic conditions by multiplying both variables at a particular place and gives a suitability score (from 0 to 100%) for a defined crop.

1. **Setting climatic parameters (rainfall and temperature) for each product**
   The parameters correspond to an absolute range (minimum and maximum absolute temperatures and rainfall at which the crop can grow) and an optimum range (minimum and maximum optimum temperatures and rainfall). An additional temperature parameter of temperature at which the crop cannot survive the cold was added to illustrate the effect of a season's minimum temperature. Specific climatic parameters can be found through:
   - Experts knowledge
   - Local technical literature
   - FAO ecocrop data base eventually

2. **Set current climatic parameters**
   Use WorldClim to model the current climate situation (historical climate data that gather means of temperatures and precipitation at the global level).

3. **Set future climatic parameters using scenarios**
   - Choose Representative Concentrative Paths (RCPs) scenarios to set the hypothetical future climatic parameters in a given area. RCPs are hypothetical time series of emissions and concentrations of GHGs and aerosols, as well as land use and land cover. One RCPs equals one hypothetical future climatic situation. Various RCPs can be chosen.
   - Chose a time frame.

4. **Downscaling**
   Downscaling allows getting higher resolution at the local scale. RCPs give grid cells on maps of more than 100 km a side and would be inappropriate for analyzing suitability of crops at a smallest scale. A downscaling method called Delta method, first developed by (Hijmans *et al.*, 2005) is needed in that case. See Jarvis and Ramirez, 2010 for more explanation of the Delta downscaling method.

5. **Set the scale**
   Where do you want to show expected changes? Sometimes changes of scale between regional and national scale can be interesting to foresee displacement of production regions in time.

STEP 4. Final analysis

1. **Carbon footprint results and analysis**
   A comparison can be made between product or between activity through contribution analysis

2. **Climate suitability assessment maps**
   Various decisions can be made on how to present the results. Results can show

suitability levels at a given time (current or future) and can show the percentage of suitability changes (no change, gain or decrease) during the time frame.

3. **Main results from both methodologies**
   Cross-cutting results to highlight important schemes per sector : consumption, food production, transportation.

4. **Insights for policy makers**
   Link results and opportunities for policies: what issues are stressed and what insights it gives to tackle food production, alimentation, climate change and other.

5. **Critical review of the methodology**
   Be transparent on assumptions that were made du to lack of data and flaws of the methodology.

To find out more, please look at:
Gerbal, Lisa, 2019. Carbon footprint and climate risk of most consumed food products in Cali, Colombia, methodological development of a decision support tool. International Center for Tropical Agriculture and Montpellier Supagro. 63 p.Available at https://hdl.handle.net/10568/107467
Or contact Mark Lundy at m.lundy@cgiar.org and visit https://blog.ciat.cgiar.org/in-focus/sustainable-food-systems/

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