**Using individual food consumption data to estimate the environmental impact of diets: the potentiality of the FAO/WHO GIFT platform**

V. P. Quadros[1], A. Balcerzak[1], R. F. Sousa[1], M. Ferrari[2], X. Schmidt Rivera[3], C.J. Reynolds[4], J. T. da Silva[5], S. L. Bridle[6], C. Leclercq[1]

[1] Nutrition and Food Systems Division, Food and Agricultural Organization of the United Nations, Rome, Italy
[2] Research Centre for Food and Nutrition, Council for Agricultural Research and Economics, Rome, Italy
[3] Institute of Energy Futures, Brunel University London, London, United Kingdom
[4] Department of Geography, University of Sheffield, Sheffield, United Kingdom
[5] Research Institute, HCor Brazil, School of Medicine, University of São Paulo, Brazil
[6] School of Physics and Astronomy, University of Manchester, Manchester, United Kingdom

Contact information: victoria.paduladequadros@fao.org

**Introduction**

Food systems, including food production, play a substantial role in global environmental change, contributing to climate change, biodiversity loss, freshwater use, interference with the global nitrogen and phosphorus cycles, and land-system change[1]. Therefore, shifting food consumption patterns towards less resource-intensive diets is key to mitigate climate change[1–3].

The FAO/WHO Global Individual Food consumption data Tool (FAO/WHO GIFT, fao.org/gift-individual-food-consumption) is an open-access online platform, hosted by the Food and Agricultural Organization (FAO) of the United Nations and supported by the World Health Organization (WHO), aimed at disseminating Individual Quantitative Food Consumption (IQFC) data. The FAO/WHO GIFT platform collates, harmonizes and disseminates existing IQFC data from different countries in the form of microdata and ready-to-use indicators. FAO/WHO GIFT is a growing repository that aims to fill a major gap regarding what people are consuming around the world, and to use these data to better inform evidence-based policies and guidelines on healthy and sustainable diets[4].

FAO/WHO GIFT collates IQFC data collected through 24-hour dietary recalls or records, which are dietary methods describing in detail all foods and beverages consumed by individuals and in which quantities[5]. The collection of dietary data through these methods allows to assess current food consumption patterns and propose alternative patterns targeted at different population groups, for example through Food-Based Dietary Guidelines[6,7].

Currently, FAO/WHO GIFT provides indicators in the area of nutrition and food safety. In order to provide standardized age and sex disaggregated food-based indicators, existing dietary data from different countries undergo a harmonization process to be inserted in FAO/WHO GIFT. This process includes the harmonization of food description with the FoodEx2 system, which is a description and classification system developed and maintained by the European Food Safety Authority (EFSA), and that is currently used at global level with the support of FAO and WHO[8]. FoodEx2 consists in a vocabulary of foods with assigned codes structured in a hierarchical manner, which can be used to

classify and describe foods reported in different types of data, such as food consumption, food composition, food carbon-footprint, food chemical occurrence, among others.

Some IQFC data harmonized with FoodEx2 have already been combined with databases of food carbon-footprint in order to assess the environmental impact of diets and help identifying sustainable food consumption patterns.

At European level, the SUSDIET and SUSFANS projects matched IQFC data harmonized with FoodEx1 and FoodEx2, respectively, to greenhouse gas emission (GHGE) estimates values[9,10]. In Italy, FOODCONS (http://www.foodcons.eu/) matches Italian food consumption data harmonized with the INRAN-SCAI food categorization to GHGE values[11].

In the UK, GGDOT (https://www.ggdot.org/) combines food consumption data[12] (which are also mapped with FoodEx2), and GHGE data[13,14] to develop visualization tools and other resources (educational games) to engage with children and adults to influence behavioral change towards more sustainable healthy food consumption. GGDOT aims to develop a flexible platform compatible with FAO/WHO GIFT that will 1) link GHGE data from multiple sources 2) enable users to understand the impacts of their own and of the potential interventions to reduce their environmental footprint.

In Brazil, a database matching food composition to GHGE accounting also for the way foods are prepared has been created[15]. With the help of GGDOT developers, Brazilian researchers are planning to deliver a meaningful use of this data, applying them to support high level decision-making as well as food choices.

The objective of this study is to explore the potentiality of the FAO/WHO GIFT platform to provide indicators related to the environmental impact of diets based on harmonized IQFC data.

**Methods**

An analysis of the strengths and limitations of the FAO/WHO GIFT platform as a possible tool to provide indicators on the environmental impact of diets was performed. The analysis covered:
- The methodology and results from projects linking food consumption data already mapped with the FoodEx2 system to GHGE values. In particular, this study investigated the methodology used to select GHGE data for each food and food group;
- The characteristics of the IQFC data inserted in FAO/WHO GIFT in terms of the information usually available to describe foods and which may determine their environmental impact;
- The feasibility of creating new indicators on environmental impact based on the platform's current software technology.

**Results**

Through this study, three main possibilities of how to integrate information on the environmental impact of foods in the FAO/WHO GIFT platform have been identified:
1. The FAO/WHO GIFT platform could provide ready-to-use indicators based only on IQFC data. These indicators would present the food consumption pattern of a given population by grouping foods based on their potential environmental impact. Possible indicators could be, for example, the ratio between the consumption levels of bovine meat and that of other meats, or the percentage of proteins deriving from plant-source foods.

2.  Alternatively, the FAO/WHO GIFT platform could provide ready-to-use indicators on the environmental impact of diets by matching each of the IQFC datasets inserted in FAO/WHO GIFT with a unique dataset of global estimates of the environmental impact of foods, which may include GHGE estimates, as well as estimates of water and land use for foods.
3.  Finally, the FAO/WHO GIFT platform could provide ready-to-use indicators on the environmental impact of diets by matching each IQFC dataset inserted in FAO/WHO GIFT with either global, regional or country-specific estimates of the environmental impact of foods, based on their availability for each country/region and the intended use of the data.

**Discussion and Conclusion**

Each of the three identified possibilities for integrating indicators on the environmental impact of diets in FAO/WHO GIFT has its advantages and disadvantages.

In the first case, the indicators would be based only on harmonized IQFC data and there would be no link with estimates of food carbon, water or land footprint. This would be easier to apply to the current FAO/WHO GIFT software, but would lack the connection with actual data on the environmental impact of foods. Users would be able to download the IQFC microdata mapped with the FoodEx2 system from the FAO/WHO GIFT, and match the dataset with other sources of data outside the platform.

In the second scenario, the matching between datasets of IQFC and of food environmental impact could be done either manually by the data manager before inserting the IQFC dataset in FAO/WHO GIFT, or automatically by the FAO/WHO GIFT system. In order to do this, all datasets used (IQFC, GHGE, etc.) would need to be mapped beforehand with the FoodEx2 system. This option would have the advantage of easing the matching of information on the environmental impact of foods to the food consumption data, but there would be the need to carefully explore the uncertainties associated to global estimates of carbon, water and land footprint for each food.

The third option would allow IQFC data from different countries to be matched with the best available dataset on food environmental impact (country-specific, regional or global) based on the availability of data for each country, and also on the intended use of the data. Also in this case, all datasets used would need to be first mapped with the FoodEx2 system, and understanding the uncertainties associated to country or regional-specific estimates compared to global estimates would be needed. In addition, the current technology of FAO/WHO GIFT would not allow for an automatic matching of information directly in the system, which would need to be done necessarily by the data manager before inserting the IQFC dataset in the FAO/WHO GIFT system.

In conclusion, this study suggests that the current technology underlying FAO/WHO GIFT and the typology of harmonized IQFC data available in FAO/WHO GIFT have a high potential to provide useful indicators of the environmental impact of diets, which could be used to promote changes towards more sustainable food consumption practices.

**References**

1.  Willett W, Rockström J, Loken B, et al. Food in the Anthropocene: the EAT-Lancet Commission on healthy diets from sustainable food systems. *Lancet (London, England)*. 2019;393(10170):447-492. doi:10.1016/S0140-6736(18)31788-4

2.  Tilman D, Clark M. Global diets link environmental sustainability and human health. *Nature*. 2014;515(7528):518-522. doi:10.1038/nature13959

3.    Intergovernmental Panel on Climate Change (IPCC). *Special Report on the Impacts of Global Warming of 1.5°C*. (V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor TW, ed.).; 2018.

4.    Leclercq C, Allemand P, Balcerzak A, et al. FAO/WHO GIFT (Global Individual Food consumption data Tool): a global repository for harmonised individual quantitative food consumption studies. *Proc Nutr Soc*. February 2019:1-12. doi:10.1017/s0029665119000491

5.    Gibson RS. *Principles of Nutritional Assessment*. 2nd ed. New York: Oxford University Press; 2005.

6.    Reynolds CJ, Buckley JD, Weinstein P, Boland J. Are the dietary guidelines for meat, fat, fruit and vegetable consumption appropriate for environmental sustainability? A review of the literature. *Nutrients*. 2014;6(6):2251-2265. doi:10.3390/nu6062251

7.    Gonzalez Fischer C, Garnett T. *Plates, Pyramids and Planets - Developments in National Healthy and Sustainable Dietary Guidelines: A State of Play Assessment*. Food and Agriculture Organization of the United Nations, The Food Climate Research Network at The University of Oxford; 2016.

8.    European Food Safety Authority (EFSA). The food classification and description system FoodEx2 (revision 2). *EFSA Support Publ*. 2015;12(5):804E. doi:10.2903/sp.efsa.2015.EN-804

9.    Hartikainen H, Pulkkinen H. *Summary of the Chosen Methodologies and Practices to Produce GHGE-Estimates for an Average European Diet*. Helsinki: Natural Resources Institute Finland (Luke); 2016.

10.   Kaptijn G, Mertens E, Geleijnse J, et al. *Environmental Sustainability Indicators for European Dietary Patterns: Towards a Public Database. Report for the Development of the Database of Environmental Sustainability Indicators of Diets in Europe (DESIDE), SUSFANS Project (HORIZON 2020)*.; 2018.

11.   Leclercq C, Arcella D, Piccinelli R, Sette S, Le Donne C, Group AT on behalf of the I-S 2005–06 S. The Italian National Food Consumption Survey INRAN-SCAI 2005–06: main results in terms of food consumption. *Public Health Nutr*. 2009;12(12):2504-2532. doi:10.1017/S1368980009005035

12.   UK Data Service. National Diet and Nutrition Survey Years 1-9, 2008/09-2016/17. 2019.

13.   Poore J, Nemecek T. Reducing food's environmental impacts through producers and consumers. *Science (80- )*. 2018;360(6392):987-992. doi:10.1126/SCIENCE.AAQ0216

14.   Clune S, Crossin E, Verghese K. Systematic review of greenhouse gas emissions for different fresh food categories. *J Clean Prod*. 2017;140:766-783. doi:10.1016/j.jclepro.2016.04.082

15.   Garzillo JMF. Food and its environmental impacts: approaches of national dietary guidelines and a study on the diet of Brazilians. February 2019. doi:10.11606/T.6.2019.tde-13022019-082545