Considering shrimp aquaculture as a Complex Adaptive System: implication(s) for planning a more resilient sector

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Planning coastal aquaculture is complex

- Fast growing sector
- Supports livelihood and local economic growth but with an environmental impact
- Policies for land use planning are often not effective, with no effect or an unexpectedly strong response occurs
The tropical farmed shrimp you eat
destroyed mangroves
Shrimp Aquaculture in the Mekong Delta

- Shrimp sector in the Mekong Delta
  - Fast Grow in 1990-2000
  - Mekong Delta - 500,000ha

- Based on small scale producers
- Coastal zone mono-culture landscape
- Risk of diseases outbreak
Shrimp Aquaculture in the Mekong Delta

- Need policies that:
  - Support sector’s growth
  - Limit environmental & social impact

- Policies are not effective with sometimes undesirable effects:
  - No response, i.e. no intensification or not in the right area
  - Limited conversion to Organic shrimp farming
  - Deforestation and over-exploitation of natural resources
Diversity of production systems within the same landscape

- Intensive pond
- Extensive pond
- Integrated mangrove–shrimp pond
- Limited area in the Mekong Delta
  Considered as less risky and more resilient
Drivers influencing farmers to adopt or not Integrated mangrove shrimp systems
An approach to integrate this complexity

- **Role Playing Games (RPGs)** to understand farmers' decision making and influence of drivers

- **Agent Based Model (ABM)** to simulate action and interactions between heterogeneous farmers (individuals) and environment at landscape level

- **Scenario** development with policy maker to explore future policies for better land use planning
Case Study – Dam Doi district
Mekong Delta, Vietnam

- Government plans to:
  - increase intensive shrimp farming
  - promote integrated mangrove shrimp farming

- but limited response to policies
  
  - What are possible scenarios for the future of shrimp farming?
Our approach: from farmers to policy makers
Using Role Playing Games & Agent Based Model

Farmers
- Heterogeneity of agents & Spatial interactions
- Design ABM and validate/calibrate with RPGs

Policy makers
- Scenario development with policy makers
- Explore future policies
Agents Behavior

- Probability to Shift:
  Baseline probability \( \times \) land suitability \( \times \) neighbor’s influence \( \times \) policies

- Example of rules
  - Shifting rule (path dependent)
  - Rule of Abandonment
Agents Behavior

- Probability to Shift:
  
  *Baseline probability* $\times$ *land suitability* $\times$ *neighbor’s influence* $\times$ *policies*

- Example of rules
  
  - *Shifting rule (path dependent)*
  
  - *Rule of Abandonment*
Model Structure

- 1 Cycle = 6 months
- >20,000 farm plots
Using the ABM with local policy makers

Three scenarios for 2030 develop & tested

**Climate change**
- No adaptation measures
- Increasing cost & risk of disease outbreak

**Intensification**
- Access to capital
- Dissemination of knowledge

**Organic coast**
- Access to PES
- Organic value chain
- Higher revenue from timber

**Baseline Scenario**
- Current policies & bio-physical conditions
Results of scenarios testing

Total shrimp production per cycle

- Intensification
- Organic coast
- Baseline
- Climate change
Results of scenarios testing

Number of abandoned farm per cycle

- Intensification
- Organic coast
- Baseline
- Climate change
Conclusion - from the simulation

- Widespread intensification: cascading effect.
- Policies to expand Integrate mangrove shrimp are not effective because farmers:
  - Lack of knowledge about such policies.
  - Associate system with submission to Forestry Services.
Does the ABM reflect the features of a Complex Adaptive System?

Component

- Farms managed by farmers. Neighboring farms influence each other

Path dependency

- Intensive ponds cannot revert to integrated mangrove-shrimp systems

Openness

- Change in policies or shrimp prices and variables external to the system influence the system.

- Limited external influence in the model of value chain functions

Unpredictability

- Impossible to predict production, price of shrimp, and diseases
Does the ABM have behaviors as a Complex Adaptive System?

Adaptability: Adaptability of the agent to disease, water level, neighbor influence and, to a lesser extent, market price changes

Self-Organization: No. The structure of the components is fixed

Nonlinear behavior: External and internal factors affect agent in a nonlinear way

Feedback loop mechanism: Cascading effects

Limited feedback loops
Conclusion - *from the approach*

- Learning tool for farmers
- Bridging communication gap between farmers - policy makers.
ALEGAMES project

Assessing Learning Effects of Games on Attitude of Stakeholders towards Sustainable Shrimp Farming:

Three year project collaboration:

- Test the learning effect of farmer’s knowledge and opinion on farming practices
- Information flows between farmers and policy makers
ALEGAMES

- 3 Study Sites

- Adaptation of the model to:
  - new type of agents
  - environment
  - context
The research goals of ALEGAMS are to assess the:

- effectiveness of Role Playing Games in triggering farmer’s learning on and adoption of IMSS practices

- Follow 3 groups of farmers with different exposure to RPGs in each case studies

- effect on knowledge and attitude of policy-makers

- Involve local policy makers in the RPGs and ABM
THANKS YOU

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