Handling Quantitative Information across Scales and Dimensions

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The complexity revolution that is slowly but steadily reshaping the scientific field of sustainability science has had no impact thus far on accounting protocols adopted by statistical offices. Several pre-analytical assumptions dating back to Cartesian times are still in use and hamper the generation of useful statistical products for dealing with sustainability issues. Two such assumptions are: (i) Statistics refer by default to observable quantities of external referents, whose definition, individuation and measurement can be carried out in an uncontested way; and (ii) The information required for dealing with relevant sustainability issues can be generated by using one scale and one dimension at the time. An integrated analysis of the sustainability of socio-ecological systems demands the generation and use of datasets describing a mix of relevant characteristics that refer to non-reducible legitimate narratives, and that can only be perceived, observed and represented using simultaneously different scales and dimensions. Three examples are used to show that present accounting protocols do not meet this demand and create an epistemological conundrum: (1) The weakness of the assessments of the traditional set of attributes carried out at the national level for inter-country comparison (e.g., using proxy variables such as GDP and energy consumption per capita per year); (2) The weakness of the Energy Intensity indicator, assessed at the national level, to study the de-materialization and de-carbonization of modern economies; (3) The impossibility of scaling up assessments of environmental impact when relying on data that are not derived from and organized in Geographic Information Systems. Innovative methods of accounting based on complexity theory offer a way out of this impasse. For example, the Multi-Scale Integrated Analysis of Societal and Ecosystem Metabolism (MuSIASEM) is capable of integrating quantitative information referring to different scales (from micro to macro) and different dimensions (biophysical and socio-economic data), combining quantitative and qualitative variables organized in multi-level matrices and GIS-based data. Three examples of integrated datasets generated by MuSIASEM are illustrated in relation to three case studies (South Africa, the Punjab region of India, and the Republic of Mauritius) in which the nexus between land use, water, food, and energy was explored for policy purposes. In conclusion the complexity revolution in the field of sustainability science implies an additional role for statistical offices: They must face the challenge of quality assurance on the process of production and consumption of quantitative assessments for governance.

Key Words: Environmental-economic accounting, multiple scales, MuSIASEM, complexity, science for governance.