

# LCA applied to sustainable diets: Double Pyramid and Tool Chef to promote healthy and environmentally sustainable consumption

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## ABSTRACT

Barilla Center for Food and Nutrition created the Double Pyramid as a means of communicating that foods we should consume often for our wellbeing tend to yield least environmental impacts. From this consideration it was created a tool that calculate both nutritional values (in terms of carbohydrates, protein, fats and energy content) and environmental impacts of the foods commonly eaten (using LCA approach). Results show that a meat-based menu has an environmental impact that is two and a half times higher than the vegetarian one. Based on this data, we can hypothesize how impactful could be simple changes of an individual eating habits' on the environment. Taking the example of a weekly human need of food, in line with nutritional recommendations, we can hypothesize that limiting animal protein to just twice a week can "save" up to 20 square global meters per day.

Keywords: environmental impacts of food, education, nutrition, sustainable diets

## 1. Introduction

Nowadays it is well-known that proper nutrition is an essential condition for health (Must et al., 1999; Burton et al., 1985). At the same time, in recent years we are facing a growing awareness regarding the environmental consequences of our actions towards the environment (Wackernagel et al., 1996). And in particular, regarding the environmental impacts of food production (Sonesson et al., 2009; Williams et al., 2006).

Since 1992, the Mediterranean Diet has been represented in many documents with the scheme of the Pyramid (Keys et al., 1967; Keys et al. 1980). This graphic form makes it possible to highlight the fact that the basis of nutrition consists of foods of plant origin, typical of Mediterranean eating habits, rich in nutrients (vitamins, minerals, water) and protective compounds (fibres and bioactive compounds of vegetable origin), and narrows towards the top to suggest a less frequent consumption of foods with increasing energy density, usually made from animal protein, fat and simple sugars. After more than 50 years of studies and research, the Mediterranean Diet has been recognized by UNESCO as an intangible heritage of humanity.

The value of the Food Pyramid is twofold: on the one hand is an excellent summary of the main knowledge in studies on nutrition, essential for anyone who pays attention to their health, on the other hand is a powerful tool for education and consumer through to its simple and intuitive schematic diagram.

Many studies have shown that the Mediterranean diet yields positive effects on both health and environment. On the basis of such premise, Barilla Center for Food & Nutrition (BCFN) has closely examined the relation between the nutritional and environmental aspects of food and, in 2010, decided to re-propose the traditional food pyramid model, which was elaborated and updated to carefully integrate the latest findings on nutrition research, combined with the impact of food on the environment and global warming. Combining the two pyramids results in a clear coincidence of a single dietary pattern of two different but equally important objectives: health and environmental protection. This is the BCFN Double Pyramid (see Figure 1) that combines the traditional food pyramid model with the environmental impacts of food (BCFN, 2009, 2010, 2012).

The environmental part of the double pyramid was instead designed by BCFN reclassifying food no longer in function of the nutritional characteristics rather regard to impact on the environment: using data from impact per kilo of product yields an inverted pyramid, which sees foods with greater environmental impact at top and those with reduced impact on the bottom.

The BCFN collected all available and public scientific data to reclassify different kinds of food. Aside from impact on health, reclassification also accounted for food's environmental impact. Use of the Life Cycle Assessment method places all environmental markers on the same level of analysis: carbon, water and ecological footprints were examined as key performance indicators of food production. The current edition engrosses over

1,100 public sources of scientific data. It is necessary to specify that the Double Pyramid has been composed in relation solely to the Ecological Footprint.

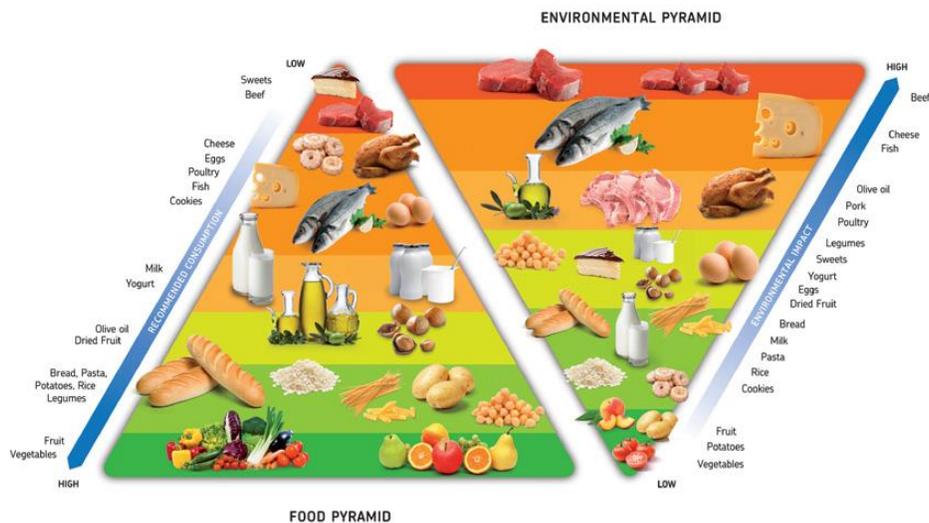


Figure 1. The Double Pyramid [BCNF, 2013]

## 2. Methods

Starting from the second edition of the Double Pyramid, the BCFN wanted to take a further step, trying to identify the most efficient ways to spread the culture of sustainable diet. BCFN proposes the Double Pyramid as a means of communicating that foods highly recommended by the Nutritional Guidelines in terms of greater consumption tend to yield least environmental impacts. From this consideration it was created a tool that calculate both nutritional values (in terms of carbohydrates, protein, fats and energy content) and environmental impacts of the foods commonly eaten using LCA approach (Andersson, 2000; Baroni, 2006).

The calculation tool, thought to be used by Barilla chefs in different ways, is not aimed at giving nutritional advices from a medical point of view but instead being a cue to spread the proper sensibility towards the right diet and the environment, reconciling human well-being with that of the environment. The purpose of the tool is calculating the environmental and nutritional impacts of dishes and menus.

The database used for the calculation contains specific nutritional and environmental values of more than 250 ingredients. The biggest part of this data derive from the Double Pyramid Database. Also, scientific studies and the Data Banks (Ecoinvent; LCA Food most of all, but also from Environmental Product Declaration Database; Ewig et al., 2006; Foster et al., 2006) are significant data sources and, for some food typologies, as meat, represent the most important source.

As you can see in Figure 2, after choosing food quantity and type and cooking typology and time, Tool Chef gives as output the results in term of nutritional values and environmental indicators. The Environmental impacts of the recipe take into consideration both the impacts of ingredient and cooking phase. That is, the total environmental impacts of the recipe is a sum of the grams of ingredient and the impacts of the ingredient cooked.

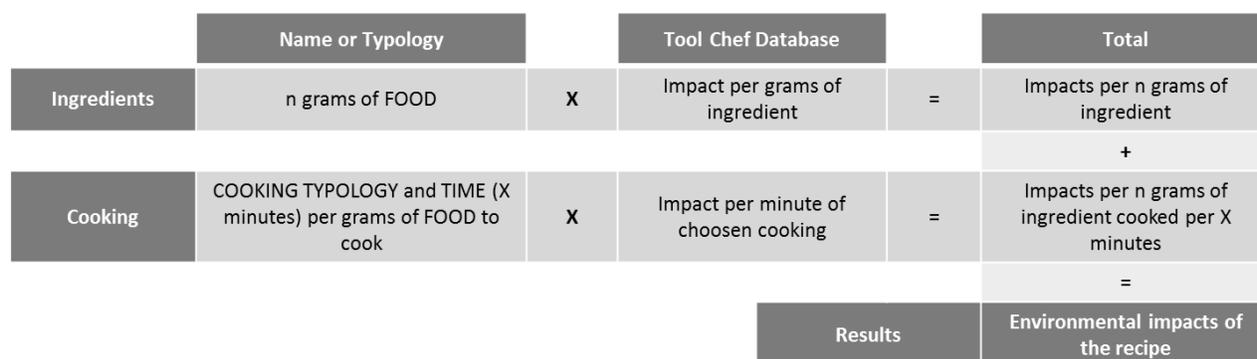


Figure 2. Tool Chef calculation process

In order to estimate the extent to which the food choices of individuals affect the environmental impacts, two different daily menus were analyzed; in the first one the protein is of plant origin (Table 1, Vegetarian menu), while in the second, it is mainly of animal origin (Table 2 Meat-based menu).

Table 1. Vegetarian menu

Breakfast	Mid-morning snack	Lunch	Snack	Dinner
1 portion of fruit 4 rusks	1 portion low-fat yogurt 1 fruit	1 portion of pasta with fennel 1 portion of squash and leeks quiche	1 portion of fruit 1 packet of unsalted crackers	1 portion of vegeta- bles: steamed green beans and potatoes with grated cheese

Table 2. Meat-based menu

Breakfast	Mid-morning snack	Lunch	Snack	Dinner
1 cup of low-fat milk 4 cookies	1 portion of fruit	1 portion of cheese pizza, mixed green salad	1 portion low-fat yogurt 1 packet of unsalted crackers	1 portion of vegeta- bles soup/pasta with peas 1 grilled beef steak 1 slice of bread

### 3. Results

As you can see in table 3, in order to be properly compared, both menu are balanced from a nutritional point of view and have approximately the same amount of Kcal.

Table 3. Menus nutritional information

	Kcal Total	Protein	Fats	Carbohydrates
Vegetarian Menu	2,030	14%	30%	56%
Meat-based Menu	2,140	15%	25%	60%

Based on Tables 4 and 5, results shown that the vegetable menu has an Ecological Footprint of 19 sq global m<sup>2</sup>, while the meat-based one 42. Carbon footprint of the vegetable menu amount at 2,177 gCO<sub>2</sub> eq. versus 7,058 of the meat one. Nearly the same proportion affect the Water Footprint indicator: 2,225 liters for the vegetarian menu versus 5,031 of the meat-based one.

Table 4. Vegetarian menu impact

	Breakfast	Mid-morning snack	Lunch	Snack	Dinner	TOTAL
Ecological Footprint [global sq m <sup>2</sup> ]	1	2	5	1	10	19
Carbon Footprint [g CO <sub>2</sub> -eq]	150	242	914	108	763	2,177
Water Footprint [liters]	230	242	499	164	1,089	2,225

Table 5. Meat-based menu impact

	Breakfast	Mid-morning snack	Lunch	Snack	Dinner	TOTAL
Ecological Footprint [global sq m2]	3	1	17	2	21	42
Carbon Footprint [g CO2-eq]	270	96	2,963	194	3,535	7,058
Water Footprint [liters]	230	186	1,915	149	2,552	5,031

#### 4. Discussion

Results show that the meat-based menu has an environmental impact that is three times higher than the vegetarian one, which represents a very significant share in the daily environmental impact of an individual.

In table 6 we made estimation on how individual's eating choices can impact on the environment. In particular, we saw that already a small change in eating habits can make the difference. That is, passing from eating meat seven times a week to eating meat twice a week can halve Carbon Footprint (from about 49,000 g CO2-eq to 25,000) and nearly the same for Ecological Footprint (294 global sq m2 versus 179).

Table 6. Variations in the environmental impact depending on eating choices

	Weekly Impact			Average daily impact		
	Carbon Footprint [g CO2-eq]	Water Footprint [liters]	Ecological Footprint [global sq m2]	Carbon Footprint [g CO2-eq]	Water Footprint [liters]	Ecological Footprint [global sq m2]
7 Times Meat Menu	49,406	35,217	294	7,058	5,031	42
5 Times Vegetarian Menu	25,001	21,187	179	3,572	3,027	26
+ 2 Time Meat Menu						
7 Times Vegetarian Menu	15,239	15,575	133	2,177	2,225	19

#### 5. Conclusion

Based on this data, we can hypothesize how impactful could be simple changes of an individual eating habits' on the environment.

Taking the example of a week's human need of food, in line with the recommendations of nutritionists, we can hypothesize that limiting animal protein to just twice a week, can "save" up to 20 square global meters per day.

We believe that with the help of targeted educational campaigns, social marketer can see positive results and shifts in population's eating habits without necessarily compromise their traditions and heritage.

Together with Barilla Center for Food and Nutrition there are many other Institutions and NGO's involved in changing and improving individual's eating choice. First of all the FAO with the concept of Sustainable Diets (FAO, 2012). Then another important one is LiveWell for LIFE, an Initiative started by WWF UK and funded by the EU's LIFE Programme for the Environment, that seeks to promote low-carbon and healthy diets in Europe (WWF, 2011).

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