CGIAR

RESEARCH PROGRAM ON Dryland Systems

Food security and better livelihoods for rural dryland communities

Steps in integrated systems analysis

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Agricultural Livelihood Systems

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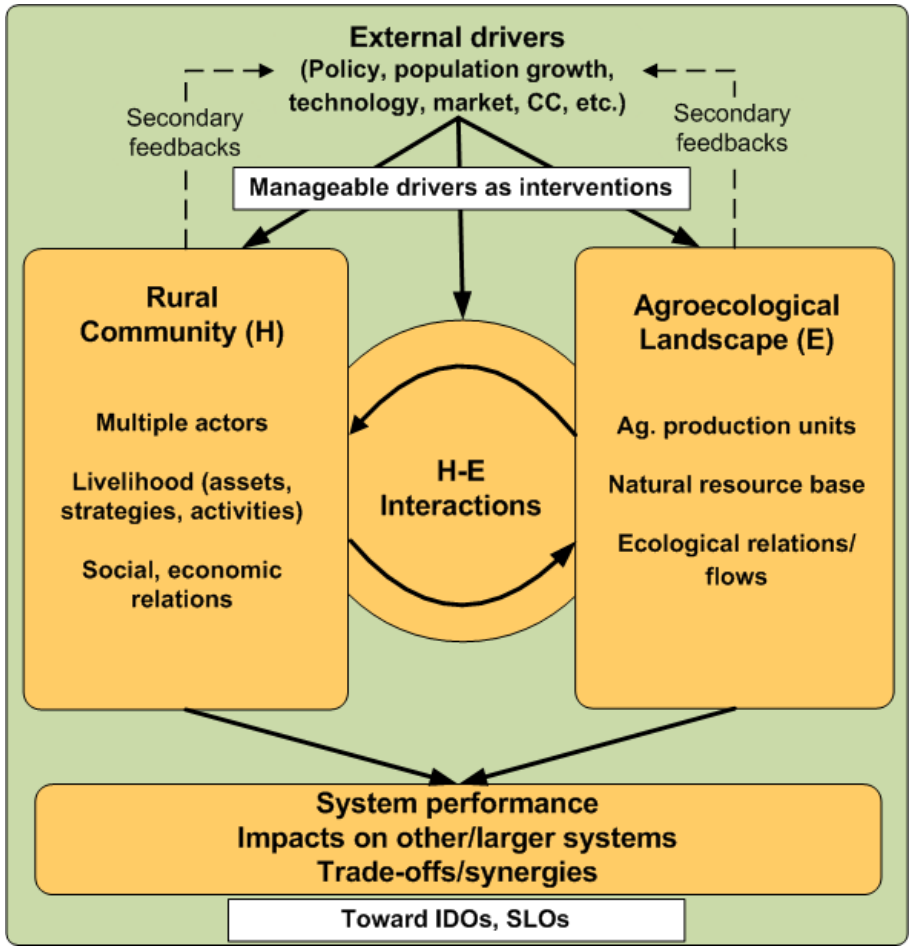
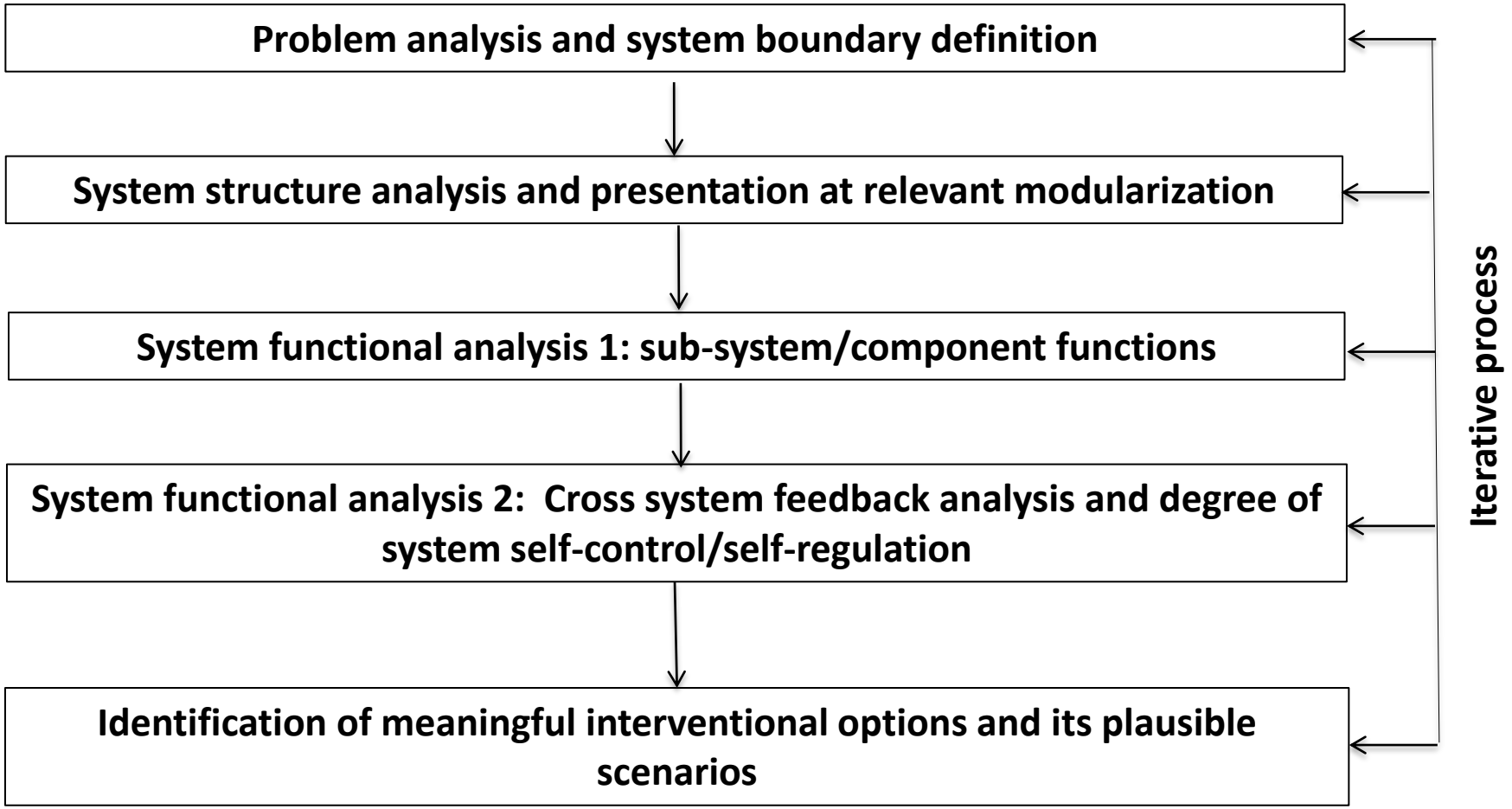
Whole farming community-landscape system consideration

- Agricultural livelihood system = the inherently coupled rural community – agro-ecological landscape system.
- Embedded in **context,** containing **external drivers** influencing ALS
- System **performance**
  - ✓total farm productivity,
  - ✓economic-ecological efficiency
  - ✓resilience (buffering, adaptive, transformative capacities)
  - ✓empowerment of disadvantages group
- **Trade-offs/synergies**
  - ✓Vs. options
  - ✓Vs. space
  - ✓Vs. social groups
  - ✓Vs. time



Integrated system analysis



System boundary definition and holistic, structured problem analysis (*keep in mind: whole-system performance, human-environment complementariness principles*)

(1) **Concrete boundary** of ALS as coupled H-E system (level n)

(2) Problems regarding system performance (**total farm productivity, efficiency, social equity, adaptability**); **key indicators of ALS performance**

(3) **Key external drivers** (biophysical, politico-cultural, technical, economic development factors) (level n+1), including **constraints** and **opportunities**

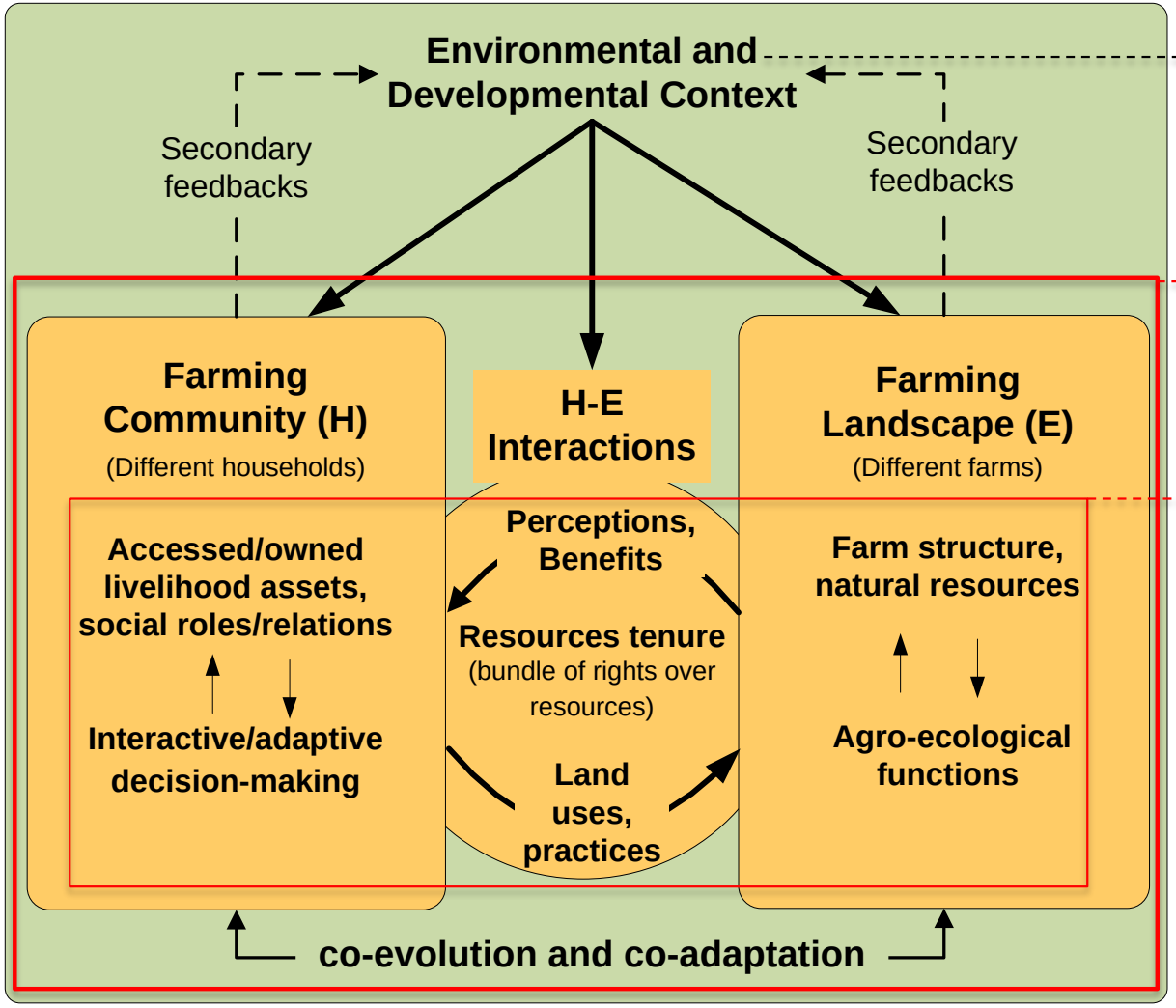
System structure analysis and presentation at relevant modularization (*keep in mind: hierarchical parsimony principles*)

(1) **Sub-systems** if necessary: household-community, farm-landscape, **social structure and relation**, **resource governance structure** (incl. tenures)

(2) **Levels of explanatory insights**: n-1: individual household, biophysical farm, n-2: household structure/members, farm components, etc.

(3) **Key attributes/variables** of each component

Agricultural Livelihood Systems (ALS) Framework



Levels n+1, n+2: Larger H-E systems provide context

Level n: ALS as coupled H-E System

Levels n-1, n-2: explanatory insights

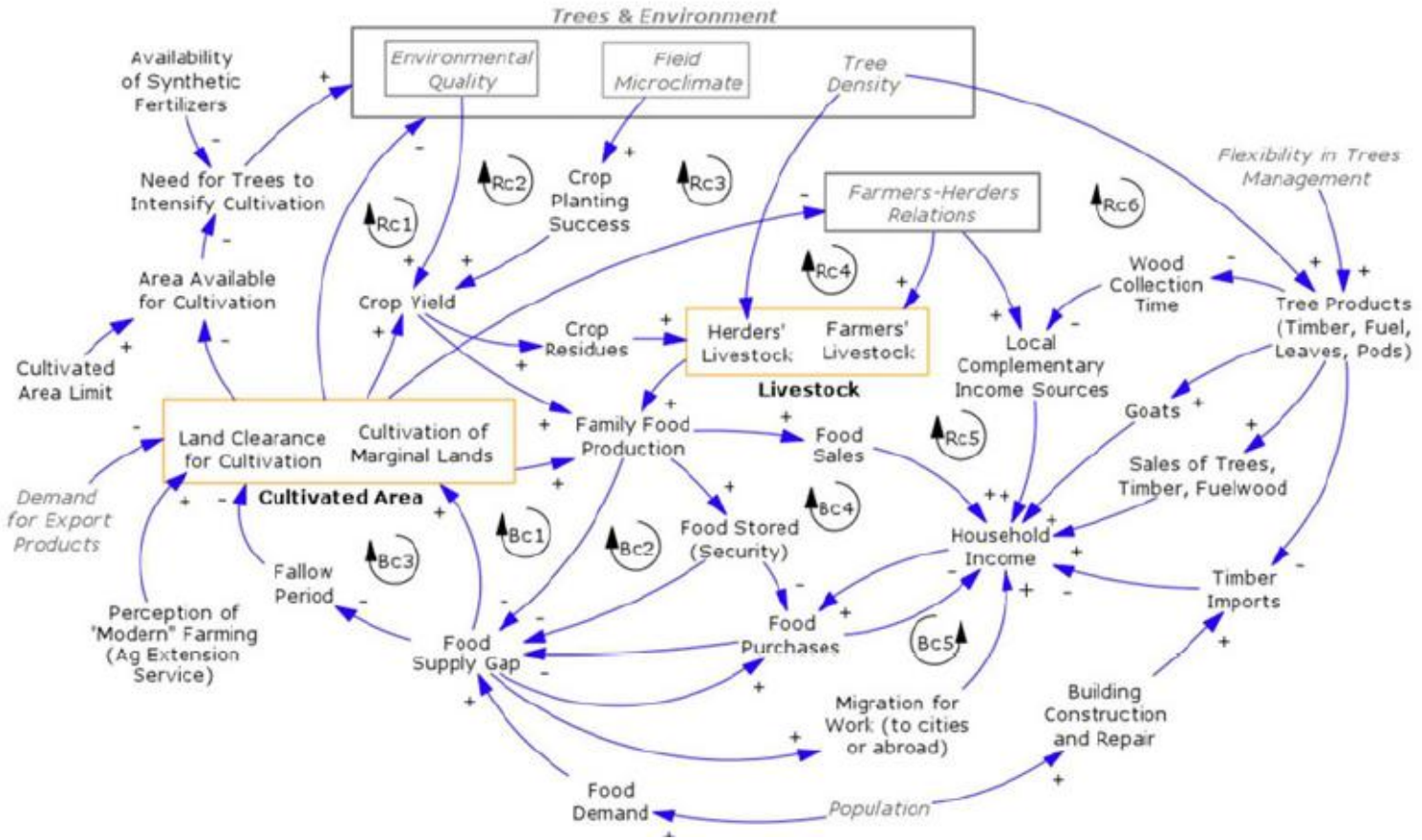
Component's functional analysis (*keep in mind: human-environment complementariness and parsimony principles*)

(1) **Relevant functions of biophysical components** (food production, resource flows and balance, ecological buffering, etc.)

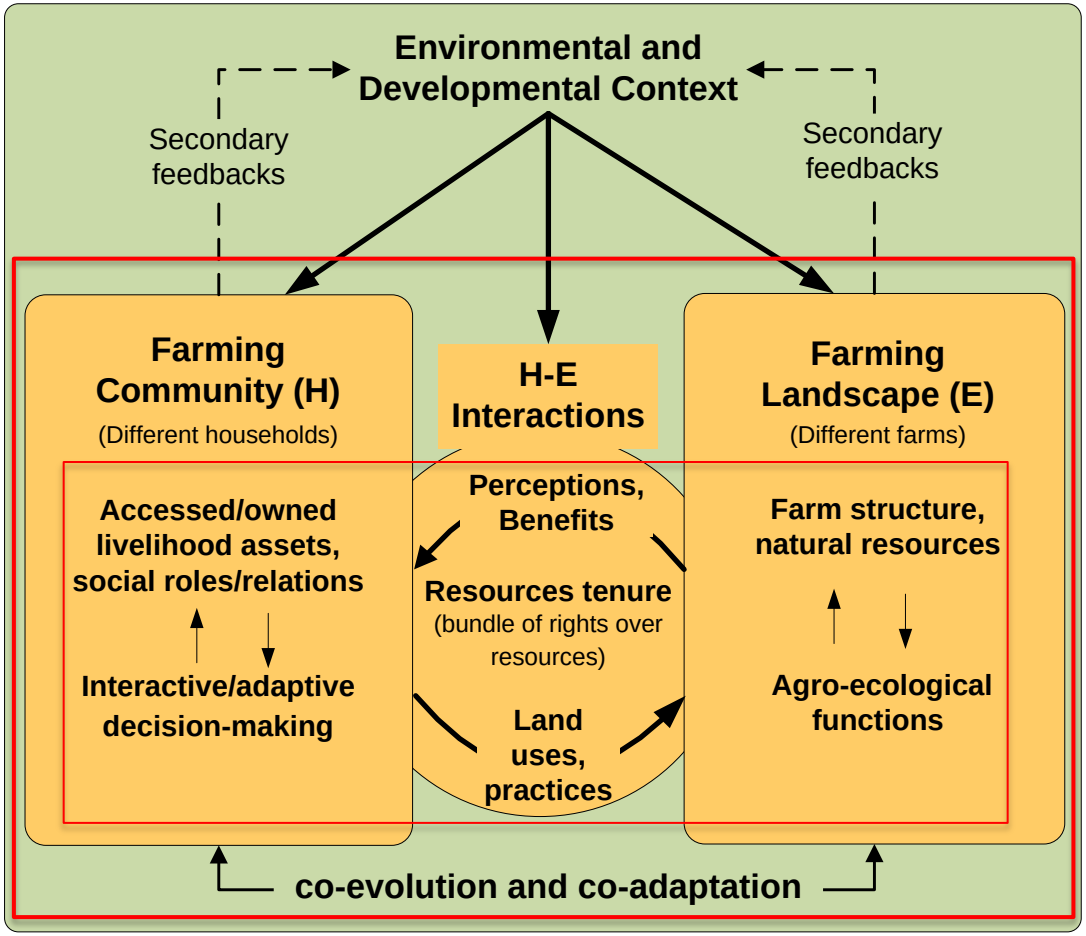
(2) **Relevant social functions of involved human actors** (roles, interactive/adaptive decisions, networking and social relations, etc.)

(3) **Time factor**: Check if the conceptualized system is sensitive to time (path-dependency) or not; define phase if needed; define scale- and component-relevant time horizon and time step if needs.

- Where to start to layout a complex ALS?
- How to avoid “too complicated” but “not missing important components and process”?
- How to avoid bias (researcher-specific design → artifact system sensitivity)?

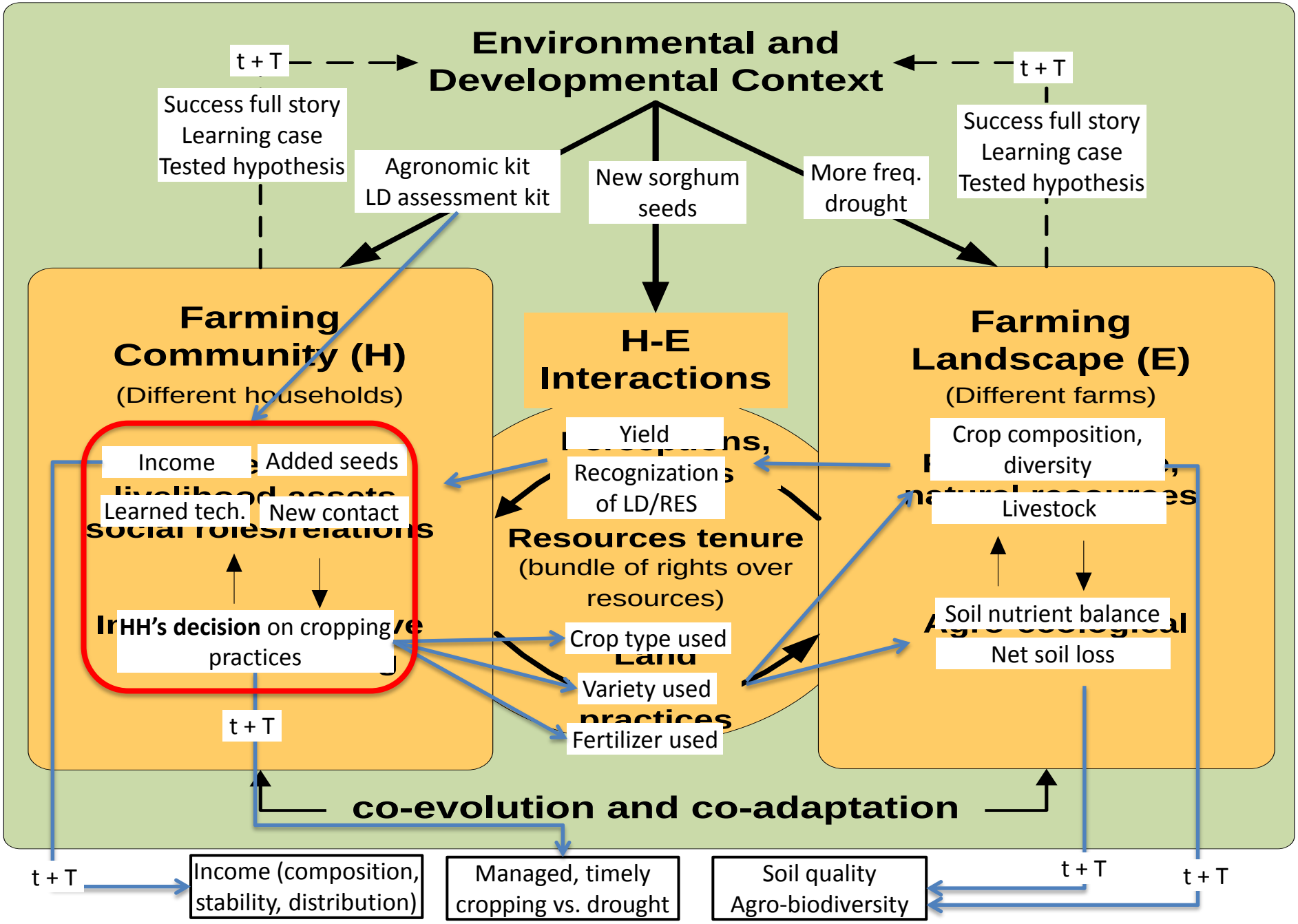


ALS-framework as “system map” to set key system components, interactions to start with



- Key components and interactions
- Help define constraints, opportunities along the “system map”
- Help short/align options along the “system map” in targeting constraints, promoting opportunities
- Help map affecting pathways from intervention to system behavior and performance
- Guide quantitative assessment, modeling

Let us the ALS-framework to map systemic effects of integrative interventions



Whole system's functional analysis (*keep in mind: human-environment complementariness, feedback loops, whole-system performance, parsimony principles*)

(1) Different **feedback loop types** (E-E, H-H, H-E) that are important for influencing system performance; clarify the **'construct' of feedbacks** (material/information/social relation)

(2) Clarify **controllability of feedback** (positive/amplifying or negative/stabilizing)

(3) A **handful set (4-5) of framing/controlling variables**

(4) Clarify **if feedback structure** is **stable or variable** over time in response to stresses/shocks/opportunities **(structural adaptability/flexibility/robustness)**

Meknes, Morocco: An example of ASL analysis result (first version)

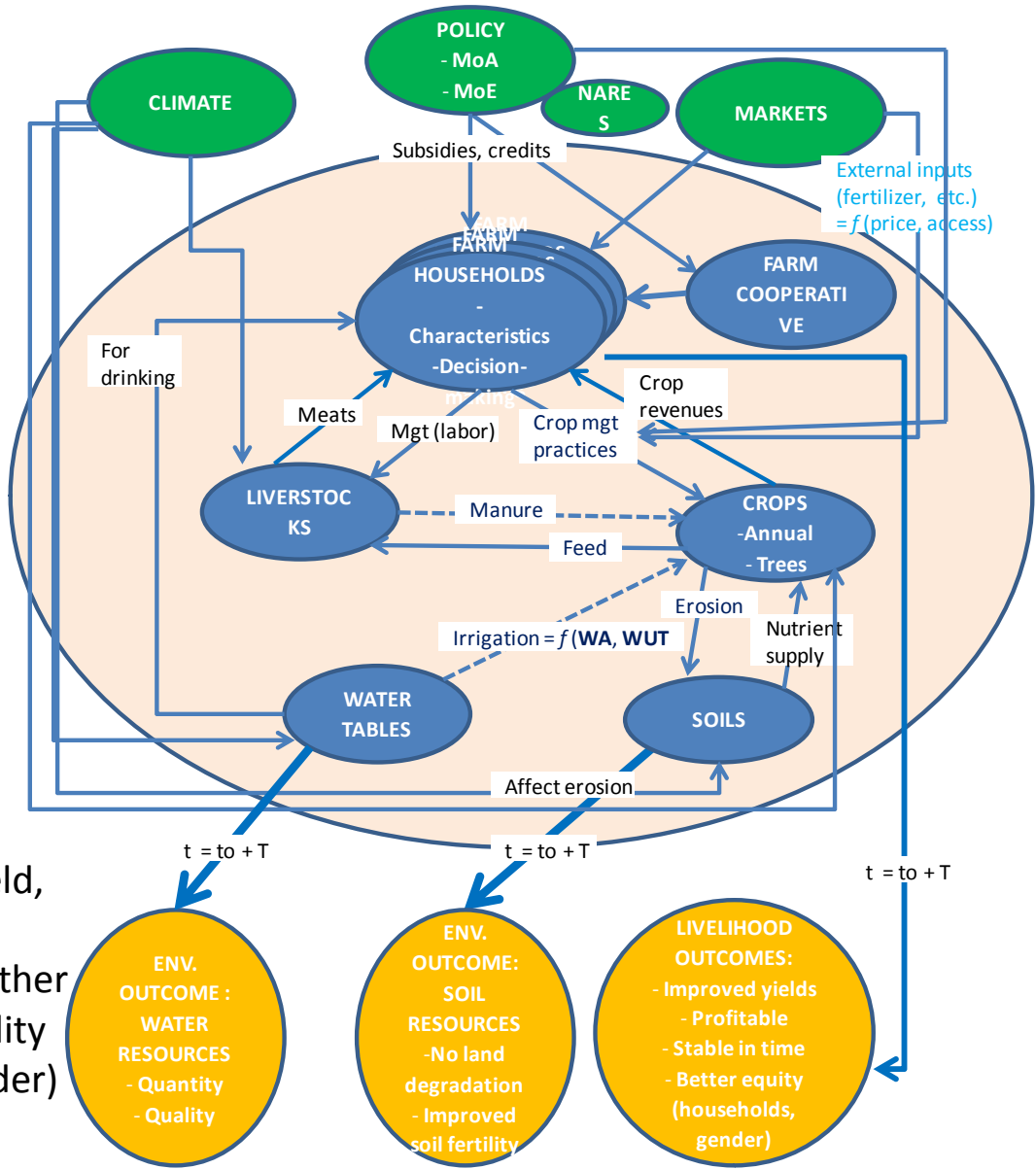
System boundary
Landscape of mixed crop productions systems (incl. livestock components) + smallholder community (incl. farmer cooperatives) + local value chains (?)

Constraints and opportunities
(well-defined, see Karou's presentation)

Important external factors
Climate change, policy, market, technological packages (well-characterized, see Karou's presentation)

Performance criteria of sustainable intensification (SI)

- Material livelihood outcomes: improved yield, profitability, stability
- Environmental livelihood outcomes: no further soil degradation or even improved soil fertility
- Improved income equity (households, gender)



Identification of entry and leverage points of intervention, and integrative intervention strategy (*keep in mind: whole-system performance and context-relevant principles*)

(1) **Interventions** focus on **manageable drivers** (external and/or internal)

(2) **Entry points:** sensible to system change, feasible, stakeholder- and policy-relevant

(3) **Integrative intervention strategy: subsidiary interventions across levels resulting in convergent changes of ALS** + involved **multi-actors innovation network**

(4) **Interrelated causal hypotheses linking interventions to ALS performance.**

Meknes, Morocco: An example of ASL analysis result (second version)

Focused system components

- Human: interactive households, farm cooperative, community networks
- Biophysical: crops (wheat-vegetables), soils, water tables, livestock

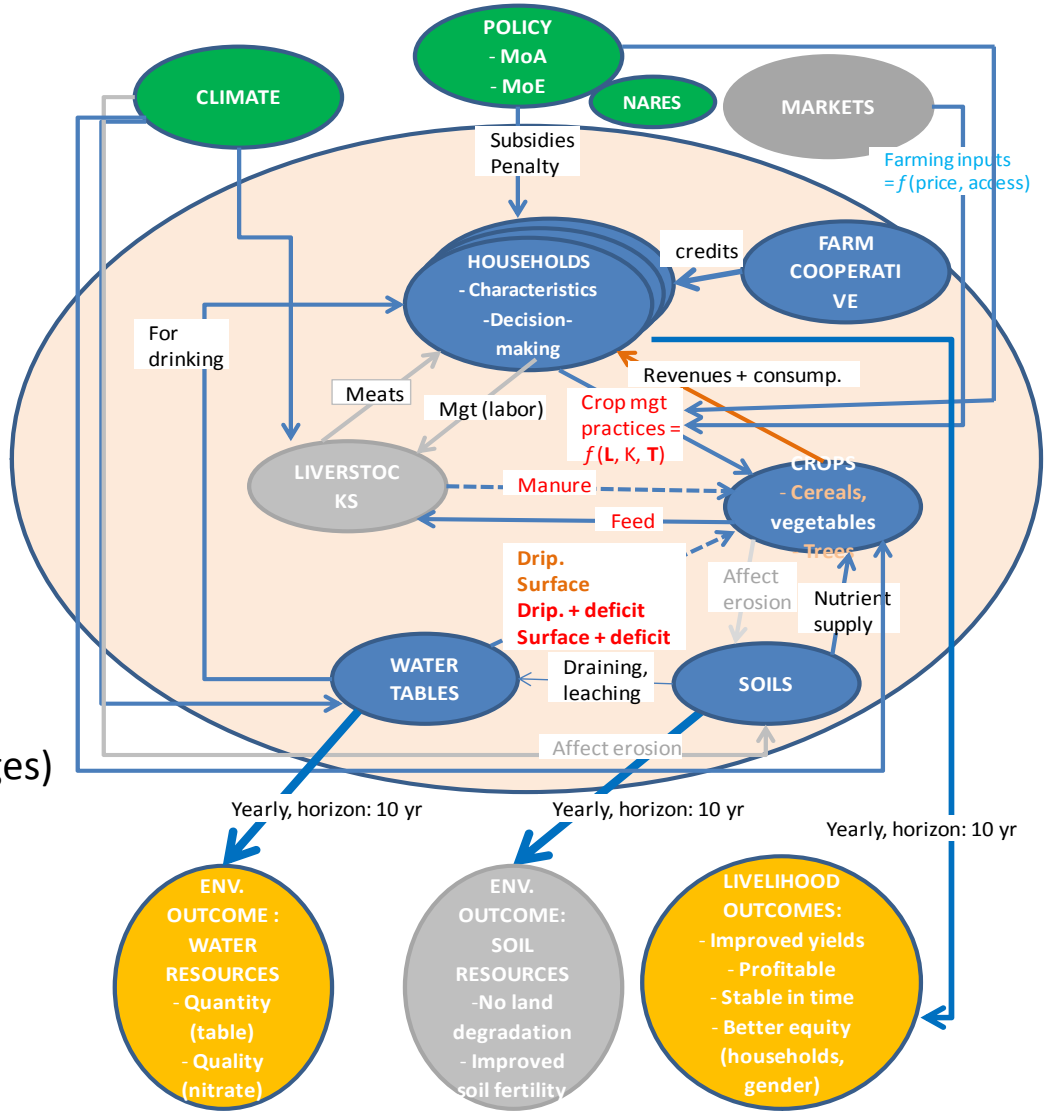
System functions

- Interactive **farmers decision-making**
- **Functions of farm cooperatives**
- Crop and livestock productions
- Soil nutrient balance
- Water balance

Leverage points and affecting pathways

- Farmers adoption of improved crop management practices (see described packages)
- Farmers application of animal manure as manure, and crop residues as feed
- Farmers uses of saving irrigation techniques
- Related enabling policies

Block: Green: AE, Blue: Analysis, Orange: PE
Red text: Possible "levers" for improve SI
Grey box/arrow/text: not to be focused



Meknes, Morocco: An example of research question and hypothesis driven from system analysis

As irrigation technology and policy are justified as important, changeable drivers for system transition into sustainable intensification, what is the specific research questions and hypothesis?

Note: Keys for research question/hypothesis: Reflect causal links from **intervention(s)** to system **performance**

Research question:

What are the likely changes in sustainable intenisification indicators driven by **improved water use technologies** and **policies**?

Hypothesis to be tested:

Combined improved water use technologies and relevant policies can increase **farmers' adoptions of technological innovation**, thereby improve **system performance** towards sustainable intensification.

Testable interventions and experimenting scenarios

Testable interventions about Improved and adapted water use technologies

Dripping irrigation

- Deficit irrigation

Testable interventions about Improved and adapted water use policy:

- Subsidies
- Credits
- Penalty of over-scale application

Scenario	Irrigation methods			Policy		
	Sur.	Drip.	Def.	Cre.	Sub.	Pen.
BAU (Baseline)	x	x				
Irrigation tech. option (single factor) vs. BAU						
S1	x	x	x			
…						
Policy option (single factor) vs. BAU						
S3	x	x		x		
S4	x	x			x	
S5	x	x				x
…						
Combined technology-policy option						
S6	x	x	x	x	x	
S7	x	x	x		x	x
….						