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Uncertainty Assessment in Multi-Criteria Sustainability Assessments

The Case of the SMART-Farm Tool

Research Questions

How can indicator weights for multi-criteria sustainability assessments be determined based on experts' opinions? How do different opinions affect the results of sustainability assessments?

Factor 1: Indicator weightings

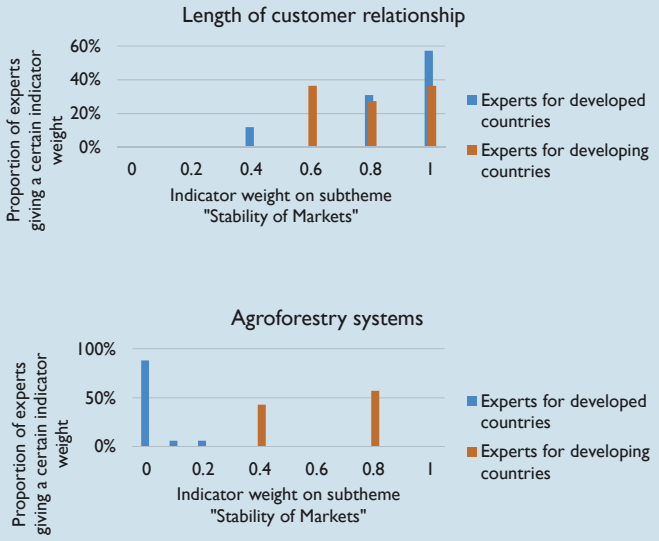


Figure 1: Examples of weights specified by experts for two (of 22) indicators that contribute to the SAFA subtheme: "Stability of Markets"

Indicator weighting:
0 - indicator is irrelevant
1 - indicator is the critical indicator for determining the degree of goal achievement of SAFA subtheme

Factor 2: Indicator ratings

Table 1: SMART-Farm Tool indicator ratings within "Stability of Markets" SAFA subtheme for four example farms in developed and developing countries

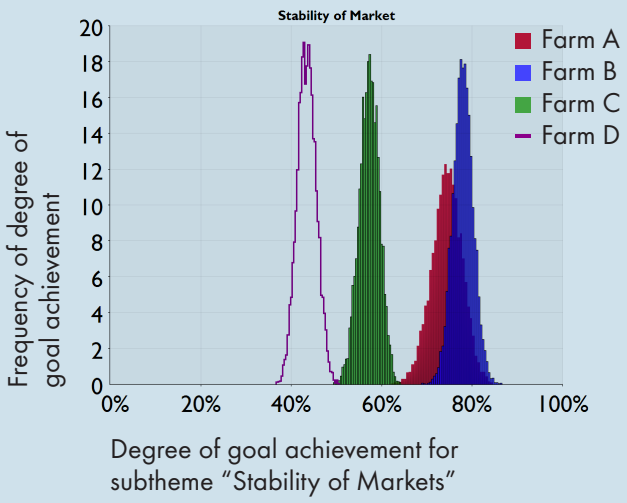
	Farm A	Farm B	Farm C	Farm D
Length of customer relationship	25%	100%	0%	0%
Agroforestry systems	10%	20%	100%	50%
Rare or endangered agricultural crops	100%	n/a*	100%	0%
Access to advisory services	100%	100%	0%	0%
… (in total 22 indicators in subtheme)	x%	x%	x%	x%

** No cropping on farm B, indicator was excluded*

Monte Carlo Simulation

Result: Subtheme score

Figure 2: Exemplary distribution of subtheme scores which are calculated based on the farms' indicator ratings (Table 1) and the differing indicator weights resulting from the NGT process (Figure 1) after Monte Carlo Simulation



SMART-Farm Tool

A globally applicable and comparable method for analysing farms of different types

- Based on SAFA Guidelines (FAO, 2014)
- Set of 327 indicators to assess the degree of goal achievement of 58 SAFA sustainability subthemes

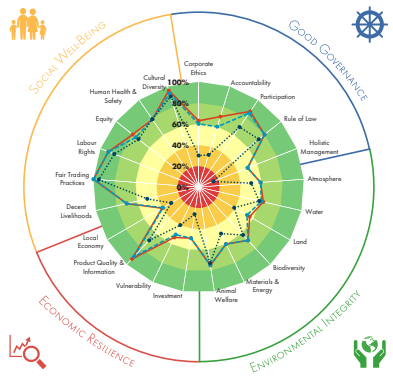


Figure 3: Illustrative results of SMART-Farm Tool sustainability assessments of SAFA Subthemes

- Each indicator can impact one or more SAFA subthemes (in total more than 1700 linkages between SAFA subthemes and SMART-Farm Tool indicators)
- The importance of an indicator in different SAFA subtheme might be stronger or weaker, thus for each subtheme different weights were defined to specify its impact
- These weights were defined by >60 international experts in developed and developing countries in temperate and tropical environments; following a 3-step nominal group technique (NGT) approach (Figure 4)

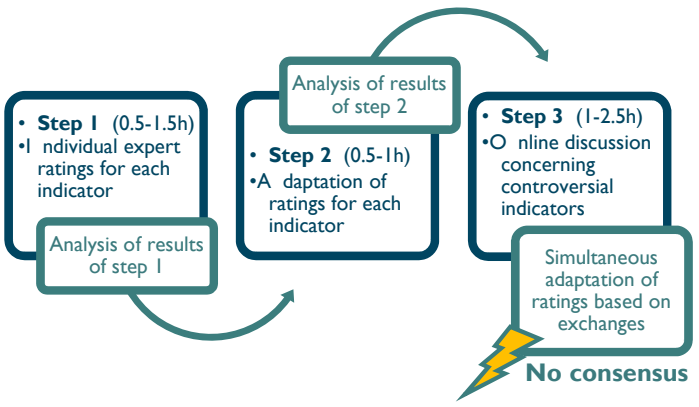


Figure 4: Overview of steps of the NGT

Conclusion

- Consideration of uncertainty is important for interpreting results from multi-criteria sustainability assessments for decision making
- The approach used for this study can be adapted to other tools
- More time and interaction needed to discuss single indicators
- Formation of an expert panel planned to improve weightings

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