Achieving renewable energy-centered sustainable development futures for rural Africa

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Context & objectives

Multi-dimensional and overlapping Nexus challenges in rural sub-Saharan Africa (>90% rained irrigation; <35% electricity access; 60% moderate/severe food insecurity; 35% below poverty line; +300 million additional people by 2050) and growing climate change impacts.

Need for multi-level interventions (from national policies, to regional/river basin-scale planning, to local planning and investment) and innovative technology-business model solutions to sustainably achieve wellbeing and increase adaptive capacity.

Study objectives: soft-linking bottom-up water and energy demand and infrastructure assessment models into a multi-node, national Nexus-extended Integrated Assessment Model (MESSAGEx-Nexus) to show how water and energy needs for agriculture can jointly shape energy access pathways.

Materials & methods

Four models integrated in the “RE4AFAGRI modelling platform” are run in sequence and soft-linked, connecting bottom-up demand onto multi-node IAM for supply and investment assessment.

Harmonized SSP-RCP and policy target scenarios to 2050 across models (baseline; improved access; ambitious development scenarios) and consistent, stakeholder-validated modelling assumptions.

Zambia implementation

95-187 MCM of water required to achieve irrigation expansion goals, growing to 239-610 MCM by 2050. In turn, total electricity demand climbing from the current 18 TWh/yr to 55-93 TWh/yr in 2030 and 87-116 TWh/yr in 2050.

Water needs for agriculture affect energy demand through water pumping and increased crop yields (and thus crop processing and storage energy use) → implications for energy planning and SDGs (energy access; nutrition security).

Stimulating agricultural uses of energy (e.g. through subsidies, regulation, innovative business models) drives much faster uptake of mini-grid and standalone electricity access systems → accelerated rural development and SDGs achievement.

National-scale integrated modelling with explicit focus on Nexus interlinkages allow assessing locally-relevant demand sources and investment needs, and their implications for sustainable development.