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Mapping dairy by-products flows in the Veneto region: a system dynamic approach

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Abstract

European Union supports the analysis of the advantages inferred from the transition to a more circular economy. Such transition would be the opportunity to create new and sustainable competitive advantages for European economy, protecting businesses against scarcity of natural resources and volatile prices (EU commission, 2015).

Dairy sector, among others food chain, is characterised by a large amount of by-products created during the process of cheese making. In particular, whey production is one of the main environmental problems cheese factories must address, as it is generated in large quantities per kilo of cheese produced. Whey consist of 80– 90 % of the total volume of milk entering the process and contains about 50 % of the nutrients in the original milk: soluble protein, lactose, vitamins and minerals, which make it very interesting as raw material for valorisation process (Gösta, 1995). With a milk production around 1.145.000 tons (ISTAT, 2016), the Veneto region produces about 900.000-1.000.000 tons of whey per year. The regional dairy sector suffers for a limited perception of quantity and quality of these flows. This lack of knowledge limits the development of business strategies and policy for the valorisation of this by-product under an approach of circular economy.

Gowreesunker and Tassou (2015) described several approach for the analysis of agri-food production system: regression analysis, LCA (life cycle assessment), IO (input-output) system analysis, and systems dynamics (SD). Among others, SD models are able to reflect the complex interaction between a complex dynamic system and the behaviour of the aforementioned system in different scenarios. The adaptability that characterizes the SD models makes them usable in a wide range of scenarios, including environmental management (Turner et al., 2013; Mashayekhi, 1990), ecological modelling (Kopainsky, 2015; Wu et al., 1993) and agricultural systems (Saysel et al., 2002; Teimoury et al., 2013).

The development of the SD model is based on the following three steps according to the approach proposed by Sterman (2000):

- i. Problem definition: highlight problem, identify key variables and characterise the problem dynamically.
- ii. Dynamic hypothesis: develop a causal loop diagram that explains causal links among variables
- iii. Formulation and deployment in software: convert the system description into SD models

The application of this SD model can help to monitor the flow of whey within a territory of production, supporting the diffusion of technologies able to process it into added-value products. Moreover, this analysis will contribute to evaluate, manage and minimise the environmental impact of cheese production system while improving competition of the sector. Such a model can finally be utilised to design and evaluate policies regarding the dairy sector.

Keywords : dairy sector, by-product, whey, system dynamics

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