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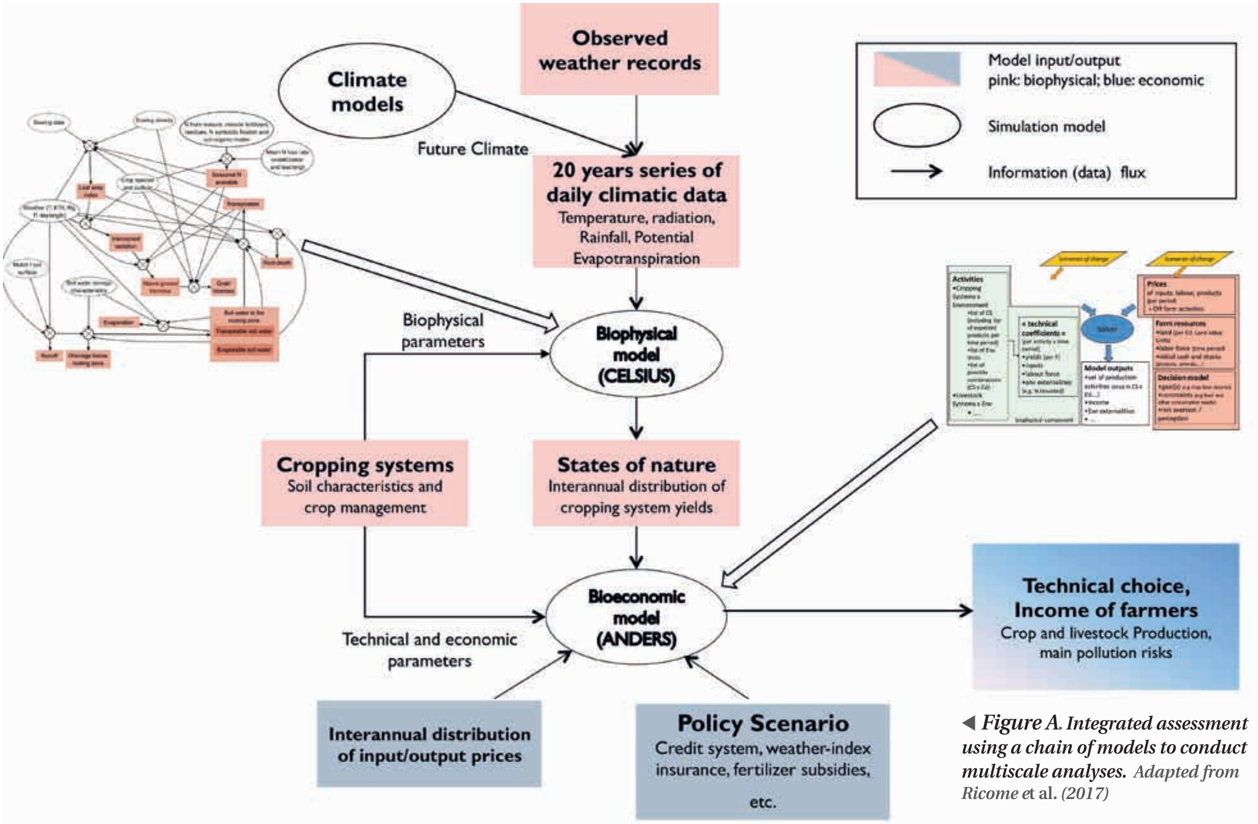
Assessing trade-offs between environmental and socioeconomic issues in agroecological systems

To be able to achieve the agroecological transition, it is necessary to resolve trade-offs between social, economic and environmental dimensions of sustainability that farmers have to cope with when changing their farming practices. For instance, replenishing the soil organic matter content will increase the soil carbon stock, thereby contributing to climate change mitigation, while also enhancing soil fertility. Consequently, household incomes may increase through the higher crop yields achieved without mineral fertilizer applications, i.e. with reduced emissions from the industrial sector. However, when this *a priori* 'win-win' situation is achieved at the expense of crop residue grazing by livestock, farmers may be obliged to purchase supplementary feed whose carbon footprint could be greater than that 'saved' by restoring crop residues to the soil. Moreover, improving soil fertility—and thus agricultural production—takes several years, and the return on this investment is therefore not immediate and is highly dependent on the prevailing soil-climate conditions. This example demonstrates: **(i) the complexity of comparing different production systems in terms of their sustainability, and (ii) the need to contextualize the analysis**. In addition to farmers, other actors have a key influence on agricultural practices, including agricultural policymakers and consumers.

Sustainability assessment is geared towards informing various actors on the expected impacts of changing practices. Standard assessment methods—such as life cycle or ecological footprint analysis—focus on the environmental dimension of sustainability. This is particularly problematic with regard to family farming in the Global South, where socioeconomic sustainability is paramount owing to farmers' poor livelihoods. When combined in integrated assessments, models focused on cropping, farm household decision making, territorial resource flows and their collective management could generate indicators covering all sustainability aspects (Fig. A). Given that these models have been developed in a conventional intensive farming framework, further research is needed to tailor them to the needs of agroecological systems. Moreover, it would be pointless to attempt to address complex systems in a perfectly objective manner. **Research should also focus on ways to take the aims and viewpoints of the different stakeholders into account (Fig. B), while dovetailing them with the available models and scientific knowledge. This could be achieved by clarifying the associated assumptions, simplifications, uncertainties and trade-offs between contradictory indicators. One challenge is to embed these assessments in approaches that reflect a dynamic view of the systems studied and their context so as to avoid reliance on innovations that might quickly turn out to be obsolete due to global changes. Agroecological systems assessments should be multidisciplinary, multiactor, multiscale and prospective in scope.**



◀ ***Figure A.** Integrated assessment using a chain of models to conduct multiscale analyses.* *Adapted from Ricome* et al. *(2017)*

◀ ***Figure B.** A between-actor discussion on ecological intensification support policies.*
The debate is prepared via a board game (here © TerriStories), staging the responses of a given production system to potential policies and climate hazards. This type of approach complements model-based assessments and helps integrate actors' viewpoints. www.terristories.org/fr/jeu.html.
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Contact

François Affholder (AIDA, CIRAD, France),
francois.affholder@cirad.fr

For further information

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