Ex ante evaluation of cropping systems for co-design with farmers

A case study of farmers involvement with the MASC model

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Outline

1- The MASC Model:

Assessment of sustainability at the level of cropping systems (CS)

2- Case Study:

Farmers participation in the use of the MASC model for co-designing a CS that reduces greenhouse gas emissions

3- Conclusion

Advantages, drawbacks and synthesis

The MASC Model: The Rationale

People in the field of agriculture are looking for innovative systems that address:

A growing number of challenges in agriculture

- Production of raw material
- Preservation of environnement
- ...

The pedo-climatic & socio-economic local context

- Soil fertility
- Local market opportunity
- ...

Different perceptions about the performances reached

- Consumer preferences
- Farmer preferences
- ...

A need of method to assess the sustainability able to handle:

- a wider range of knowledge *via* the use of **qualitative and quantitative information**
- a larger **diversity of context and of decision-makers**
- operational scales for farmers such as the **cropping system (CS) level**

Cropping System = crop sequence at the field scale + management of each crop

The MASC Model:

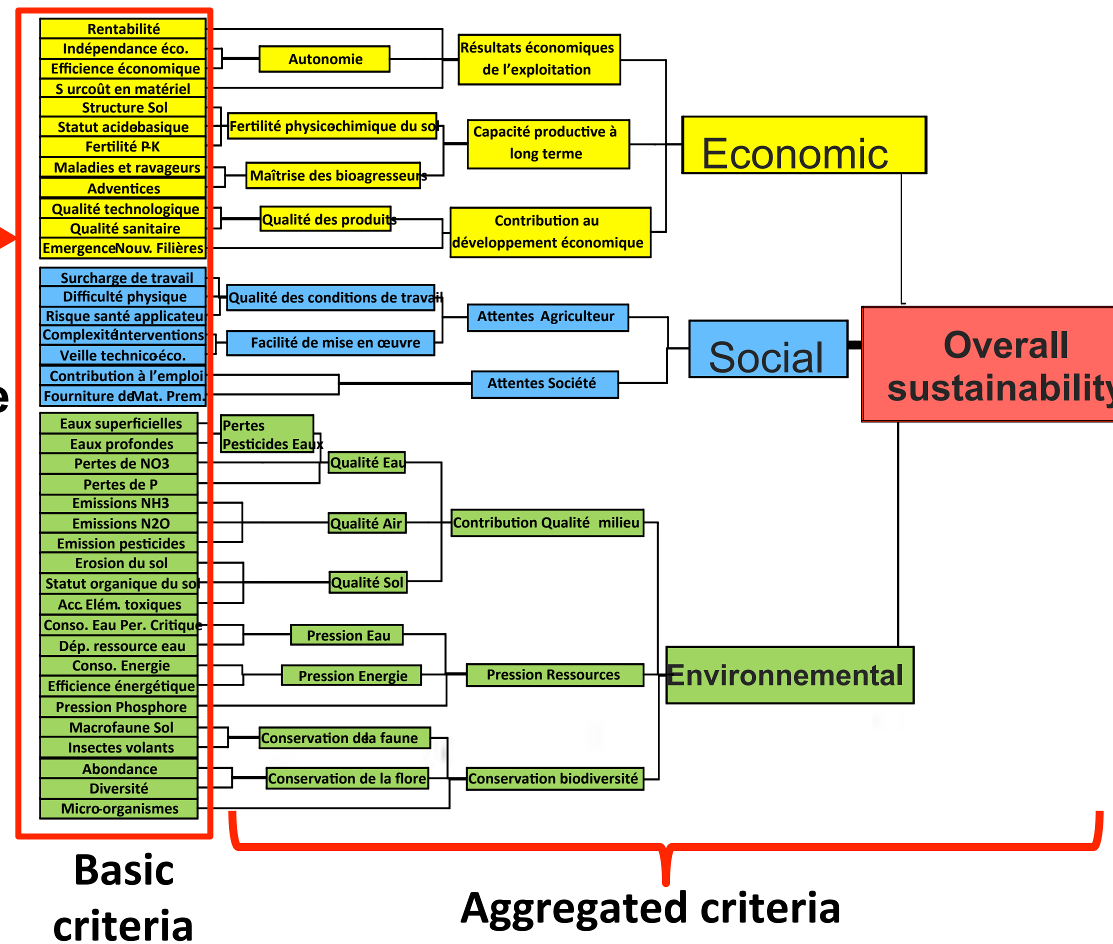
Multi-attribute Assessment of the Sustainability of Cropping Systems

- **Implemented with <u>DEXi DSS</u>**, (M. Bohanec - JSI, Slovenia).
- **MASC 1.0 published in 2009** (Sadok *et al.*)
- **Structuring & breaking down** the assessment problem of sustainability **into sub-problems**

❑**Each dimension is split up into a set of "basic criteria"**
(e.g.: profitability, NO3 losses)

❑**MASC decision tree all criteria are qualitative**
(e.g.: low, medium, high)

❑**MASC aggregates information towards overall sustainability**
(through Utility Functions)



The MASC Model: Principles of Utility Function

Utility functions permit aggregation of information through the decision model

Manual method:

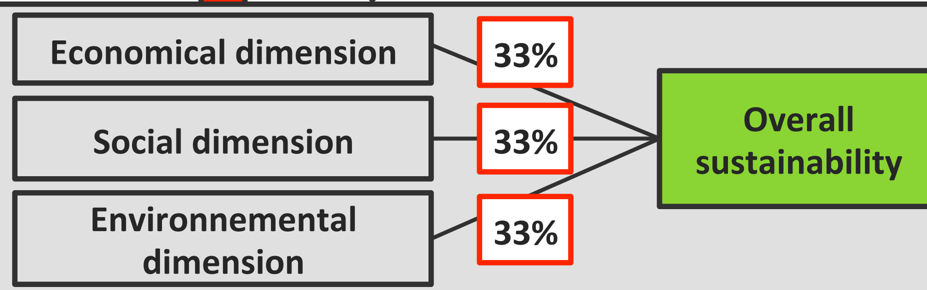
By according a value to upper-level criterion for each combination of the possible values of the lower-level criteria.

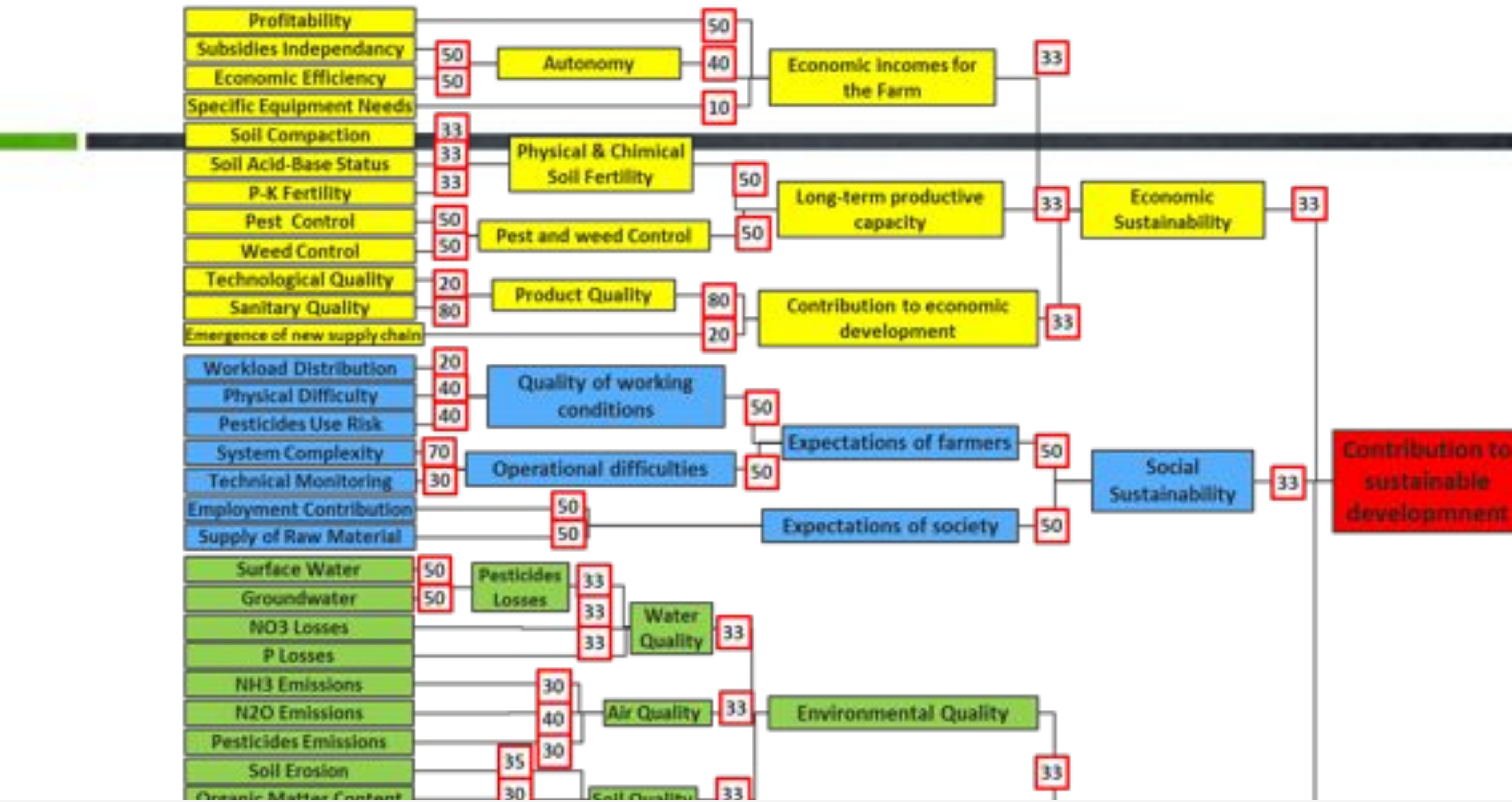
	Economical dimension	Social dimension	Environmental dimension	Overall sustainability
32	low	low	low	very low
33	low	low	medium	low
34	low	low	high	low
35	low	low	very high	rather low
36	low	medium	very low	very low
37	low	medium	low	low
38	low	medium	medium	rather low
39	low	medium	high	rather low
40	low	medium	very high	medium

Feedback performed by DEXi

Automatic method:

By according weights (%) for the lower-level criteria





Users can modify weights to introduce:

- Local issues
- Personnal perception of sustainability

%

The MASC Model:

Multi-attribute Assessment of the Sustainability of Cropping Systems

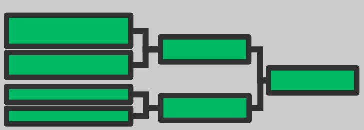
Three different indicators to fill in basic criteria

Indicators

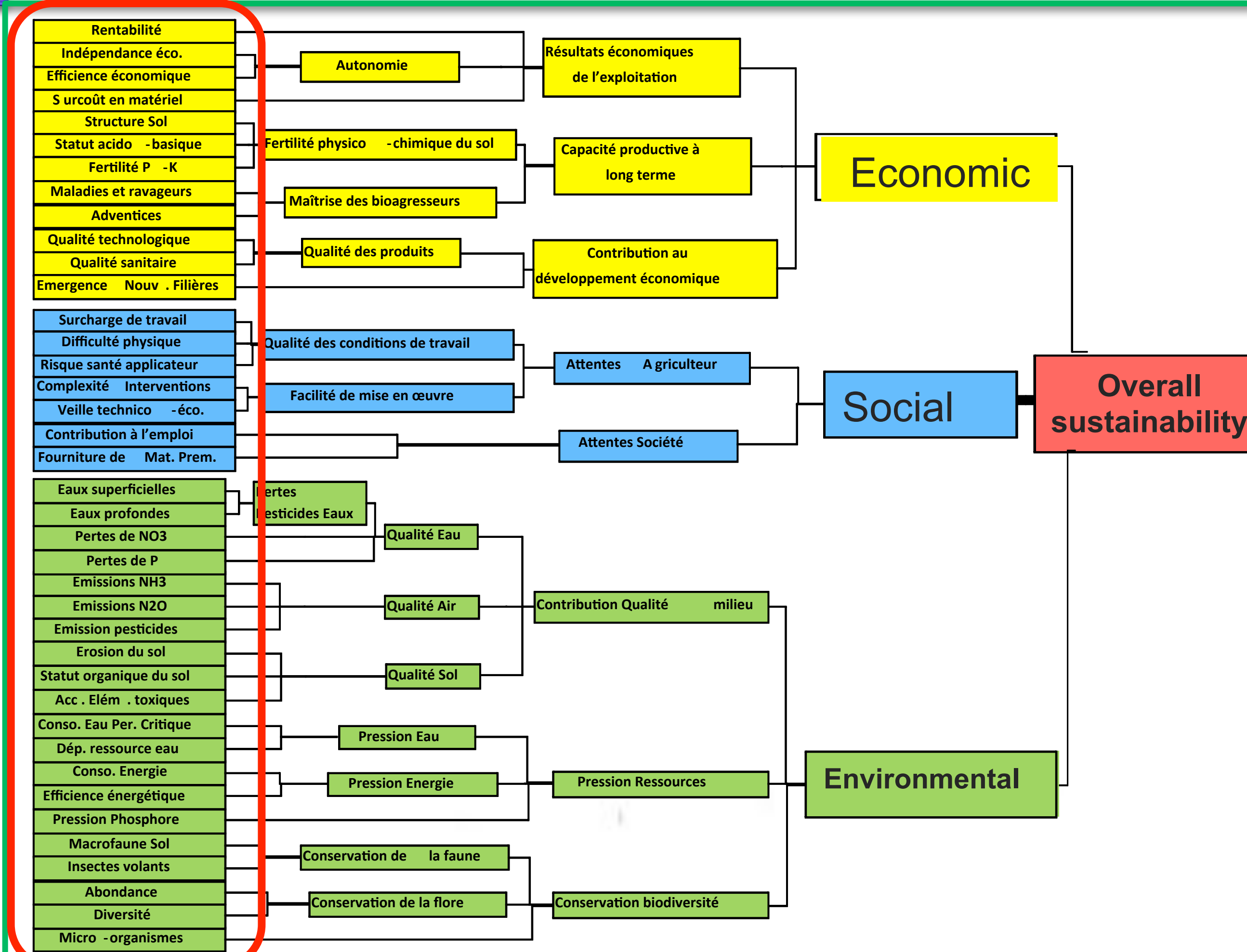
Calculation + threshold values
Gross Margin…

Qualitative expertise
low/medium/high

“Subtree”

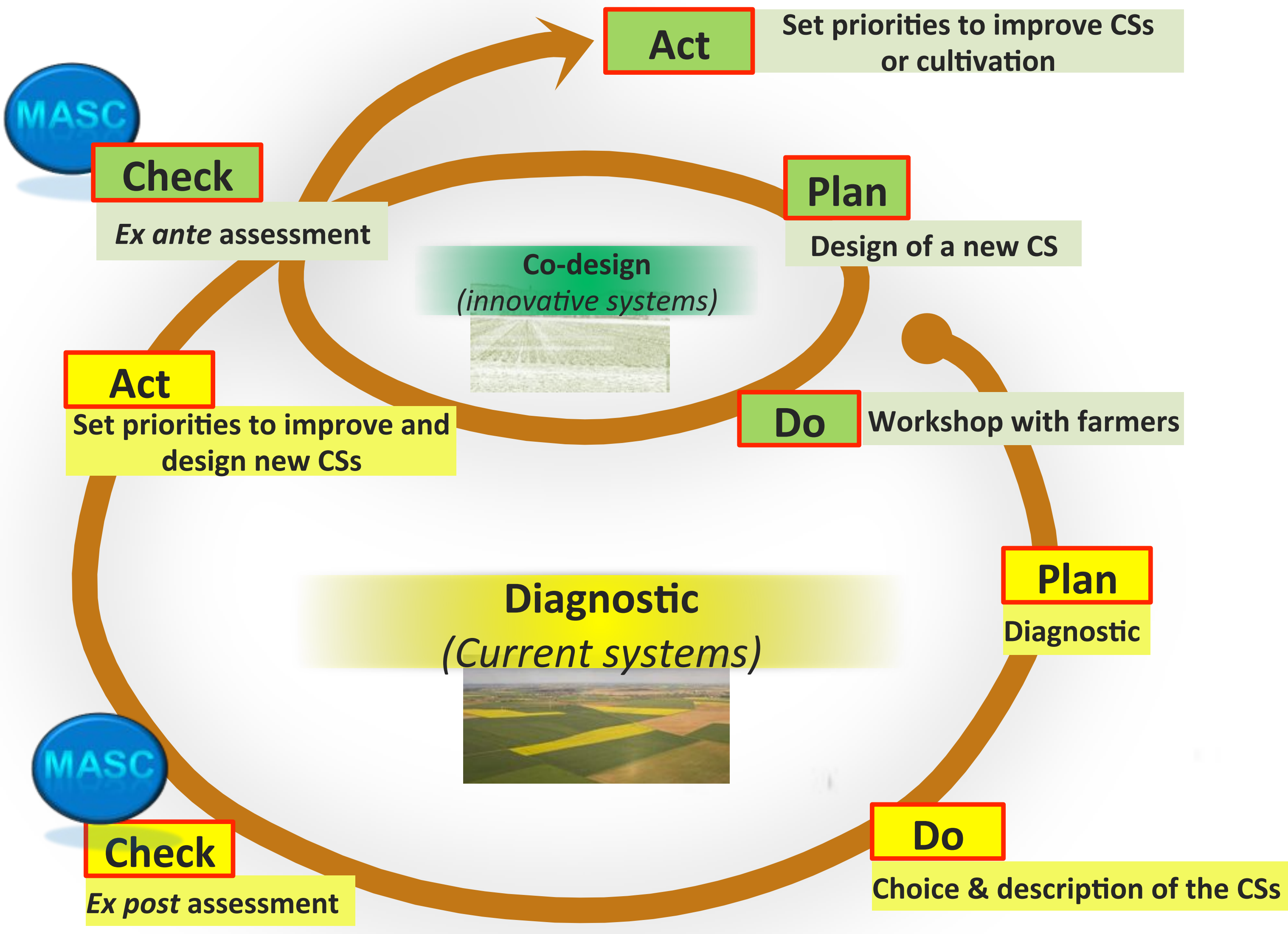


MASC tree



The MASC Model: use in a process of co-design of innovative systems

The Deming Wheel



PLAN: the SYSCLIM project

Project conducted in partnership with…

Public financing body	Agricultural research	Agricultural cooperative

Set of priorities

Design innovative CSs that

reduces greenhouse gas emissions

- By taking into account farmers expectations

- By taking into account the sustainability requirements

DO: Set priorities to improve CSs

Workshop to identify the farmers expectations

- **Should be done very early in the participative process**

(to keep them involved and interested)

- **Should be conducted with ice-breakers**

(i.e. effective process to make easier farmers participation)

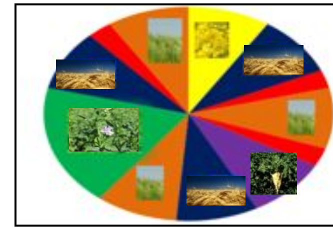
Main objectives assigned to CSs by farmers:

- **Enhance profitability**
- **Maintain soil fertility**
- **Reduce workload**
- **Reduce dependency on external inputs** (fertilizers, pesticides, oil)

Case study

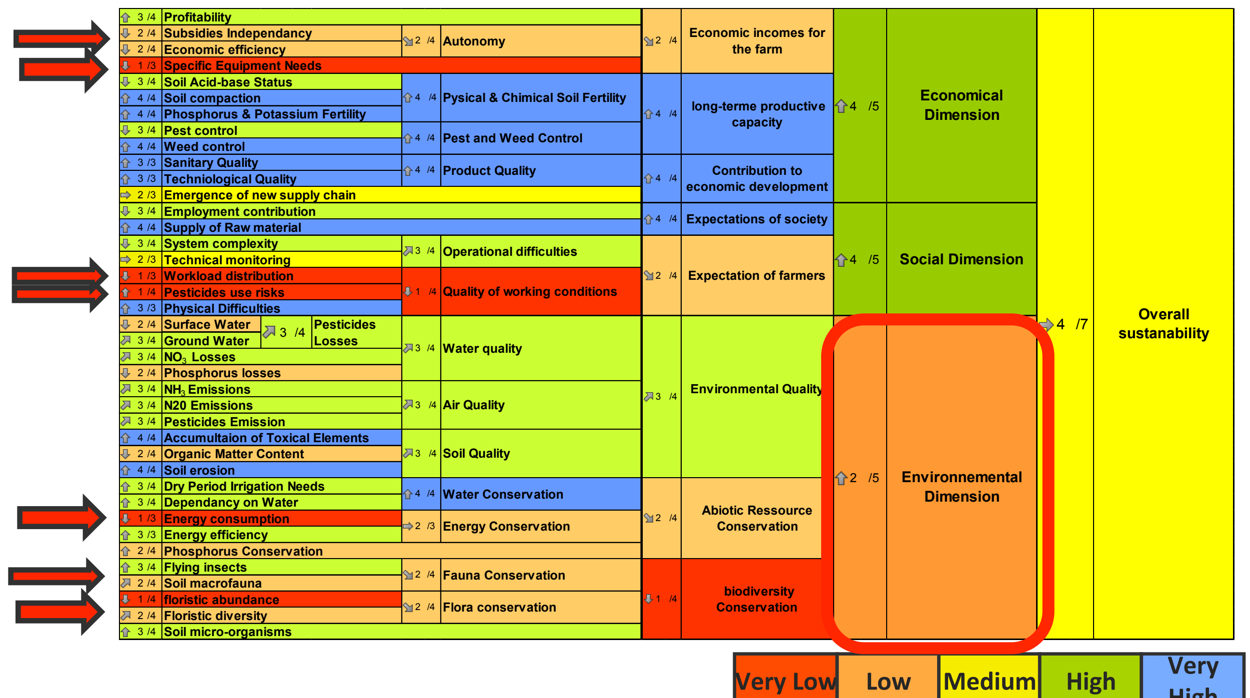
CHECK: Diagnostic to identify sustainability issues

Identify and describe a representative CS
with farmers & advidors



MASC

Strengths & weaknesses were analysed by small groups of farmers
(supervised by an organizer)



- **Farmers sought to pinpoint which of their agricultural practices have led to these results.**

Case study

PLAN: Set priorities to improve CSs

Collective analysis of the compatibility between issues

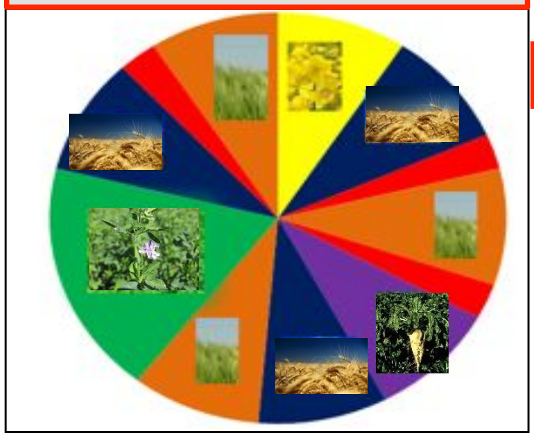
Reduce greenhouse gas emissions (Strategies)	Farmers expectations	Weaknesses identified (criteria of MASC)
Reduce the use of mineral N	Reduce dependency on external inputs	Economic efficiency
Reduce fuel consumption *(i.e. reducing soil tillage)*	Reduce the working time	Woarkload distribution Pressure on fossil energy
Increase soil carbon storage	Maintain soil fertility	Soil Macrofauna conservation

- ❑ **Important step to get the farmers involved and to guide the design**

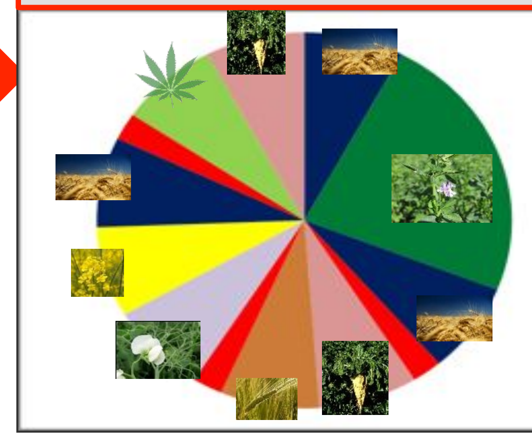
DO: Co-design a new cropping system

Workshop to co-design in a participative process

Current CSs



Newly co-designed CSs

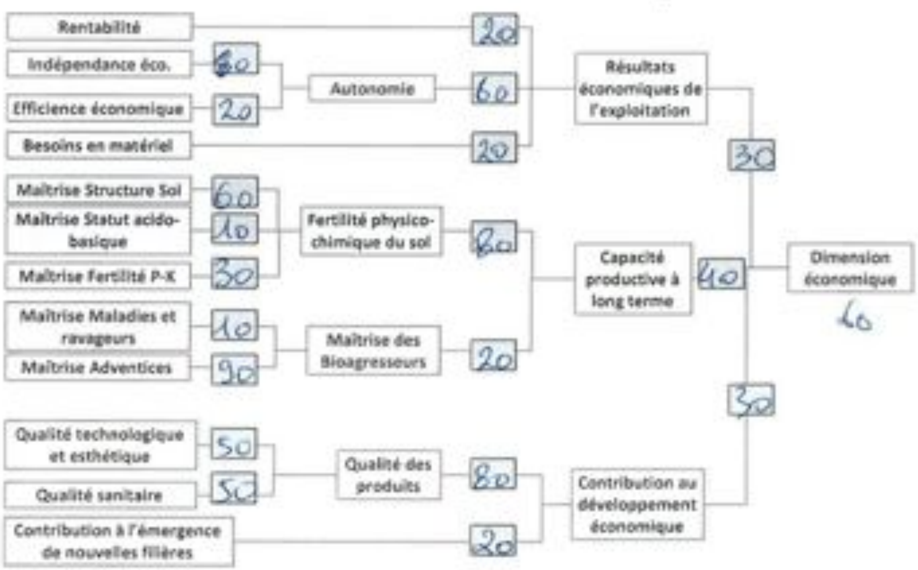


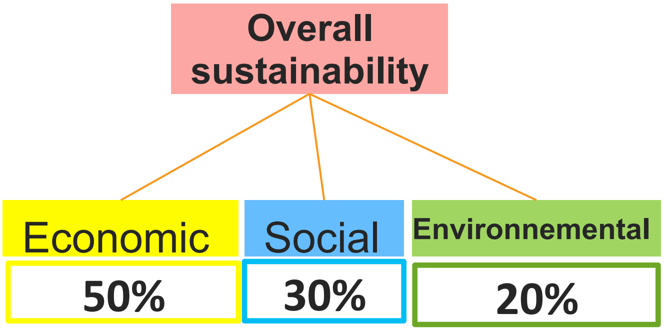
Strategies proposed by farmers

- Increase the proportion of legume crops
- Reduce the nitrogen mineral fertilizer,
- Increase the use of organic matter
- Reduce the frequency of plowing
- …

CHECK: Co-design a new cropping system

Introduce farmers vision of sustainability into parameter settings

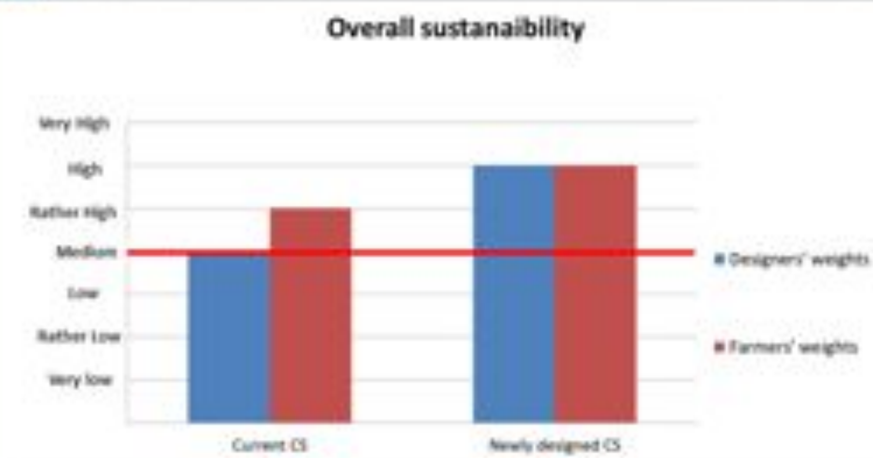




- Farmers expressed their concerns individually or collectivelly

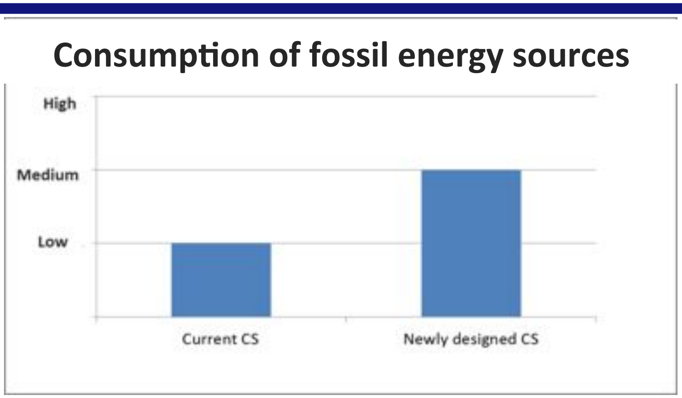
Case study

CHECK: Collective interpretation of results

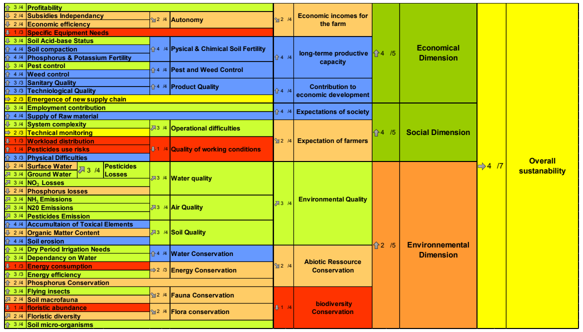


… According to their overall performance

- With designer’s weights
- With the farmers’ weights



… According to specific goals

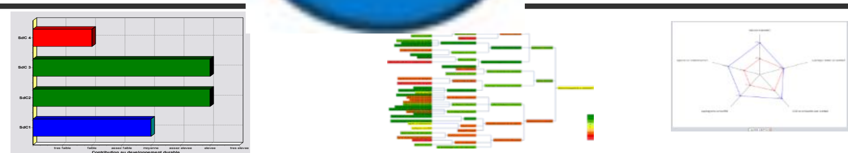


…according to their strengths and weaknesses

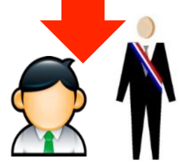
ACT: Communication & dissemination of results

Current CS

Co-designed Cs



Communication & dissemination of results



…to stakeholders of the profession

…to public decision makers

…by implementation in the field

Conclusion & perspectives

Advantages & Drawbacks of this approach to involve farmers

Advantages	Drawbacks
▪ Targets **an operational scale** for farmers	▪ **Calculation of basic criteria remains a bit laborious**
▪ **Does not focus solely on environment** (+ social & economical impacts)	▪ **A lot of basic criteria which means dedicating time to become familiar with the means of evaluation**
▪ Includes **farmers perception by modifying the** parameter settings	▪ **2 or 3 meeting at least with farmers are necessary to conduct the whole process**
❑ **Considers both preferences & issues farmers deal with**	❑ **Necessary to remember that assessing sustainability takes time**

Conclusion & perspective

Synthesis

Involving farmers in the assessment of sustainability is promising…

- **Useful support for <u>sharing knowledge</u> between researchers, advisors and farmers**

- **Farmers <u>expressed their concerns</u> which <u>could guide the action of advisors</u>**
(e.g., pesticides toxicity, workload distribution and soil erosion)

- **Farmers <u>proposed some realistic improvements of their CSs</u>**

Thank you for your attention

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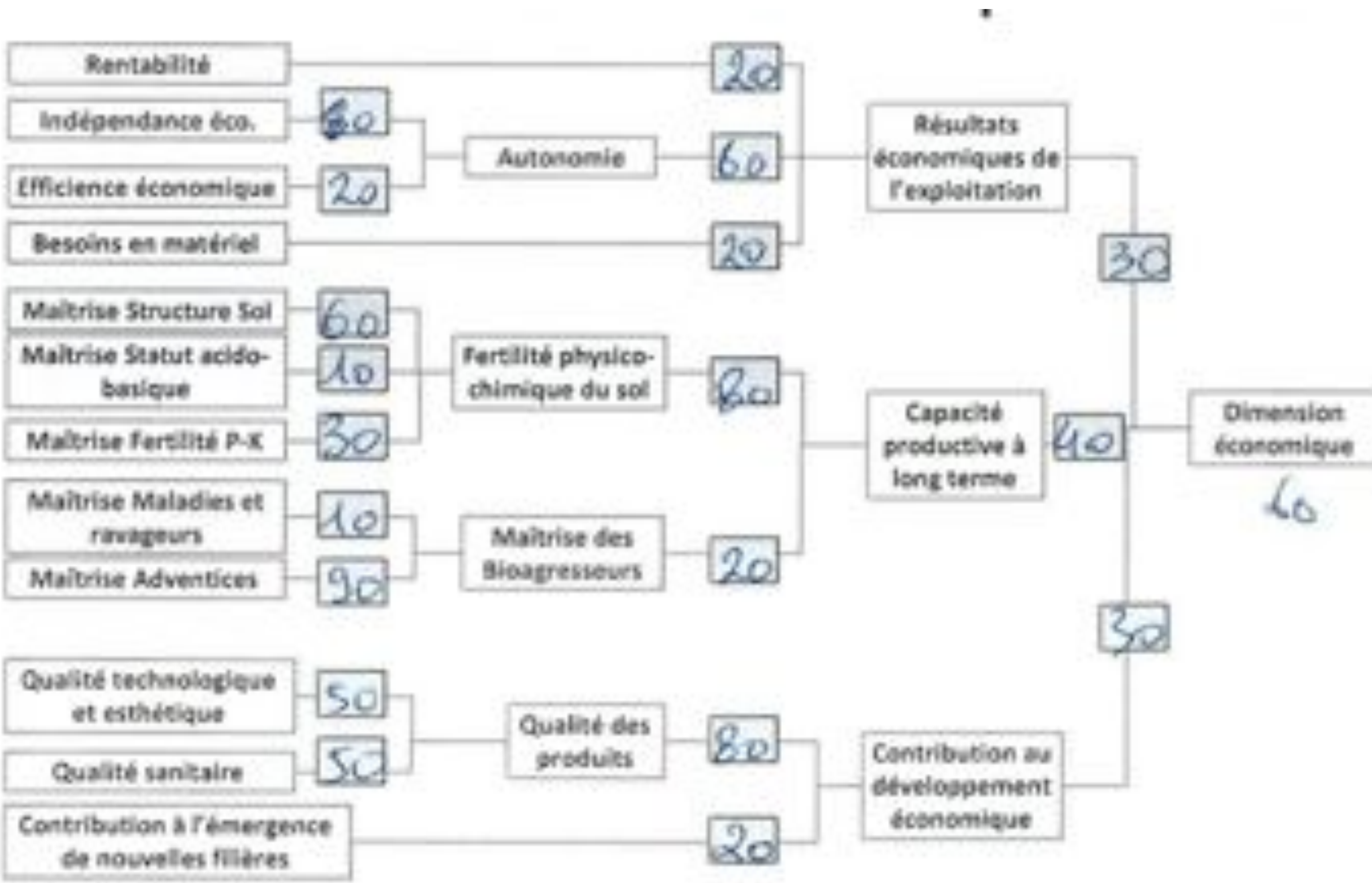
To download the MASC model

https://www5.versailles-grignon.inra.fr/agronomie/Productions/logiciels_et_modeles/MASC/Modele-MASC

Act : **Set priorities to improve CSs**

- Modifying weights (collectively or individually)



Results

Global analysis of the performances of the CS by simulation of different sets of weights

Collective interpretation of results

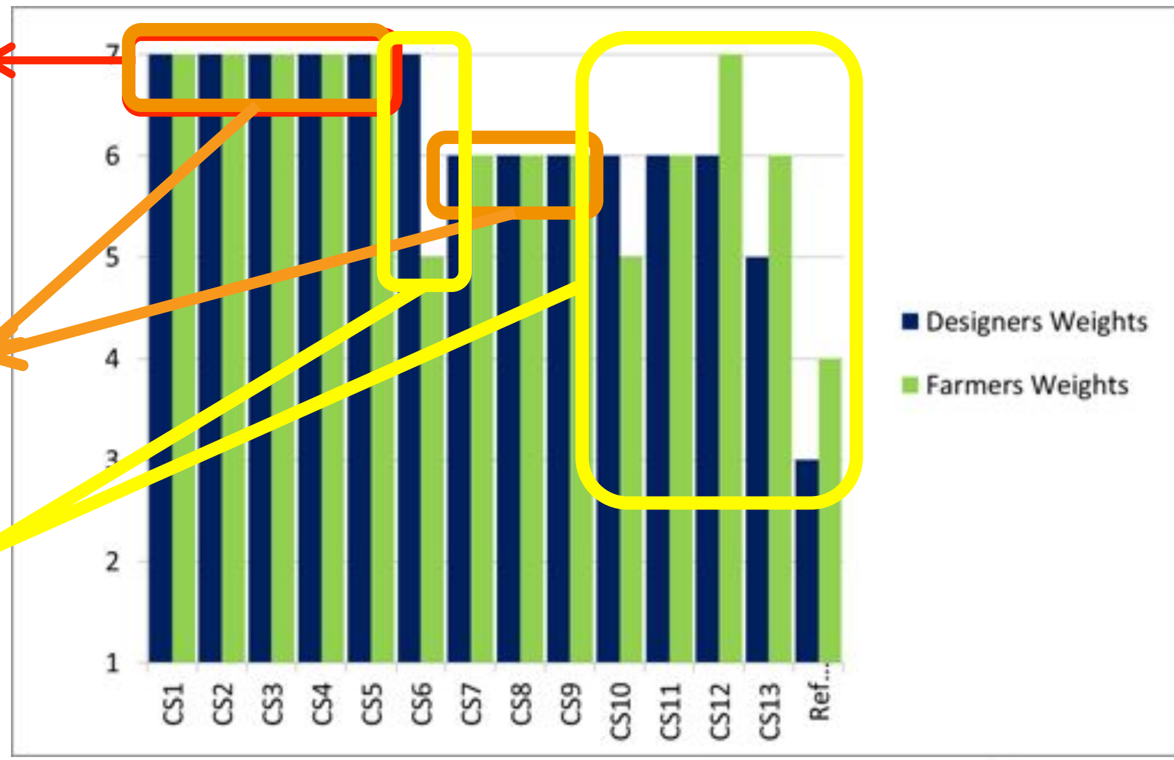
Caracteristic of the best CSs :

- Long/diversified rotations
- Grassland
- Green manure crops

Robustness against weights

Differences explain by weights given to economic and agronomic criteria

Results of the overall sustainability



Propríté attendue du modèle

- Fexibility

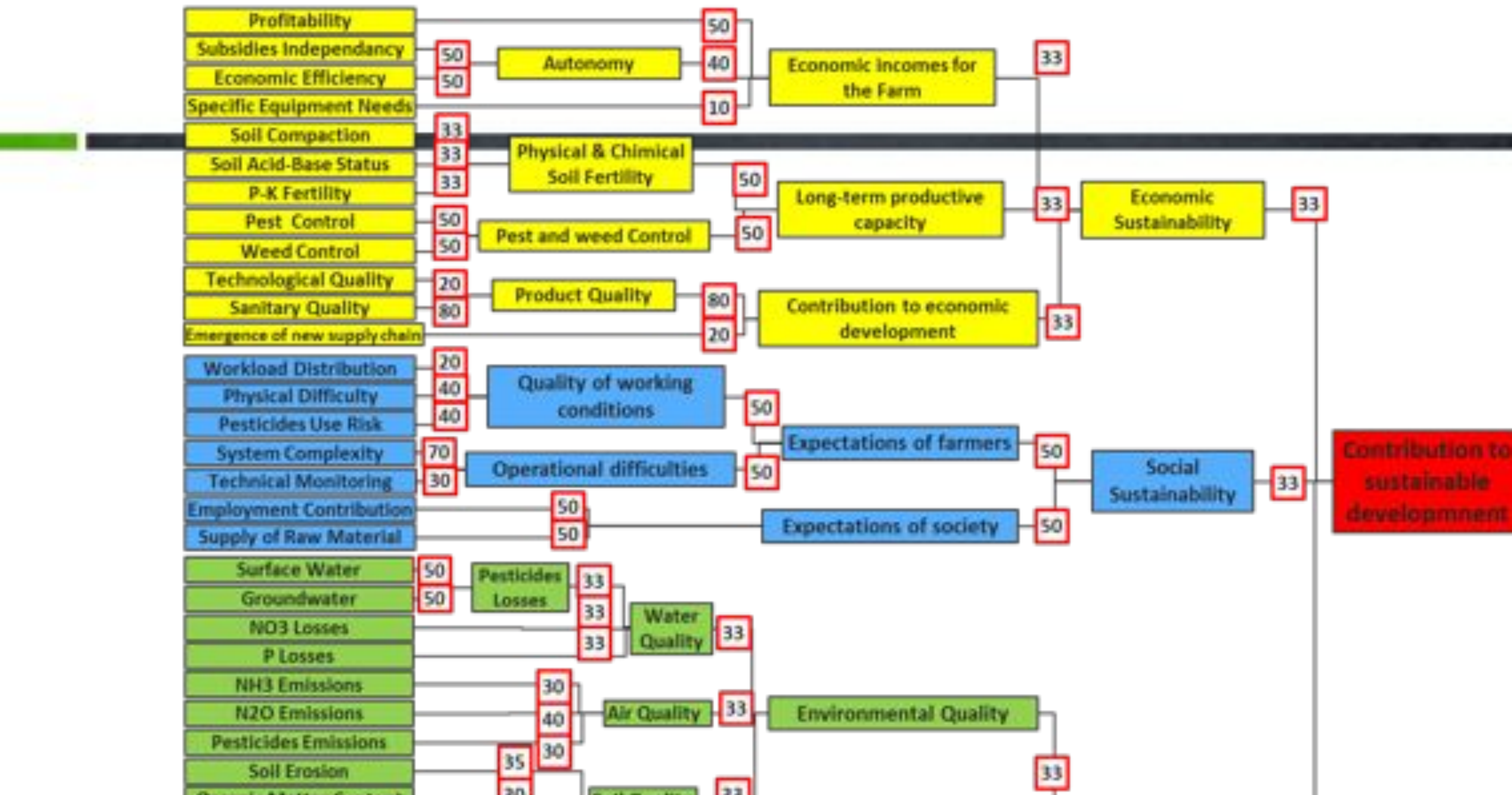
- pour considéré des préférences
- Des différences de contexte pédoclimatique
- Une utilisation en ex post et en ex ante

Transparence

- pour faciliter compréhension et l'interprétation
- Eviter les effet boite noir qui diminue la confiance des utilisateurs

Viser un échelle et un objectif pratique

- Targets an operational scale for farmers
- Mettre les performances économiques avec les performances sociales.



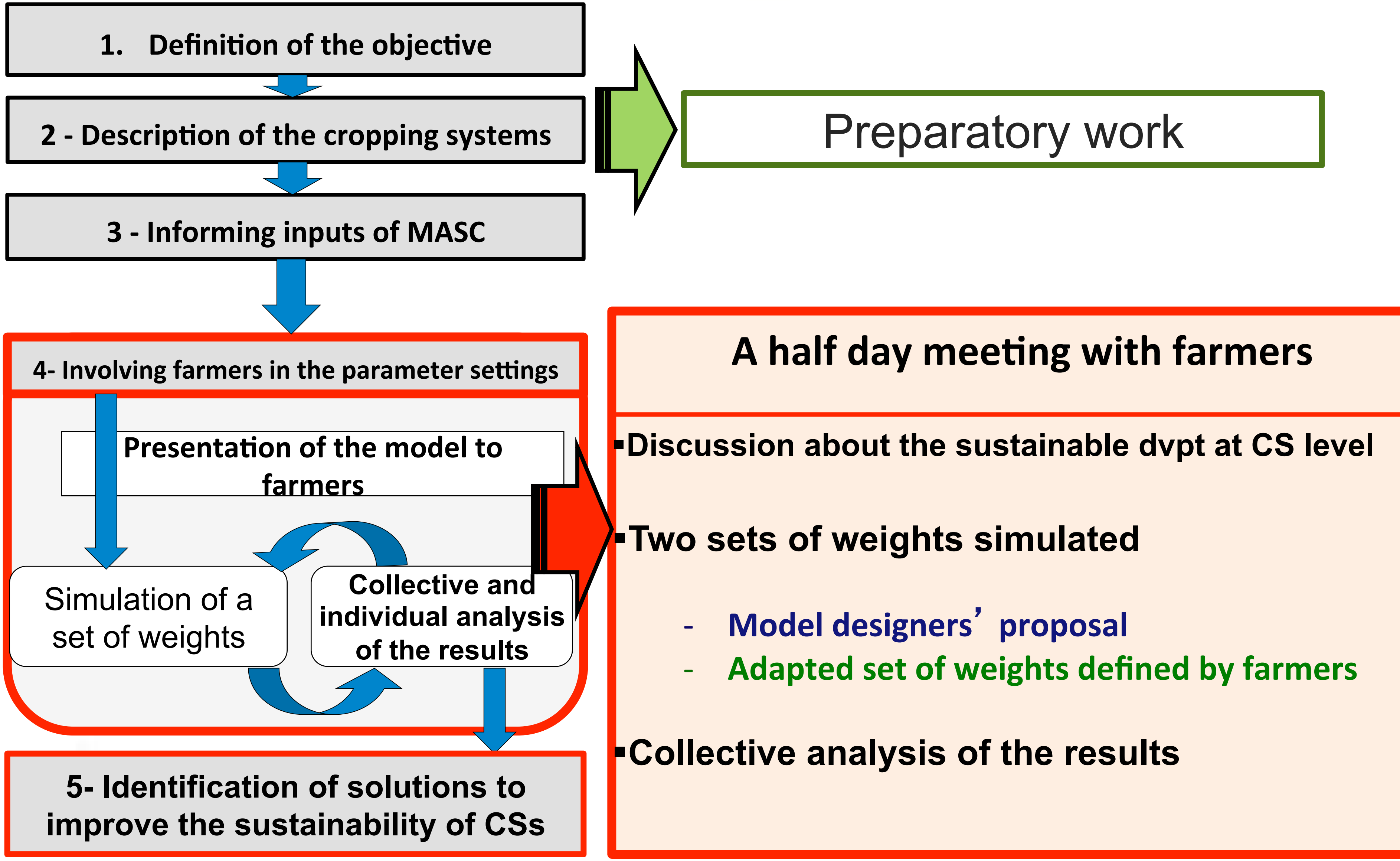
Users can modify weights to introduce:

- Local issues
- Personnal perception of sustainability

%

Results:

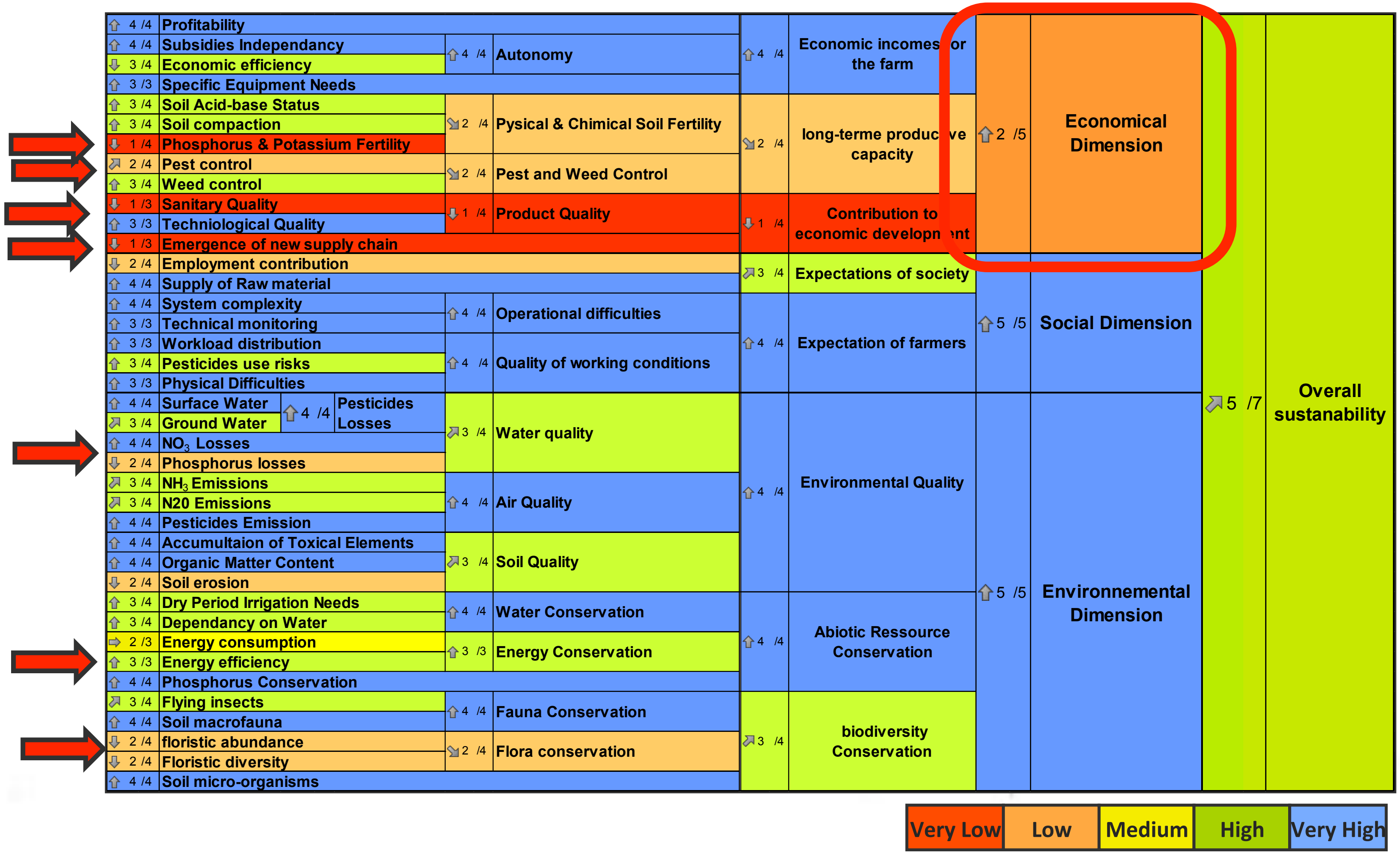
A methodological approach in 5 steps



Results

Analysis of the Individual cropping systems under assessment

- **Strengths & weaknesses were analysed by small groups of farmers** (supervised by an organizer)



- **Farmers seeking to pinpoint which of their agricultural practices have led to these results.**

A case study of farmer involvement thanks to the MASC model

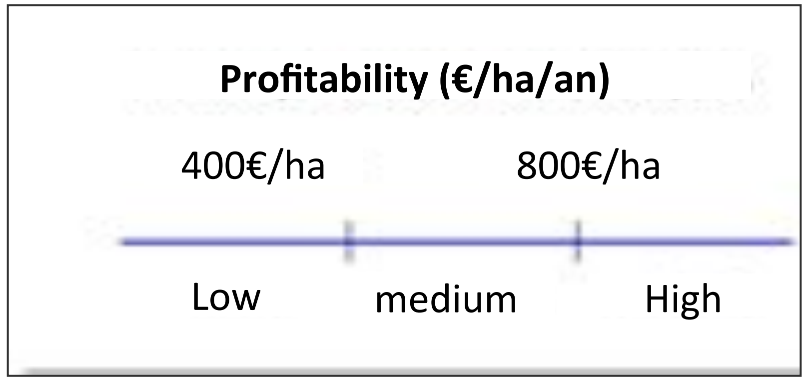
Involving farmers in the assessment of sustainability is promising…

- **Sharing knowledge**
- **Expressing concerns to help draw up advisor guidelines**
- **Giving rise to realistic improvements of CSs**

Only for calculated Data…

- ❑ **Conversion into qualitative data is necessary:**
  (compatibility with the DEXi Software)

- ➢ **Using threshold value**
  Example→



Threshold-values are proposed by designers and could be adapted:

- ❑ To express **personal preference** on the calculated value
- ❑ To adapt assessment to the **socio-economic and pedo-climatic context**
- ❑ To **discriminate the assessed cropping systems** on their performances