RESEARCH PROGRAM ON Dryland Systems

CGIAR

Food security and better livelihoods for rural dryland communities

How to present MAS modelling work and results

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Cairo, 13-21 September, 2015

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ODD protocol

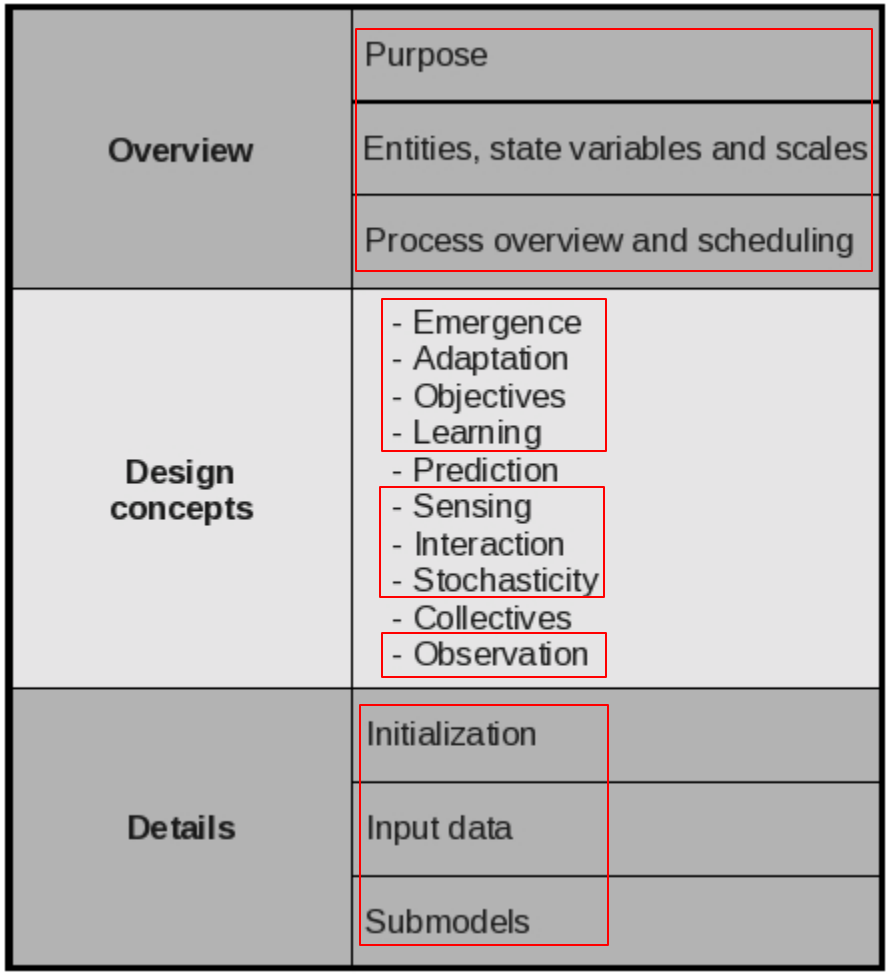
- Please read and comprehend:

  - General introduction of ODD: **Grimm et al. (2006)**

  - ODD-related questions: **ODD protocol.pdf** (my explaining note)

  - Some examples of using ODD: e.g. in **Le et al. (2010)**

Please ask me. If you have any questions.



How to present and analyze your simulation results in an insightful and effective way?

1. Describe properly your experiment:

- **Justify** the relevance/plausibility of your **study issue** → define **experiment factors**→ define **experiment parameters**

- Streamline the affecting pathways: to what way the change in your experimental factor leads to change in agent's behavior? (**Use-case flow diagram**)

- Clearly state your simulation experiments (e.g. **summary table**)

- Clearly state your impact variables (**brief definition & unit)**

- If stochasticity is used, please describe how you measure the uncertainty of the simulation outputs (**replicated runs, mean, confidence interval of the mean**)

Example of Experiment Issue, Factors, and Parameters

- Issue: Proper regulation governing villagers' access to forest timber (i.e. forest protection regulation). Why?
  - Forbidden all access → harm community livelihood
  - Uncontrolled/free access → high risk of deforestation

- Factors: What aspects policy-makers care in their protection policy?
  (1) Target area: Amount & location of protected forest
  (2) Enforcement of the protection regulation

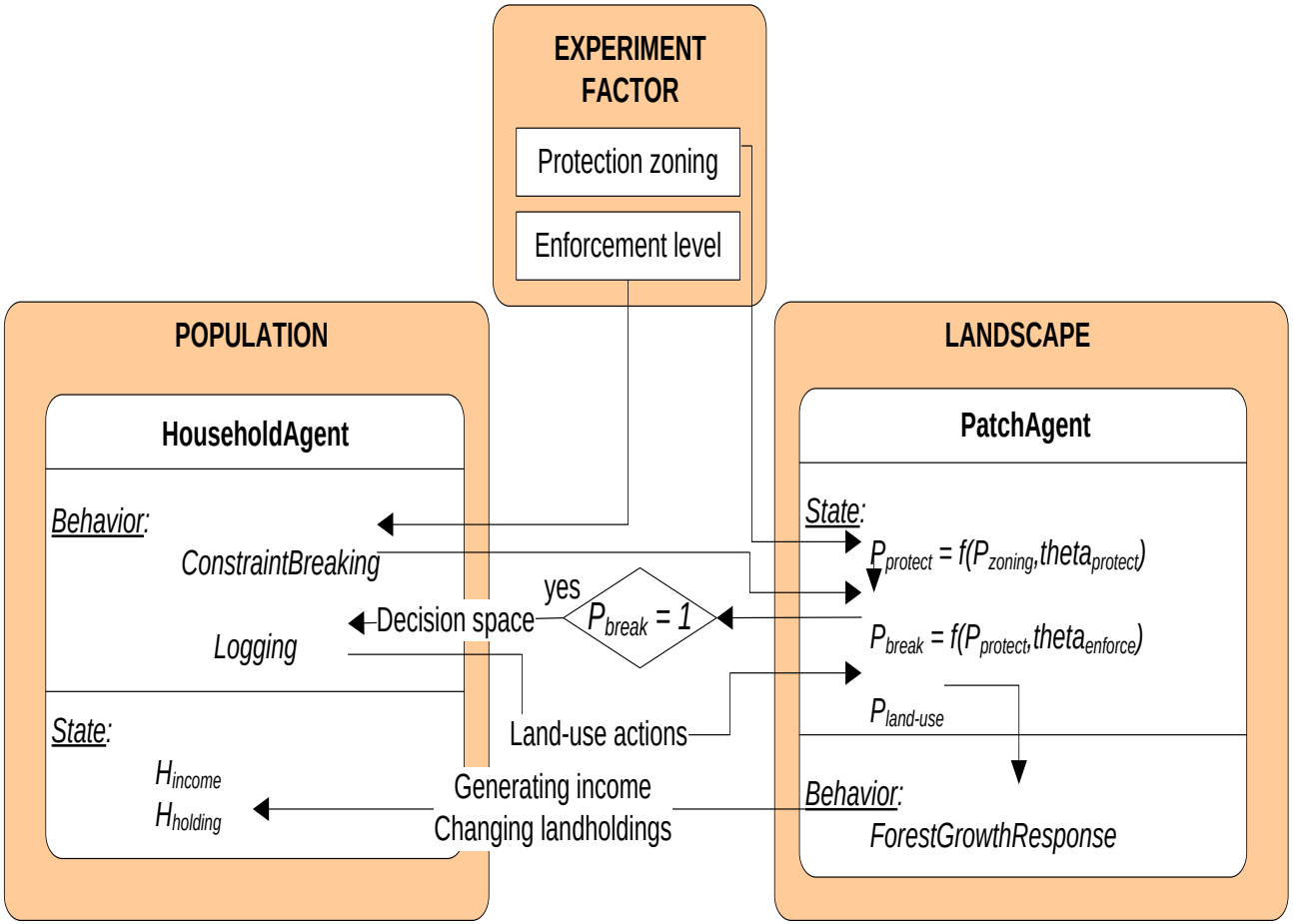
- Parameters: What variables can help defining the experiment factors?
  (1) "**Slope-threshold":** user-defined slope threshold for controlling the spatial extent of protected area.
  E.g. IF `p_slope` > "`slope-threshold`" THEN `p_protect` = 1
  (2) "**Protection-power**": User-defined probability representing enforcement degree of forest protection law

Streamline the affecting pathways: Simulation Use-Case flowchart

- To what way the change in your experimental factor leads to change in agent's behavior and elementary environmental processes?

Example:
An Use-Case flowchart to simulate impact of changes in forest protection policy

See details in Le et al. (2010)



Designing your simulation experiments

- Different settings for defining the protected area

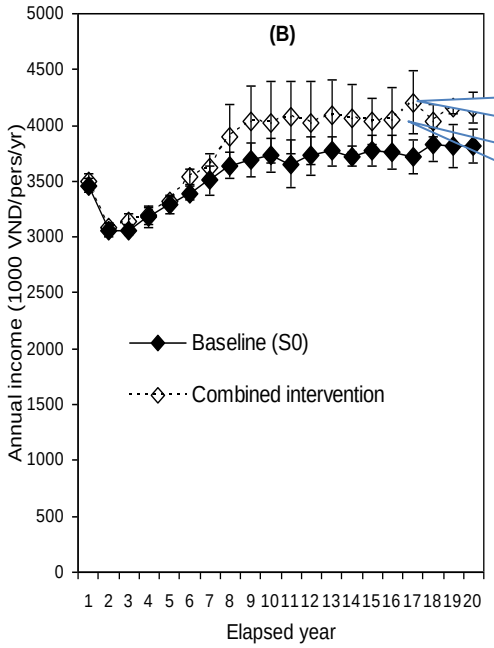
Experiment factor	"Slope-threshold"
No explicit target area	0
Targeting at least critical area	15
Targeting only very critical area	25

- Different settings of law enforcement

Experiment factor	"Protection-power'
No enforcement ("only-on-paper" policy)	0%
Weak enforcement	50%
Strong enforcement	90%

If stochasticity is used, please describe how you measure the uncertainty of the simulation outputs

- Replicated runs
- Calculate mean value and its confidence interval (CI)



mean values of multiple simulation results given the same input parameters

Confidence interval (CI) of the mean value:

E.g. at the confidence level of 95% (α=0.05):

$$CI_{0.05} = 1.96 \times SD/\sqrt{n}$$

where SD is the standard deviation of the mean, n is number of replication runs.

- If the uncertainty bands of two trajectories (of two different scenarios) overlap, there is no confidence to conclude a significant impact caused by your experiment factor.

How to present and analyze your simulation results in an insightful and effective way?

2. To what aspects considered in your simulation results:

- Overall (linear) trend (increase/decrease/steady)

- Overall non-linear trend (convex/concave increase/decrease)

- **Scale-specific changes**

- **Phasing changes**

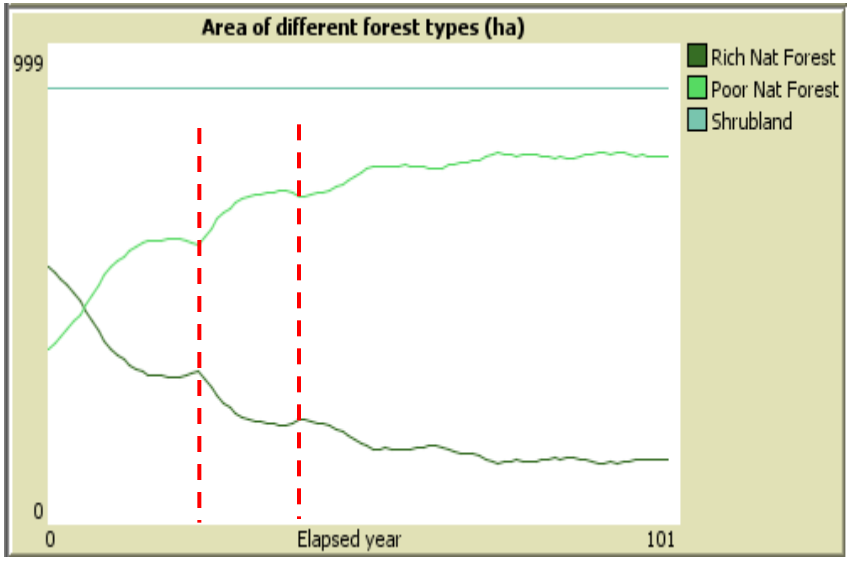
- **Delayed effects**

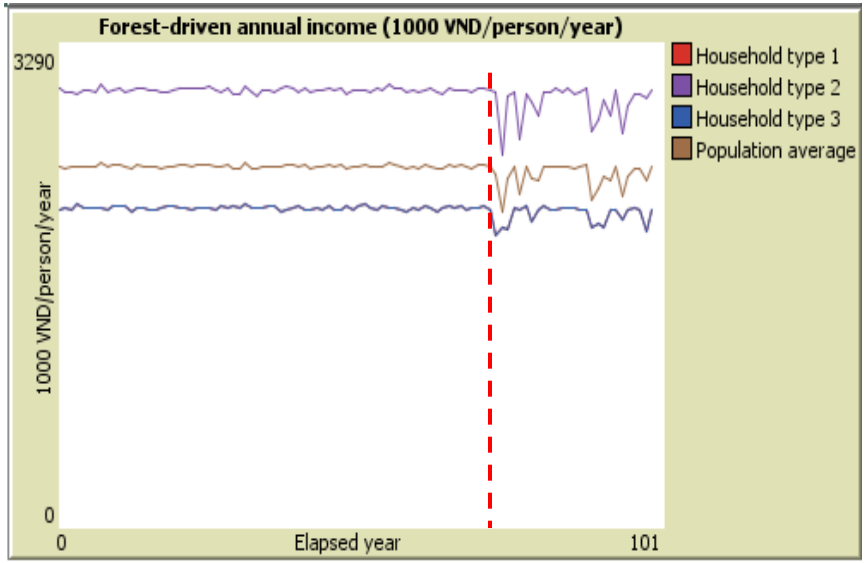
- **Trade-offs between different outcomes** (e.g. income gain/lost vs. rich forest gain/lost)

- Etc. (your creative thinking, please!)

Phasing changes

E.g. Simulation results using “landuse_change4.1.nlogo”, free-access setting.





Different phases of growth/degradation

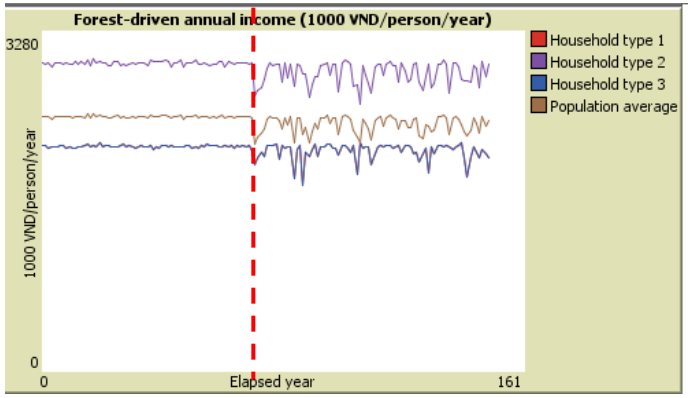
Stable phase – instable phase of annual inc

- Reasons of phase changes: changing equilibriums, etc.

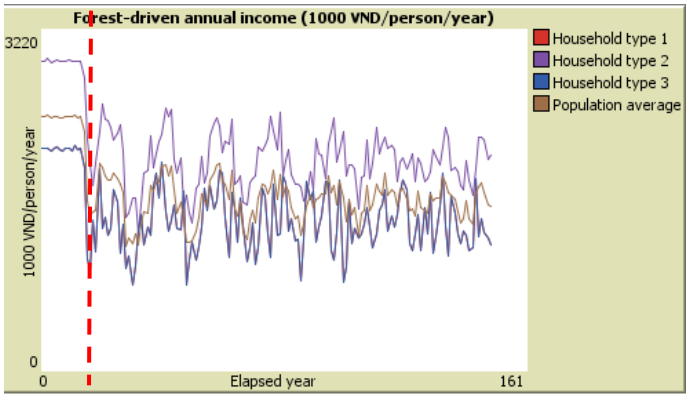
- Anticipation of the ‘**tipping points**’ (e.g. the time points marked by red dash lines above) is crucial for supporting sustainable development.

Phasing changes: an example of logging mechanization impact

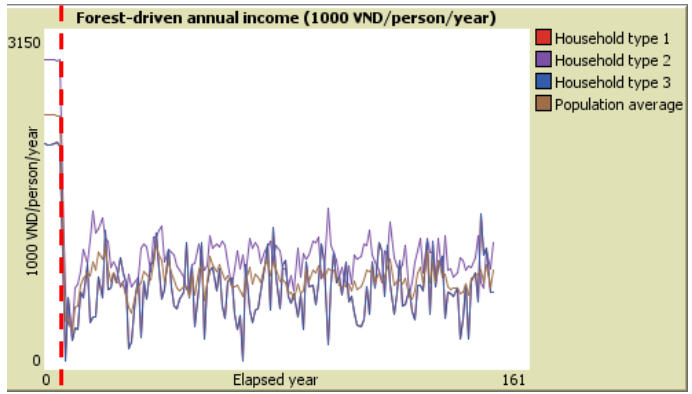
No mechanization
(30 days to log a tree and saw it into wood panels)



Medium mechanization
(20 days to ...)

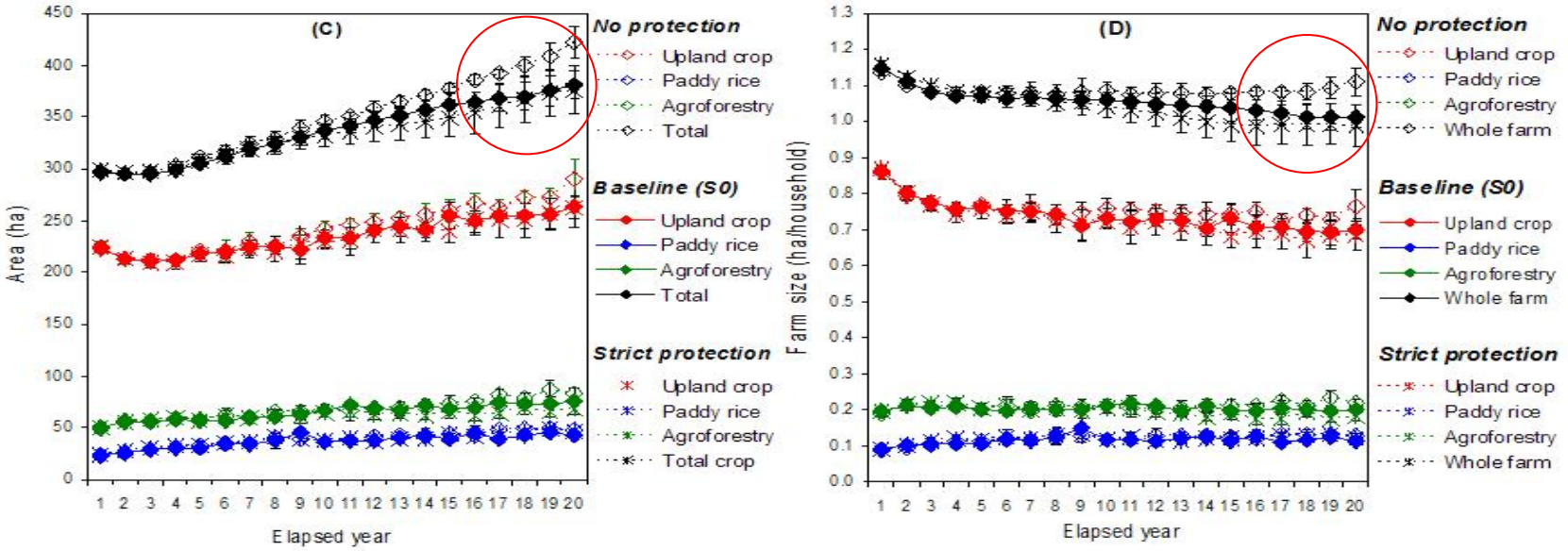


High mechanization
(10 days to ...)



→ Technological intervention to better timber withdraw **alone** likely causes an **earlier onset** of the crisis phase for forest dependents

Delayed/legacy effects



E.g. Shift of forest protection regime likely causes significant impacts on the total farmland area and farm size after 15-17 years (see Le et al., 2010).

- Reasons of delayed effects: buffering and elastic capacities caused by heterogeneous interactions within the coupled HES.

- Implications for sustainability research: multi-generation externalities and long-term benefits, etc.

How to present and analyze your simulation results in an insightful and effective way?

3. Discussions about your simulation results

- What changes are theoretically understandable/explainable ? (intended/expected/common sense changes)

- Is there any changes that are counter-intuitive?

  Scientifically discovered, truths are often called *counter-intuitive* when intuition, emotion and other cognitive processes outside of deductive rationality interpret them to be wrong. However, the subjective nature of intuition limits the objectivity of what to call *counter-intuitive* because what is counter-intuitive for one may be intuitive for another (Source: Wikipedia).

  Counter-intuitive in science:
  Many scientific ideas that are generally accepted by people today were formerly considered to be contrary to intuition and common sense.

- What do the results suggest for (1) better management, planning, etc. and (2) new research questions and hypotheses?
- … (your creative thinking, please!)