

Valorising olive waste and by-products in the Mediterranean region: a socio-economic perspective

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In the Mediterranean region, the agrifood sector is considered as strategic for the socio-economic development in terms of employment and incomes, and as part of the cultural heritage. However, the increase in agricultural production, often through intensification and costly external inputs, is leading to negative externalities on the social and natural environment, such as abandonment of small-scale farmers, loss of biodiversity, land degradation, or greenhouse gas emissions (Antonelli *et al*, 2019). Agriculture is the main water consumer in this region where its scarcity requires intelligent agricultural growth schemes and efficient usage of all agro-resources produced (Capone *et al*, 2016). Moreover, agricultural and food waste and losses deteriorate the efficiency of the food chains and therefore contribute to food and nutrition insecurity (Di Terlizzi *et al*, 2016). There is a need for a more coherent and rational agrifood system.

This project seeks to address this challenge with a particular emphasis on the olive sector, which contributes with nearly 10 million hectares of plantation and cultivation and more than 2,5 million tons of olive oil produced per year in Europe and Africa (Vilar & Pereira, 2018) significantly to revenues and employment, especially in Mediterranean rural areas. More specifically, the project aims to understand the socio-economic processes and conditions under which groups of farmers and food SMEs develop new circular business models for valorising olive waste (wood, leaves and branches) and by-products (olive pomace and olive mill wastewater). Huge waste streams are generated by olive pruning and olive oil processing, amounting up to an estimated 21,4 million tons/year in the European producer countries alone (Berbel & Posadillo, 2018). These olive waste and by-products have the potential to be converted into new value-added and marketable ingredients and products, such as bioenergy and bio-fertilizers, bio-based materials, food and feed additives, or nutraceuticals (Roselló-Soto *et al*, 2015). A review of existing literature on circular economy principles and practices within the olive domain shows a strong focus on chemical or biotechnical aspects of waste and by-product treatment and valorisation (e.g. Galanakis, 2017), while a socio-economic perspective on this topic is very sparse.

In order to identify major success factors, opportunities and bottlenecks for valorising waste and by-products from the Mediterranean olive sector, an analysis of the conditions and processes is done at three different interconnected action levels: (i) at a macro-level, agricultural and environmental policies regarding waste and by-product valorisation are reviewed in Spain, France, Morocco and Tunisia; (ii) at a meso-level, case studies are performed on circular business models within olive oil-producing groups of farmers and food SMEs; and (iii) at a micro-level, individual farmers' and consumers' attitudes and behaviour towards olive waste and by-product valorisation are investigated.

First, results show that some policies and regulations for the protection of the environment and waste treatment exist in the four studied countries, but a common regulatory basis for olive by-product management is lacking and the treatment of olive waste is not regulated at all. It also seems that real political incentives and financial measures to actively support olive waste and by-product valorisation are yet insufficient. Second, while all resources of the olive tree and olive oil production process have the potential to be valorised, value-adding business activities are currently limited to one or several resources (principally by-products), and rather converted into low added-value (bioenergy or fertilisers). Third, a study conducted in Catalonia points out that small-scale olive farmers tend to apply some kind of circular economy strategies, however, mostly driven by the aim to get rid of their waste problem, rather than participating in cohesive circular production models that potentially create additional incomes. Fourth, a number of qualitative consumer interviews in Tunisia indicate that consumers are

aware of the olive waste and by-product problem and even know about their valorisation opportunities, but rarely use e.g. soap and cosmetics issued from olive residues.

Based on the project's final results, recommendations will be developed and shared with olive oil farmers, processors, and policymakers, with the aim to contribute to improving and innovating policies and practices for sustainable usage of all olive resources in the Mediterranean area. Continuous exchange and cooperation between different actors at various action levels seem crucial for co-creating value out of olive waste and by-products.

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