建三江垦区水稻产量估算模型研究

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摘要：水稻是三大主要粮食作物之一，世界上有超过一半的人口以水稻为主食。中国是世界上最大的水稻生产国和消费国，因而，中国的水稻产量是世界粮食安全的有力保障。提高单位面积的水稻产量一直是科学研究的重要议题，及时、准确地获取水稻产量信息不仅可以支持农业宏观政策调控、合理规划生产布局，对农业生产管理也有重要的指导意义。黑龙江省是我国重要的水稻生产基地，代表着中国水稻的最高生产水平。因此，更精准地估算黑龙江省水稻单位面积产量信息有助于掌握我国水稻生产状况。传统的水稻产量估算方法主要有抽样调查法和作物生长模型法，前者耗费人力物力，后者因相关输入参数较难获取在实际应用中受到限制。目前在我国气象部门应用较为成熟的主要是基于气象数据的统计学估产法。另外，遥感技术具有无损、高效、精度高的优点，随着近年来卫星遥感资源的获取难度降低，基于卫星遥感数据的水稻估产得到了很好地推广和应用。本研究以黑龙江省建三江垦区的水稻单位面积产量为研究对象，首先在研究区通过实地调查选取 5 个样点并获取样点的产量数据，利用 FY-3D 卫星遥感影像数据计算得到样点的植被指数，同时获取样点水稻的时间序列植被指数曲线并提取曲线特征参数，进而分析各特征参数与单产的相关关系，筛选相关性较高的参数作为水稻产量估算模型的输入量，以此来构建水稻产量估算模型。其次，从 2000-2019 年的水稻产量中分离出气象产量，再与建三江垦区水稻生育期 5-10 月的各气象因素进行多元逐步线性回归，构建水稻产量估算模型。最后计算两种方法的准确率、正确率、估算单产与实际单产的相关系数，进行拟合检验，对比两种方法特点及优劣。研究结果表明，在种植结构单一的垦区，基于遥感数据的水稻产量估算模型优于基于气象因子的统计模型，具有良好的估测单产的潜力，研究结果为建三江垦区水稻单产的估算和模型优选提供科学依据。

关键词：水稻单产、遥感、气象因子、模型

A case study on rice yield estimation model for Jiansanjiang Farming Area

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Abstract: Rice is one of the three major food crops. More than half of the world's population depends on rice as their staple food. China is the world's largest rice producer and consumer, so China's rice production is a strong support for ensuring world food security. Agriculture is the foundation of national economic development, and increasing rice yield per unit area has always been a key research topics in the world. Timely and accurate acquisition of rice yield information can not only assist policy regulation and reasonable planning of agriculture production at the large scale, but also be used for guiding agricultural production activities. Heilongjiang Province is an important rice production base in China and represents the highest rice production at national level to a certain extent. Therefore, accurate estimation of rice yield per unit area in Heilongjiang Province will help understand the status of rice production in China. Traditional rice yield estimation methods mainly include the statistical sampling survey and the crop growth model estimation, but the former is labor and resources costing, and the latter is limited in practical application because many relevant parameters are difficult to obtain. At present, the statistical yield estimation method based on meteorological data is mainly used in the meteorological departments and relatively mature. In addition, remote sensing technology has the advantages of non-destructive, high efficiency and high accuracy. As the access to satellite remote sensing data has become easier in recent years, rice yield estimation based on satellite remote sensing data has been well promoted and applied. This study took the rice yield per unit area in the Jiansanjiang Farming Area of Heilongjiang Province as the study topic. First, five sample points were selected and field surveys in the study area were conducted, and finally the yield data of the sample points were obtained. The FY-3D MERSI satellite data was used to calculate the normalized vegetation index for all sample points, obtain the time series of vegetation index for all sample points, and extract the curve characteristic parameters, and then the correlation between each characteristic parameter and the yield was analyzed. Secondly, the meteorological yield was separated from the rice yield from 2000 to 2019, and then the multiple stepwise linear regression was performed with various meteorological factors during the rice growth period from May to October in Jiansanjiang farming area to build a rice yield estimation model. Finally, the accuracy, correctness, and correlation coefficient between the estimated yield and the actual yield of the two methods were calculated, and a fitting test was performed to compare the characteristics and advantages and disadvantages of the two methods. The research results show that in this farming the rice yield estimation model based on remote sensing data is better than the statistical model based on meteorological factors, and has good potential for estimating rice yield. The study may provide scientific basis for the estimation of rice yield and model optimization in Jiansanjiang farming area.

Keywords: rice yield; remote sensing; meteorological factors; model