Tropentag, September 16-18, 2026, hybrid conference

"Towards multi-functional agro-ecosystems
promoting climate resilient futures"

Digital tool for landscape investment planning: identifying context specific agronomic, land and water management practices

Sudharsan Malaiappan[1], Mohammad Faiz Alam[2], Gopal Kumar[3]

[1]*International Water Management Institute (IWMI), India*
[2]*International Water Management Institute (IWMI),*
[3]*International Water Management Institute (IWMI), Sustainable Water infrastructure & Ecosystems (SWIE), India*

Abstract

The sustained multifunctionality of agricultural landscapes often relies on the synergistic implementation of land, water and agronomic practices. However, planners and stakeholder often lack integrated decision support systems to identify context specific interventions that cuts across both agricultural production system and land-water management. Existing tools typically address the challenges in isolation. This fragmented approach often leads to siloed implementation and thin distribution of resources. To prioritise and implement context specific and integrated agri-land-water interventions, it is essential to understand their local suitability.

To address these challenges, we developed a comprehensive tool, that integrates agricultural production recommendations with land and water management practices. Within this analytical framework, the biophysical suitability of crops, livestock, and land-water interventions is quantified using core environmental parameters – specifically rainfall, temperature, topographical slope, and essential edaphic factors. These variables are evaluated using trapezoidal scoring aggregated with Liebig's law of minimum, ensuring environmental limiting factors are accurately modelled.

Following the biophysical suitability, candidate species – including crops, livestock and aquatic foods - are subsequently evaluated using weighted, multi-criteria functional trait matrix across agronomic and socioeconomic challenge domains, including land degradation, drought, monocropping, nutritional insecurity, chemical dependence, economic constraints, and livestock integration. To evaluate the landscape's food and nutritional security, a landscape-level nutrient adequacy model calculates the collective dietary output of the optimised crop-livestock-aquatic recommendations. Land and water management practices are scored against the same challenge domains and matched to recommended production systems by spatial, temporal, and functional compatibility.

By operationalizing landscape multifunctionality into a quantifiable, empirical matrix, this DSS enables stakeholders to transition from fragmented planning of agricultural production system and land-water management to a data driven and landscape level resource optimisation. Designed to translate complex methodologies into the language of practitioners and farmers, the tool prevents siloed recommendations and aims to foster resilient, nutrition-sensitive landscape management.

Keywords: Digital tools, food security, land and water management, multifunctional landscapes

Contact Address: Sudharsan Malaiappan, International Water Management Institute (IWMI), Delhi, India, e-mail: s.maliappan@cgiar.org