Shaping the Future Landscape: Catchment Systems Engineering and the Decision Support Matrix Approach

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Land degradation is widely recognised as one of the great environmental challenges facing humanity today, much of which is directly associated with human activity. The negative impacts of climate change and of the way in which we have engineered the landscape through, for example, agriculture intensification and deforestation, need to be addressed. However, the answer is not a simple matter of doing the opposite of current practice. Nor is non-intervention a viable option. There is a need to bring together approaches from the natural and social sciences both to understand the issues and to act to solve real problems.

We propose combining a Catchment Systems Engineering (CSE) approach that builds on existing approaches such as Natural Water Retention Measures, Green infrastructure and Nature-Based Solutions with a multi-scale framework for decision support that has been successfully applied to diffuse pollution and flood risk management. The CSE philosophy follows that of Earth Systems Engineering and Management, which aims to engineer and manage complex coupled human-natural systems in a highly integrated, rational manner. CSE is multi-disciplinary, and necessarily involves a wide range of subject areas including anthropology, engineering, environmental science, ethics and philosophy. It offers a rational approach which accepts the fact that we need to engineer and act to improve the functioning of the existing catchment entity on which we rely. The decision support framework proposed draws on physical and mathematical modelling; Participatory Action Research; and demonstration sites at which practical interventions are implemented. It is predicated on the need to work with stakeholders to co-produce knowledge that leads to proactive interventions to reverse the land degradation we observe today while sustaining the agriculture humanity needs.

The philosophy behind CSE and examples of where it has been applied successfully are presented. The Decision Support Matrix (DSM) approach is introduced as a way to engage stakeholders at all scales, helping to inform decision making and motivate intervention. Two existing visualization and communication tools produced using the DSM approach are discussed: The FARM (Floods and Agriculture Risk Matrix) and CAVERTI (Communication And Visualizing Erosion-associated Risks to Infrastructure). Such tools can play a central role in encouraging a more holistic engineering approach to managing catchment system function that combines food production with a reversal of land degradation, providing a 'win-win' situation for all.