Example of MAS-based analysis of a rural community-landscape system

Quang Bao Le
CRP-DS
Agricultural Livelihood Systems

Cairo, 13-21 September, 2015

www.drylandsystems.cgiar.org

Hong Ha commune (Vietnam)

- Size of the study area: about 35-40 km^2

- Protected mountain watershed in tropical forest zone

- 240 households who are **agriculture- and forest-dependents**

- Puzzles in policy decisions on:
  - Forest protection zoning
  - Agricultural extension
  - Agrochemical subsidy

Thua Thien – Hue province
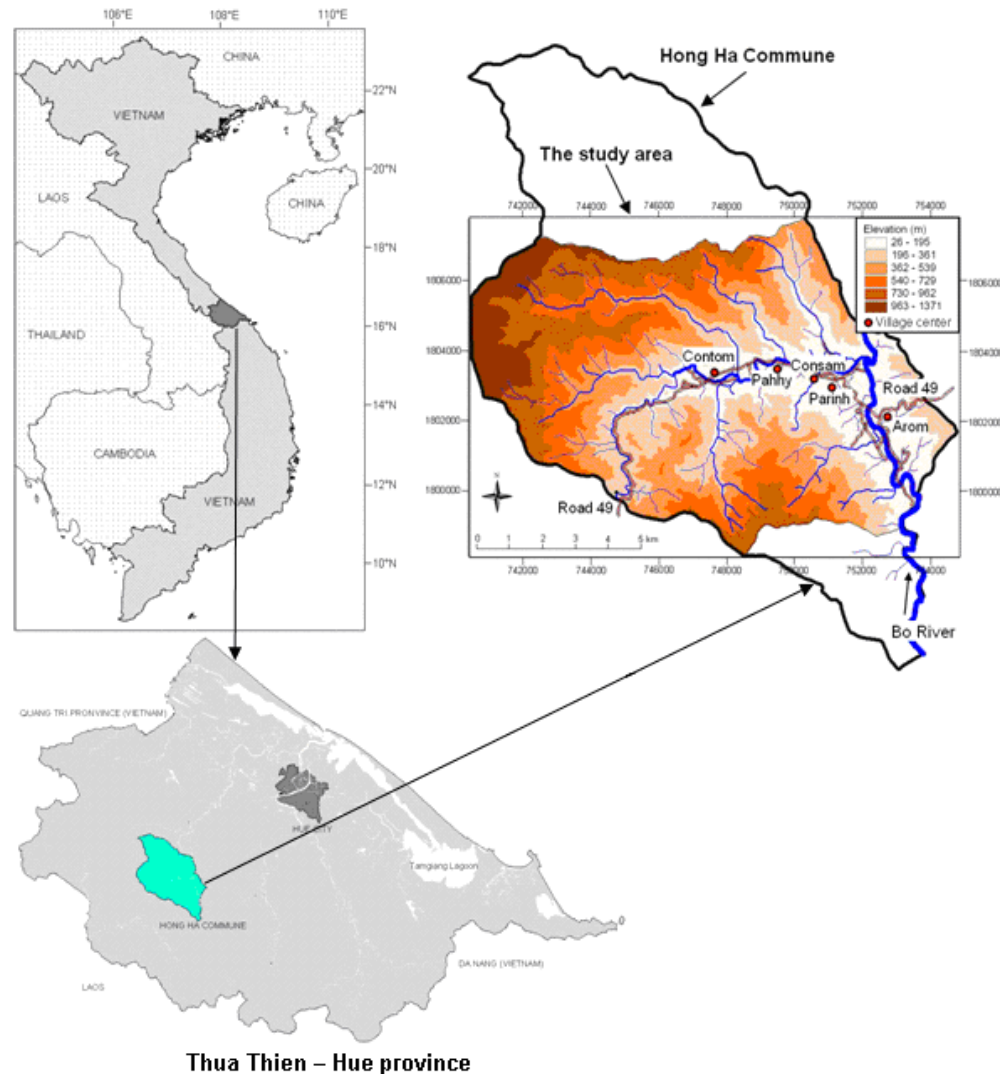
Objective

- To build a model of land-use changes, and use it to **explore** impacts of some policy interventions
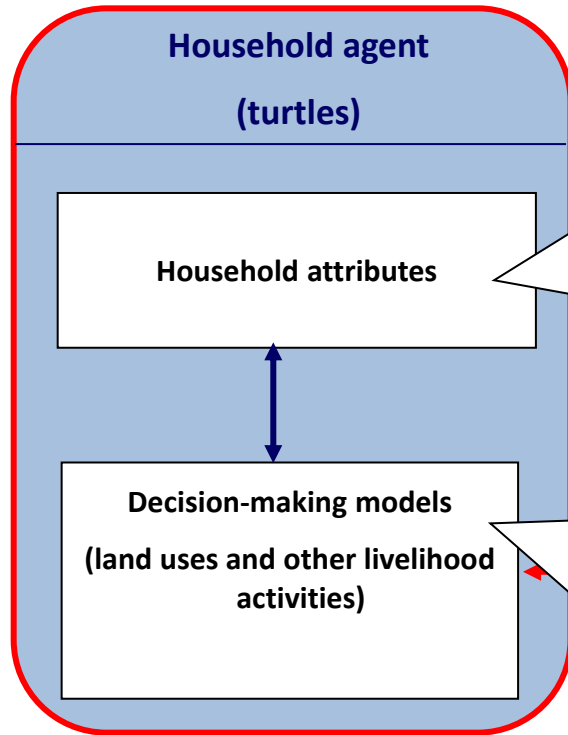
For example, to answer different what-if questions:

WHAT will happen with household income and forest cover IF the forest protection regulation is canceled, or stronger?

WHAT will happen with household income and forest cover IF farmer is subsidized for fertilizers?

WHAT will happen with household income and forest cover IF farmers have more access to agricultural extension services?

WHAT will happen with household income and forest cover IF (1) only critical forest are protected by law, and (2) only poorest are subsidized, and (3) all are reached by extension services?

Household agent

Household agent

Household agent

(turtles)

Household attributes

↕

Decision-making models
(land uses and other livelihood activities)

See Le (2005), Chapter 4

Household variables [Hx]

- age, sex
- education status,
- labour availability,
- dependency ratio,
- land holding,
- annual income
- etc.

Land-use choices:
depending on: [Hx],
Environment variables [Ex],
policy factors [Px] (goal-oriented bahavior)

Logging activity:
depending on: physical transaction cost, protection policy (heuristic rule-based behavior)

Turtle's variables you set in

```
turtles-own
[h_age
 h_edu
 h_depend
 h_holding
 h_income
; etc.
]
```
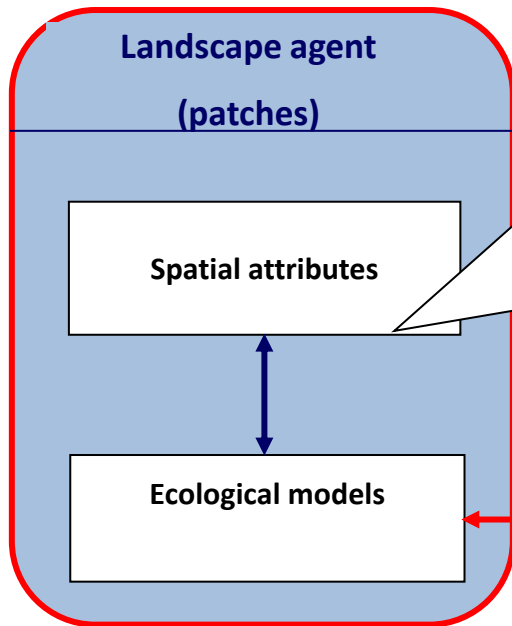
Turtle-context procedures

```
To FarmChoices
Use-holding
Encroach-new-farmland
End

To Logging
; rule-based behavior
End
```

Patch agent

Landscape agent

(patches)

Spatial attributes

Ecological models

See Le (2005), Chapter 5

Environment variable [Ex] (GIS raster):
- Land-use/cover
- Slope
- Wetness index
- Upslope contributing area
- Distance to road
- Etc.

Crop yield model: depend on
- Labour input
- Agrochemical input
- Soil erosion risk (via slope)
- Nutrient deposition potential
- Cropping time length

Patch's variables you set in

```
Patches-own
[p_landuse
 p_elevation
 p_slope
 ;etc.
]
```

A patch-context procedure
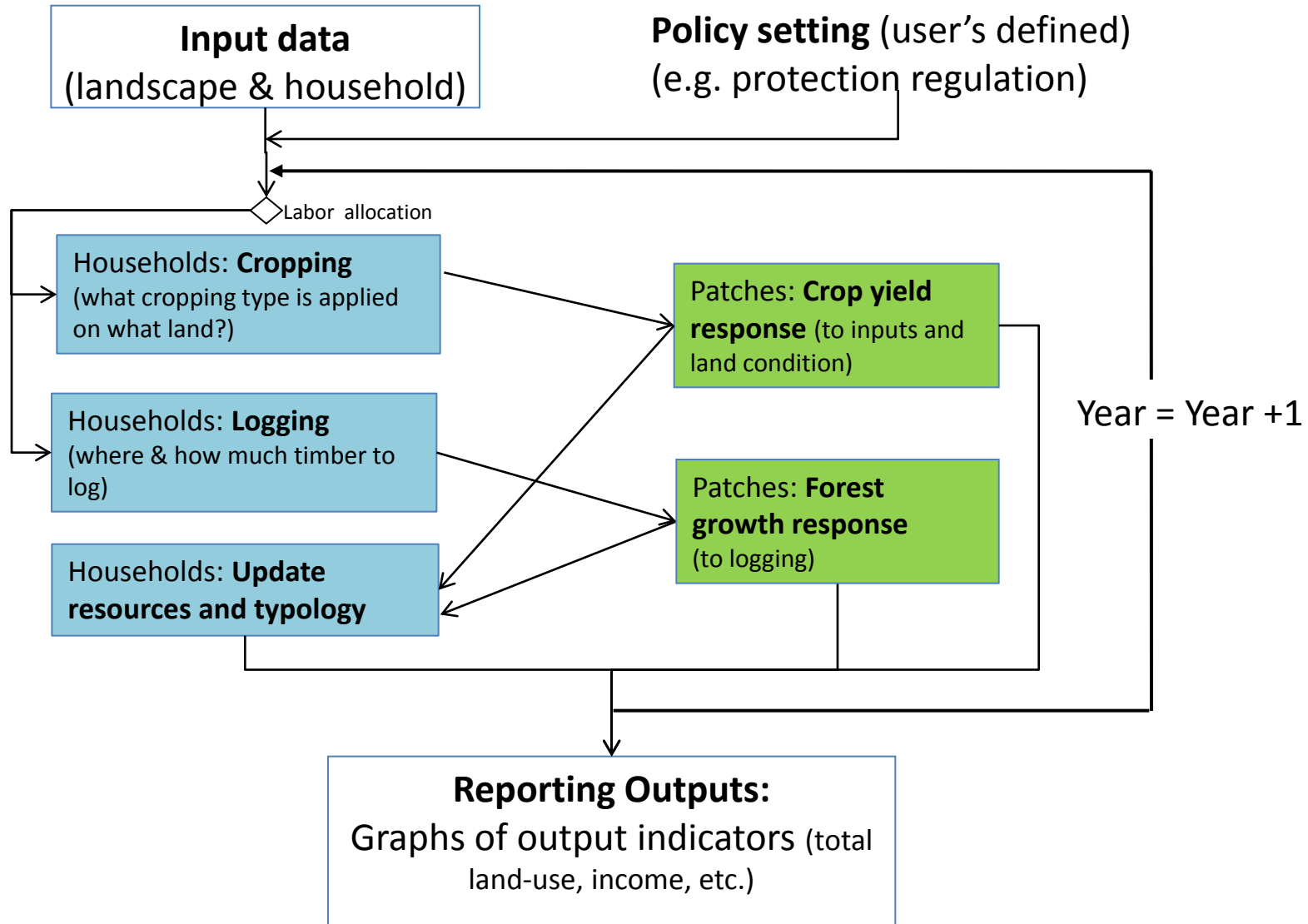
```
To CropYieldRespons

; etc. and etc.

End
```

Our tasks

1. Let's construct a diagram of model's key procedures. Use this diagram as the road map for our model development.

Flowchart of agent-based simulation process of „Example System"

Input data (landscape & household)

Policy setting (user's defined) (e.g. protection regulation)

Labor allocation

Households: **Cropping** (what cropping type is applied on what land?)

Households: **Logging** (where & how much timber to log)

Households: **Update resources and typology**

Patches: **Crop yield response** (to inputs and land condition)

Patches: **Forest growth response** (to logging)

Year = Year +1

Reporting Outputs: Graphs of output indicators (total land-use, income, etc.)

Our tasks (computer lab 2)

2. Let's define agent's variables (use <u>Code Resources.doc</u>)

3. Let's write a procedure of data input (use <u>Code Resources.doc</u>)

4. Let's write the OOP program of main procedures for blocks shoed in the simulation chart **.**