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1S1b Models and tools for estimating circularity of alternative food and agricultural systems

USE OF BIO-ECONOMIC FARM MODELS AND TOOLS FOR EX-ANTE ANALYSIS OF IMPACTS OF POLICIES RELATED TO CIRCULAR AGRICULTURE

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The focus of this paper is on a model toolbox for circular-agriculture policy assessment at farm level. Decisions regarding transition and investments towards circular agriculture are taken by the individual farmer. As a result, knowledge on how (transition to) circular agriculture affects farm management practices and outcome in the field of finance and economics, soil quality, use of finite resources, emissions and biodiversity is essential for the development of a circular agriculture that achieves its ambitions and policy objectives and provides solutions for all involved stakeholders. Based on the above-mentioned integrated knowledge requirements it is concluded that Bio Economic Farm Models (BEFMs) should be in the core of the toolbox. Because our focus is on BEFMs available within Wageningen Research (WR), DairyWise and Farmdyn were selected as the most suitable BEFMs regarding dairy farming. The simulation model DairyWise gives a detailed and integrated description of biophysical and economic processes on dairy farms, including feeding, animal production, fertilization, plant production and environmental emissions. Besides dairy farming, the optimization model Farmdyn also enables modelling of arable farms and mixed dairy and arable farms. Additional tools added to the toolbox focus on grassland management and aspects of arable farming. It appears that none of the above-mentioned BEFMs and tools does fulfill all the requirements needed to give quantitative answers to the complex questions related to impacts of circular agriculture at farm level. We show, however, that the different models and tools in the toolbox can be used in combination. This enlarges the scope of the analysis and enables answering more complex questions, despite possible overlap in modules and differences in methodology, e.g., simulation versus optimization. The toolbox is applied

to assess the economic and environmental impacts of a circular-agriculture policy scenario on a representative dairy and arable farm in a region in the Netherlands. The conclusion is that overlapping data and assumptions need to be harmonized, including behavioral assumptions. If these requirements are fulfilled, combined use of optimization and simulation BEFMs broadens the scope of results and enables efficient analysis of policies.

Keywords: farm, indicators, optimization, simulation, model linking