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A Geospatial Methodology for Modelling Lymphatic Filariasis Transmission Risk in Relation to Irrigation Schemes in the Gambella Region of Ethiopia

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Abstract

Lymphatic filariasis (LF) is a persistent public health challenge in Ethiopia. The Gambella Region's extensive irrigation schemes create environmental conditions that could promote mosquito vector breeding and alter transmission dynamics. A standardised, spatially explicit approach to assess LF risk in relation to these anthropogenic water bodies is required. This methodology article aims to develop and describe a geospatial model to map the relative risk of LF transmission associated with irrigation schemes in the Gambella Region. The primary objective is to provide a reproducible framework that integrates environmental, climatic, and anthropogenic data to identify high-risk zones for targeted action. The methodology is based on a multi-criteria decision analysis (MCDA) within a geographic information system (GIS). Satellite-derived data layers are integrated, including distance to irrigation canals, land use and land cover, normalised difference vegetation index (NDVI), rainfall, and temperature. These factors are weighted according to expert opinion and entomological knowledge to create a composite risk index. A step-by-step process is detailed, covering data acquisition, processing, model construction, and validation using historical prevalence data. As a methodology paper, it presents no new empirical findings. However, a pilot application of the model demonstrated a clear spatial pattern, with modelled risk scores increasing markedly within a two-kilometre buffer of major irrigation infrastructure. The proposed geospatial methodology offers a robust and adaptable framework for modelling LF transmission risk in irrigated areas. It facilitates the visualisation of high-risk zones to guide surveillance and intervention planning. National LF elimination programmes should consider adopting and adapting this GIS-based methodology for risk mapping in other irrigated regions. Future applications should integrate ground-truthed entomological data to refine model parameters and enhance predictive accuracy. lymphatic filariasis, geospatial modelling, irrigation schemes, risk mapping, multi-criteria decision analysis, Ethiopia, Gambella This article provides a standardised

methodological framework for public health practitioners and researchers to conduct spatially explicit risk assessments of lymphatic filariasis in relation to irrigation infrastructure, supporting evidence-based programme planning.

Keywords: *Geospatial modelling, Lymphatic filariasis, Transmission risk, Irrigation schemes, Horn of Africa, Ethiopia, Vector-borne disease*

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