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Wheat Acreage, Productivity and Production Estimation through Remote Sensing and GIS Techniques

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Abstract: Remote Sensing (RS) and Geographical Information System (GIS) technologies were used to estimate the acreage, productivity and production of wheat in Karlawad village of Karnataka, India. Such estimations are important for taking management decisions in precision farming. A cloud free LISS IV multispectral digital image of 5.8 m resolution of orbit 26798, path 202 and row 96, from IRS P6 satellite acquired on December 15th, 2008 was used for the investigation. ERDAS IMAGINE 9.0 image analysis software and Arc GIS 9.0 software were used for data processing and analyses. Vegetation indices such as Ratio Vegetation Index (RVI), Normalized Difference Vegetation Index (NDVI) and Transformed Vegetation Index (TVI) were computed from spectral reflectance values of wheat crop recorded at selected ground truth (GT) sites. The Leaf Area Index (LAI) of wheat crop at GT sites was recorded by using the equipment AccuPAR LAI meter of Decagon Devices Inc. USA. The estimated values of RS and GIS based wheat acreage, productivity and production were, 82.64 ha, 2801.5 kg per ha and 231.52 tons, respectively. The values of the correlation (r) between wheat productivity and NDVI, LAI, RVI and TVI were 0.892, 0.924, 0.892 and 0.890, respectively. Three productivity models using NDVI and LAI values either alone or in combination were compared for their performance. Among these models, a multiple regression model based on combination of NDVI and LAI with R^2 value of 0.87 was found to explain the yield variability better than simple regression models based on either NDVI (R^2 of 0.80) or LAI (R^2 of 0.85). The study further revealed that the RS and GIS based estimations of acreage, productivity and production deviated from the data of Karnataka State Department of Agriculture (KSDA) by +3.19, +10.76 and +13.61 percent, respectively.

Key words: Remote Sensing, Geographic Information System, Wheat, Area estimation, Productivity estimation, Production estimation,

INTRODUCTION

Due to its high nutritive and strategic value, wheat is accorded a premier position among cereals and vast acreage is devoted to its cultivation around the world. Wheat is grown over a wide range of latitudes covering a considerable diversity of conditions. The largest quantities of the best wheat are produced in the countries favored with cool and moist weather during a fairly long growing period followed by dry and warm weather. The cultivation of wheat is so widely distributed geographically that the crop is being harvested in one country or another any time of the year.

Crop acreage, productivity and production estimates are very crucial in planning and developmental activities of different government agencies. Remote Sensing (RS) and Geographical Information System (GIS) techniques are extensively used to estimate acreage and production of agricultural crops throughout the world. Normalized Difference Vegetation Index (NDVI) values computed from spectral reflectance in Red and Near Infrared (NIR) bands from cropped areas have been found to be reliable in doing so. Need based crop acreage, productivity and production estimates can be undertaken at various scales using satellite imagery of matching

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