Development of concepts for human labour accounting in Emergy Assessment and other Environmental Sustainability Assessment methods

Human labour is central to the functioning of any human-influenced process. Nevertheless, Environmental Sustainability Assessments (ESAs) do not systematically include human labour as an input. Systematic omission of labour inputs in ESAs may constitute an unfortunate, significant bias in favour of labour intensive processes and a systematic underestimation of environmental impacts has implications for decision-making. A brief review of the evaluation of human labour in ESAs reveals that only Emergy Assessment (EmA) accounts for labour as standard. Focussing on EmA, we find, however, that there is no agreement on the calculation method for labour. We formalise the calculation of human labour unit emergy values (UEVs) as being the ratio between the emergy resource basis of the labour system and a proxy for labour, with or without allocation to account for different qualities of labour. The formalised calculation approach is demonstrated using examples from the literature (USA, with allocation based on educational level; Ghana, with allocation based on income level; the World, with no allocation). We elaborate on how labour may be considered as endogenous or exogenous to the studied system, and how inputs can be categorised as direct labour taking place in the system under study and indirect labour occurring upstream in the supply chain associated with the studied system. With appropriate modifications, the formalised calculation approach and the distinction between direct and indirect labour may be transferred to other ESA methodologies. Concerning EmA, we recommend that product UEVs should systematically be calculated with and without labour, and that working hours rather than salary should be used when accounting for labour inputs. We recognise that there is a risk of double counting of environmental impacts when including labour. We conclude, however, that it can be ignored for most production systems, since only a negligible fraction of emergy already accounted for is likely to be included in the emergy flow from labour inputs.