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Stochastic impact evaluation of a road water harvesting intervention in northern Ethiopia

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Abstract

For efficient resource allocation and optimised returns from development interventions, decisions should be made based on detailed ex-ante evaluation. However, due to measurement difficulties, and a lack of appropriate tools to integrate the available uncertain information, such evaluation has often remained inadequate. Stochastic Impact Evaluation (SIE) presents a novel approach for evaluating complex development projects in the face of system complexity, uncertainty and variability. We used SIE to evaluate the viability of road-water harvesting interventions in the Tigray region of Ethiopia. After eliciting expert knowledge about the planned intervention, we generated a causal impact pathway model and collected estimates for all parameters. We used SIE tools, including Monte Carlo simulation, Partial Least Squares regression and Value of Information Analysis, to forecast project outcomes, identify sensitive parameters and detect critical knowledge gaps in decision-making. The experts identified percolation ponds, farm ponds, and check dams as suitable strategies for harvesting road-water. Model results indicated that the communities in the vicinity of the road are likely to benefit from road-water harvesting structures, while such measures are costly for the implementer. Harvesting flood water using percolation structures was found likely to generate positive impact with a value ranging between \$18,000 and \$120,000 per structure, while the overall benefits appeared negative for check dams. Harvesting road-water using farm ponds could generate positive impacts, but viability remains uncertain because of several knowledge gaps that should be narrowed by measurements before an investment decision is taken. This case study confirms the feasibility of using the SIE approach for analysing decisions on complex systems under uncertainty, suggesting broad applicability to similarly complex decisions.

Keywords: Climate smart road, check dam, farm pond, feasibility, percolation pond, simulation