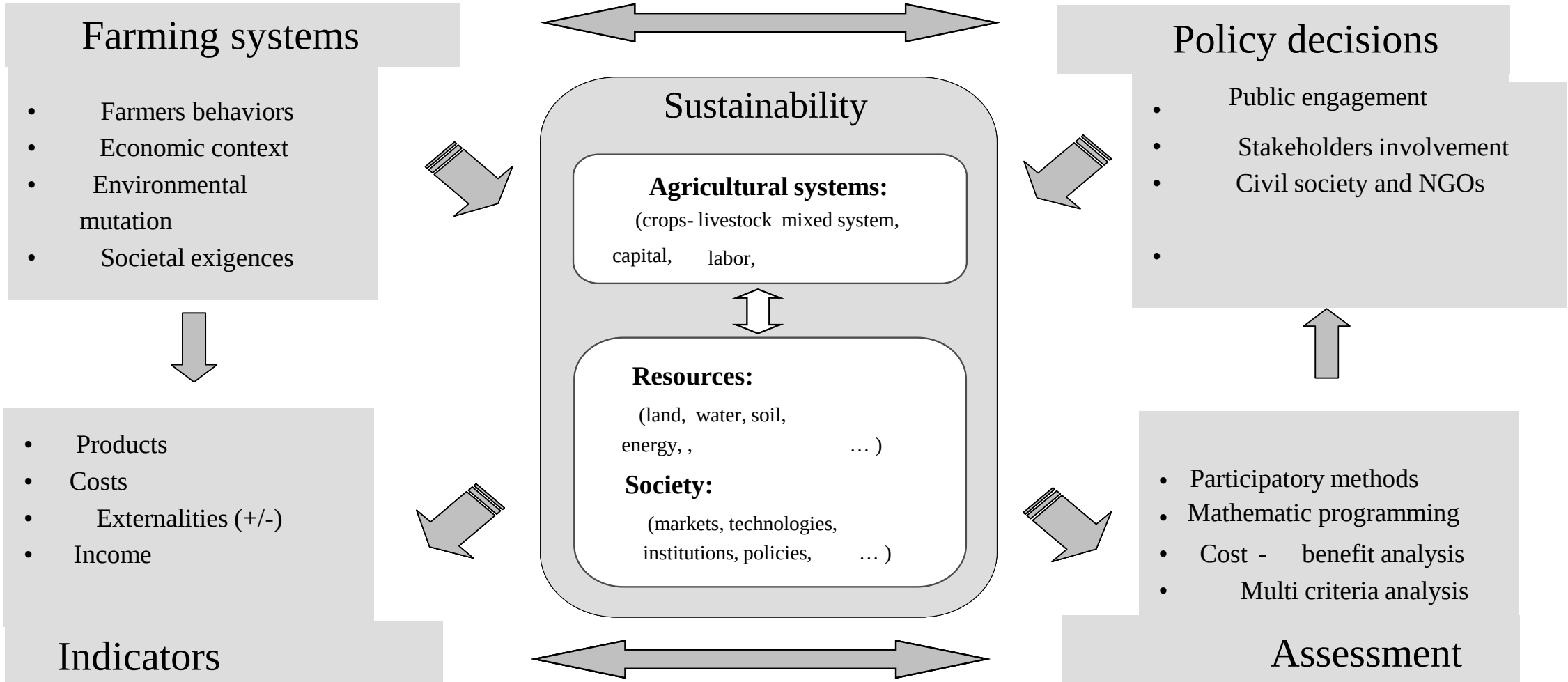
Use of Conservation Agriculture in Crop-Livestock Systems (CLCA) in the Drylands for Enhanced Water Use Efficiency, Soil Fertility and Productivity in NEN and LAC Countries

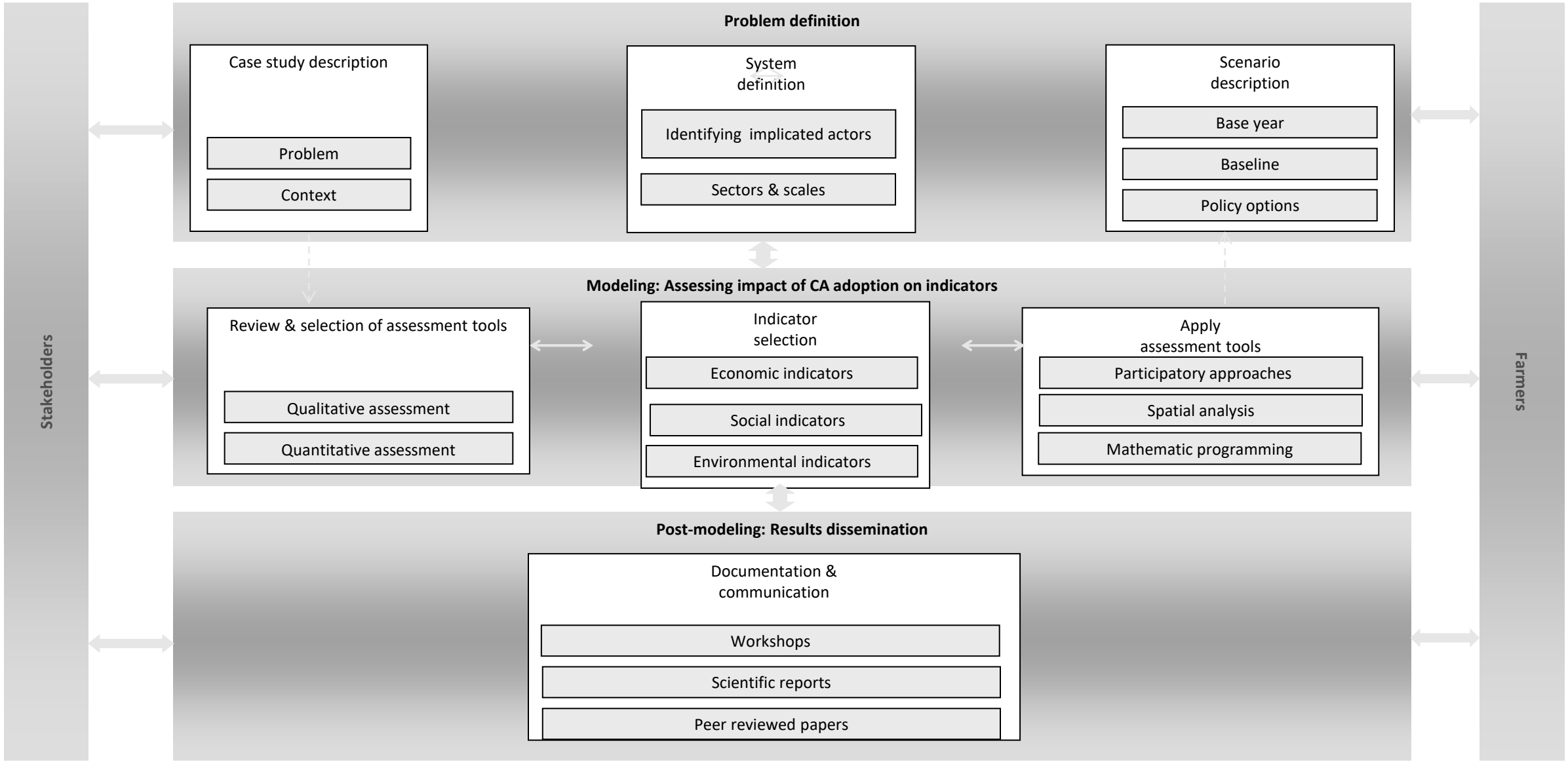
Tunisia CLCA Project: Socio-economic activities

Tunis, March 5th, 2020

How to deal with complex systems ?



Conceptual framework



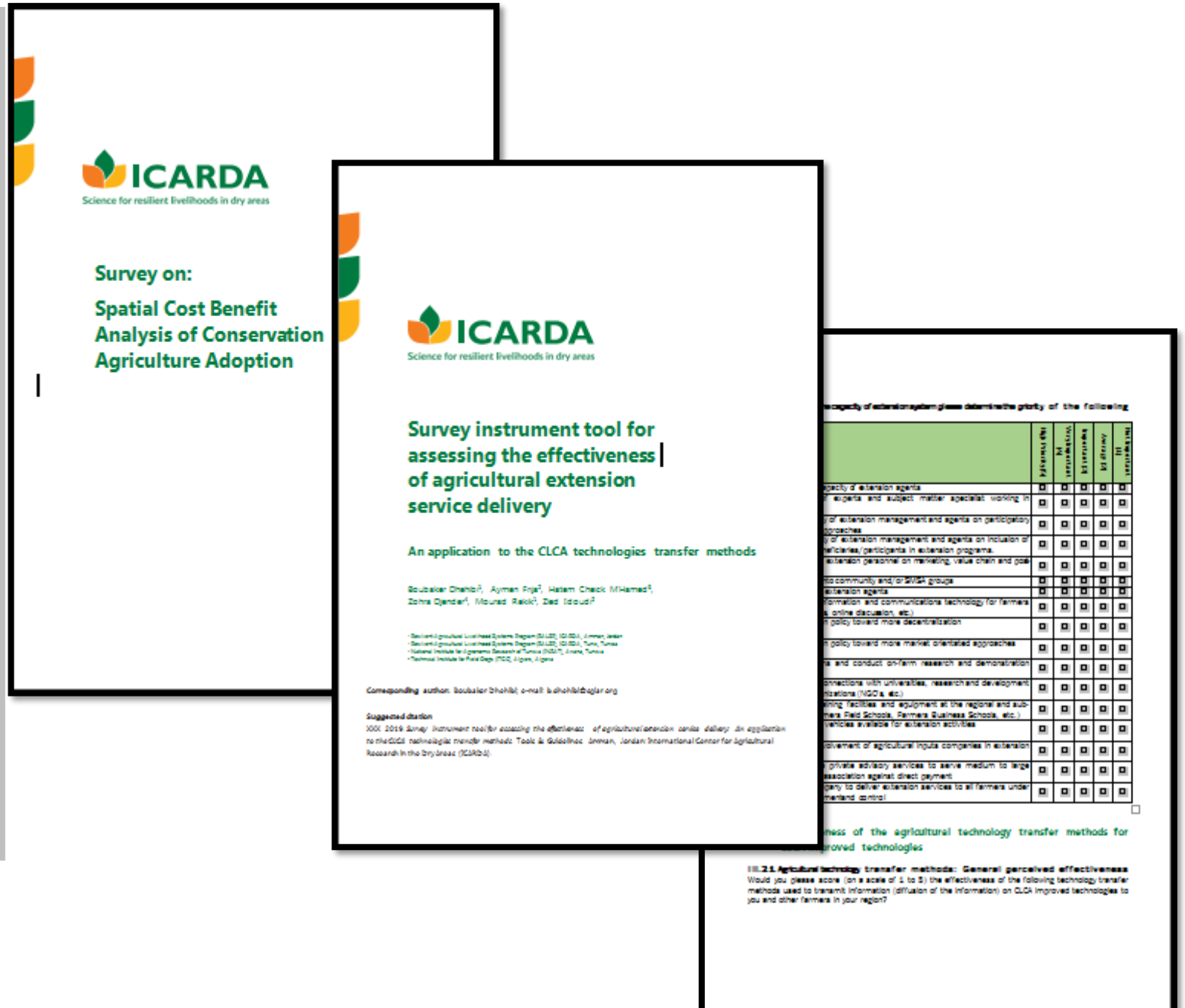
Where we are right now ?

- **Achievement:**
  - Assessment of constraints to the Adoption of Conservation Agriculture
  - Assessment of farmers perceptions of extension services
  - Quantification of crops residues + BBN model + typology of crop residues patterns.
  - Cost benefit assessment 79 ha… methodology + some results.
  - Presentation of Farm Design model,
- **Ongoing activities:**
  - Stakeholders perception of extension services
  - Spatial Extended cost benefit assessment .
  - Suitability map for sustainable CA adoption

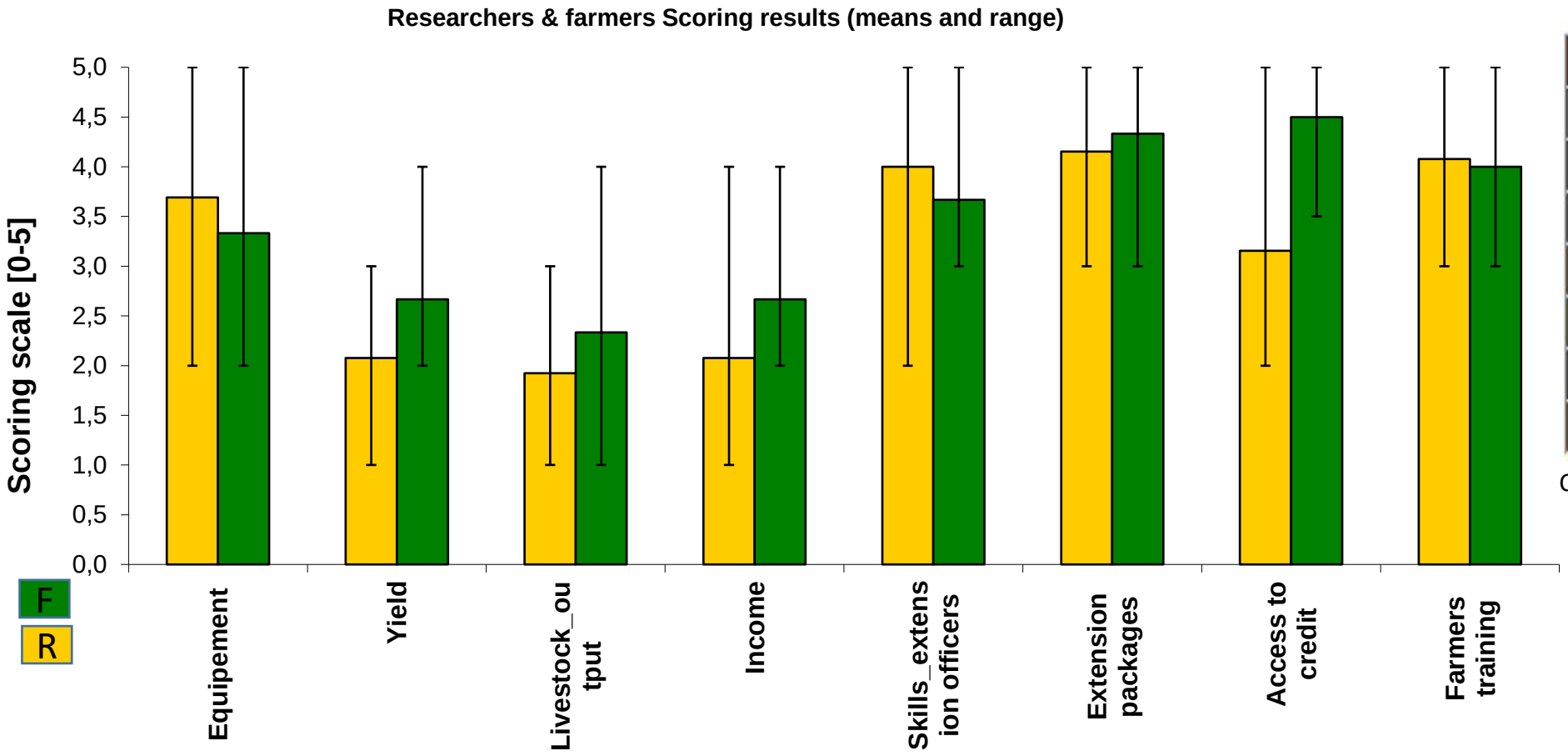
Activities of socioeconomic teams

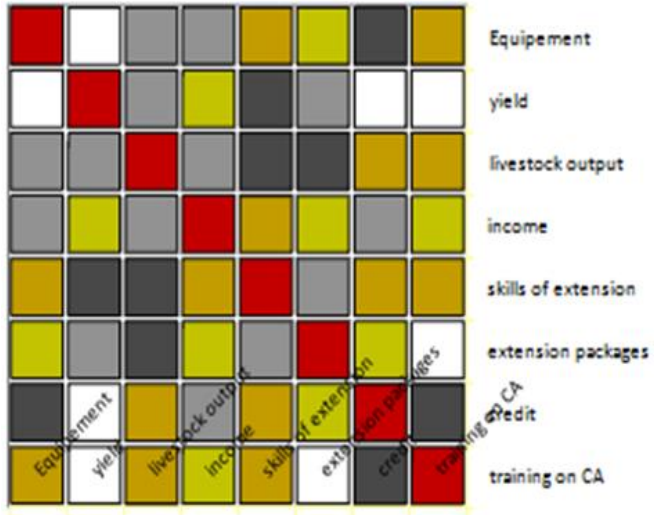
Participatory approach & Socio-economic surveys → *stakeholders & farmers perception on CA adoption/ extension techniques* **(20 surveys with farmers & 16 with researchers)**

- **Socio economic survey** → mathematical programming & optimization **(farm typology (150 surveys and 5 farm type surveys)**
- **Socio economic survey** → Spatial extended cost benefit analysis **(survey design and testing)**
- **Spatial analysis** → Generation of suitability map for sustainable CA adoption



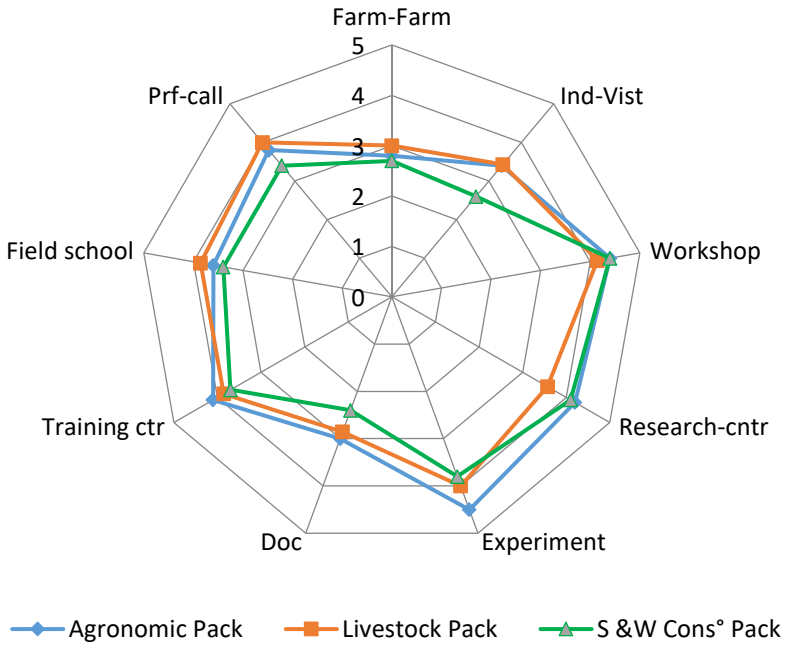
Perception of constraints on CA adoption



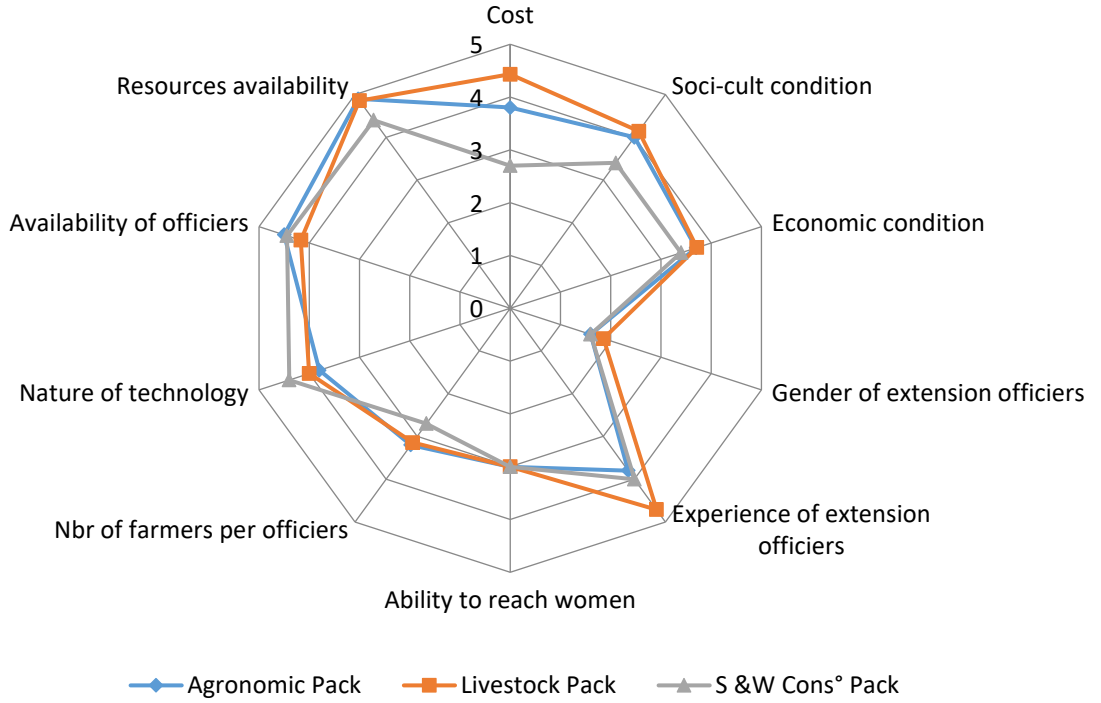


Correlation map, Kendall test

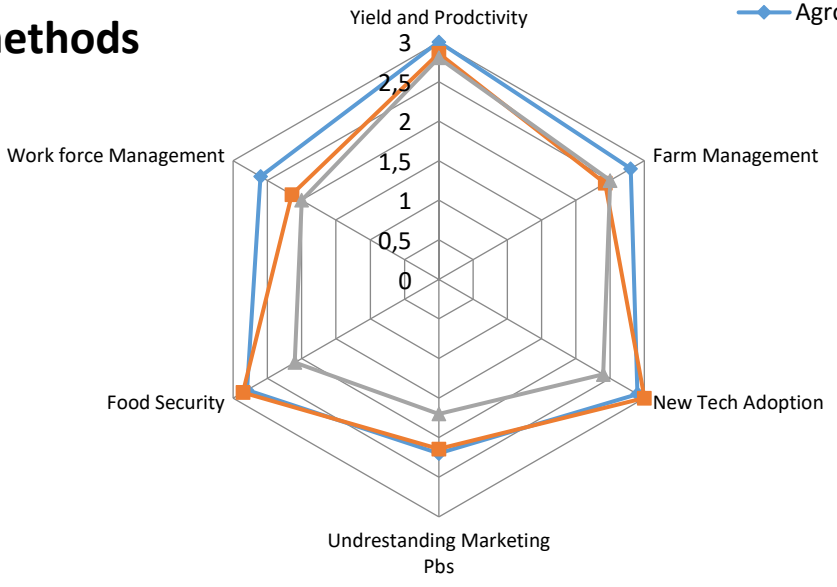
Effectiveness of agricultural extension



Effectiveness of the Extension methods



Factors influencing effectiveness of Extension methods



Potential impacts of Extension on the Livelihood of CA adopters

Assessment of trade-offs (1)

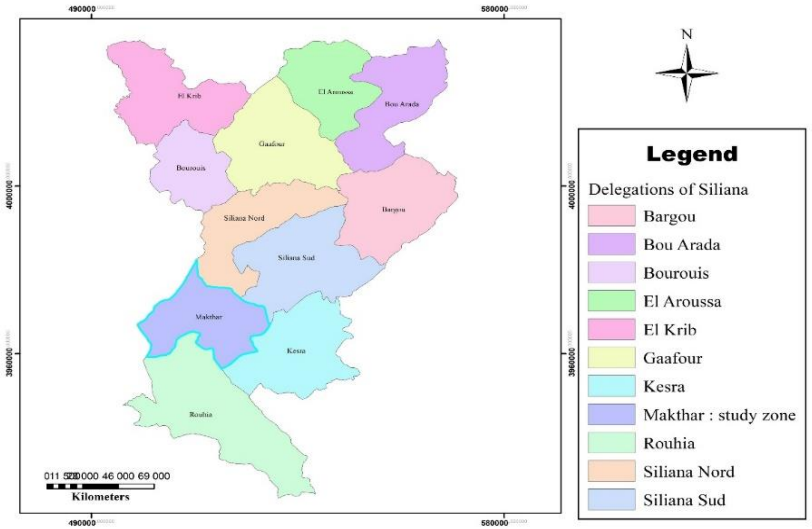
- **The objective** is to characterize trade-offs related to the use of crop residues in the small cereal-sheep farms of North West Tunisia (152 farms of the region of Siliana).
  - *Calculated the quantity of cereal residues left on the soil after the harvest and the summer grazing (HI).*
  - *Analyzed the complex relationships of factors influencing farmer's choices regarding crop residues allocation using a Bayesian Belief Network (BBN) model.*
  - *Typology analysis of farms based on their patterns of residue management in addition to other structural variables.*

CR left on the soil:

$$\mathrm{CRS}_{ij} = \mathrm{AGM}_{ij} - (\mathrm{TQG}_{ij} + \mathrm{SS}_{ij} + \mathrm{GY}_{ij})$$

Conditional probability for CR patterns drivers:

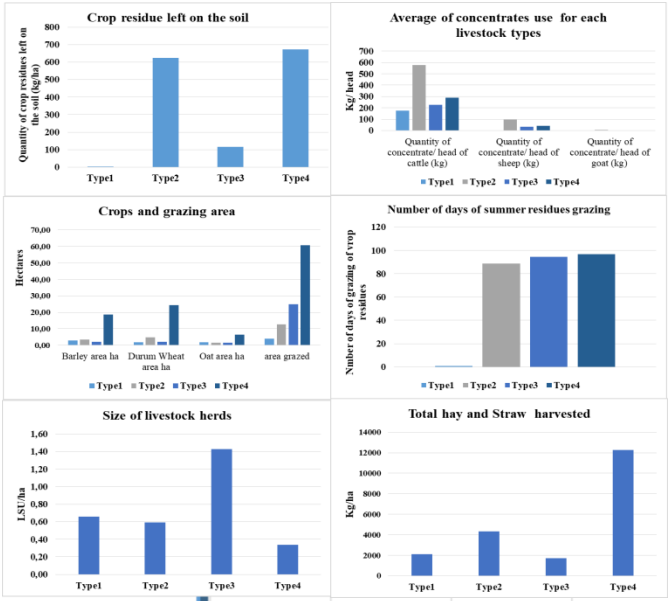
$$\mathrm{P}(\mathrm{X1}, \ldots \mathrm{Xn}) = \prod \mathrm{P}\left(\frac{\mathrm{Xi}}{\Pi \mathrm{i}}\right)$$

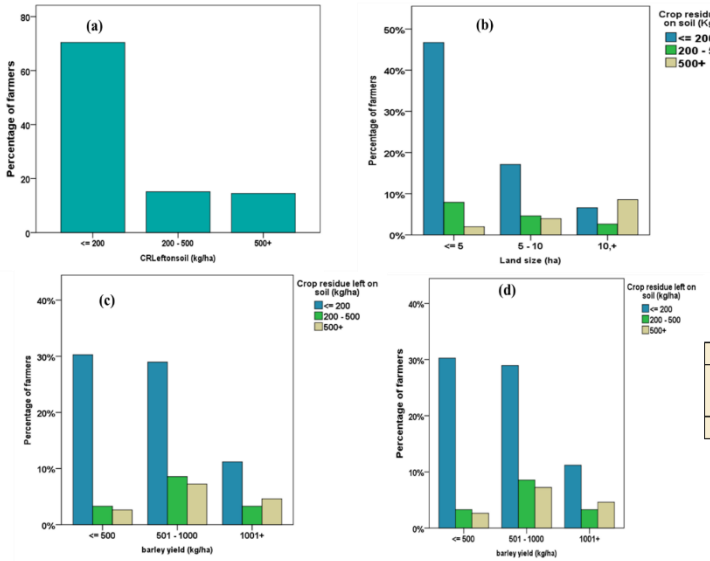


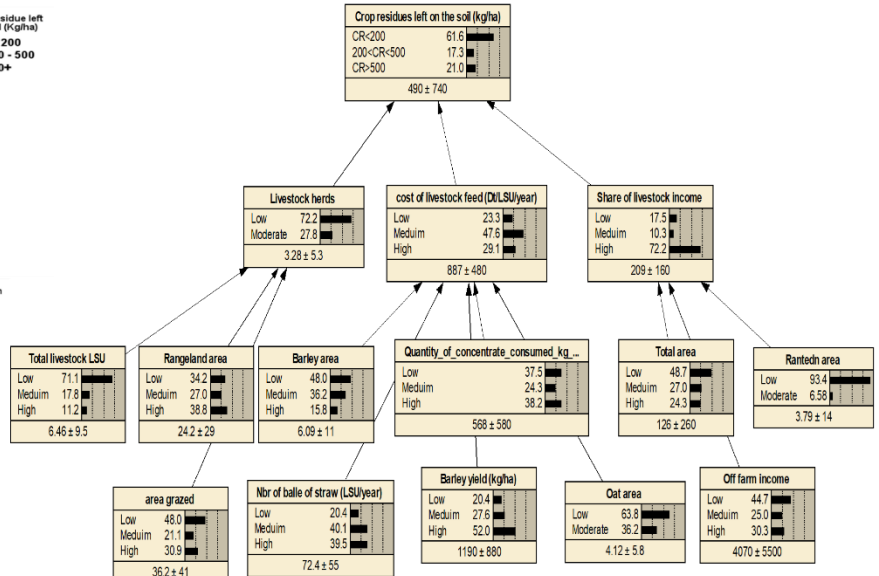
Assessment of trade-offs (2)

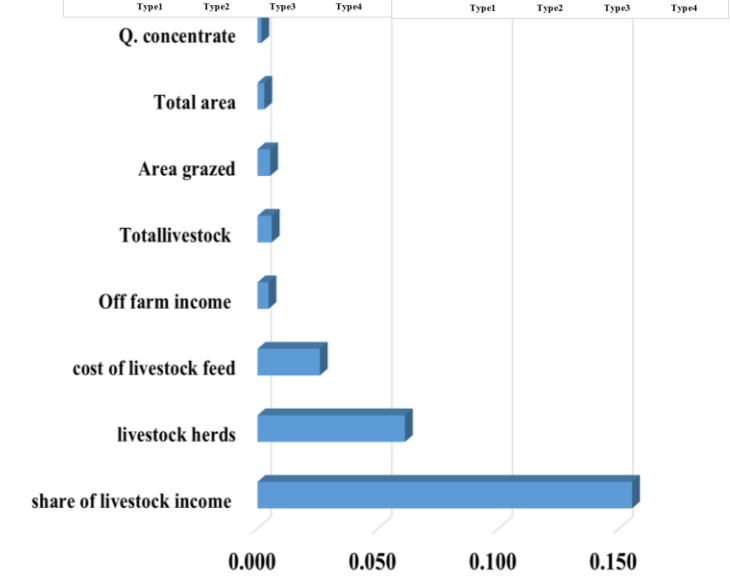
Results:

- 74% of farmers in our sample are keeping less than 200 kg/ha of crop residue as mulch.
- This is especially relevant for the smallest farms with limited grazing opportunities and financial capacities to complement their animals with concentrates feed
- The residue management is especially influenced by the share of livestock income, livestock herds, cost of livestock feed, barley area, and available grazi









Generation of suitability map for sustainable CA adoption

Step 1: Pre-selection of potential sites

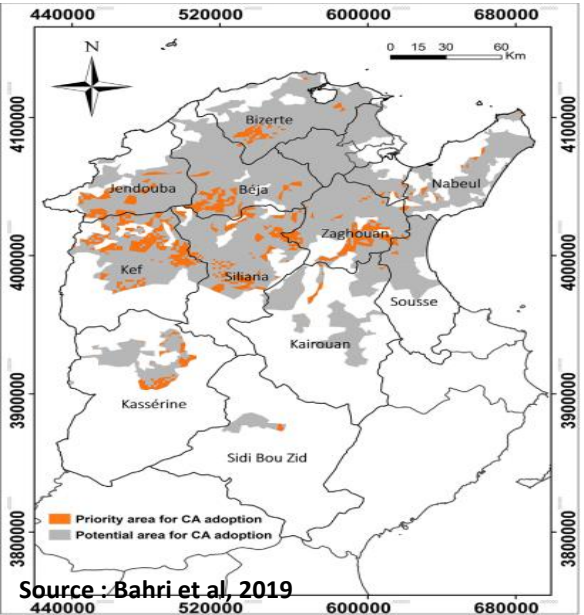
Step 2: Sustainability Composite Index (SCI)

- Economic indicators
- Social indicators
- Environmental indicators

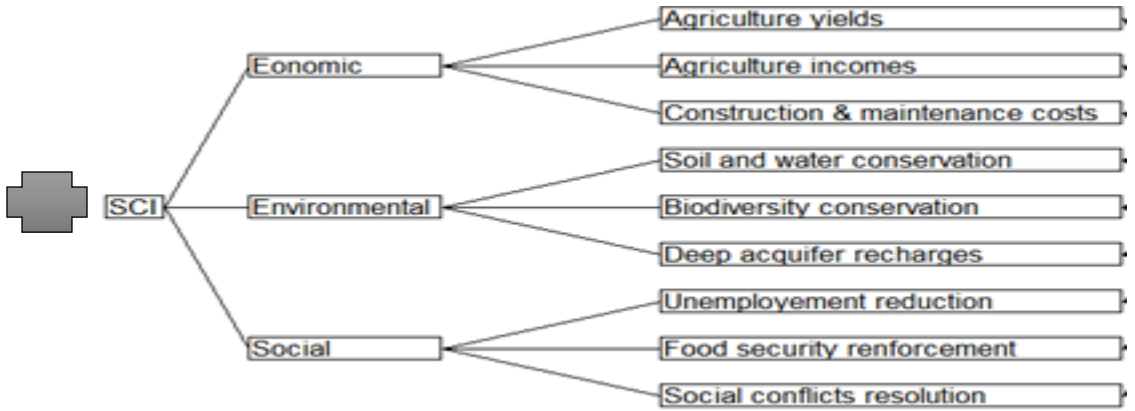
Step 3: Generation of the potential areas

- Land use
- Slope
- Stream network
- others

Step 4: Spatial integration of SCI and feasibility maps



Source : Bahri et al, 2019

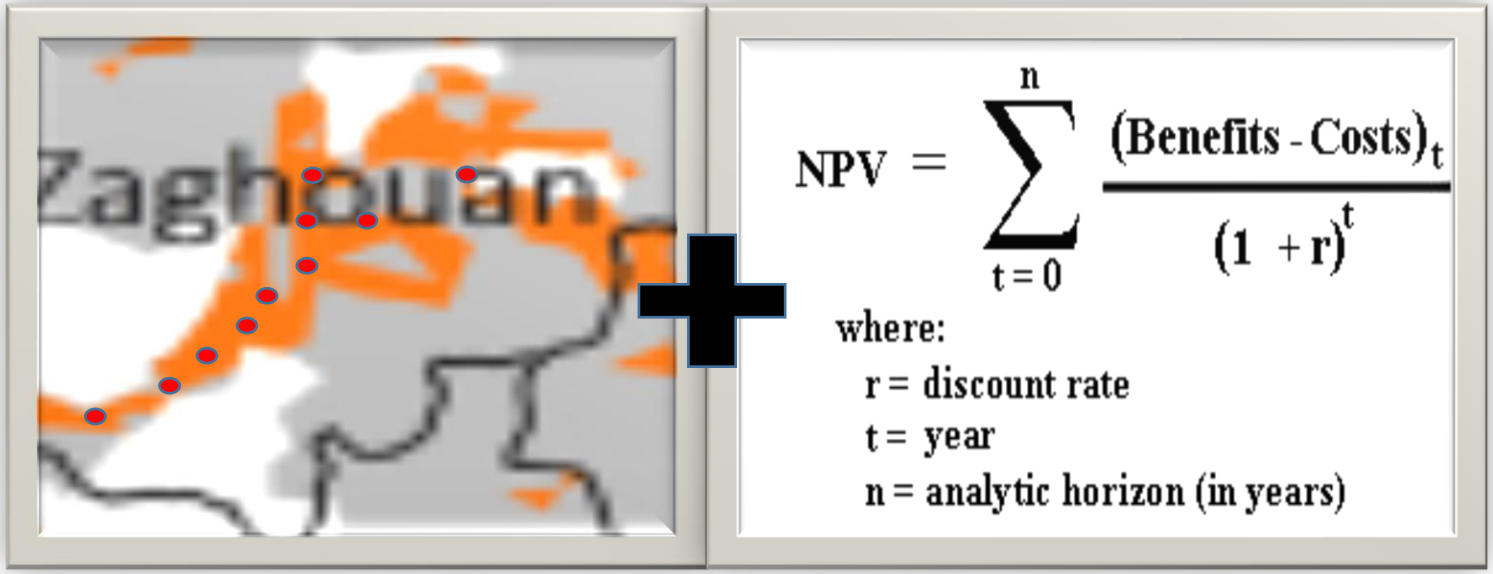


suitability map for sustainable CA adoption

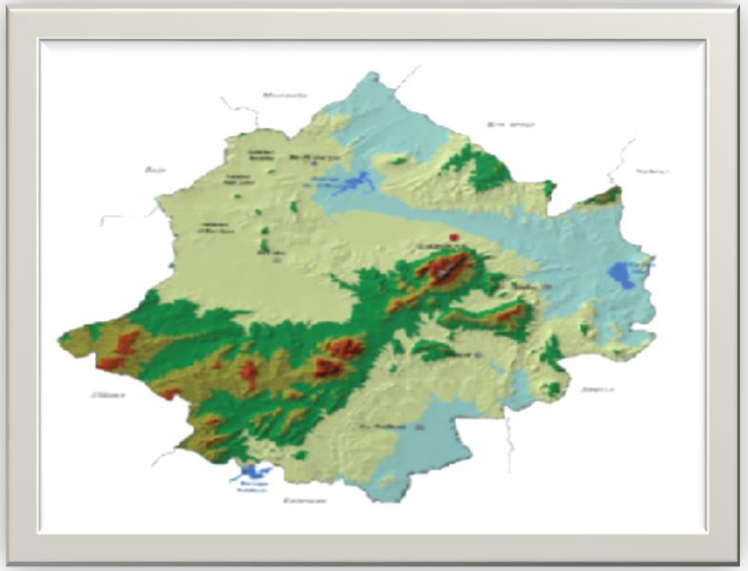
Extended spatial Cost Benefit Analysis

Potential suitable map for sustainable CA adoption
Net Present value of CA on different locations

Financial aspects (cost & benefit)
and environmental aspects (preventing water erosion and enhancing soil fertility)



EXTRAPOLATION (under condition, slops and markets proximity)



Preliminary results

	Financial CBA (12%)	Extended CBA (12%)
NPV/Ha	374 DNT	746 DNT
IRR	16.15%	20.40%

Farm area: 73 ha
Investment cost : Seeder,Tractor and land preparation

Thank you !