Multicriteria Assessment of the Effects of Tillage Practices on Cropping Systems: Development of the Decision Support Tool DEXiSol

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Introduction

Tillage operations have numerous effects on cropping systems (direct or indirect ones – via modifications of soil structure). Labreuche et al. (2014) defined tillage strategies (succession of tillage operations) and summarized their potential effects on the cropping systems, depending on some elements of context, like crop succession and pedo-climatic conditions. Assessing holistically performances of tillage strategies implies the characterisation of cropping systems with many indicators of various natures (economic, environmental, social...) and taking into account the agro-pedo-climatic context. The DEXi method, which manage this type of aggregation for decision-making was therefore used (Bohanec et al., 2015) to develop the DEXiSol tool for the multicriteria assessment of tillage practices on cropping systems.

Material and Method

The development of such a tool requires i) decomposition of the complex problem into sub-problems easier to solve; ii) definition of characterization criteria that can be filled in different ways and iii) definition of ponderations to aggregate these criteria in a decision tree. Some of the criteria were selected from MASC 2.0, a model of sustainability assessment also based on DEXi (Craheix et al., 2012). Indicators informing the characterization criteria were chosen to describe the tillage effects and are mainly based on cultural practices or quantitative (hence need to be discretised). They were defined by a literature analysis or from interviews of 25 experts. The first version of DEXiSol was tested on the long-term tillage trial of Boigneville (**3 tillage strategies**: ploughing; shallow tillage; direct drilling and **3 crop successions**: winter wheat; w. wheat - maize; sugar beet - w. wheat - spring pea - s. barley).

Results and Discussion

The DEXiSol structure is presented in figure 1. A guide is provided for each criteria that users should fill (italic). Underlined criteria (fig 1) integrate pedo-climatic context in their definition or in the ponderations used for their aggregation (for example, *soil erosion limitation* is more important for soil physical fertility in some French regions). Synoptic tables are used to compare easily tillage strategies for all the identified indicators (examples are provided in Craheix et al., 2012). The overall performance in the Boigneville trial mainly depends on crop succession (a higher performance for a longer crop succession). For each succession, tillage systems have the same overall performance, but differences appear between them deeper in the tree, on basic indicators or less aggregated indicators (such as *preservation of soil quality*).

Conclusion

DEXiSol assembles in an holistic way recent knowledge on tillage practices effects on cropping systems and presents assessment results in a synthetic way (all characterization criteria in one synoptic table). Therefore, it could become a decision support tool to improve or select a tillage strategy. Complementary work is needed to continue model evaluation and perform sensitivity analysis. The model should also be evaluated in other contexts (e.g crop successions with rapeseed and winter cereals, sown mainly with reduced tillage in France).

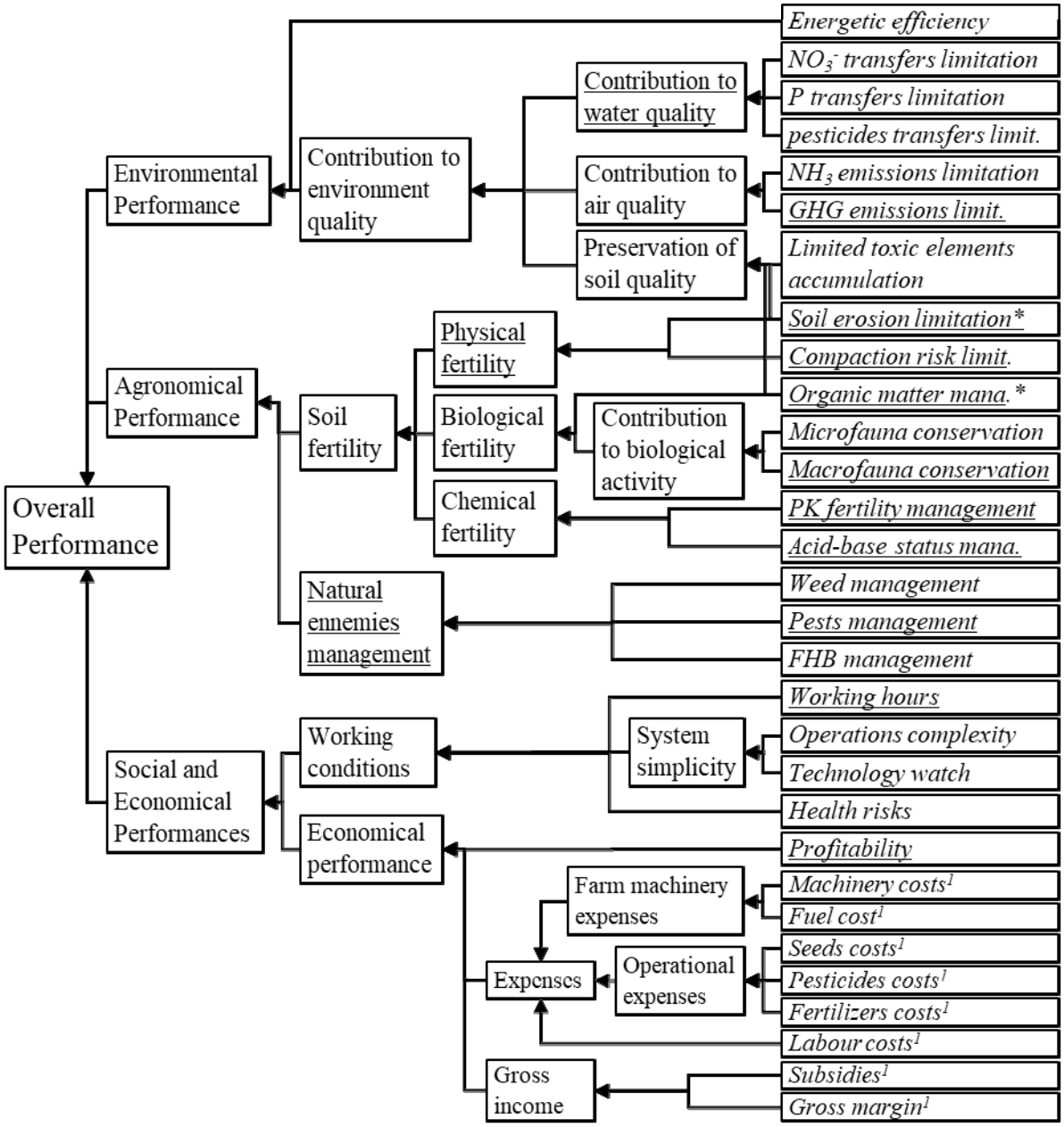

Figure 1: **DEXiSol structure**. User should fill every criterion in italic. A user's manual is provided for each of these criteria. User can adapt the evaluation to pedoclimatic context with underlined criteria (basic criteria are function of soil parameters, and ponderation of aggregated criteria can be modified to describe the context). [1]These criteria are used to describe farm economics but with a nil contribution to economical performances (if Profitability is known). *Criteria used to describe soil fertility and soil preservation. GHG: greenhouse gases. FHB: fusarium head blight.

References

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