

An Agent-Based Modeling Approach for Understanding Land-use Adaptation in the Mekong Delta under the Context of Climate Change

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Keywords

Agent-Based Modeling, farmer decision, GAMA platform, land-use change, climate change.

Abstract

In recent years, the combined effects of fluctuations in the benefit of agricultural and seafood production, management policies and environmental changes (increase of saltwater intrusion due to subsidence and sea level rise, increase of the length of drought periods because of the elevation of temperatures and the decrease of freshwater availability) have seriously affected the agricultural production of the coastal provinces in the Mekong Delta. Adaptation of farmers take many forms, including deep changes in their agricultural practices and land-use in order to maintain their income. However, the somewhat uncontrolled conversion of farming systems to follow market demand and get immediate profits will in some cases negatively impact the environment (degradation of soils, increase of salinization) and locally disrupt the long-term land-use plans established by provinces, normally designed to be sustainable at the global scale.

In this work, we focus on land-use decision in the Mekong Delta. This region is planned to be a sustainable land-use types, but farmers tend to shift from rice to shrimp farming systems due to economic reasons. These decisions endanger the planned sustainable development of the area and the effects of infrastructures built to reach the plan. It is thus necessary to study and forecast this conversion to support the land-use planning and recommend the best suitable strategy to farmers. However, this forecasting work is currently lacking tools. It is mainly based on the human-made land inventory carried out every 5 years, which is obviously made under times and human resources limitations.

This work aims to apply an Agent-based model to support managers' decision-making and to provide a picture of the future to encourage people to choose land-use types. The model is designed by agent-based approach where farmers are represented as the cell from the land-use map and the description of their states and behaviors. The simulation will let them interact and from these interactions, the dynamics of the system is expected to emerge. Decision making process is based on the multicriteria analysis in which farmers will thus have to make their decisions given environmental, climate and socio-economic changes. The input data for verification and calibration of the model have been collected from the existed land-use map in 2015 and interpreted from Sentinel 2 satellite images in 2020 for the land-use. The climate change scenarios are forecasting to 2030. The results of the experiments showed evolutions of land-use in 2030 with climate change scenarios to analyze farming risks when the environment (including temperature, rainfall, water volume) and prices change in a harsher direction.

Additional material

Code of the model: https://github.com/tcquang/MK_landuse