

Article

Business Engagement with Sustainable Water Resource Management through Water Footprint Accounting: The Case of the Barilla Company

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Abstract: This study investigates business engagement in sustainable water management, focusing on water footprint accounting as a tool to account for water use in food supply chains. An explorative analysis is conducted on the Barilla Company. The study explores two corporate strategies aimed at achieving more sustainable water use: the adoption of environmental products declarations (EPDs), a reporting system that accounts for the environmental footprints of Barilla's pasta and other products; and the implementation of the Aureo Wheat Programme. The study deployed both primary and secondary data. The study shows that the largest share of the water footprint of pasta relates to the cultivation phase (over 90%), which is almost fully rainfed. EPDs show that the water footprint of the other phases of the supply chain is negligible. It is argued that the use of water footprinting in EPDs can raise awareness about water use in agricultural supply chains to reach a broad spectrum of stakeholders, including consumers. The study also shows that the implementation of the Aureo Wheat Programme, consisting of a shift in cultivation site and in the type of wheat, enabled a reduction in the blue water footprint of pasta, with water savings amounting to 35 million m³ of blue water since 2011.

Keywords: water footprint; food supply chain; Barilla; environmental product declarations

1. Introduction

1.1. Background and Objectives

Water resource scarcity is a global concern. It is also a problem that requires global solutions, as many countries have externalized their water footprint by importing water-intensive commodities produced in other countries, thus putting pressure on the water resource base in the exporting economies [1]. The food sector is highlighted, as agriculture accounts for 70% of freshwater withdrawals at the global level [2]. The interest of business in the outcomes of decisions made about water resources management is huge, as water is a primary ingredient in many products and an essential enabler of business activities and market expansion [3]. Pressures on the world's water resource can thus threaten business production levels and profit margins, as well as its "licence to operate" in water-scarce areas [4]. The occurrence of water crises has recently been identified as one of the top societal risks facing the world and is also among the risks of highest concern for doing business at the global level [5]. In this context, indicators based on life cycle assessments (LCAs) have become increasingly used as a means to account for the environmental impacts of production and consumption [6].

The objective of this study is to analyze the extent to which water footprint accounting can provide a useful tool to raise awareness of water consumption for food production and to assess the water-related performance of agents in food supply chains. In doing so, the study seeks to contribute to the understanding of the usefulness of water footprint accounting as an indicator of corporate water use and to identify promising avenues through which it can progress. The water footprint is an indicator of the use of water resources in terms of the water consumed and polluted over the entire supply chain of a product. Companies traditionally focus on water usage in their operations rather than their supply chain, although supply-chain water footprints are generally much larger than their operational water footprint. Water footprint accounting consists of three components: the blue, green and grey water footprints [7].

Applied to nations, the water footprint indicator sheds light on the globalization of water and the interdependencies between producing and importing countries; for developing food security and environmental policies, as well as for helping prioritize policy action towards demand-side measures aimed at changing consumption patterns; for improving agricultural water efficiency or exploring whether a site is suitable for producing certain types of crops for export [8–11]. Applied to commodities, the water footprint indicator also has the potential to empower consumers by providing them with information on the way their choices affect water security globally [12]. However, some authors argue that water footprints do not provide sufficient information on the opportunity cost of water, so it cannot be used as a stand-alone instrument to assess the environmental impacts of water use, unlike the carbon footprint; and it is too aggregated to inform consumer choices [13,14]. Concerns have also been raised about the wide range of different methodological approaches to assess water footprints [14]. A new International Standardization Organisation (ISO 14046) standard has been released very recently that provides "a harmonised framework for the assessment and reporting of water footprints" [15] (p. 2).

The water consumed by societies in food supply chains has been referred to as "food water" and accounts for about 90% of the water needed by individuals [16]. Food water is mainly managed by farmers, as opposed to "non-food water", *i.e.*, water used for domestic and industrial purposes [16].

The significance of water resources in food supply chains is “economically and politically invisible”, especially to consumers, who are not fully aware that their food choices affect water resource security [17,18]. Agents in food supply chains play a crucial role in determining the use and misuse of the world’s water resources and are responsible for water allocation in the production of food, its trade as “virtual water” and its processing, retail and consumption [17,19]. Business leaders’ decisions significantly affect water resource security. It is thus important to draw attention to the extent to which these decisions could bring improvements for society as a whole [20].

The role that agents in the food supply chain play in protecting water ecosystems has not been fully appreciated by public policy-making [16]. The market regulates water resources and is the locus of food supply chains [8]. Consumers’ demand is generally met by low prices, but markets do not include consideration of social and environmental impacts of the global commodity trade. However, it is politics and political processes that shape water resource allocation and management. These processes are subject to changing economic and social conditions and interests, rather than informed by notions of long-term economic efficiency or environmental stewardship [21].

The majority of the world’s 100 leading companies in water-intensive industries have weak management and poor disclosure of water-related risks, which include physical, reputational, regulatory and litigation risks [4]. Some players have become aware of the role they play in meeting the challenge of achieving water security at the global level, often propelled by NGOs and the scientific community. Some business players have quite recently engaged in sustainable water resource use by means of water footprint accounting. They include, among others, Coca Cola, SABMiller, Nestlé, Unilever, Heineken, ABInBev and Pepsi Co [22–26]. For more details, the reader is referred to Daniel and Sojamo [27].

The corporate water footprint can be defined as the total volume of freshwater that is used directly and indirectly to run the business [7]. Corporate engagement in water footprint accounting is a useful way to encourage companies to comprehensively take account of their water consumption in their supply chain and to make their environmental impact more transparent, although most of the studies developed so far do not make use of their own spatially- and temporally-explicit water footprint values [14]. It has been recognized that “the value of water footprint is more in its components than in the total sum” [27]. The water footprint can also be applied to a product, consisting of the use of freshwater that can immediately be related to the product and the use of freshwater in overhead activities [7]. By taking an integrated approach, the water footprint can inform a business about water use in supply chains, provide strategic information to reduce business risks related to water use, enable business leaders to understand more fully how best to operate in a water environment and be used as a standard for comparing and benchmarking water use in different industries [28].

In order to analyze corporate water strategies and to disentangle information on corporate water use, an explorative analysis was conducted on Barilla, one of the top Italian food groups and a lead player in the pasta market worldwide. Its position in the world pasta market makes the case study analyzed here relevant and representative for large-sized food companies. Barilla has engaged in sustainable water strategies since 2008, by adopting the LCA to account for the environmental impact of their products. Since 2011, the company has also engaged in water footprint accounting by adopting environmental products declarations (EPDs), voluntary instruments that are based on international standards and independent verification [29].

1.2. Methodology and Study Design

The research made use of both primary and secondary data. Secondary data collection was based on publicly available information found on the company website and also included annual and sustainability reports, press releases and scientific articles. The research also involved the collection of previously undisclosed quantitative data, developed for Barilla by Life Cycle Engineering (LCE), an independent research and consulting company based in Turin that specializes in LCA assessments and EPDs. Primary data were collected through semi-structured interviews in order to analyze the company's engagement in sustainable water management. The interviews were held at the Barilla Company, between September 2014 and January 2015. The interviews were preceded by observations, and informal and unstructured interviewing. The research did not include testing of this information against possible information available from other sources.

The data shown in Section 3 were computed by LCE. The collaboration between the company and LCE started in 2008, when Barilla engaged with the environmental accounting of its products by means of LCA analysis. Since 2011, the Barilla Group has engaged in EPDs, which provide an assessment of the water, ecologic and carbon footprints of products. As Barilla is a world leader in the production and commercialization of pasta, the focus here will be on the water footprint of this product. The environmental performance of pasta is calculated through the LCA methodology, in compliance with the Process Certification Clarifications guidelines for the International EPD System [29].

EPDs report the environmental performance of a company in producing a good or service based on LCA analysis and other relevant information. Information on the environmental performance over the full life cycle of a product includes the use of renewable and non-renewable resources, energy consumption, polluting emissions and water resource use. The use of water footprinting, as well as ecological footprinting, is considered an optional tool to account for water use. Water footprint accounting has also been deployed in EPD reporting in the food sector by the Italian companies Granarolo and COOP Italia. EPDs are verified by a third party to comply with the requirements expressed in ISO 14025 on the program operator. EPD certifications are valid for three years, after which the declaration must be revised. EPDs are applicable to any type of good and service and any type of company. They have been used to account for environmental information on a wide range of product categories: food and agricultural products; textile and leather products; wood and paper; fuels, metal and chemical products; constructions and infrastructure; transport, vehicles and equipment; *etc.* [29]. Barilla's EPD internal process is based on the LCA database, the product system and the product specific data [30].

The data presented herein refer to durum wheat semolina dried pasta produced by Barilla in 2013. Pasta production includes the following steps: cultivation of durum wheat; durum wheat receiving, pre-cleaning and tidying up; conditioning; milling; raw material storage; mixing dough; rolling; drying; packaging; storage; and distribution. The steps considered in the water footprint assessment contained in the EPD for pasta are cultivation, the milling process, packaging production, the processing phase, distribution and cooking (Figure 1). The accounting of water use in pasta production provided by EPDs thus includes both the operational supply chain and the end-use water footprint of the product.

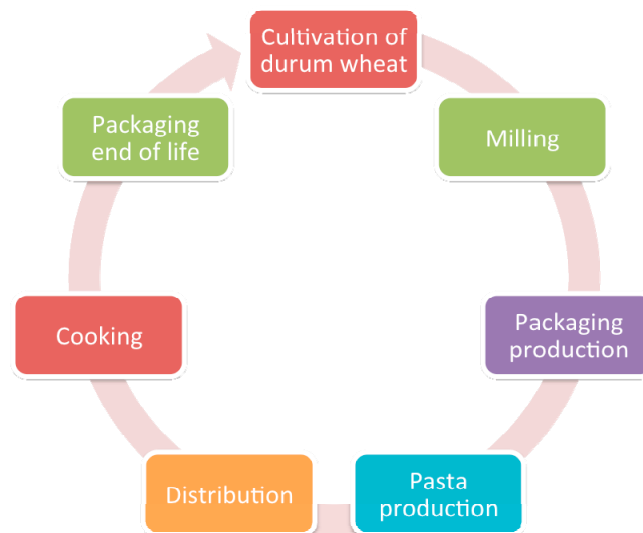


Figure 1. Phases considered in the environmental products declaration (EPD) of pasta.
Source: authors' elaboration.

This study used the methodology set out by the *Water Footprint Assessment Manual* by Hoekstra *et al.* [7], which provides the global standard for water footprint assessment. Water footprints are shown in their three components: the blue water footprint, defined as the volume of freshwater consumed of surface or groundwater that does not return to the catchment from which it was withdrawn; the green water footprint, that is, the volume of water consumed during the production process; and the grey water footprint, corresponding to the volume of water needed to assimilate pollutant loads associated with the production of a product over its supply chain to such an extent that the quality of the water remains above agreed water quality standards [7]. The water footprint related to crop production (the cultivation phase) was obtained from Mekonnen and Hoekstra [31]. Data are country specific and refer to the areas where durum wheat is grown (North, middle and South Italy; France; north and southwest USA; Canada; Turkey; and Greece) (Figure 2). The water footprint was calculated by multiplying the water footprint of durum wheat by the total amount purchased by Barilla from each country. Country-specific data were also used for the amount of fertilizer, crop yields and water use. Water use in the milling process has been accounted for using primary data from each of the company's property mills, which are located in Italy (four), Turkey (one), the USA (one) and Greece (one). The indirect water footprint in this phase was calculated using secondary data from the Ecoinvent database. The contribution of this phase to the overall water footprint of pasta is negligible. The water footprint of packaging production is also accounted for by considering the heaviest packaging used per 500 g of product, in a conservative fashion. Primary data were used in this phase. The water footprint of the processing phase was calculated as the sum of the direct and indirect water use in pasta manufacturing in the company's seven plants in Italy (three), Greece (one), the USA (two) and Turkey (one). In this phase, water consumption was accounted for through primary data; energy consumption and the packaging process were evaluated through secondary data [32]. The water footprint of plants in Italy and the USA was calculated by weighting the consumption of water of each plant based on its pasta production. The water footprint of distribution was computed using a combination of primary and secondary data using specific hypotheses for each area. The contribution

of this phase to the overall water footprint of pasta is negligible. Water footprint data are herein expressed in liters/kg of product.

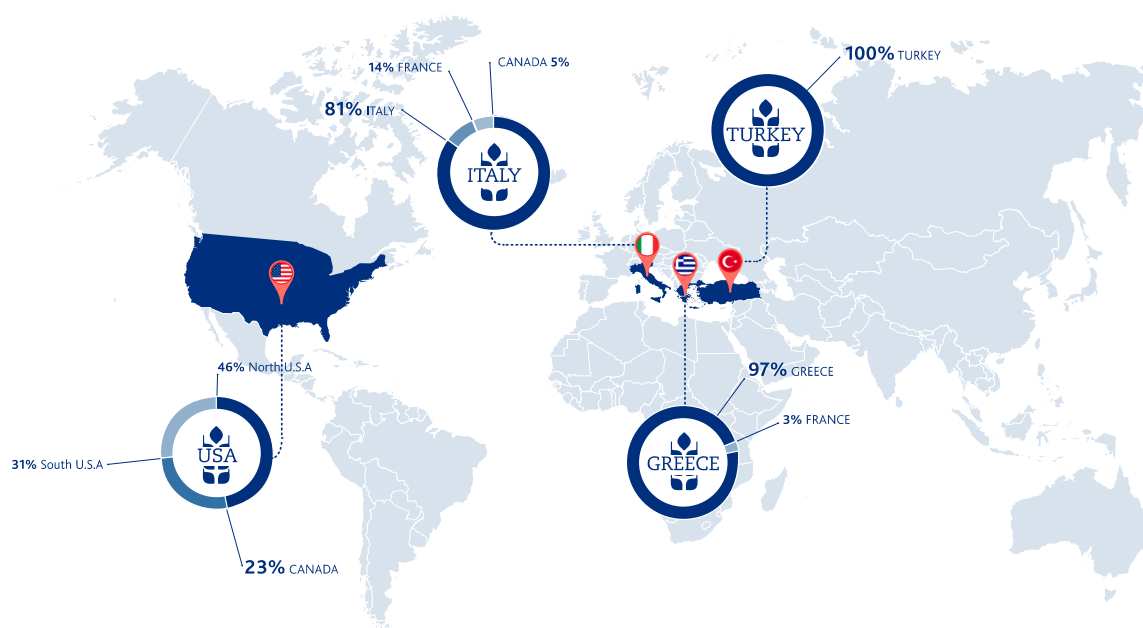


Figure 2. Percentage of durum wheat grown locally and supplied from other countries in the four countries where pasta is manufactured (Italy, Turkey, Greece and the USA), in 2013. Source: EPD Durum Wheat Semolina Pasta, Rev. 5, 19 September 2014 [33].

The remainder of the study is structured as follows. The next section presents the Barilla Company and investigates the relationship between its corporate social responsibility strategy and sustainable water management. The third section outlines Barilla's sustainable water strategies and, in particular, the adoption of EPDs and the reduction of the blue water footprint of wheat production through the implementation of the Aureo Wheat Programme. The final section draws some conclusions.

2. The Barilla Case

2.1. The Company

The Barilla Company, founded in Parma in 1877, is one of the top food companies in Italy and a world leader in the pasta market, with approximately one million tons produced each year. With five offices and 30 productive sites across the world (14 in Italy and 16 abroad), the Barilla Group had an annual turnover of 3198 million Euros in 2013 and about 1700 million tons of products sold. The two main business areas are meal solutions and bakery products. More than 95% of Barilla products are wheat based, approximately half of which are consumed within Italy, and half are exported to more than 100 countries. The company has over 1000 suppliers of raw materials (about 800 ingredients) and packaging materials (about 50 types) from all over the world. The most important supply chains are those of durum wheat, common wheat, rye, tomatoes, eggs and sugar, as these are the main ingredients of pasta, bakery products and sauces. The Barilla Group produces in five countries: Italy, Greece,

Turkey, the United States and Mexico. Durum wheat supplies originate from North, middle and South Italy; France; north and southwest USA; Canada; Turkey; and Greece [34].

2.2. Corporate Social Responsibility and Engagement in Sustainable Water Resource Management

The company's corporate social responsibility strategy can be described through the slogan “Good for you, good for the planet”, which is defined by the most recent Sustainability Report [34] as “the only...way of doing business”. The company's strategy encompasses issues related to the quality of raw material and food safety, animal welfare, energy and water resource use, recyclable packaging, education and communication, stakeholder engagement and social inclusion (Figure 3). The company also runs a number of international projects consistent with this business strategy in Canada, the USA, Germany, Sweden, Switzerland, Greece, Brazil, Italy and France [34]. “Good for you, good for the planet” is the strategy that the Barilla Group has identified to double its business by the year 2020, by strengthening its presence in existing markets and penetrating emerging markets. This strategy envisages a 30% reduction of water and CO₂ per ton of finished products for the production processes, compared to 2010 [35]. More importantly, as detailed in Section 3.2, the company has also reduced its supply chain water consumption by switching the supply of a typology of durum wheat from the southwest USA to another typology of durum wheat grown in Central and South Italy.

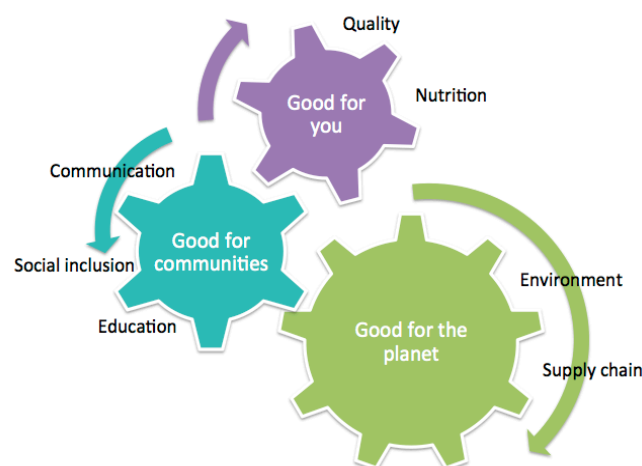


Figure 3. “Good for you, good for the planet” strategy. Source: authors’ elaboration based on [34].

The company has reduced the CO₂ emitted in absolute value by plants, as well as total water consumption by 27% and 25%, respectively, compared to 2008 levels [34]. In addition, water re-use projects have been developed for the plants in Cremona (Italy), Foggia (Italy), Ames (USA) and Avon (USA). Since 2011, the water footprint has been deployed as an environmental and supply chain indicator of water use [35]. The water footprint of pasta, as well as the virtual water “flows” associated with pasta and durum wheat trade have been disclosed since 2013 [36]. The water footprint of a wide range of Barilla’s products (including pasta, bakery products and sauces) has been made public through the release of EPDs (more details in Section 3.1).

Since 2009, the Barilla Group has engaged in education and communication programs addressing global sustainability concerns related to nutrition and food production through the establishment of the think tank Barilla Centre for Food and Nutrition (BCFN), which became a foundation in 2014. In

2009, the BCFN presented the Double Pyramid (Figure 4), a framework that relates food nutritional values and environmental impacts, showing the inverse relationship between nutritionally recommended foods and their environmental impact [37]. The company's strategy towards the year 2020 includes the goal to offer products only at the bottom of the Double Pyramid [37]. A Water Pyramid (Figure 5), comparing the traditional food pyramid with its impact on water resources through water footprint accounting, has also been conceptualized [38]. Finally, in March 2015, the Foundation established an Observatory on "sustainable diets" with the aim of exploring the avenues through which it is possible to shift towards more healthy and sustainable food consumption patterns.

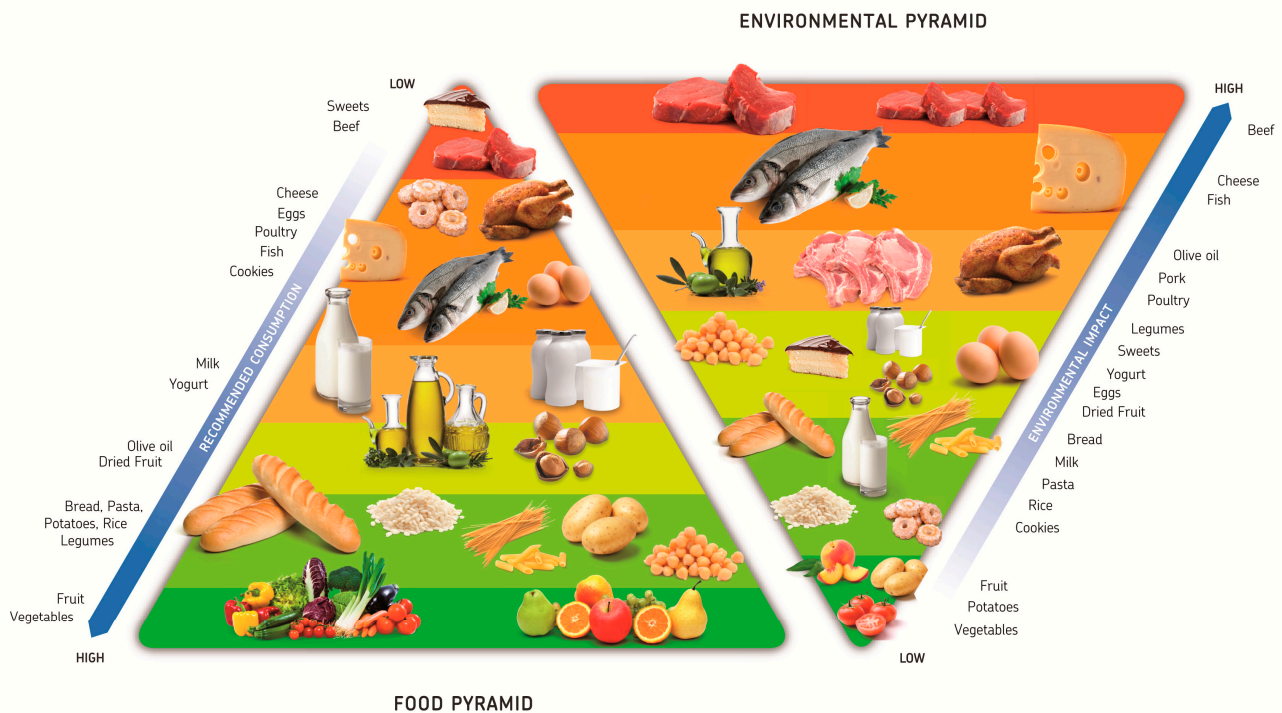


Figure 4. The Double Pyramid. Source: [37].

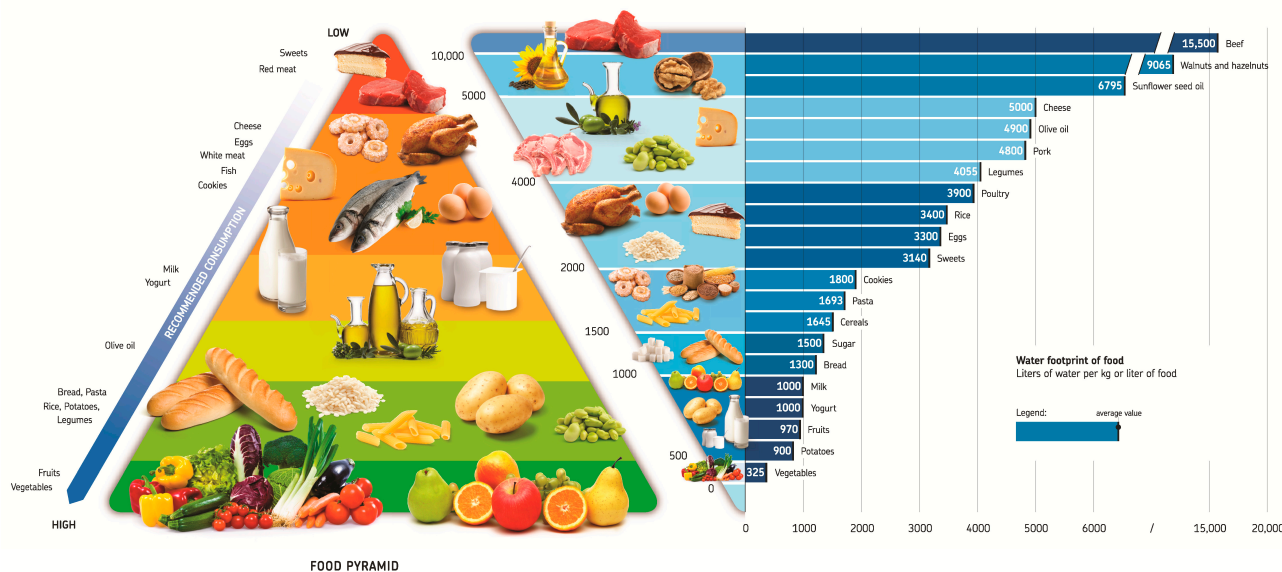


Figure 5. The Water Pyramid. Source: [38].

3. Barilla's Sustainable Water Programs

3.1. Environmental Products Declarations

Since 2008, the Barilla Group has included the use of the LCA approach in its corporate social responsibility strategy in order to assess the impacts of its products in the different phases of the supply chain [35]. In 2011, the company also adopted EPDs as part of its corporate social responsibility strategy. Barilla is the first food company in the world to develop an EPD Process System. EPD process verification is performed both internally (by the Process Assessor) and externally (by an accredited body certified for audit of management systems). The System works in compliance with the International Standards (ISO 14025). Product Category Rules and General Program Instruction, which are published and regularly updated, assure the reliability of the LCA. The System allows for comparison among the same product group. EPDs and LCAs cover the environmental impacts of production by accounting for the ecological, carbon and water footprints over the whole supply chain of the products considered. The System allows products to be certified with an EPD Process Certification [29]. The EPD process of Barilla products is fully described in [30].

The first EPDs for Barilla products were released in 2010 and certified by Bureau Veritas in 2011. In 2012, EPDs covered more than 50% of the products put on the market by the company. This proportion reached up to 74% of the volumes produced in 2013. Figure 6 presents the evolution in time of Barilla's EPDs. Figure 7 shows a sample EPD for dry semolina pasta produced in Italy for the local market. The EPD shows that the water footprint of pasta is 1292 liters/kg. Over 90% of the water footprint of pasta is associated with the first phase of the production chain, the largest share of which is green (83%).

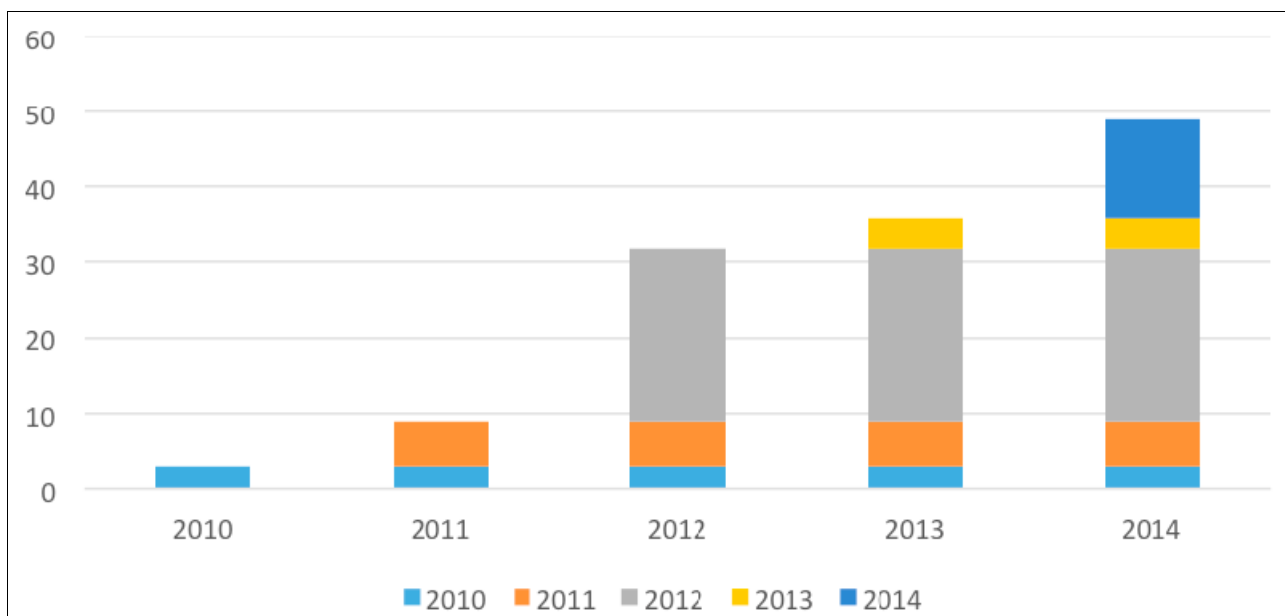


Figure 6. Number of EPDs published in 2010–2014. Source: authors' elaboration.

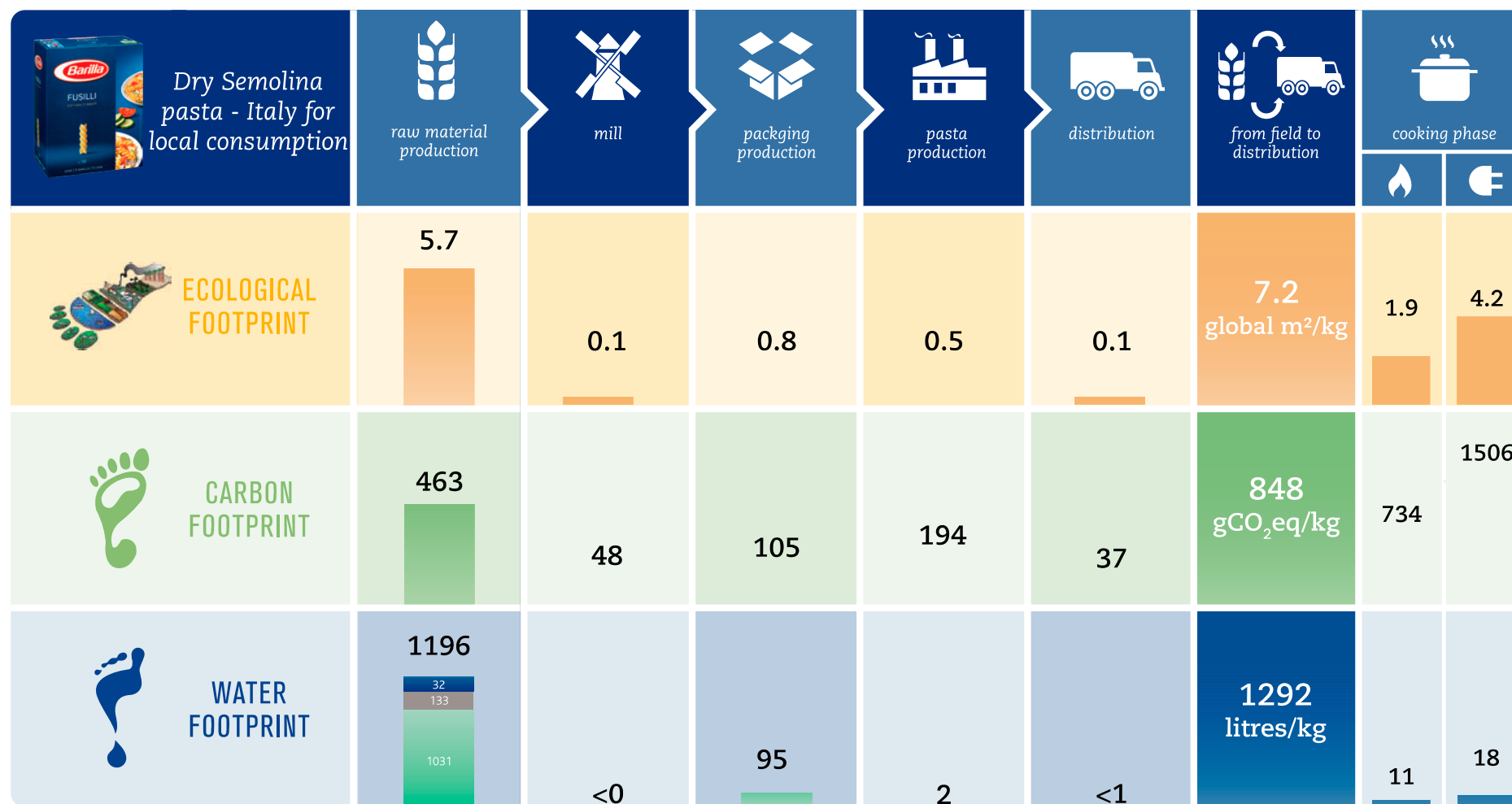


Figure 7. The EPD of dry semolina pasta produced in Italy for the local market. Source: EPD Durum Wheat Semolina Pasta, Rev. 5, 19 September 2014 [33].

Figure 8 shows the proportion of green, blue and grey water in the water footprint of wheat production by country supplying the Barilla Company. Green water is by far the main source of water used for wheat cultivation in all countries. The water footprint of wheat is overwhelmingly green as its production is dominantly rainfed, as confirmed by other studies [39,40]. It is important to distinguish green and blue water resources, as they fundamentally differ in terms of opportunity costs and for informing food and water policy-making. Compared to blue water, green water has a far lower opportunity cost, as it cannot be easily reallocated to uses other than agriculture or vegetation, and its use has relatively few externalities with respect to irrigation [40,41]. Using green water for agricultural production is generally efficient in terms of opportunity cost, because its use for vegetation growth generally yields lower economic value than crop production [42]. The largest share of blue water consumption is associated with supplies from the USA (26% of the total water footprint). As is shown in Section 3.2, since 2011, the Barilla Group has progressively decreased its wheat supply from the USA.

The EPD of pasta also shows that the volume associated with most of the phases of the supply chain after cultivation, *i.e.*, milling, production and distribution, is negligible. Packaging production is the exception, with a water footprint of 95 liters/kg. Moreover, EPDs enable a comparison between the different footprints of a supply chain. Raw material production is associated by far with the largest ecological and carbon footprints (almost 6 m²/kg and 848 gCO₂ eq/kg, respectively). Packaging production and pasta production show the largest carbon footprint after cultivation; packaging production accounts for the largest ecological footprint after cultivation. The cooking phase uses about 10–18 liters/kg of water and shows considerable carbon and ecological footprints.

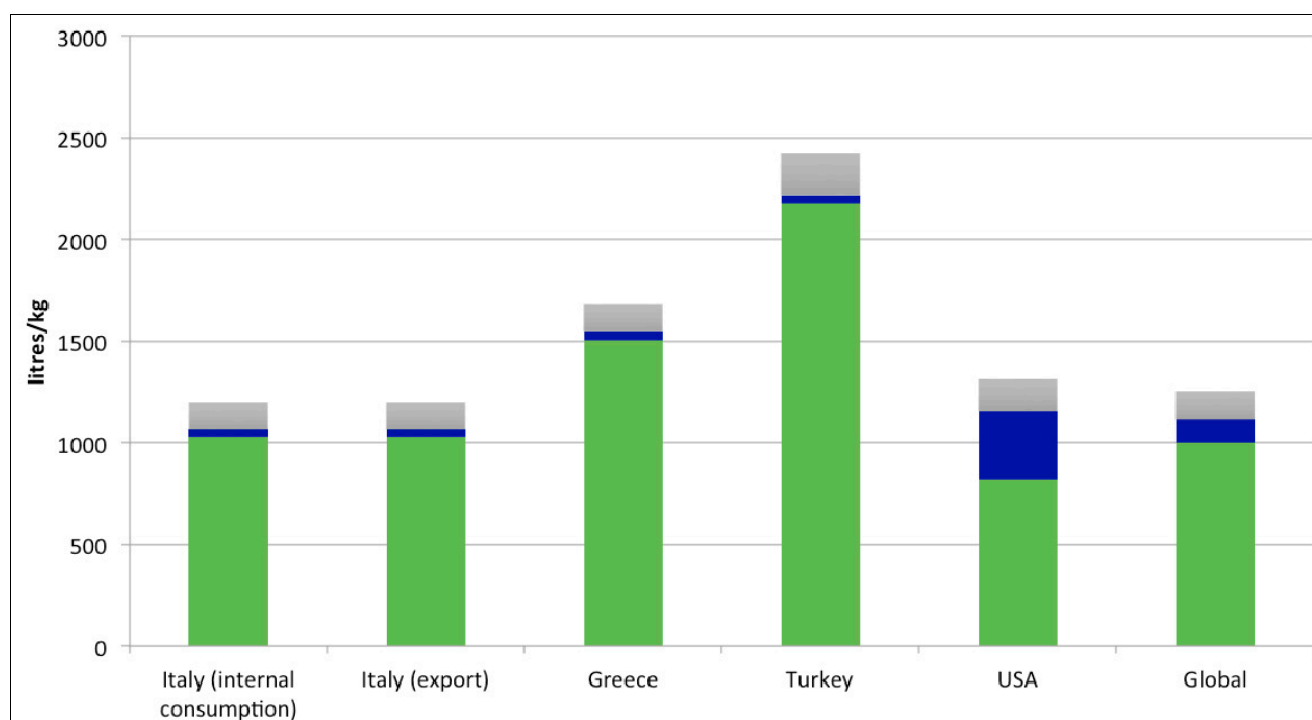


Figure 8. The green, blue and grey water footprint of dry semolina pasta at the sites of production of durum wheat. Source: authors' elaboration based on [31].

3.2. Water Footprint Reduction: The Aureo Wheat Programme

Over the past few years, Barilla has reduced its supply chain water footprint by adopting the Aureo Wheat Programme. This program consisted of progressively shifting the cultivation of a variety of durum wheat (Alamo) from a desert-prone area in Arizona, to Aureo wheat, a typology cultivated in Central and South Italy (the Abruzzi, Molise, Apulia, Basilicata and Campania). As Figure 9 shows, the Alamo durum wheat has a substantial blue water component, accounting for about 60% of its water footprint (28% green; 11% grey). Aureo is, on the contrary, fully rainfed. The total water footprint reduction amounts to 50 liters/kg of durum wheat. Such a strategy brought about freshwater savings amounting to 40 million cubic meters of blue water per year, as well as a decrease in the carbon footprint, previously related to transportation. The amount of blue water saved through the adoption of Aureo brought about savings that are fivefold higher than the freshwater saved in 2008–2014 in the company's plants all over the world. The adoption of this program also decreased the volume of imported virtual water related to durum wheat, as reported by Ruini *et al.* [36] for 2011. It can be argued that relieving the pressure on blue water resources is particularly important in dry contexts, such as Arizona, where agricultural water accounts for 80% of total freshwater withdrawals. Freshwater use in agriculture actually competes with other uses (industrial and domestic), which would yield much more value per drop of water used [43]. The country's increasing demand for water can be fulfilled by shifting water from the agricultural sector, as the potential for increasing the water supply is limited [44].

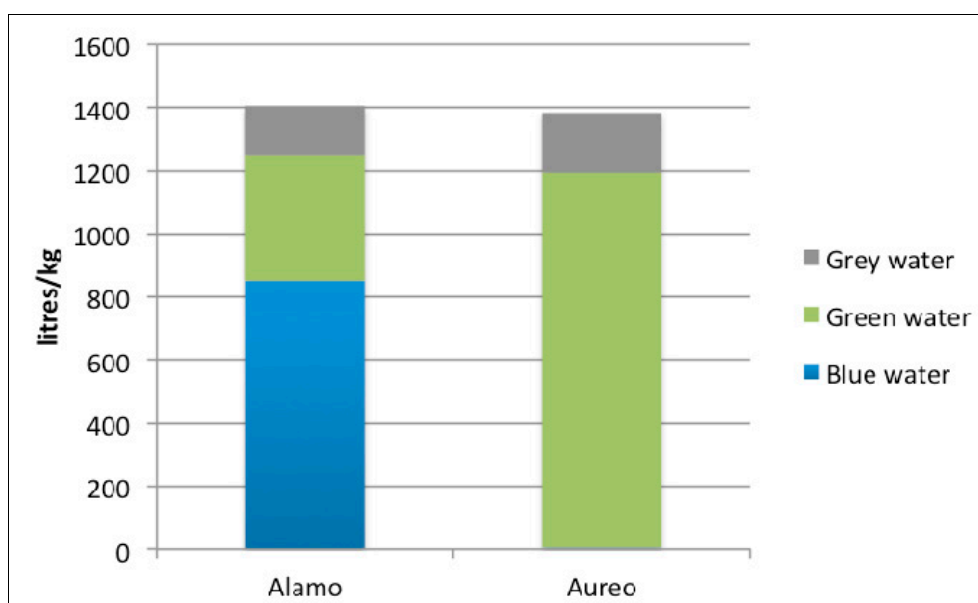


Figure 9. Durum wheat water footprint: Aureo and Alamo. Source: Authors' elaboration based on [31].

3.3. Other Initiatives

This subsection presents some other initiatives aimed at improving the sustainability of business practices undertaken by the Barilla Company. In 2010, the company engaged in the project Sustainable Farming, which aimed to increase the use of sustainable cropping systems, maintain safe and high-quality agricultural products and ensure environmental sustainability, while enhancing the social and economic

condition of farmers. The Sustainable Farming model was applied on 13 farms in 2011/2012 and 22 farms in 2012/2013, in areas of Italy where durum wheat cultivation is more significant. The tools provided to farmers and technicians of the selected farms included the Barilla Handbook [45], outlining sustainable agricultural practices in durum wheat cultivation, and granoduro.net[®], a decision support system designed to assist farmers in making operative decisions regarding cultivation (optimal seeding rate, nitrogen requirements, risk of diseases and weather forecasts). The adoption of appropriate cropping systems, combined with the suggestions provided by the Barilla Handbook and the use of granoduro.net[®], led to an increase in yields of up to 20%, a decrease in farmers' direct costs of up to 31% and a reduction in CO₂ emissions of 36%, on average. The results of this project show that environmentally-friendly practices are not only environmentally sustainable, but also economically advantageous, as they can reduce production costs through improved efficiency. The company recognizes that the combined use of new cultivars and better farming practices can lead to more sustainable water consumption and a reduction of the corporate water footprint [46]. In recognition of its effort in promoting sustainable farming of durum wheat, in 2013, the Company was awarded the first European Corporate Social Responsibility Award Scheme promoted by the European Commission.

Similar initiatives aimed at promoting more efficient and sustainable cultivation of durum wheat have also been developed in Greece, Turkey, the USA and Canada. Barilla has also engaged with the tomato supplier Consorzio Casalasco del Pomodoro and the University of Piacenza "Cattolica" to test a set of agro-techniques, which include improved water management, combined with minimum tillage, use of digestate and crop rotation, to increase soil fertility, while minimizing inputs. Finally, other initiatives are being developed for wheat cultivation in Italy and France and rye cultivation in Sweden [34].

4. Conclusions

The water footprint has become a key indicator of water use for business. Its assessment allows the inclusion of both operational and supply chain water use; the differentiation of green, blue and grey components; and the identification of measures to reduce risks related to freshwater shortages, financial or reputational risks. The present study has analyzed the engagement of the Barilla Company in sustainable water management through water footprint accounting. The study has shown that, over the past few years, the company has included water footprint accounting as part of its corporate social responsibility strategy. Water footprinting has been used as part of the EPD process to account for the environmental impacts of the production of almost 75% of Barilla's products. The EPD of pasta was analyzed here, as pasta represents the main product of the company. The water footprint indicator has also been used to appraise the impacts on water resources generated by progressively shifting wheat supply from Arizona to Italy. The adoption of a new typology of high-quality durum wheat (Aureo), which is fully rainfed, has generated about 40 million m³ of blue water savings since 2011. Other initiatives put forward by the company have also been outlined. More research is needed to increase understanding of the key role of corporations as global water security agents. By analyzing a leading company in the pasta market worldwide, this study has attempted to provide a representative analysis of large-sized food companies' engagement in sustainable water management.

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Author Contributions

Marta Antonelli designed the research project, conducted the data collection and analysis and wrote the study. Luca Ruini coordinated the whole research project.

Conflicts of Interest

The authors declare no conflict of interest.

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