LOOKING AHEAD Dealing with trade-offs: Participatory process is key

Jeroen Groot
Associate professor, Farming Systems Ecology Group / Wageningen University & Research

Combining quantitative and qualitative methods is necessary to address and alleviate trade-offs. In this short essay, Jeroen Groot describes different ways of dealing with trade-offs.

**This essay is based on an article submitted for publication as: Groot JCJ, Yang X, 2022. Trade-offs in the design of sustainable cropping systems at the regional level – an analysis in the North China Plain. Frontiers of Agricultural Science and Engineering (FASE).*

Overview

A toolkit for trade-off analysis contains various tools and methods that can be used in concert, such as systems analysis and simulation, scenario building, cost-benefit analysis, and risk assessment (Kanter et al., 2018). These quantitative tools should be embedded in a participatory process involving relevant actors to address the trade-offs, because decision-making when facing trade-offs is unavoidably dependent on the values and priorities of the actors involved (Gibson, 2006). It is therefore crucial to determine which and whose values play a role in the design and application of tools and in the use of deliberative processes (Gibson, 2006; Ditzler et al., 2018).

Contrasting opportunities exist to address and alleviate trade-offs

If the scope for technological development - for instance for improving the efficiency of land-use systems - is limited or absent and therefore the trade-off is unsolvable, then decisions should be made using the perspectives and values of the involved stakeholders. This can be supported by multi-criteria decision-making approaches that weigh priorities, for instance based on private (farmer) and public (societal) interests (Parra-Lopez et al., 2008; 2009). This results in selecting the best compromise solution for the problem.

On the other hand, if options for mitigation of negative impacts on the agroecosystems and/or improvement of benefits such as productivity and economic returns are present for the existing land-use options - or by introducing new practices and technologies - then these can be used to move the trade-off frontier in the desired direction towards synergistic improvements (e.g., Adelhart Toorop et al., 2020), see Figure 1. In this case the conflict is alleviated but it will be difficult to completely overcome the trade-off.

RESEARCH PROGRAM ON Water, Land and Ecosystems CGIAR
INTERACTIVE LEARNING MODULES Synergies and tradeoffs in food, land and water systems

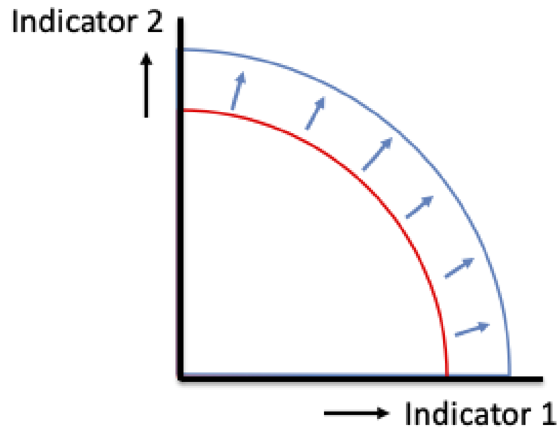

***Figure 1**. Moving a trade-off frontier by technological innovation leading to improved performance in two indicators.*

Alternatively, when the trade-off is very strong, as in intensified agroecosystems with high resource use and large losses, the problem could be transformed and alternative ways to fulfil objectives of the stakeholders can be considered, leading to 'integrative solutions'. As an example, when crop residues can be used for cooking or as soil amendment, introducing a new heating technology, for instance based on solar energy, would resolve the trade-off. An integrated solution would lead to a better outcome for all actors rather than a compromise, but this type of solution takes more analysis and understanding of the agroecosystem and its management, a greater understanding of the needs of all stakeholders, and more creativity (Scheffer et al., 2000).

Deciding about changes when confronted with trade-offs among various interests or objectives is strongly influenced by the values that people involved in the decision-making process hold. Creativity and collaboration is needed to identify opportunities to alleviate or transform the trade-off problem.

Key references

Adelhart Toorop, R., Ceccarelli, V., Bijarniya, D., Jat, M.L., Jat, R.K., Lopez-Ridaura, S., Groot, J.C.J., 2020. Using a positive deviance approach to inform farming systems redesign: A case study from Bihar, India. Agric. Syst. 185, 102942. https://doi.org/10.1016/j.agsy.2020.102942

Ditzler, L., Klerkx, L., Chan-Dentoni, J., Posthumus, H., Krupnik, T.J., Ridaura, S.L., Andersson, J.A., Baudron, F., Groot, J.C.J., 2018. Affordances of agricultural systems analysis tools: A review and framework to enhance tool design and implementation. Agric. Syst. 164, 20–30. https://doi.org/10.1016/j.agsy.2018.03.006

Gibson, R.B., 2006. Sustainability assessment: basic components of a practical approach, Impact Assessment and Project Appraisal, 24:3, 170-182, https://doi.org/10.3152/147154606781765147

Kanter, D.R., Musumba, M., Wood, S.L.R., Palm, C., Antle, J., Balvanera, P., Dale, V.H., Havlik, P., Kline, K.L., Scholes, R.J., Thornton, P., Tittonell, P., Andelman, S., 2018. Evaluating agricultural trade-offs in the age of sustainable development. Agric. Syst. 163, 73–88. https://doi.org/10.1016/j.agsy.2016.09.010

Parra-López, C., Groot, J.C.J., Carmona-Torres, C., Rossing, W. a. H., 2008. Integrating public demands into model-based design for multifunctional agriculture: An application to intensive Dutch dairy landscapes. Ecol. Econ. 67, 538–551. https://doi.org/10.1016/j.ecolecon.2008.01.007

Parra-López, C., Groot, J.C.J., Carmona-Torres, C., Rossing, W. a. H., 2009. An integrated approach for ex-ante evaluation of public policies for sustainable agriculture at landscape level. Land use policy 26, 1020–1030. https://doi.org/10.1016/j.landusepol.2008.12.006

Scheffer, M., Brock, W., Westley, F., 2000. Socioeconomic Mechanisms Preventing Optimum Use of Ecosystem Services: An Interdisciplinary Theoretical Analysis. Ecosystems 3, 451–471. https://doi.org/10.1007/s100210000040