Biophysical and monetary valuation of ecosystem services: a semi-systematic review of theories and techniques for the Italian spatial planning

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Abstract Despite being acknowledged by the European Soil Strategy as a key resource in addressing major challenges such as climate change and biodiversity loss, soil remains underrepresented in spatial planning and decision-making over territorial transformations. The European objective of "no net land take" (NNLT) by 2050 is far from being met—particularly in Italy, a "middle-of-the-road" country in aligning planning systems with NNLT goals (ESPON, 2024), largely due to fragmented land transformations and a highly dispersed administrative structure of small municipalities. These entities are often not required to fully integrate soil conservation strategies into local plans—as in the case of European Greening Plans, which apply only to cities with at least 20,000 inhabitants. This situation is compounded by widespread illiteracy regarding soil quality and the role of soil ecosystem services in supporting human well-being, economic stability, and environmental sustainability. Yet, in Italy small and medium-sized municipalities remain the main contributors to soil sealing (ISPRA, 2024).

In this context, the research investigates whether and how the concept of ecosystem services (being inclusive, multidisciplinary, and accessible to practitioners) can serve as a strategic tool to enhance the role of soil in territorial decision-making. Previous studies have shown opportunities for their partial integration into planning instruments in Italy (Richiedei, 2024; Geneletti & Cortinovis, 2021). However, new tools are needed to overcome the financial, regulatory and institutional constraints of local administrations. In this regard, recent literature increasingly supports the use of monetary ecosystem service valuation both as a practical planning tool and a communication instrument for policymakers.

To explore this, a semi-systematic literature review was conducted, guided by two questions: (1) how can ecosystem services valuation be integrated into planning instruments, and which valuation frameworks and techniques have been proposed within the scientific literature? and (2) according to past researches, which monetary metric can ethically and effectively reflect the economic value of ecosystem services within planning frameworks? Both operative and theoretical studies were screened using thematic, temporal and geographical filters to ensure relevance to the Italian spatial planning system. The findings from this review are critically compared with the System of Environmental Economic Accounting – Ecosystem Accounting (SEEA EA) framework— the current international statistical standard for biophysical ecosystem service accounting and a key reference for monetary valuation – and culminate in a comparative reading grid that synthesizes the most effective tools and

techniques for integrating ecosystem services into planning in resource-constrained small and medium municipalities.