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Assessing challenges and opportunities of Industrial Symbiosis in the Agro-Food sector

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Abstract

Industrial Symbiosis (IS) engages traditionally separate entities in a collaborative perspective, through the physical exchange of energy, materials, and, especially, by-products, in order to create and share mutually profitable transactions and to improve businesses and technical processes (Chertow, 2000).

The implementation of IS schemes in the agro-food sector has the potential to bring environmental, economic and social advantages, reducing waste and enhancing resource provisioning options. Agro- industrial by-products may be recovered and exploited either to replace inputs, either to generate innovative and value-added products (Borrello et al., 2016; Fraccascia et al., 2016).

However, the literature on Agro-Industrial Symbiosis (AIS) is rather recent and many aspects deserve to be further investigated.

Firstly, circularity is usually exploited through the valorisation of supply-chain wastes as an alternative way to produce livestock feed (Borrello et al., 2016; C Strazza et al., 2015) or bio-energy (Arodudu et al., 2017; Blades et al., 2017; Old et al., 2016), but little attention is given to new product generation options (Fraccascia et al., 2016).

Secondly, most studies follow a top-down approach (i.e. interconnections are theoretically designed a priori), rather than a bottom-up approach (i.e. AIS is driven by a spontaneous and self-organized process undertaken by firms) (Chertow, 2007; Fraccascia et al., 2016). Hence, these studies offer a number of interesting conceptual insights on AIS, but little information is available concerning the actual viability of real case studies (Borrello et al., 2016; Strazza et al., 2015).

As a third issue, AIS is most often evaluated based on the physical flows generated, as in the case of the Material Circularity Index (Ellen MacArthur Foundation, 2015), or based on their environmental impact, as through Life Cycle Assessment. However, in order to provide a useful knowledge base for either private and public actors, an economic feasibility study should be included in the overall evaluation.

In the light of these considerations, the objective of the present study is to explore the challenges and opportunities of geographic proximity and collaboration to design, implement and evaluate AIS actions.

To this end, the study will provide a case study analysis, based on the "Food Crossing District" project (co- funded in the framework of the POR FESR 2014-2020 program). Following a bottom-up approach, the project aims at identifying economically viable solutions for the reuse and the enhancement of agro-food wastes and by-products from two major production chains of the Emilia-Romagna region (tomato skins/seeds and durum wheat bran), to obtain innovative eco-friendly value-added products.

As a first outcome of the project, a dynamic map of local circular economies is proposed, based on a geo- linked software tool gathering input-output data from enterprises, to foster by-product exchanges and collaboration among actors.

Then, the economic viability is assessed by means of a cost-benefit analysis encompassing both industrial and market aspects. Preliminary results point out the influence of the costs related to the design/adaptation of industrial processes and plants (including biomass availability, storage and transportation options). Among the most important factors affecting the success of the new products on the market, product attributes and consumer perception are considered.

Keywords: Industrial Symbiosis, Agro-food sector, Economic viability

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