Integrated simulation/optimization models to deal with multiple farming objectives

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The analysis of livestock farming systems must integrate the three pillars of sustainability, i.e. economic, social and environmental. The design of new management strategies requires the valuation of trade-offs within and between these three pillars. Models with different levels of detail have been used as tools to cope with complexity in LFS as they are able to integrate multiple variables and interactions. We present an integrated decision support tool for sheep farming systems that combines simulation and optimization procedures. A stochastic and dynamic Animal sub-model (voluntary intake module and management-nutrition-reproduction interactions module) and a Farm sub-model (feeding resources module and economics module) are able to represent multiple interactions between variables. The optimization model is based on a Genetic Algorithm (GA) (a search of optimal solutions based on natural selection and evolution procedures). The GA searches for optimal solutions within delimited values of simulation parameters (e.g. feeding, reproductive, management decisions) that maximize a 'fitness' function that includes technical, economic and environmental objectives (e.g. income, costs, N and E surplus, GHGs). The GA allows for the evaluation of complex and non-linear problems, specifically in terms of trade-offs between management strategies and objectives. However, this approach is time demanding and it yields no unique solutions.