Adaptation Potential Maps

Climate Smart Warehouses and Irrigation for Potato in Tanzania

Introduction

Adaptation potential maps could facilitate understanding the identifying regions where adaptation measures could be used or could provide potential benefits based on the resources and the factors in the specific location.

Method

We used Multiple criteria decision analysis (MCDA) to derive adaptation potential maps. MCDA provides a formal, quantitative means of evaluating agricultural decisions by considering possible factors. In this tool, we consider the Risks and Opportunities of the location in implementing adaptation measures. This tool focuses on weighting the criteria and the step used to quantify the relevance of the selected criteria.

Other advantages can include: 1. making a decision more transparent to others, 2. providing a focus for discussion, 3. providing a means of problem structuring and working through the information, and 4. breaking the decision down so that people better understand the decision both from their own and from others' perspectives.

Factors considered deriving adaptation potential maps

Crop Growth Suitability:

Crop growth suitability map derived from climate, agronomic properties, soil properties, and socio-economic conditions via machine learning approach.

Photovoltaic Power Potential (PVOUT):

Developed by SOLARGIS (https://solargis.com) and provided by the Global Solar Atlas (GSA), this data resource contains photovoltaic power potential (PVOUT) in kWh/kWp covering the globe. Data is provided in a geographic spatial reference (EPSG:4326). The PV power output (PVOUT), defined as the specific yield, illustrates this potential. PVOUT represents the amount of power generated per unit of the installed PV capacity over the long term, and it is measured in kilowatt-hours per installed kilowatt-peak of the system capacity (kWh/kWp).

PVOUT is a significant factor in the energy supply for climate-smart warehousing systems. Higher energy capacity is high in potential, and lower energy capacity has been classified as low in potential.

Global Gridded Relative Deprivation Index (GRDI)

The Global Gridded Relative Deprivation Index (GRDI), Version 1 (GRDIv1) data set characterizes the relative levels of multidimensional deprivation and poverty in each 30 arc-second (~1 km) pixel, where a value of 100 represents the highest level of deprivation and a value of 0 the lowest. GRDIv1 is built from

sociodemographic and satellite data inputs that were spatially harmonized, indexed and weighted into six main components to produce the final index raster. Inputs were selected from the best-available data that either continuously varies across space or has at least administrative level 1 (provincial/state) resolution and has global spatial coverage.

GRDI has been considered for classifying the purchasing power of individuals for climate-smart warehousing. Higher values have been classified as low potential, and lower values have been classified as high potential.

Wind Power Density

Wind Power Density (WPD) is a quantitative measure of wind energy available at any location. It is the mean annual power available per square meter of the swept area of a turbine and is calculated for different heights above ground. Calculation of wind power density includes the effect of wind velocity and air density.

Wind Power Density is a significant factor in the energy supply for climate-smart warehousing systems. A higher density is high in potential, and a lower density has been classified as low in potential.

Distance to the nearest city (Accessibility)

Accessibility is defined as the travel time to a location of interest using land (road/off-road) or water (navigable river, lake, and ocean) based travel. This accessibility is computed using a cost-distance algorithm which computes the "cost" of traveling between two locations on a regular raster grid. Generally, this cost is measured in units of time. The cells in this raster grid contain values that represent the cost required to travel across them. Hence this raster grid is often termed a friction surface.

Accessibility is much needed in transporting goods to the warehouse, infrastructure facilities, and market.

Elevation (GTOPO30)

GTOPO30 is a global digital elevation model (DEM). Elevations in GTOPO30 are regularly spaced at 30-arc seconds (approximately 1 kilometer). GTOPO30 was developed to meet the needs of the geospatial data user community for regional and continental scale topographic data.

The elevation is crucial to construct a climate-smart warehouse or transporting goods to the warehouse. In this assessment, Higher elevations are classified as lower potential, and lower elevations are classified as a higher potential.

HydroBASINS

Distance from the location to the next downstream sink along the river network, in kilometers. This distance is measured to the next downstream endorheic sink (if there is one) or (if there is none) to the most downstream sink (i.e., the ocean).

Distance to the river stream is crucial to implement irrigation infrastructure. In our assessment, minimal distance has been considered a higher potential to implement irrigation, and maximum distance has been considered as a lower potential.

Trends in Global Freshwater Availability from the Gravity Recovery and Climate Experiment (GRACE)

The Trends in Global Freshwater Availability from the Gravity Recovery and Climate Experiment (GRACE), is a global gridded data set at a spatial resolution of 0.5 degrees that presents trends (rate of change measured in centimeters per year) in freshwater availability based on data obtained by NASA GRACE. Terrestrial water availability storage is the sum of groundwater, soil moisture, snow and ice, surface waters, and wet biomass, expressed as an equivalent height of water. GRACE measures changes in the terrestrial water cycle by assessing small changes in Earth's gravity field. This observation-based assessment of how the world's water cycle is responding to human impacts and climate variations provides an important tool for evaluating and predicting emerging threats to water and food security

Water source is mandatory to implement irrigation infrastructure. An increasing trend of natural water resource availability is considered to have a higher potential, and a decreasing trend has been considered to have a lower potential.

Factors	Inputs to derive factors	Irrigation	Climate Smart Warehouse
Crop Growth Suitability	Climate, Soil, Agronomic practices, and socio-economic variables	10%	15%
Photovoltaic Electricity Potential	aerosol data set, Water vapor, Ozone, and irradiance	10%	20%
Relative Deprivation Index	Sociodemographic datasets from satellite remote sensing	10%	10%
Wind Power Density	Topography, Orography, Land use to roughness length, and Bathymetry	10%	20%
Distance to major cities	Road network, Railway network, Navigable rivers, Major waterbodies, shipping lanesShipping lanes, LULC, and Elevation	15%	20%
Elevation	Altimeters measurements	15%	15%
HydroBASINS	Elevation, River stream orders	15%	Not Applicable
Freshwater Availability	Groundwater, soil moisture, snow and ice, surface waters, and wet biomass	15%	Not Applicable

Table 1: Factors and weightage for each adaptation measures

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This Global Wind Atlas version 3.0 was developed by a team consisting of Jake Badger [1], Ides Bauwens [3], Pau Casso [2], Neil Davis [1], Andrea Hahmann [1], Søren Bo Krohn Hansen [5], Brian Ohrbeck Hansen [1], Duncan Heathfield [6], Oliver James Knight [4], Oriol Lacave [2], Gil Lizcano [2], Albert Bosch i Mas [2], Niels Gylling Mortensen [1], Bjarke Tobias Olsen [1], Marko Onninen [6], Albertine Potter Van Loon [4] and Patrick Volker [1], with financial support from the Energy Sector Management Assistance Program (ESMAP), a multi-donor trust fund administered by The World Bank.

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