



Food and Agriculture  
Organization of the  
United Nations



**Agro-ecological zones**  
**Assessing alternatives for future cropping systems**  
Part of the Land Resources Information Management System  
**(LRIMS)**

©AIT



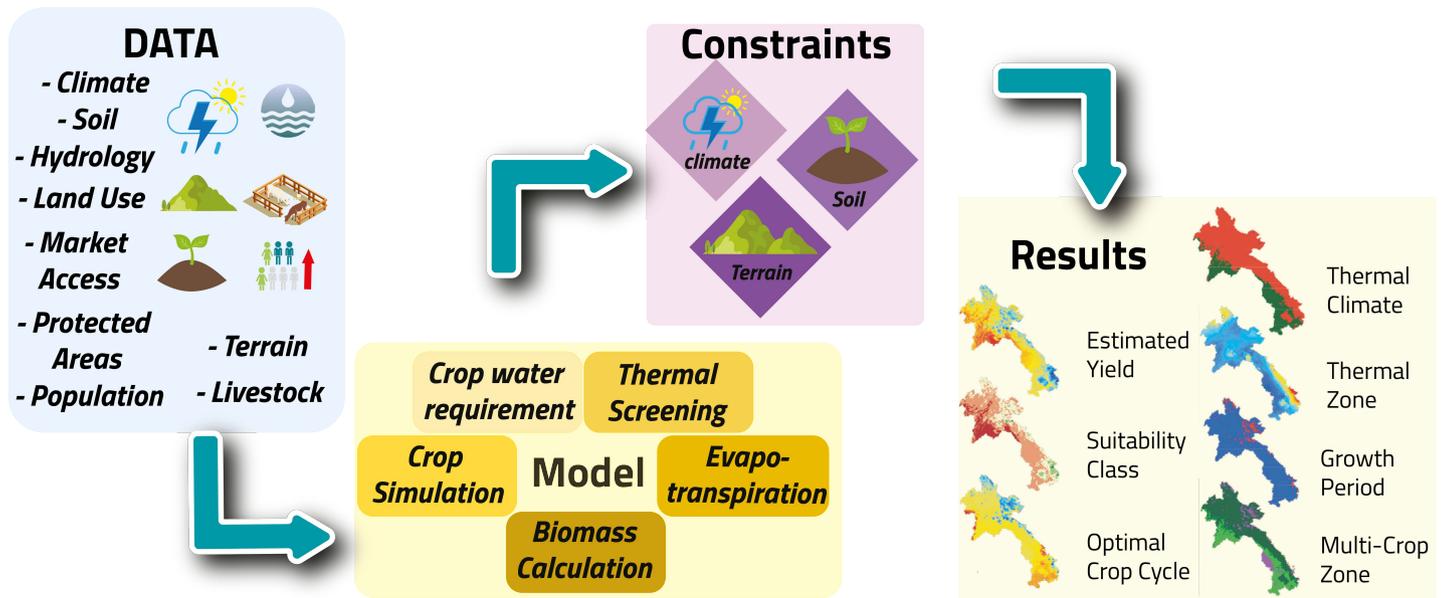
[www.theGEF.org](http://www.theGEF.org)

# What are agro-ecological zones?

The agro-ecological zoning approach aims at answering questions about land and climate related zonation of an area. Depending on the available data and resolution the area size can be on the scale of a single mountain side or the whole globe. The aim is to identify the potential use the zones in this areas can be put to. Focusing on agriculture and natural resources, questions center around crop suitability or other natural resource based land uses, best management practices, and potential yields.

Crop suitability takes into account many factors relevant to plant performance, such as soil type, soil nutrients, water availability, day length, temperature range, light intensity, in relation to crop characteristics and cultivation practices. The final product is a map of potential crop yields in a given location. As crops respond to changes in temperature and precipitation, AEZs need to be adjusted to a changing climate to assess the potential of crops in the future in any given location.

The methodology was developed in the late 1970s and is now implemented on a global scale (GAEZ). While AEZ can be carried out with spreadsheets and conventional cartography, modern approaches, such as GAEZ, are based on a series of databases, linked to GIS and dedicated computer models. While this allows national zoning (NAEZ) projects to make use of data-downscaling from global level, significant local data input is still required.



# National agro-ecological zones in the Lao People's Democratic Republic – from tool to model

In an innovative transnational collaboration, the Lao People's Democratic Republic has co-financed the Asian Institute of Technology (AIT) to develop the PyAEZ python package. PyAEZ offers a user friendly, intuitive data input interface, handles all AEZ calculations and provides a clear, state of the art presentation of results. Its six main modules are Climate Regime, Crop Simulations, Climate Constraints, Soil Constraints, Terrain Constraints, and Economic Suitability Analysis.

As part of this project, the Department of Agriculture and Land Management (DALaM) of the Ministry of Agriculture and Forestry (MAF) has developed the capacity to undertake the complete modeling procedure independently. The NAEZ delivery model adopted by the Lao People's Democratic Republic has shifted demands for expertise to the regional and local levels.

Ultimately, the results from the NAEZ scenario modeling will be uploaded to the Land Resources Information Management System (LRIMS), a database and visualization tool that will be publicly available online.

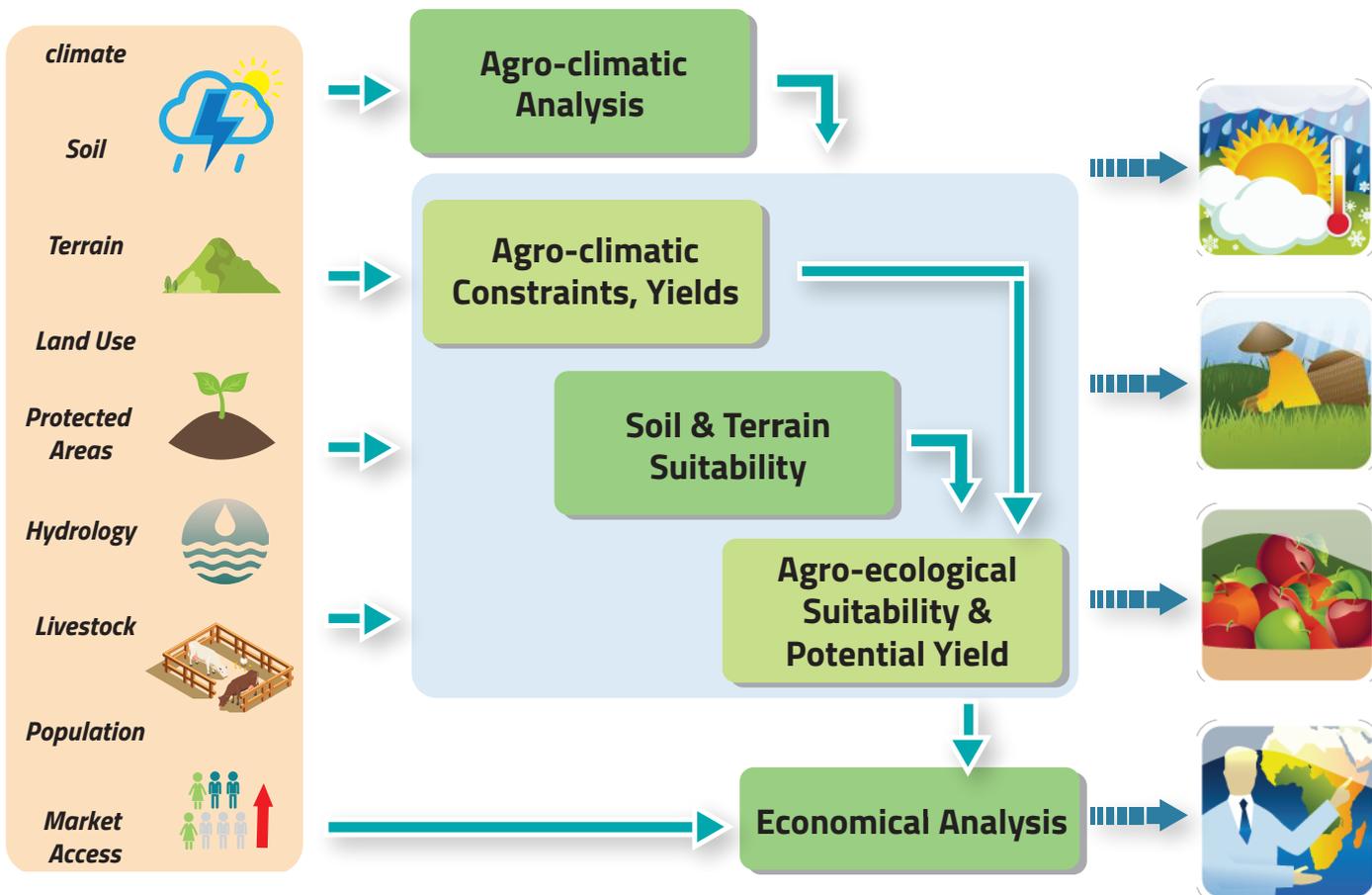


# How it works

To be able to make meaningful predictions about future crop performance or land-use in general, many parameters need to be combined to a holistic picture. NAEZ combines a broad spectrum of relevant data to deliver the desired analyses:

- Climate data, including observed climate and climate scenarios are the basis for a climate data analysis and compilation of general agro-climatic indicators.
- Crop-specific agro-climatic assessment and potential water-limited biomass/yield calculation, estimate crop performance for all crops and varieties in the system, requiring the addition of land use/cover data. Parameters include temperature/radiation defined maximum yields, yield reduction due to sub-optimum thermal conditions, yield impacts from soil water deficits, estimated soil water deficit, potential and actual evapotranspiration, accumulated temperature sums during each crop cycle, and optimum crop calendars. Due to the detailed calculations, this is the most demanding component in terms of computer time and CPU power in AEZ.
- Yield reduction due to soil and terrain limitations, evaluating expected crop-specific yield reductions due to limitations imposed by soil and terrain conditions, founded on soil data, elevation data and derived terrain slope.
- Yield reduction due to agro-climatic constraints, draws on soil and biotic data to assess the effect of year-to-year variability of soil moisture; Yield losses due to pests, diseases and weeds; effects on product quality; Yield losses due to soil workability constraints; Yield losses due to early or late frosts.
- The subsequent integration of climatic and edaphic evaluation combines all previous analyses and adds slope ranges for cultivation of each crop including likely yield reduction due to loss of fertilizer and topsoil depending on farming practices.
- Finally, farm-gate prices of crops are used in an economic evaluation to assess comparative advantage of major crops in terms of attainable net revenue.

# Modelling Process

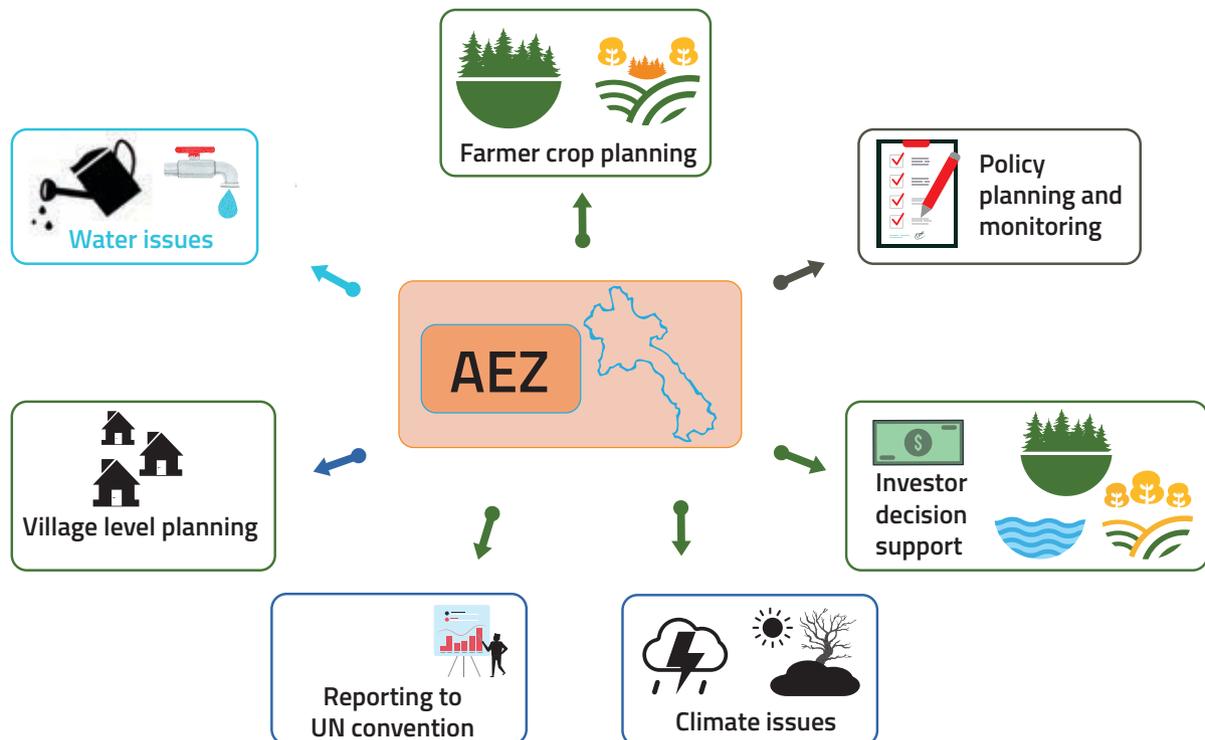


# Who will benefit from national agro-ecological zones?

Agro-ecological zoning allows policy makers to look ahead and adjust policies now to prepare for climate related changes that will affect the prosperity of the country. It shows that certain crops or land uses will lose their competitive edge, while others or new ones might become more viable. It also gives indications of drought, flood and water-related limitations in the future, and measures can be undertaken to prepare for these changes. It can also be used to prepare plans and reports to United National environmental conventions, as it help establishing realistic agricultural sector targets.

At the village or district level, it can guide establishing priority crop plan and future-proof land allocation to specific and sustainable crop production. The DALAM is updating the village planning method to add the scenario thinking and vulnerability assessment. For investors NAEZ is a powerful predictive tool to help plan strategies, showing if areas are likely to be suitable crops or land uses, and how this suitability will change over time. It thus gives long-term outlooks, which is especially relevant for perennial crops or for long lease contractual arrangements.

For farmers and other landowners, the foresight provided by NAEZ support adjustments such as choosing new crops, and an overview of the future of agricultural commodities throughout the country.



# Specification of the generated maps

**Resolution:** 5 km

**Time scale:** Present time, 30 and 60 years in the future

**RCP used:** 4.5 and 8.5

**Coordinate System:**

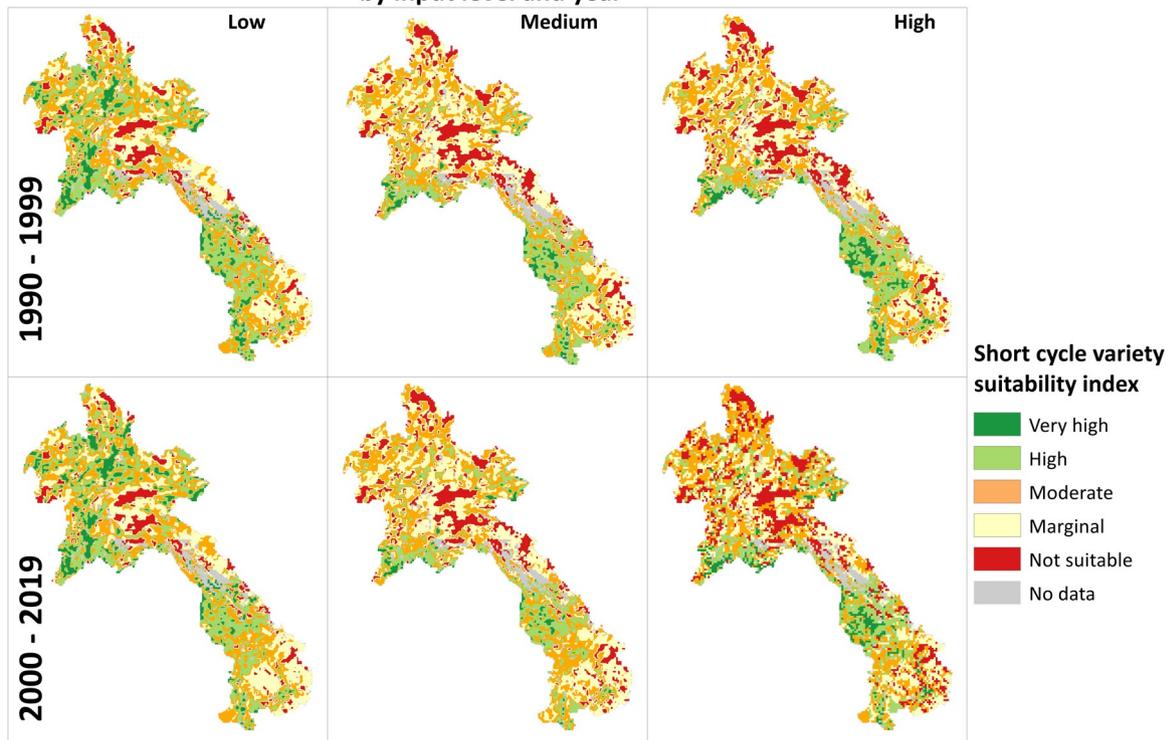
Spheroid GRS80

**Projection:** Transverse

Mercator

**Tool used:** pyAEZ

## Suitability of Maize by input level and year



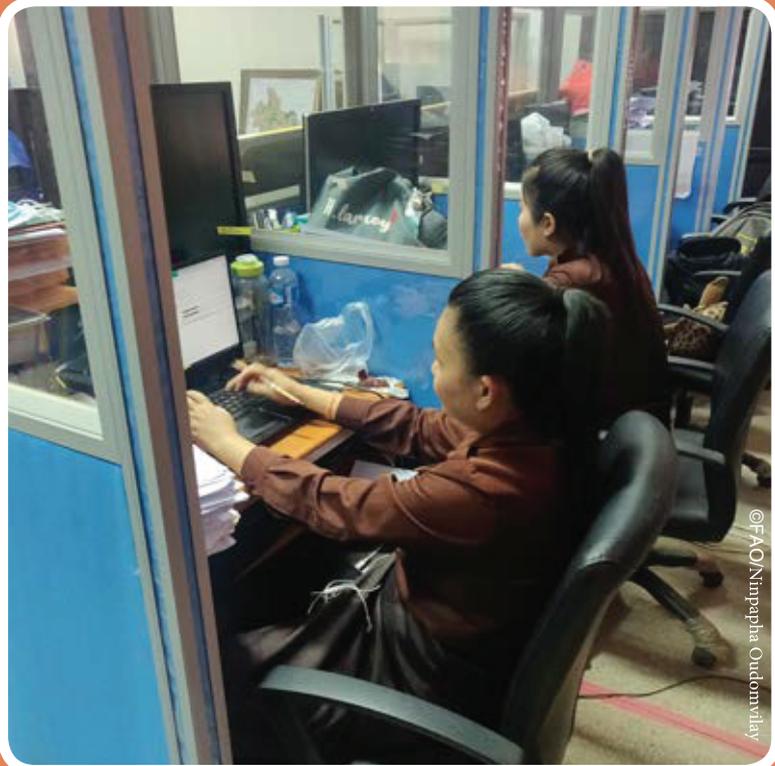
Source: DALaM and FAO SAMIS, 2021. Maps comply with UN. 2004. [Map 3959, Rev. 2.](#)

## Implementing agencies

NAEZ and its integration in the LRIMS is implemented under the Department of Agriculture and Land Management (DALaM) under the Ministry of Agriculture and Forestry (MAF), with technical support from the Geoinformatics Center of the Asian Institute of Technology (AIT-GIC) Thailand, and FAO Geospatial Unit.

The Department of Meteorology and Hydrology (DMH) of the Ministry of Natural Resources and Environment (MONRE) provided the agro-climatic data.

The National Agriculture and Forestry Research Institute (NAFRI) under MAF and the International Center for Tropical Agriculture (CIAT) provided information on crops and crop varieties in South East Asia.



## Further information

Further information on the generated land cover maps and the SAMIS project under which they were developed can be found on the respective FAO page: <http://www.fao.org/in-action/samis/en/>  
 FAO Representation in Lao People's Democratic Republic  
 FAO-LA@fao.org

**Food and Agriculture Organization of the United Nations**  
 Vientiane, Lao People's Democratic Republic

Concrete inquiries can be directed at DALAM GIS Unit: +856-(0)21 770075  
 The pyAEZ software and training manuals are available at: <https://github.com/gicait/PyAEZ/>  
 Detailed documentation can be found in the : <https://github.com/gicait/PyAEZ/tree/master/tutorials>  
 The LRIMS is under development and will be made available shortly.



Some rights reserved. This work is available under a CC BY-NC-SA 3.0 IGO licence

The boundaries and names shown and the designations used on these maps do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement.