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Fresh milk supply through vending machines: Consumption patterns and associated environmental impacts

A. Pereira^{a,*}, Villanueva-Rey^{b,c,d}, X. Vence^a, M.T. Moreira^b, G. Feijoo^b^a ICEDE Research Group, Department of Applied Economics, Universidade de Santiago de Compostela, 15782 Santiago de Compostela, Galicia, Spain^b Department of Chemical Engineering, Institute of Technology, Universidade de Santiago de Compostela, 15782 Santiago de Compostela, Galicia, Spain^c Centre for Environmental and Marine Studies (CESAM), Department of Environment and Planning, University of Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal^d Peruvian LCA Network, Department of Engineering, Pontificia Universidad Católica del Perú, 1801 Avenida Universitaria, San Miguel, Lima 15088, Peru

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ABSTRACT

Fresh pasteurized milk consumption is evaluated from environmental and socio-economic perspectives. Two different supply chains are analysed: traditional supply chain and vending machines—a circular business model based on a short supply chain. Milk vending machines show that consuming milk in proximity, eliminating intermediaries between producers and consumers and, therefore, reducing the use of resources and energy (packaging and transportation), has environmental advantages. Hence, milk distribution, electricity consumption and consumer transport caused the largest impacts. When the environmental profiles of pasteurized milk consumption in supermarkets and vending machines are benchmarked, the vending machine has a considerable lower impact. The sensitivity analysis emphasizes the latter findings, highlighting the relevance of consumer choices upon the environmental profile of milk consumption. Despite the environmental benefits, vending supply chain unexpectedly failed in Spain from a socioeconomic point of view due to several factors: the farmers' lack of processing and marketing capacities, the difficulty of networking and collaboration with other key stakeholders, the necessity to raise consumer awareness of the benefits of pasteurized milk and the limited range of dairy products offered. The development of a close short supply chain can bring significant environmental and socio-economic benefits. Notwithstanding, the case analysed in this paper indicates that the isolated entrepreneurship is not sufficient and the transformation of the food system towards a circular model requires political and societal commitment.

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1. Introduction

In the context of the paradigm shift towards Circular Economy, the characteristics of the global food system are under great scrutiny due to the enormous amount of food waste and other important environmental impacts generated from farm to fork (Garnett, 2011; Weetman, 2017). Partly in response to this question and also in order to overcome the linkages of the dominant food system, which is featured by the commoditization of agricultural inputs and market exchange through national and global markets as well as by the strong power of global food supermarkets at the stage of food retailing (Goodman et al., 1987; Hendrickson and Heffernan, 2002; Morgan et al., 2006), some small farmers are becoming entrepreneurs.

Small farmers in Europe are leading the way in defining alternative supply chains, such as sale at the farm, sale in covered or

street markets, e-commerce, collective food supply, community supported agriculture and box shopping systems (Gallaud and Laperche, 2016). These also correspond to differentiated patterns of consumption. Opposite to centralized consumption in supermarkets, new consumption patterns are related to different aesthetics and appreciation of food, as well as to broader concerns about the environmental and economic conditions of production.

Sustainable food networks can be defined as new social networks and entrepreneurial initiatives focused on “investing in the local environment, creating and strengthening local institutions, and employing people and their resources” (Morgan et al., 2006). This article focuses on a supply chain based on milk vending machines. It is a short supply chain because there are no intermediaries between the producer and the final consumer and it is a nearby supply chain because all actors are geographically close to each other (Gallaud and Laperche, 2016).

This paper tries to shed light on the potential contribution of short food supply chains in the context of Circular Economy. In 2015 the European Commission adopted an ambitious Circular

* Corresponding author.

E-mail address: angeles.pereira@usc.es (A. Pereira).

Economy action plan, which includes measures aimed to “close the loop” and tackle all phases in the lifecycle of a product: from production and consumption to waste management and the market for secondary raw materials (European Commission, 2015). The mentioned plan has a special focus on actions to avoid food waste and it also addresses other challenges faced at the different stages of the food supply chain, such as the need to reduce energy use and plastic packaging.

Opportunities for a new food system embedded in the Circular Economy include, amongst others (Weetman, 2017): getting more from less (e.g. using vegetable parts often discarded), designing food to stay fresh and retain nutrients (through packaging innovation), developing new farming models (e.g. aquaponics and underground farming), reducing waste and eliminating packaging, etc.

This article aims to estimate the environmental benefits of milk sold through vending machines compared to milk sold in supermarkets, as well as to assess it from a socio-economic point of view. To tackle this objective, a case study was conducted in Galicia (NW Spain). Dairy farming is a strategic activity in the agri-food sector in Galicia and represents around 30.5% of total agricultural production (Consellería do Medio Rural, 2008). Thus, there are 10,134 farms (INE, 2013), producing an average of 2.5 billion litres of raw cow milk per year. The production represents around 38% of all the cow milk produced in Spain. However, the sector is structurally weak as it lacks a strong processing industry.

Data from InLac (2016) indicates that milk consumption in Galicia amounts to 89.7 L per capita per year on average, being the second autonomous community after Castilla-León. Milk consumption patterns in Spain show a preference for semi-skimmed milk (45.3%), followed by skimmed milk (28.5%). In contrast, the consumption of whole milk has declined in recent years (–17.1% between 2011 and 2015). As for the thermal processes to which milk is subjected, raw milk or pasteurized fresh milk has traditionally been the most consumed in Spain through local gate to gate delivery from farm and traditional retailers. However, for 25 years, the most consumed milk has been long-life milk (UHT), and it is purchased in supermarkets (53.7%), discount stores (20.1%) and hypermarkets (18.6%), favouring large supply chains (InLac, 2016). The high penetration of UHT milk was supported by aggressive advertising campaigns highlighting its features and health benefits: longer shelf life, safety, product diversity—i.e. skimmed, semi-skimmed, whole, calcium and or vitamin enriched, etc. Consequently, and despite the superior quality of pasteurized milk in terms of health benefits (more vitamins and protective effects) (MacDonald et al., 2011), pasteurized milk consumption decreased progressively to marginal figures, from 60% to 3.5% over the period 1980–2016 (Collantes, 2014; MAPAMA, 2017).

Milk vending machines have been implemented in several Spanish cities over the last decade as an innovative strategy by dairy entrepreneurs. Milk vending machines are quite spread across a number of European countries, such as Switzerland, Italy, France, Austria and Slovenia.¹ Some countries do not permit the sale of raw milk through vending machines (Denmark, Ireland, Greece, the Netherlands, Spain and the UK), which may make a difference in consumer behaviour and motivation to purchase. In any case, vending machines represent a supply chain that meets the principles of an alternative food system in line with the basis of Circular Economy. Firstly, they eliminate intermediaries and allow a more direct relationship between dairy producers and

consumers; secondly, they avoid much of the processing and packaging of milk; and thirdly, they rely on local proximity; thereby, reducing food miles and associated impacts (transportation, storage, energy). Nevertheless, the initiative of vending machines failed in Galicia; thus, the paper tries to shed light of the factors that explain this unsuccessful attempt.

The rest of the paper is organized as follows: the second section presents a state of the art on the main obstacles faced by short food supply chains, which limit their chance of success. The methodology is explained in the third section. The fourth section presents the main results, which are discussed in section five. The paper finishes with a brief conclusion and some recommendations.

2. Short food supply chains as an alternative to the prevailing food system

In recent years, the sustainability of the dominant food system has been questioned by several authors. Several threats to productivity growth have been identified, as well as social concerns such as the health and social costs of diet-related illnesses and food waste for the US food system (Heller and Keoleian, 2003). In addition, significant negative environmental impacts have been attributed to a highly industrialized and globalized food system (Gallaud and Laperche, 2016; Garnett, 2011; Heller and Keoleian, 2003).

External pressures for better environmental, animal welfare and food safety practices, together with the internal pressures faced by the conventional food system, have led to the development of new supply chains. They are often presented as a promise of sustainability, although some criticisms have also emerged (Ilbery and Maye, 2005).

In general, alternative food systems encounter at least three types of difficulties: the selection of actors and the establishment of relationships to build the supply chain; the relationship with the mainstream, usually linked to the process of scaling up and the need to raise awareness and maintain a close relationship with consumers. In this sense, Wiskerke and Roep (2007) identified some crucial elements that contributed to success in building a new supply chain in the pig sector in Netherlands, such as the creation of additional net value added and its redistribution among all chain partners, shared decision-making processes based on trust, strategic alliances, chain stability and shared risks. On the other hand, the communication of the specific qualities directly to consumers was highlighted as the main weakness.

Taking an innovation systems policy approach, Vandermeulen et al. (2011) analysed four different food supply chains and argued that common failures are related to institutions, capabilities and interaction. Institutional failures include a contradiction between consumer attitude and consumer behaviour, reflected in a difficulty in adequately conveying the quality image by the producer; the limits imposed by the choice of a particular supply channel; the need for small farmers to comply with strict regulation, and the enforceability of agreements between the members of food supply chains. In the area of capabilities, lack of competences, capacities or resources, such as supply chain management and marketing skills, constraint the ability of the organization to undertake new activities. The most important failure stems from the difficulty to build a common vision between the participants in the food chain, which is mainly due to the limited interaction between producers and consumers.

Brunori et al. (2008) conducted a case study focusing on the process of scaling up faced by an organic beef cooperative in an Italian region. The study shows the importance of constructing and communicating the image of quality and the necessary involvement of consumers. Thus, keeping contact with final costumers is key to ensure the successful development of new food supply chains.

¹ Italy has the largest number of vending machines (1066 in 2013), followed by Slovakia (182 in 2012), Austria (121 in 2013), France (93 in 2013), the Czech Republic (14 in 2013) and Lithuania (6 in 2013) (EFSA Panel on Biological Hazards, 2015).

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