**Tidal River Management Implementation Strategies in Southwest Bangladesh**

The low-lying coastal region of southwest Bangladesh, relies on poldering (the creation of embanked islands) to mitigate the effects of tidal inundation and storm surge. This has had the unintended consequence of starving the landscape of sediment and creating a 1-1.5 m offset between the interior polder elevations and the mean high water level (MHWL) of the tidal channel. Meanwhile, elevations of the natural system maintain pace with MHWL. Tidal River Management (TRM) is often proposed a solution to re-equilibrate the suppressed poldered landscape to that of the natural level. Using TRM, locals open embankments to tidal inundation during specific times to encourage sediment accumulation. However, sediment accumulation is not uniform over the entire landscape and therefore the burden of inundation and benefits of recovery are not shared equally among polder inhabitants.

1. **Purpose**

The purpose of this study is to model how communities might make collective decisions regarding implementing TRM and what strategy may be the most successful. Community decisions can be made through voting or bargaining between individual households.

1. **Entities, state variables, and scales**

The entities in this model are households (turtles) living on a polder (patches) adjacent to a tidal channel. These households have state variables of location in space, growing wealth.

The landscape is a grid of patches representing a polder with state variables of elevation, degree of water logging, and degree of flooding. Each grid represents a 10x10m square and total number of grids can be adjusted to represent varying polder sizes with no edge wrapping.

The model time step is one year and simulations run for 50 years.

1. **Process overview and scheduling**

This ABM uses outputs from a probabilistic sediment model to determine polder elevation through time. Processes are executed over a time step of one year as follows:

* *Cultivate.* Households decide to cultivate rice or shrimp based on current patch variables of degree of water logging and flooding.
* *Accounting.* Households update their wealth state variable to include previous wealth plus the wealth from the current year. If bargaining instead of voting, then current wealth is updated according to bargained amount. Bargained amount is a function of elevation.
* *Breach.* Community decides to open or close embankment based on household interactions.
* *Output.* Polder displayed with elevations, plots updated, data output to csv.

1. **Design concepts**

*Basic Principles*

This model attempts to determine how communities make decisions regarding implementation of TRM and which strategies are most successful in accommodating the entire community.

*Emergence*

The ABM is coupled with a simple elevation model. The primary output is households wealth through time which emerges from community decisions regarding breaching the embankment and household’s decision to cultivate rice or shrimp.

*Adaptation*

Households adapt by deciding whether to cultivate rice or shrimp and whether to support embankment breaching. Households adapt yearly based on changes in elevation from the previous year.

*Objectives*

*Learning*

There is no learning.

*Prediction*

Households predict future wealth based on current wealth, expected wealth from cultivaton, and any bargaining wealth.

*Sensing*

There is no sensing.

*Interaction*

Households interact through voting or bargaining to breach an embankment.

*Stochasticity*

Household locations can be initialized randomly.

*Collectives*

There are no collectives.

*Observation*

The world display shows the elevation of each patch and the location of each household. Plots show the mean wealth and elevation of households over time.

1. **Initialization**

The patch elevations are initialized with the starting elevation of a polder ~1.5 m below MHWL.

Households locations can be initialized at random, in clusters, or by modeling actual locations on a polder. Household wealth is initialized as a function of elevation.

1. **Input Data**

Elevation data from sediment accumulation model.

1. **Submodels**
   * Cultivate. Households calculate expected income from bargaining and risk and profit for rice and shrimp. They then choose to cultivate based on expected income.
   * *Accounting.* Households update their wealth based on previous wealth, income from cultivating, and income from bargaining.
   * *Elevation model.* External model that calculate sediment accumulation over a year. Used as input for ABM.