Spatial targeting of adaptation efforts in the livestock sector

Lucy Kimani [a], An Notenbaert [b], Rein Van Der Hoek[c]

a Alliance of Bioversity and CIAT, Tropical Forages Program, Kenya

Abstract

Climate change has emerged as a significant threat to livestock and the ecosystem goods and services on which they depend. With projections of rising temperatures and CO2 levels, changing rainfall patterns, and increased climate variability and occurrence of extreme events, the direct impacts of climate change on livestock can be seen through behavioral and metabolic changes, including reduced feed intake, increased energy requirement, and decreased conception rates. Additionally, indirect impacts are felt through various channels, including a mismatch between increasing water demand, and decreasing water supply, increased pest and disease pressure, biodiversity losses, changes in quantity and quality of feed resources, and changes in overall system productivity and livelihood patterns. Regions identified as the most vulnerable to climate change, such as Sub-Saharan Africa and South Asia, also rely heavily on livestock for food, income, and livelihoods. Thus, adaptation is critical for these regions to cope with the multiple stresses caused by the rapidly changing climate. To address this need, we compiled spatially explicit climate risk layers for Ethiopia, Tanzania, Kenya, Senegal, Mali, Tunisia, and Colombia and uploaded them to the Targeting Tools platform for easy access. Targeting Tools is a web-based GIS tool (https://targetingtools.ciat.cgiar.org/) that facilitates the combination of different climate risk indicators, including bio-climatic variables, risk of droughts, floods, heat stress, flooding, and waterlogging, into risk hotspot maps. The tool is user-friendly and packaged with a spatial database, making it ideal for use by students, educators, and development practitioners. Through the characterization function of the tool, users can estimate the extent to which people, animals, and crops are exposed to climate risks and identify priority areas for adaptation action. In summary, our study provides a practical solution for supporting adaptation efforts in vulnerable regions by providing easy access to spatial climate risk information.

Keywords: Adaptation, climate risk, mapping

Introduction

The livestock industry plays a significant role in the global economy and is an essential part of rural livelihoods. Livestock's roles vary depending on several factors, including resource availability, environmental conditions, socio-economic context, and the political and institutional landscape. The escalating situation of climate change presents numerous challenges for various stakeholders, including the global population and livestock keepers. In response to these challenges, the global spatial analysis community has made significant strides in creating a variety of livestock-specific climate risk maps. These maps encompass a wide range of elements like bio-climatic variables, drought and flood risks, heat stress, waterlogging, and prevalence of pests and diseases. As a spatial analysis community, we have actively collaborated to create a diverse set of livestock-related climate risk maps. These maps include depictions of bio-climatic variables, potential for droughts, floods, heat stress, waterlogging, pests, and diseases.

The Targeting Tools platform is a user-friendly web-based Geographic Information System (GIS) tool designed to meet the needs of students, educators, and development practitioners, even those without prior GIS experience or skills. The tool has been widely used for conducting suitability analysis for various crops and forages under current and future climate scenarios, predicting future climate-related prevalence and distribution of crop pests and diseases among others.

Our approach to using the Targeting Tools on Climate Risk mapping emphasizes the tool's use for climate hazard mapping by assembling a set of spatially explicit climate risk layers. These layers serve as indicator maps that help identify areas particularly vulnerable to climate risks and provide an estimation of exposure levels for people, animals, and crops. By providing easy access to these climate risk layers, our goal is to facilitate their use in informed decision-making processes, planning, and implementation of adaptation actions. This initiative aims at mitigating the impacts of climate change on vulnerable communities.

Material and Methods

The Targeting Tools platform is a user-friendly web-based GIS tool that allows for the combination of various climate risk indicators, such as bio-climatic variables, risk of droughts, floods, heat stress, flooding, and waterlogging, into risk hotspot maps. It comes with a spatial database populated with climate data, climate risks datasets, and human and livestock population data among other crucial geospatial datasets in raster format.

The platform has three sub-components: Land Suitability, Land Similarity, and Land Statistics.

1. ***Land Suitability Tool***: This tool can be used to identify areas suitable for planting a certain type of crop based on user criteria. In the context of climate hazards, users can identify areas with high climate risk through the suitability function. The characterization function allows users to estimate the extent to which people, animals, and crops are exposed to these climate risks, thereby identifying priority areas for adaptation action. The tool provides an index map indicating the degree of stress or risk under various thresholds: very low to very high.
2. ***Land Similarity Tool***: This tool can be used to find areas with similar characteristics to already existing areas under a certain stress.
3. ***Land Statistics Tool***: This tool performs zonal statistics. It takes in more than one input value raster and a vector boundary that limits your analysis.
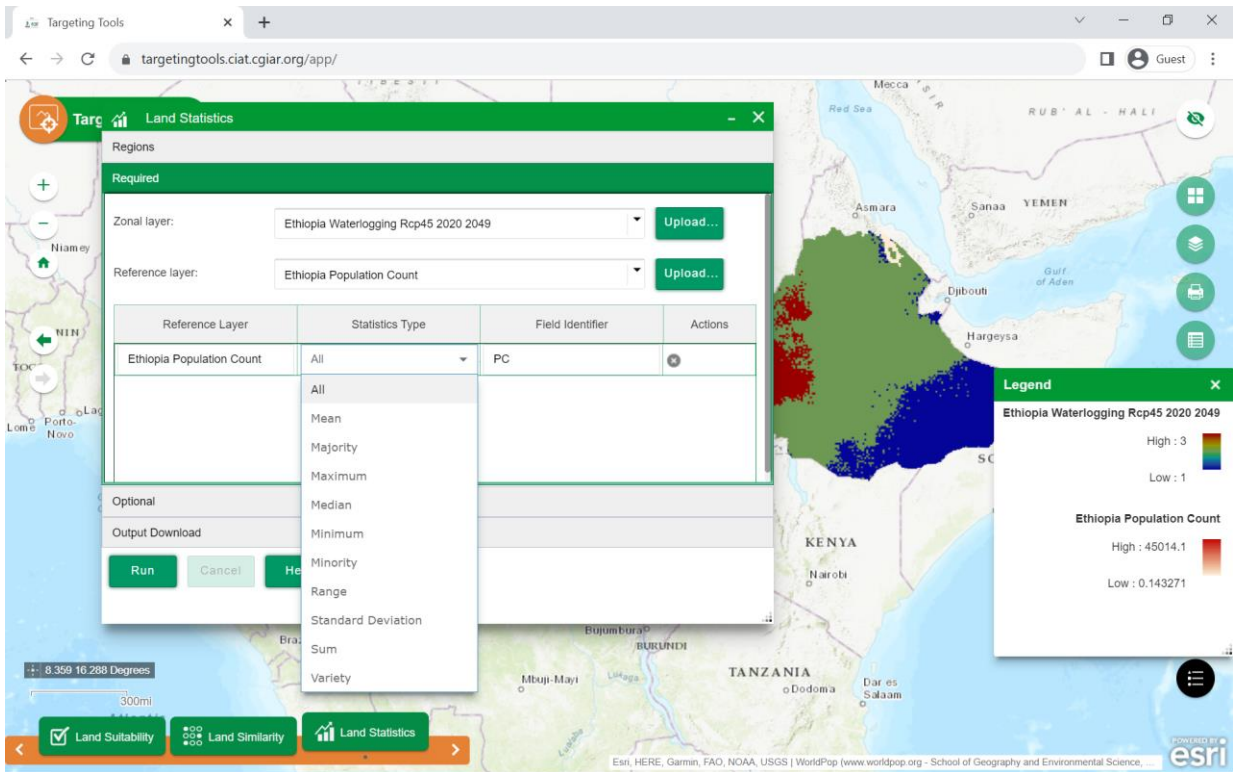
Results and Discussion

The Suitability Tool and the ***similarity tool*** each gives an index output ranging from very low to very high suitability/similarity index.

Land Statistics gives the zonal statistics calculated on a dataset within the defined zones in tabular format which can be downloaded in excel format.
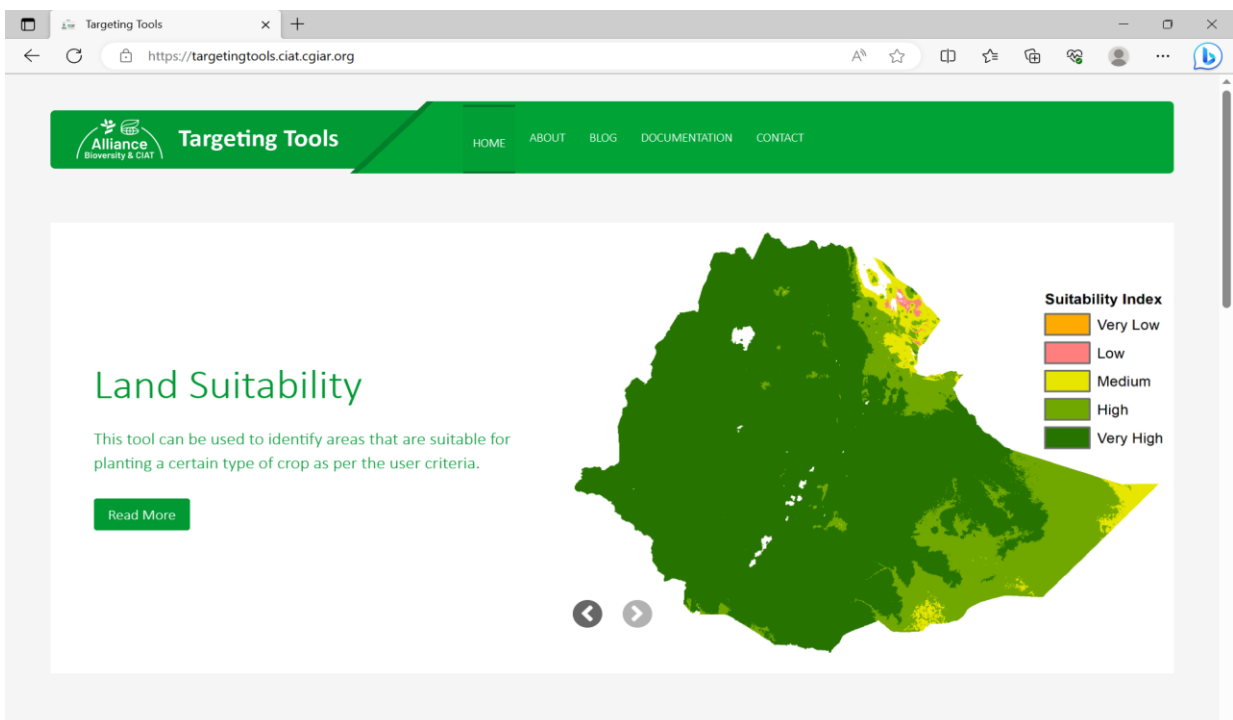
Conclusions and Outlook

These maps serve as vital indicators, playing a key role in pinpointing climate risk hotspots and evaluating the vulnerability of people, animals, and crops to these risks. This crucial information can then be used to identify priority areas for the implementation of adaptation strategies. This approach is aimed at mitigating the impacts of climate change on vulnerable communities.

References

1. Kimani, L.; van der Hoek, R.; Notenbaert, A. (2023) Spatial targeting of adaptation efforts in the livestock sector. Poster prepared for Tropentag 2023 - Competing pathways for equitable food systems transformation: trade-offs and synergies. Berlin, Germany, 20-22 September 2023. Cali (Colombia): International Center for Tropical Agriculture. 1 p.
2. Kimani, L.; Mutua, J.; Notenbaert, A. (2021) Current and future forage suitability maps for Zambia. https://doi.org/10.7910/DVN/CG7YCI, Harvard Dataverse, V1
3. Mutua, J. (2021) Webinar Summary Report: Targeting Tools 2.0: Targeting and out-scaling interventions in agricultural systems. 4 p.
4. Mutua, J.; Notenbaert, A.M.O. (2020) Targeting Tools 2.0: Targeting and out scaling interventions in agricultural systems – Zambia. [Video file]. Retrieved from https://youtu.be/rrdCvncFkxU
5. Nguru, W.; Mwongera, C. (2023) Predicting the future climate-related prevalence and distribution of crop pests and diseases affecting major food crops in Zambia. PLOS Climate 2(1):e0000064 25 p. ISSN: 2767-3200