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Analysis of the Management Policy and Comprehensive Benefit of Agriculture in the Rural Area: A Case Study on Pujiang County, China

FANG Bin and MENG Ying

College of Land Management, School of Geography Science, Nanjing Normal University, Nanjing 210046, P.R.China

Abstract

To solve the problems of the poverty in rural areas and raise the output efficiency of agriculture, policy is the primary factor. Guiding by good policies, the design of agricultural structure and management technology are the two main technical supports for agricultural development. The authors apply the model to determine the consequences of four so-called poverty alleviation strategies: (i) intensification of production, (ii) diversification of livestock production, (iii) land expansion, and (iv) an exit from agriculture, with a set of regional poverty and biodiversity indicators. Diversification seems to be the most promising poverty reduction strategy, but requires an efficient use of animal manure in cropping systems to avoid environmental problems. Improved nutrient management in cropping systems is effective in reducing the regional nitrogen surplus, but less effective in increasing per capita income. The exit strategy is beneficial for reducing poverty and achieving biodiversity goals, but may have important social consequences, which are not addressed in this study. Further reduction of rural poverty is hampered by labor constraints during the harvesting period of high value crops, such as vegetables and fruits, which calls for research and development in the field of agricultural mechanization.

Key words: diversification, intensification, LP, sustainability, ecosystem approach

INTRODUCTION

To solve the problems of the poverty in rural areas and raise the output efficiency of agriculture, policy is the primary factor. Guiding by good polices, the design of agricultural structure and management technology will be two main technical supports for agricultural development (Xiao 2007; Chen L Y and Chen Y H 2007). The authors have used Pujiang County, in Zhejiang Province, China, as the area of case study for performing the analysis. Pujiang is characterized as a lowland ecosystem facing moderate prevalence of poverty (Dixon *et al*. 2001). In general, rice-based ecosystems are being challenged by simultaneous demands for increased productivity, contributing to poverty alleviation and reduced environmental impact. Diversification of agricultural production, for example, by including vegetable and livestock production, is considered as one of the means to increase the farmers' income and improve food security (Hossain 1998). However, the consequences of wide-scale introduction of vegetables and livestock for the ecosystem are unknown, and may result in pollution (Pingali 2001). Technological innovations, such as, site-specific nutrient management (Dobermann *et al*. 2004) may improve productivity and environmental performance of these rice-based ecosystems simultaneously, but their effects on agricultural development still have to be fostered.

This study is to identify the direction for rural devel-

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Correspondence FANG Bin, Tel: +86-25-85891283, E-mail: wenyanfang731@163.com

opment in Pujiang on the basis of four possible poverty reduction strategies (Dixon *et al*. 2001): (i) intensification of agricultural production, (ii) diversification of agricultural production, (iii) expansion of land area or herd size, and (iv) an exit from agriculture. In different scenarios, the consequences of these strategies for poverty and biodiversity indicators in Pujiang have been explored. The analysis of Pujiang's agricultural development contributes to transparency in the debate on poverty alleviation and biodiversity preservation, in relation to the opportunities and limitations of agricultural development. The methodology applied in this study is based on integrated resource management and land use analysis (IRMLA) (Bouman *et al*. 1998; Roetter *et al*. 2005).

MATERIALS AND METHODS

Study area

Based on Pujiang Statistical Yearbook (Chen 2005), Pujiang County (119°79´E, 29°31´N), covering about 91 535 ha, is located in the center of Zhejiang Province, China, about 120 km far away from the provincial capital and Metropolis Hangzhou (Fang *et al*. 2005). It is located in the subtropical climate zone, with a mean annual temperature of 16°C and annual rainfall ranging between 1 100 and 1 900 mm. The altitude of Pujiang varies between 30 and 1 050 m asl, it is representative because of its nature of society resource (Fang 2004). Its total population is 391 000, of which 293 700 are agricultural. According to the recent survey, however, only about 108 000 are formally employed as farmers. These farmers traditionally focus on rice cultivation, although their production portfolios are being increasingly diversified with vegetables, fruits, ornamentals, and livestock, as they are supported technically and financially by local government. Moreover, the number of part-time farmers in Pujiang has increased, because of the ample nonfarming employment opportunities in the nearby industrialized zone around Hangzhou.

In Pujiang, about 31 070 ha are suitable for agriculture, of which only 24 928 ha are currently cultivated. Despite a recent decline in cultivated land, single and double rice cropping systems are the still predominant agricultural land use activities in Pujiang. About 49.65% of the cultivated area consists of rice paddies on fertile soils, mainly in the lowlands, whereas, vegetable systems and fruits are mainly located on less fertile soils in the uplands. Expansion of agriculture is only possible in the upland area, up to a maximum of 6 142 ha. The remainder of the county is not suitable for agriculture because of steep slopes, or it is under sustainably managed forest and bamboo with a semi-protected status. Environmental problems in Pujiang are associated with the frequent use of chemical inputs in agriculture such as nitrogen fertilizers and biocides (Fang *et al*. 2005), especially in vegetable crops. In general, only 20 and 15% of the applied nitrogen is taken up by rice and vegetables, respectively, suggesting agriculture as a major source of nitrogen pollution of ground and surface water in Pujiang county (Fang *et al*. 2005). The information on biocide usage in Pujiang also raises major concerns about environmental pollution and occupational health.

Methodological framework

The applied methodology consists of three main components (Fig.1): (i) a bio-economic linear programming (LP) model, (ii) an expert system TechnoGIN was designed to quantify inputs and outputs for a large number of cropping and animal production systems, and (iii) a geographic information system (GIS) to store and manage spatially explicit input data and to create maps from an LP output.

GIS A GIS (using ArcGIS) was applied to store, georeference, and manipulate regional resource data. Digital maps at scale 1:50 000 were available for current land use, soil characteristics, topography, and administra-

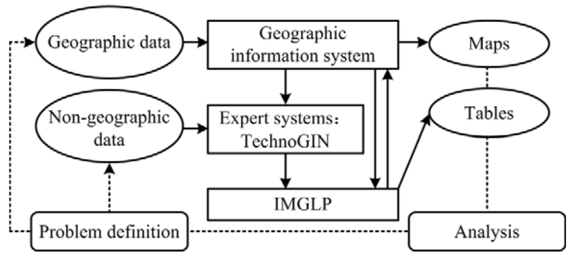

Fig. 1 Structure of the applied framework based on IRMLA and LUPUS.