D8.8: The socio-economic impacts of wastewater sludge valorization: The case of biofertilizers in Italy

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SUMMARY:
Municipal wastewater has high potential for nutrient valorization and sustainable supply chain development. The objective of this case study is to evaluate its economic and social impacts. To this end, this empirical case study applied a hybrid input-output (IO) analysis, combining data on new processes and sectors with an existing supply-use table (Exiobase). In particular, direct and indirect impacts for replacing a synthetic fertilizer with fertilizers derived from wastewater were quantified. The results show that the development of a biorefinery for the valorization of nutrients from sewage sludge has great relevance in creating added value and employment for the rural society of the local area.

RESEARCH QUESTIONS:
How does nutrient valorization from organic residues affect the local economy? How does the socio-economic sustainability of fossil-based fertilizers change with sludge as a replacement for nutrient inputs?

CASE:
The cascading socio-economic implications of nutrient valorization from organic residues for agricultural use

BIO-BASED PATHWAYS:
Wastewater treatment plants, bio-based fertilizers and biosolids

DEVELOPMENT STAGES: Mature

DATA SOURCEs:
Exiobase, literature

DATA ANALYSIS:
Hybrid IO analysis; production layer decomposition analysis

INDICATORs:
Value added, Employment

GEOGRAPHICAL SCOPE:
Italy

TIME REFERENCE:
2019

AUDIANCE:
Policy-makers; Researchers

KEY RESULTS:

- This research has shown that biofertilizers and biosolids can generate more value added in the national economy than conventional synthetic fertilizers industries.
- For the production of a million euros, the bio-based industry stimulates a total of 0.85 million euros of economic growth and about 9 jobs.
- Considering only a partial demand substitution for fossil-based fertilizers, the bio-based industry can lead to new job opportunities in the local context.
- The production layer decomposition analysis showed that more than 64% of the positive socio-economic impact of the waste management industry derives from upstream sectors.

CONTEXT and DRIVERS:

- Biofertilizers production from sludge benefits from a low livestock density, high demand for organic fertilizer, and from a high density in crops cultivation such as rice that shows substantial yield increases without hazardous accumulation of heavy metals.
- The bio-based supply chain is negatively affected by the seasonality of agricultural activities and by a multifaceted and outdated regulation that no longer matches current needs and expectations.

LIMITATIONS:

- Input-output analysis requires several assumptions: (i) fixed production structure of industries; (ii) constant returns to scale; (iii) and fixed commodity prices.
- The level of sectoral and spatial detail in input–output databases highly affect the analysis. In general, high sectoral aggregation yields significant errors and uncertain results, so-called aggregation bias.
- IO tables do not account for all material requirements meeting the final demand unless such material flow has a traceable economic value.

GOOD PRACTICES:

- This study suggests hybrid IO models as a tool to monitor progress toward a more sustainable future. By considering impacts from the entire supply chain, hybrid IO analysis eliminates truncation errors caused by the selection of a sub-set of the sectors involved. This aspect makes this method particularly relevant for bioeconomy-related phenomena whose boundaries may not be immediately clear.

FEEDBACK and RECCOMANDATION to other WPs

WP1 Indicators:
Most of the indicators defined within the BioMonitor project fit the Hybrid IO framework, allowing a comprehensive approach for a systematic impact quantification. However, not all indicators are readily measurable from basic monetary IO tables. Most indicators can only be handled using MIOTs coupled with non-economic, physical data or Physical Input-Output tables. A final recommendation concerns the employment indicator. It is important to note that for it, available data are reported by gender and by low-, medium-, and high-skill level groups. This information can be used as other useful sub-indicators to address a more thorough social assessment of the bioeconomy within the BioMonitor monitoring framework.

WP2-3 Data collection:
In accordance with the main findings of BioMonitor WP2, this case study assessed EXIOBASE as a trustworthy data source for monitoring bioeconomy-related phenomena for the European Union member states given its disaggregated sectoral data completeness, geographical coverage, and time span. In addition, the database meets the data needs for socio-economic indicators, not just for climate footprint assessments.

WP4-5 Model Toolbox:
Applying input-output analysis using data from PIOTs instead of MIOTs implies: (i) avoiding distortions of results due to the monetary structure of the economy; (ii) deriving directly conversion factors and multipliers; (iii) reducing uncertainty due to variation driven by changing prices and exchange rates. Despite these advantages, the very limited and restrictive data situation and the lack of complete PIOTs hinder the application of physical input-output analysis. This aspect highlights the importance for impacts analysis of monitoring and measuring all the material flows within the economy, and between the economy and the Environment.

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