

Landscape Diversity and Ecosystem Services in Agricultural Ecosystems: Preliminary Results from China

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Introduction

Land use diversity can support ecosystem services such as biological pest control and reduce the need for insecticides. Empirical evidence in support of this principle has been collected in North America, Europe and Australia, but very limited information is available for developing countries. Chinese agriculture is characterized by highly disturbed agro-ecosystems but also very diverse land use at the small plot level, which offers a unique case to study. In addition, economic growth has caused major changes in land use in China over the last 20 years. A pervasive concern is that landscape simplification results in an increase in insect pest pressure, and thus an increased need for insecticides. The project investigates the empirical relationships between land use, pest pressure, natural enemy abundance and insecticide application at both the county and landscape scales for cotton, and assesses the income effect on the poor smallholders in China. Understanding the relationship is critical if we want science-based policy to guide future landscape change. Our team members include: Mark Rosegrant and Wei Zhang (IFPRI), Jikun Huang, Xiangzheng Deng, Feng Wu and Ke Zhou (Chinese Academy of Sciences), Yanhui Lu and Kongming Wu (Chinese Academy of Agricultural Sciences) and Wopke van der Werf (Wageningen University).

Methods

This poster reports preliminary results from the analysis on the relationship between land use, pest pressure, natural enemy abundance, and insecticide use at the county as well as the landscape scale.

For the county-scale analysis, we used long-term panel data (1996-2005) combined from three sources: 1) data on pest levels and the use of insecticides obtained from databases maintained by the national pest monitoring network of the Chinese Academy of Agricultural Sciences (CAAS), 2) land use data on six major land use classes (cultivated, forest, grassland, water, built-up and unused) obtained from a national land use/cover dataset maintained by the Chinese Academy of Sciences (CAS), and 3) socio-economic data obtained from a database of agriculture and rural sector maintained by the CAAS.

The landscape-scale study used biological field experiments, crop-specific land use assessment, and household survey instruments, for which the field work was implemented in Heibei province in the summer of 2011. The household survey was uniquely designed to collect both plot-level insect (pest and natural enemies) sampling data and socioeconomic data on production input and output, pest management practices, demographics, and other factors that affect household income and pest control outcome.

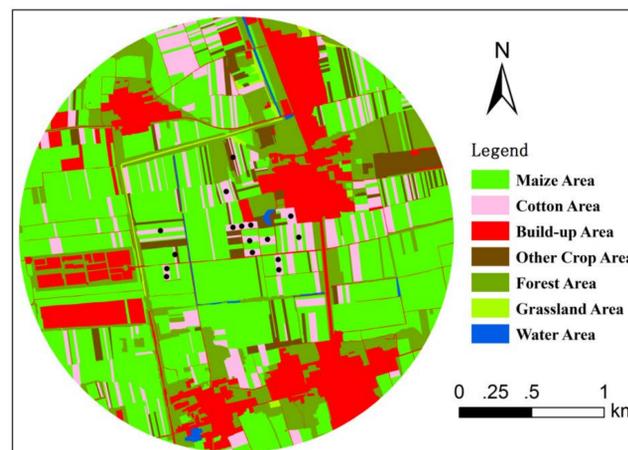
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Results

Landscape scale study:

Figure 1. Land uses in Chenjiawu village, Langfang, Hebei. Black dots are farmer fields where pests & natural enemies were sampled in 2011.

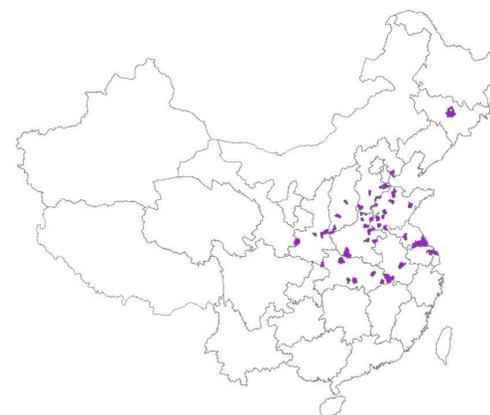


- The proportion of maize area in the landscape is positively correlated with the abundance of ladybeetles in cotton field, likely due to favorable habitats in rotational wheat-maize fields both in terms of availability of alternative prey and less insecticide disturbance.

- The area of cotton in the landscape is negatively correlated with ladybeetle abundance, likely because arthropods are generally susceptible to the broad-spectrum insecticides used frequently in cotton.

County scale study:

Figure 2. Counties included in the national pest monitoring network set up in the main cotton producing regions of China



- Counties with higher land use diversity tend to have overall lower mirid infestation levels and lower insecticide use. Mirid bugs exploit a variety of host plants. Habitats outside the cotton fields (and biodiversity in the landscape) are more likely to reduce the mirid population in cotton.

- Consistent with the findings of Lu et al. (2010), we found that mirid bugs may have progressively increased population sizes in cotton, in association with expanded Bt cotton adoption and resulted drops in insecticide use.

Key Findings

- While results on the economic value and the income effect of ES to smallholders are being finalized, the findings so far demonstrate that promotion of land use diversity has the potential to become an effective means to support cotton mirids biological control services in agricultural landscapes.
- At present, enhancing biological control services by promoting land use diversity is unlikely to be cost-effective for smallholder producers given the high return rate for insecticide use.
- However, coordinated habitat management at the landscape scale can potentially be economically viable, especially for organic producers. Policies that encourage farmers to account for the human health and environmental costs of insecticides would help incentivize the adoption of habitat management.