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Carbon footprint of honey produced in Argentina

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ABSTRACT

The urgent need to mitigate the emissions of gases that contribute to climate change is creating a new scenario for the international trade of goods and services. Countries that are making efforts to reduce those emissions are now demanding that imported goods contain low levels of embedded carbon for those goods to fairly compete with locally produced products. For this purpose the implementation of standards such as the "carbon footprint" becomes critical. Carbon footprint is an environmental sustainability indicator that quantifies the emissions of greenhouse gases generated during the lifecycle of a product. Argentina, as an exporter of agricultural products, has conducted initial studies to estimate the carbon footprint of several food products of high impact in its exports such as meat and wine but yet little had been done about honey production even though the country is one of the world's three largest exporters. This study is the first assessment of the carbon footprint of honey produced in Argentina where almost 95% of the production goes to the export markets. This study also adds scientific value by comparing economic value-based allocation and production-based allocation.

Official information, interviews and surveys to key stakeholders in the Argentinean beekeeping chain revealed that the cluster is characterized by low technology development and small-scale production based exclusively in the sale of a commodity (bulk product without differentiation) but recognized by its genuine quality valued on flavor and safety issues. Carbon footprint of honey evaluates greenhouse gas emissions throughout the lifecycle; specifically carbon dioxide, nitrous oxide and methane. Activity data collected includes annual honey production, geographical location of beehives and processing plants, technology used, and fuels and energy consumption. Based on the ISO 14040 method that uses lifecycle assessment, the calculated carbon footprint of honey is 2.5 ± 0.17 kg CO_2e/kg honey, being the extraction process responsible for the highest contribution to greenhouse gases (GHG) emissions (90.7%) in contrast to hive management and freight emissions. A strong linear, positive correlation ($R^2 = 0.999$) is found between process emissions and honey production pointing out a high dependence of the process with the use of fossil energy. Carbon dioxide is the dominant GHG emitted (98%) compared to methane and nitrous oxide emissions. The subdivision method applied to calculate emissions allows tracing the burden of each phase of the production process; the functional unit used to estimate emissions proved adequate for comparison purposes and the results achieved were close to those reported in the literature in spite of honey carbon footprint is strongly dependent on the production practices and honey beekeeping chain characteristics. From the results obtained, energy efficiency measures during the processing stage could alleviate the carbon impact of honey production in Argentina.

1. Introduction

In the context of mitigation and adaptation to climate change, the relationship between the environment and global commerce is becoming more relevant since there is an important contribution to greenhouse gases (GHG) emissions by the exchange of tradable goods (Papendiek, 2010). Embodied emissions are those related to goods and services production, consequently, under the United Nations Framework Convention on Climate Change (UNFCCC) emissions are measured from production, therefore embedded emissions on imported goods are attributed to export rather than to import countries. The question of whether to measure emissions on production instead of consumption is partly an issue of equity, i.e. who is responsible for emissions (Toth et al., 2001). In this context,

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the dissimilar access to clean technologies between developed and developing countries, the high concentration of raw materials for goods and services in developing countries, and issues regarding trade and transportation services and the associated emissions are key factors over which the debate has not yet concluded (Papendiek, 2010).

The process of creating an international legal instrument to protect the environment has gone through a long and bumpy road, where the equilibrium between the two large normative bodies, the UNFCCC and the World Trade Organization (WTO), should be achieved in the short term. On one side, the UNFCCC contain the general principles and main actions for mitigation and adaptation to climate change, but does not contain provisions for mitigation of climate change related to global trade. On the other hand, there are decisions taken by the WTO with the goal of regulating environmental issues inside the multilateral trading system. The General Agreement on Trade and Tariffs (GATT), and previously the Marrakech Agreement, established the first multilateral negotiations on trade and the environment, searching to foster coherence and mutual backing (Papendiek, 2010).

Under this framework of interrelationship between international trade and the environmental security, the implementation of standards arises, such as the carbon footprint (CF) of goods. The CF is an environmental sustainability indicator that quantifies the emissions of GHGs generated during the lifecycle of a product. Cucek et al. (2012) described at least seven types of environmental footprints (carbon, water, energy, emission, nitrogen, land, biodiversity) delaying that CF was first defined in scientific literature and it is generally understood as derived from the global warming potential (GWP). Virtanen et al. (2011) developed a Life Cycle Analysis (LCA) of a food portion based on the assumption that CF carbon footprint, as a contribution of food to climate change, is arguably one of the most important aspects for improving the environmental responsibility of the food chain. According to Qi and Chang (2013) CF is a holistic estimate of total GHG emissions as a result of a defined action over the product's lifecycle that, facing the rising concern of global climate change, should be suitable in a future carbon-regulated environment. CF discussions focus on the identification of environmental impact of products, even though exists other environmental criteria linked to the sustainability of the production processes that also impact the exports of developing countries. The CF does not intend to be just an instrument to quantify the emissions of a determined product during its life cycle, but rather result in a significant tool to establish the traceability of a product, to act as a product certification (eco-tag) that communicates producers and consumers and to build policies of sustainable production inside of a program of assurance and continuous improvement of quality.

In terms of a business performance, Zeng et al. (2010) founded out that cleaner production activities have larger contributions to financial performance because they do not require significant financial inputs but may bring immediate financial benefits such as employment improvements and environmental awareness that can help discover low-hanging fruits for energy savings and waste reuse. Some markets demand standards or tagging the CF of certain products. European Union (EU) search the implementation the eco-label for twenty seven countries; Germany, Spain, Italy and Sweden join the initiative of the European Commission. The United States with a primary interest of routing the topic, finds itself inside an environmental parliamentary process (Papendiek, 2010). From all the projects under debate the implementation of a "Cap & Trade" and border tariffs systems emerge. In Latin America, several sectors such as meat, milk, rice, wine, flowers, coffee, sugar and apples started activities in order to identify critical environmental impacts in the production chain (Frohman and Olmos, 2013). The labeling schemes of CF are focusing on several products such as wine, crustaceans and fish, citrus fruits, apples, pears and other fruits, fruit juice and natural honey, many of which Argentina is a recognized exporter (Lottici, 2012). As an example, the United Kingdom requires "food miles" label for lemon, apple, pear, lamb and meat imported from Argentina (Idígoras and Martínez, 2011). According to the Second Meeting on Carbon Footprint organized by the Ministry of Agriculture, Cattle and Fishery (IICA, 2012) and based on a vulnerability analysis of Argentina's exports, honey exports would be potentially affected by the labeling of CF.

The government of Argentina has pointed out through the Agricultural Food and Agribusiness Federal Participatory Strategic Plan (PEA2),[1] that "*…there is a likely short-term scenario where clusters of high quality production and consumers willing to pay for good quality and environmentally friendly products is to come and to which Argentina should be prepared*". As response to this situation, the National institute of Agricultural Technology (INTA) and other local organizations such as Argentine Association of Regional Consortiums for Agricultural Experimentation (AACREA)[2] have conducted initial studies to advance in the calculation of the CF of those sectors of higher impact in the export markets such as cattle breeding, raising and meat, soybean, and dairy products (Galbusera, 2010; Galbusera and Hilbert, 2011). The wine industry made a first attempt to develop indicators for carbon emissions. Rodríguez et al. (2012a) designed an electronic spreadsheet to estimate the CF of white wine. Castro et al. (2012) developed five indicators of eco-efficiency including specific consumptions of electricity, water use, wastewater and waste generated in wine industry. Rodríguez et al. (2012b) proposed a model based on an integral scorecard applied to the wine industry that includes the minimization of the CF. Curadelli et al. (2011) determined the CF of wine produced in Mendoza (Argentina) by using typical local technology under different recycling scenarios. While these studies do not reach the full life cycle of the sectors, the initiatives constitute important contributions to the measurement of the carbon impact of these products.

According to Food and Agriculture Organization of the United Nations (FAO) statistics (FAO, 2011) Argentina is one of the three major exporters of honey; together with China and Mexico produce about 60% of the world trade (FAO, 2009). Argentina domestic consumption of honey is approximately 200 g/cap/year, while in developed countries – such as Japan, USA and Germany – the annual consumption per capita is about 1 kg. This consumption pattern causes that almost 95% of the local honey production goes to the export market (Blengino, 2013).

Argentina established a legal framework to achieve traceability of the honey production chain. The National Food Code (CAA, Chapter X, Sugar foods) defines the identity of the product in terms of its technical specifications such as the physical and chemical characteristics, quality parameters, origin and packaging among others; the National Register of Honey Producers RENAPA establishes the compulsory registration of producers and facilities (RENAPA, 2001); the National Control Authority of Animal Health (SENASA) establishes the legal framework to be accomplished by the honey processing facilities. In addition, there are a large number of specific rules for the management of waste, packaging, pollutants, commercialization and classification of botanical origin between others (Secretary of Agriculture, Livestock, Fishery and

[1] Agri-Food and Agribusiness Federal Participatory Strategic Plan, 2010–2016. Chap. 4. Presentation on the international stage and opportunities in this context for Argentina, with the horizon at 2020. Page 73.

[2] Argentine Association of Regional Consortiums for Agricultural Experimentation http://www.aacrea.org.ar/.