Available online at www.sciencedirect.com

SCIENCE DIRECT®

Ecological Economics 53 (2005) 223–246

ECOLOGICAL ECONOMICS

www.elsevier.com/locate/ecolecon

ANALYSIS

Developing effective policies for the sustainable development of ecological agriculture in China: the case study of Jinshan County with a systems dynamics model☆

Tian Shi[a,b,*], Roderic Gill[b]

[a]*Policy and Economic Research Unit (PERU), CSIRO Land and Water, PMB 2, Glen Osmond, SA 5064, Australia*
[b]*Centre for Ecological Economics and Water Policy Research (CEEWPR), University of New England, Armidale, NSW 2351, Australia*

Received 20 December 2002; received in revised form 16 August 2004; accepted 16 August 2004
Available online 1 February 2005

Abstract

This paper focuses on a search for concrete policy measures to facilitate the overall sustainability of ecological agricultural development at a county level. For this purpose, a system dynamics model (AISEEM) has been developed to explore the potential long-term ecological, economic, institutional and social interactions of ecological agricultural development through a case study of Jinshan County in China. The model provides an experimental platform for the simulation and analysis of alternative policy scenarios. The results indicate that the diversification of land-use patterns, government low interest loans and government support for training are important policy measures for promoting the sustainable development of ecological agriculture, at least in the case study context. In addition, the study reveals that environmentally sound technology (e.g., biogas project) alone cannot sufficiently induce farmers to adopt ecological agricultural practices. Limited availability of information, risk aversion and high transaction costs are major barriers to the adoption of alternative agricultural practices. In this regard, the importance of capacity building and institutional arrangements are emphasised through the development of an improved policy-making process on agricultural sustainability. This case study highlights the importance of combining the ecological economics analytical framework with the system dynamics modelling approach as a feasible integrated tool to provide insight into the policy analysis of ecological agriculture, and thus set a solid basis for effective policy making to facilitate its sustainable development on a regional scale.

Keywords: System dynamics modelling; Ecological agriculture; Sustainable development; STELLA; Jinshan County; China

☆ A modified version of this paper was presented by the first author at the International Ecoagriculture Conference and Practitioners' Fair, 27 September to 1 October 2004, the World Agroforestry Centre in Nairobi, Kenya.

* Corresponding author. Tel.: +61 8 8303 8536; fax: +61 8 8303 8582.
E-mail address: tian.shi@csiro.au (T. Shi).

0921-8009/$ - see front matter © 2004 Elsevier B.V. All rights reserved.
doi:10.1016/j.ecolecon.2004.08.006

The best explanation is as simple as possible, but no simpler.—Albert Einstein

1. Introduction

Philosophical definitions of agricultural sustainability are relatively easy to state, but operational definitions and methodologies to allow them to be applied in agricultural policy making and planning are much more difficult to determine (Smith and McDonald, 1998). This is particularly the case in Chinese ecological agriculture (see Shi, 2002a,b, 2003a,b, 2004d). Therefore, it is urgent to adopt a comprehensive analytical framework and a holistic approach in ecological agricultural research and practice, and to develop effective bottom-up policy initiatives for facilitating its sustainable development. Although ecological agricultural development has many potential ecological, economic and social problems with complex long-term impacts, it is important to recognize that these dynamic human-natural interactions can be understood and, thus, managed to minimize unintended adverse consequences (Saysel et al., 2002). In the past, the evaluation of sustainable agricultural practices was confined to individual farms and villages (e.g., Ma, 1988; Qu et al., 1997; Gliessman, 1998), but it is currently imperative to effect a comprehensive assessment that integrates broader ecological, economic and social dimensions going beyond the local level. A methodological synthesis of ecological economics and system dynamics modeling may provide an appropriate analytical framework and tool for this purpose (see Shi, 2004b).

In this paper, a case study of the ecological agricultural development in Jinshan County is elaborated to illustrate how an ecological economics framework and a system dynamics model are woven together to address agricultural sustainability through effective policy making at the county level. In the following sections of this paper, a short background to the case study area is provided, including a description of its historical development and present situation, current problems and prevailing policy and management practice. Next, the methodological framework for this case study is outlined. Then, a high level aggregated system dynamics model is developed as a policy-learning laboratory through which to support the analysis of ecological agricultural development in the case study area. Finally, the major findings from model simulations under different scenarios are analysed and corresponding policy recommendations are offered. Although the system dynamics model in this case study is applied to site-specific problems, the implications of its general application to other similar regions and situations are briefly discussed. Conclusions then follow.

2. Background information

Agricultural systems can be identified on national, regional and local spatiotemporal scales. On each of these scales there are different sociological, biophysical, economic, and other performance criteria of interest (Wolf and Allen, 1995). Local authorities construct, operate and maintain infrastructure (economic, social and environmental); oversee planning processes; establish local policies and regulations; and assist in implementing national and sub-national policies. As this level of governance is closest to the people, it plays a vital role in educating, mobilising and responding to the public to promote sustainable development (UNCED, 1992). In the Chinese countryside, the county is a basic unit of government and administration that is empowered to interpret and implement the policies of the central and provincial governments. At county level, political, social, cultural and economic factors interact very powerfully with biophysical processes, and these considerations need to be integrated in the decision-making process of ecological agricultural development. In this sense, the county may in effect be an excellent geographical scale on which Chinese national policies on sustainable agricultural development can be implemented and delivered. Moreover, the stability at this level must be ensured in order to maintain the stability of the larger hierarchical system at both higher (e.g., regional or provincial) and lower (e.g., household or farm) levels. Since agricultural production is socially organized and its social dimension differs from place to place, analysing it on a local small scale is more logical and more representative (Simon, 2000). In this regard, the county is a suitable scale for identifying a relatively comprehensive picture of rural changes brought about by ecological agriculture.