Spatializing Growth Suitability for Spring Soybean Cultivation in Northeast China

YINGBIN HE,*,+ DONGMEI LIU,# YANMIN YAO,* QING HUANG,* JIANPING LI,* YOUQI CHEN,*
SHUQIN SHI,@ LI WAN,& SHIKAI YU,* AND DEYING WANG*

*Key Laboratory of Resources Remote Sensing and Digital Agriculture, Chinese Ministry of Agriculture, Beijing, China
+Hulunber Grassland Ecosystem Observation and Research Station, Institute of Agriculture Resources and Regional Planning,
Chinese Academy of Agricultural Science, Beijing, China
#Institute of Rural and Regional Development, Chinese Academy of Sciences and Technology for Development, Ministry of Science
and Technology, Beijing, China
@School of Management, Tianjin Polytechnic University, Tianjin, China
&Laboratory of Riverine Ecological Conservation and Technology, Chinese Research Academy of Environmental Sciences,
Beijing, China

ABSTRACT

In this paper, an integrated indicator-based system is established to map the suitability of spring soybean cultivation in northeast China. The indicator system incorporates both biophysical and socioeconomic factors, including the effects of temperature, precipitation, and sunshine on the individual development stages of the spring soybean life cycle. Spatial estimates of crop suitability derived using this indicator system are also compared with spring soybean planting areas to identify locations where there is scope for structural adjustment in soybean farming. Results of this study indicate that northeast China is moderately suited to spring soybean cultivation. Areas classified as suitable, moderately suitable, and unsuitable for soybean cultivation, respectively, occupy approximately 9.09×10^4, 11.45×10^4, and 7.99×10^4 km^2, accounting for 11.5%, 10.11%, and 14.49% of the total area of northeast China. The Songnen and Sanjiang Plains are identified as the most and least suitable places, respectively, for spring soybean growth. A comparative analysis indicates that the suitable, moderately suitable, and unsuitable areas account for 24.78%, 46.30%, and 28.92%, respectively, of the total area presently under soybean cultivation. The analysis suggests that soybean cultivation in Heilongjiang Province is generally unfavorable, with equivalent percentages of 15.39%, 51.70%, and 32.91%. Results suggest that agricultural structural adjustment may be required to encourage farmers to grow spring soybeans. It is anticipated that this study will provide a basis for follow-up studies on crop cultivation suitability.

1. Introduction

China is the fourth-largest soybean producer in the world after the United States, Brazil, and Argentina (Kou and Feng 2008, 4–6). The total area of soybean growth and production reached nearly 9×10^6 ha and more than 16×10^6 t, respectively, based on data from China's Bureau of Statistics. As a consequence, fluctuations in soybean growth area and production in China have a large impact on the world supply and price of edible oil and soybeans (Yang et al. 2010). Although soybeans are extensively cultivated across China (Yang et al. 2006, 12–14), approximately 50% of the total area of soybean cultivation in China is located in the northeastern part because of its high productivity (Zhao et al. 2003; Wei et al. 2007). For this reason, we selected northeast China as the study area in this paper.

In the past 30 yr, data from China's Bureau of Statistics have indicated that the total area and production of spring soybean in northeast China has been steadily increasing. In 1980, the total planted area and production amounts were 265.94×10^4 ha and 334.49×10^4 t, respectively. By 2009, those numbers reached 460.93×10^4 ha and 703.89×10^4 t. Farmers appeared to have expanded the planting area of spring soybeans into highly