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A survey-based exploration of land-system dynamics in an agricultural region of Northeast China

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ABSTRACT

Understanding the complexity of agricultural systems requires insight into the human–environment interactions. In this paper we used survey data to analyze land system change and its relation to farmer's attitudes in a typical agricultural region of Northeast China, focusing on land tenure, crop choice and intensification. Our survey shows that land transfer was fairly common across the study area: average farmland acreage per household almost doubled from 1.3 ha by early 1980s to 2.6 ha by early 2010s, especially due to urban migration of farmers. The survey indicates an increase in land transfers over time with a sharp decrease of the average period of land transfer contracts. Crop choice displays a trend of decreasing diversity as several cereal crops are no longer grown in the study region and the majority of bean cultivation has been replaced by maize and tobacco. Land transfers can explain part of these changes, butnot necessarily the full change to a dominance of a smaller number of crops at the region level. Irrigation intensity is related to the locations of rivers, while agricultural inputs, along with land transfer and crop allocation, show a spatial pattern which is related to road accessibility. Survey results show that two family characteristics (*education level* and the *initially allocated land rights*) and two socio-economic factors (*infrastructure* and *crop prices*) are important in making land transfer decisions, while external factors such as *market*, *policy*, *local cropping system*, and *agricultural disasters* have substantially influenced crop choice decisions. The survey approach is very valuable to analyze land system changes from a stakeholder's perspective, especially in the absence of statistical data atfarm level.

1. Introduction

Land change in agricultural systems is increasingly receiving attention for its importance to food security and human sustainability (Foley et al., 2011; Yu et al., 2012a). In spite of considerable progress, grand challenges still remain in the emerging land system science (Rounsevell et al., 2012). One of these is to characterize land use in its comprehensiveness, rather than the focus on land cover, which is still predominating (Verburg et al., 2009). This is especially true for agricultural systems, because agricultural land systems may drastically change without any change in land cover. For example, land tenure is an important part of agricultural land systems as it determines access to output and services from land by individuals or groups (Deininger andFeder, 2009), crop selection and its allocation to plots are at the core of farm management (Dury et al., 2012), while agricultural intensification has great impacts on food production and ecosystem services (Tilman et al., 2011). However, these above-mentioned land system changes are not easily observable with traditional remote sensing devices (Verburg et al., 2011). Consequently, more attention is given to the transitions between land cover types than to the changes within agricultural land systems.

To close this gap, You et al. (2009) and Foley et al. (2011) used crop acreage data for administrative units to generate plausible geographic crop allocation maps. Temme and Verburg (2011) and Neumann et al. (2011) analyzed intensification patterns on cropland in terms of nitrogen input and irrigation. These studies employed a macro-level perspective to map the spatial characteristics and determinants of crop/intensification pattern in agricultural land systems. However, these large-scale, grid-based empirical analyses provide limited insights into the human–environment interactions underlying the observed patterns (Rounsevell et al., 2012). As land management in agricultural systems mainly occurs atthe farm level, land system changes and its drivers are best investigated at small-scales, addressing the effect of human decision-making processes as well as the institutions

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