Can models be useful for deciding to convert to organic fruit growing ? An introduction to the discussion

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Abstract

Modern high-input agriculture has produced great increases in crop yields but social and environmental costs have also been high. Over the past decades, sustainability has become more and more a guiding principle in agriculture. In this context, organic farming became recognised by farmers, policymakers and consumers as one of the possibilities for the farmer in a more sustainable way (De Cock L., 2005).

Keywords: decision tool, conversion, fruit growing, multi-attributes

Introduction

Multi-attribute decision models (MADM) are useful tools in the scientific and professional context, for they can help end-users (farmers among a wide variety of users) in taking decisions for complex problems or situations, without working under quantitative and long-term basis. Literature attests that a variety of agricultural problems can be solved with computer modelling, especially in case of perennial crops such as fruit trees, with long-term management practices (Pacek *et al.*, 2005). Alvisi *et al.* (1992) developed MULTIFRU for decision making in orchard management.

Various models have been developed for MADM applications (Electre, Hiview, Prime..., Belton & Stewart, 2002), but it seems that DEX-i has been more commonly used for agricultural purpose. The main characteristic of the DEX method is its capability to deal with qualitative variables.

Marko Bohanec for Institute of Mathematics of Maribor has been the conceiver of DEX-i (formerly DEX, as for 'Decision EXpert') whereas Crtomir Rozman is one of the agri-economists that developed agricultural applications, especially in organic farming.

Literature compiled on decision tools for helping fruit growers to convert to organic farming drove me to a significant number of papers giving theory and sociology aspects of transition to organic (Acs *et al.*, 2006), but Rozman's papers gave means to elaborate a qualitative tool with hierarchization of various determinants, from technical to social including economical.

We aim to gain know-how in use of DEX-i programmation and understanding its construction by starting from a simple question : "*is my orchard suited for organic farming ?*". MADM will help achieving a cost-benefit analysis (CBA) under various scenarios.

The model should in a second step be validated through field assessments and interviews of growers that already experienced transition to organic, in order to compare the model results with the real situation of orchards.

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Indeed, we may consider many failures of transition to organic farming because
- orchard was not adapted,
- grower was not motivated enough,
- financial situation did not permit sustainable management
- ...

Also, many fruit growers may refuse to take the risk to go organic although their situation would deserve it.

Theoretical papers and models established 5 types of farmers in respect to their behaviour face to organic farming :
- the committed conventional
- the pragmatic conventional
- the environment-conscious but not organic
- the pragmatic organic
- the committed organic   (Darnhofer *et al.*, 2005)

Growers suffer (in France at least) from a lack of technical support, because of its cost. Asking advisors about the relevance of transition requires a considerable effort and time to assess the CBA of transitioning.

Our proposition is not to give an exact estimation of "what if", but to give headlines and indications of major factors of risks and bottlenecks if there are. Those indications may help the grower to improve the plot situation, before considering again the transition and running the model. We may not be able to be more accurate in the answers to be brought to the end-user. The aim of the tool is as far as possible to avoid failures and possible discredit of organic farming. Official transition should indeed be anticipated and prepared with a field but also a "moral" part.

A complementary answer to the end-user is the AHP (*Analytical Hierarchical Process*) method, which gives quantitative evaluation of different scenarios. Pacek and Rozman also used AHP (Expert Choice$^{©}$ program) in evaluation of Slovenian organic farms (2005, 2006) and concluded on the complementary contributions of DEX-i and AHP.

Material and Methods

The basic approach of the DEX methodology is a multi-objective decomposition of the problem : the decision problem is decomposed into smaller and less complex decision problems (sub-problems). In this way, a decision model is obtained consisting of attributes which represent individual sub-problems. The attributes are then organised hierarchically, and connected to the utility functions. These utility functions evaluate each individual attribute with respect to their immediate descendants objective in the hierarchy. Instead of numerical variables, which typically constitute quantitative models, DEX-i uses qualitative variables. Values are represented by words rather than numbers. Expert decision rules ("if then" type) are used to evaluate utility functions, in an empirical manner.

All determinants have to be listed, then sorted according to their relevance and potential weight and impact on the final decision. Considering that all factors can't be valuably processed by the model, less relevant and determining factors will be removed ; others will be weighed and organised under a hierarchical tree thanks to decision rules. Each factor gets a value according to the experts knowledge and estimation.

Results

Main determinants listed have been organised under three major parts, ie ecological, technical and economical.

The figure below shows current organisation of the architecture, susceptible of changes according to expert proposals.

a) ecological suitability

Main biotic and abiotic factors affecting orchard's behaviour are considered.

Extreme climatic conditions (drought and high rainfall) are considered to have impact on pests (moths, aphids) or diseases (cryptogams), respectively.

Soil however was not maintained, although crucial in organic farming ; indeed, its structure and characteristics may not easily be linked to suitability to organic management.

Orchard's vigour and susceptibility has been connected to this ecological part in order to lighten the technical pool. Vigour is connected to pest attraction and dependence to water and nutrients : an optimal growth has to be established to guarantee yield without creating risky unbalance.

Biodiversity in and around the orchard is determinant, but its functionality and real influence (on natural pest control especially) is not measurable : therefore, only a rough description of wild and cultivated surrounding flora can be proposed. Potential pathogenic inoculum sources have been added.

b) technical suitability

Mainly current practices, damage levels and farmer's expertise are considered here.

We focused on major pests and diseases for apple, although others may be significant, at a local scale, as described.

c) economical suitability

In most of cases, economics may keep prevailing among elements to be considered by the grower : if CBA is not favourable, conversion will not take place even if the orchard is well adapted to organic farming.

Parameters so far considered are :
- Marketing facilities, on the farm or on adapted selling channels, with attractive cultivars for specific customers.
- Conversion costs, linked to the necessity of investment for specific machine for organic management : soil mowing, sprayer, ...
- Complementary crops : these should be useful to avoid bankrupt in case of 1-year failure on the orchard.

Some factors should not be considered, as
- not significant as compared to other ones
- irrelevant in respect to organic farming specificity (frost, hail risks)

Expert decision rules will help ranking attributes and putting weights on each factor.

Those rules have to be discussed by many experts (including growers) to get stronger and more reliable.

Example below shows the current decision rule (last column on the right) when combining other factors together. Final expert decision may be arbitrary in some extent and should be considered with precaution, especially in case of positive final answer.

Discussion

Current step consists in submitting and discussing the tree organisation and hierarchy to various experts in Europe, in order to gather and mix their knowledge and reflections about relevance and reliance of the tool.

UN-FAO recently agreed to consider organic farming as the most sustainable model for future small-scale agriculture, in Europe and throughout the world. As long as advisory services remains deficient, models for decision making will be of interest to spare time and propose answers to end-users.

References

Acs S., P.B.M. Berentsen, R.B.M. Huirne, 2005. Modelling conventional and organic farming : a literature review. *NJAS Wageningen Journal of Life Sciences*, Vol 53, No 1

Alvisi F., C. Malagoli, D. Regazzi, 1992. Multifru – Multiple-criteria decision making for orchard management. *ISHS Acta Horticulturae* 1992 : 313, 1

Belton V., J.T. Stewart, 2002. Multiple Objectives Decision Analysis. An Integrated Approach. Kluwer Academic Publishers, Norwell MA, USA

Burton M.D., D. Rigby, T. Young, 1999. Analysis of the determinants of adoption of organic horticulture techniques in the UK. *Journal of Agricultural Economics*, 50(1), pp. 48-63

Darnhofer I., W. Schneeberger, B. Freyer, 2005. Converting or not converting to organic farming in Austria : farmers type and their rationale. *Agriculture and Human Values*, 22:39-52

De Cock L., 2005. Determinants of organic farming conversion. Proceedings of the XIth EAAE Congress, "The Future of Rural Europe in the Global Agri-Food System", Copenhagen, Denmark , 24-27 August 2005

Mazzeto F., R. Bonera, 2003. MEACROS : a tool for multi-criteria evaluation of alternative cropping systems. *Agricultural systems*, 76, pp. 19-38

Pazek K., C. Rozman, F. Cejvanovic, V. Par, A. Borec, D. Majkovic, J. Turk, 2005. Multi-attribute decision model for orchard renewal – case study in Bosnia and Herzegovina. *Agricultura* 3 : 13-20

Pazek K., C. Rozman, A. Borec, J. Turk, D. Majkovic, M. Bavec, F. Bavec, 2006. The use of multi-criteria models for decision support on organic farms. *Biological Agriculture and Horticulture*, vol. 24, pp. 73-89

Rozman C., K. Pazek, F. Bavec, M. Bavec, J. Turk, D. Majkovic, 2006. A multi-criteria analysis of spelt food processing alternatives on small organic farms. *Journal of Sustainable Agriculture*, vol. 28(2), pp. 159-179

Tiwari D.N., R. Loof, G.N. Paudyal, 1999. Environmental-economic decision-making in lowland irrigated agriculture using multi-criteria analysis techniques. *Agricultural systems*, 60:99-112