Chapter 15

The Development of an Organic Agriculture Model: A System Dynamics Approach to Support Decision-Making Processes

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ABSTRACT

This article describes the problem state of organic farming development and procedures for modeling by the means of system dynamics, with emphasis on the organic products market. The modeling principles are described in the following steps: problem state formulation, development of causal loop diagrams, model development, scenario analysis and formulation of acceptable strategies. Basic structures developed by the system dynamics principle are presented. The concept of archetypes in the field of organic agriculture modeling is described. The simulation scenarios are formulated as a case study for the Slovenian organic agriculture. [Article copies are available for purchase from InfoSci-on-Demand.com]
INTRODUCTION

Organic farming is the most environmentally valuable agricultural system, and has strategic importance at the national level that goes beyond the interests of the agricultural sector. The development of ecological agriculture countrywide can be regarded as a long-term process of economic activities, land use, population growth, material energy-information flows, and interactions between humans and nature that satisfy regional sustainable development demands. It emphasizes the sustainable use of internal resources (in the ecological, economic, and social senses), rather than external (or extra-regional) flows, to support long-term agricultural development. In particular, it emphasizes intensive use of renewable resources, which allows the recycling of matter, which is a basic requirement of ecological farming. This alternative agricultural paradigm may provide the link between the objectives of sustainable resource use and sustainable regional development.

The consequences of policies are long-term and irreversible. In this light, the system approach for evaluation of development policies for organic farming must be developed. The decision support and system analysis in organic farming has been described by Pažek et al. (2006), Rozman et al. (2006), and Pažek et al. (2006). System dynamics methodology (Forrester, 1961; Sterman, 2000) can be used as an alternative to econometric and mathematical programming approaches when modeling agricultural systems for policy evaluation (Bockerman et al., 2005; Elshorbagy et al., 2005; Saysel et al., 2002). For our research, the most important work are presented by Shi and Gill (2005) and Kljajić et al. (2002, 2003). Shi and Gill are developing a simulation model based on system dynamics (SD) for the ecological agricultural development of Jinshan County, China. Kljajić et al. produced an integrated SD model for the development of the Canary Islands, where the main interactions between agriculture, population, industry and ecology were taken into consideration. The preliminary research in the area of system dynamics SD simulations of organic farming development was conducted by Rozman et al. (2006), Rozman et al. (2007), and Rozman et al. (2008). Yet this research did not incorporate the aspect of the food market fully.

The aim of this study was to develop an SD-based model for the development of organic agriculture in the Republic of Slovenia, with emphasis on the aspect of food markets. The present article will describe the problem state of organic farming development and the procedures for modeling it by the means of SD, with an emphasis on organic food market development. The modeling principles are described by the following steps: problem state formulation, model development, scenario analysis and formulation of acceptable strategies. Basic structures important for organic agriculture developed by the SD principles are presented. The simulation scenarios are presented as a case study for the Slovenian public’s assessment and decision.

THE SYSTEM STRUCTURE AND MODEL DEVELOPMENT

There are approximately 80,000 farms in Slovenia, both conventional and organic. In the year 2006, only 1,728 farms were in the organic farm control system. Even though a subsidy has been offered to the farmers, the proportion of the organic farms is still low, not higher than 5% of all farms. The short term strategic goal is to reach 10% or 15% by the year 2015. This was determined by the state action plan, ANEK (Majcen & Jurcan, 2006). The long-term plan considered the feasibility of a complete conversion from conventional farming to organic farming. Our previous research (Rozman et al., 2007) demonstrated that conversion to organic farming relied on subsidies to provide the main means of conversion from conventional farming to organic farming, and that the negative feedback loops in the systems were dominant. The
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