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Prediction of Potato Crop Yield Using Precision Agriculture Techniques

Khalid A. Al-Gaadi[1,2], Abdalhaleem A. Hassaballa[1]*, ElKamil Tola[1], Ahmed G. Kayad[2], Rangaswamy Madugundu[1], Bander Alblewi[3], Fahad Assiri[3]

1 Precision Agriculture Research Chair (PARC), King Saud University, Riyadh, Saudi Arabia, **2** Department of Agricultural Engineering, College of Food and Agriculture Sciences, King Saud University, Riyadh, Saudi Arabia, **3** Saudi Agricultural Development Company (INMA), Wadi Eddawasir, Saudi Arabia

* ahassaballa@ksu.edu.sa

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Data Availability Statement: Our data are divided into two parts: (1) Satellite images, and available at the Earth Explorer website at: http://earthexplorer.usgs.gov/. (2) Potato yield data, are uploaded with the supplementary file.

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Abstract

Crop growth and yield monitoring over agricultural fields is an essential procedure for food security and agricultural economic return prediction. The advances in remote sensing have enhanced the process of monitoring the development of agricultural crops and estimating their yields. Therefore, remote sensing and GIS techniques were employed, in this study, to predict potato tuber crop yield on three 30 ha center pivot irrigated fields in an agricultural scheme located in the Eastern Region of Saudi Arabia. Landsat-8 and Sentinel-2 satellite images were acquired during the potato growth stages and two vegetation indices (the normalized difference vegetation index (NDVI) and the soil adjusted vegetation index (SAVI)) were generated from the images. Vegetation index maps were developed and classified into zones based on vegetation health statements, where the stratified random sampling points were accordingly initiated. Potato yield samples were collected 2–3 days prior to the harvest time and were correlated to the adjacent NDVI and SAVI, where yield prediction algorithms were developed and used to generate prediction yield maps. Results of the study revealed that the difference between predicted yield values and actual ones (prediction error) ranged between 7.9 and 13.5% for Landsat-8 images and between 3.8 and 10.2% for Sentinel-2 images. The relationship between actual and predicted yield values produced R^2 values ranging between 0.39 and 0.65 for Landsat-8 images and between 0.47 and 0.65 for Sentinel-2 images. Results of this study revealed a considerable variation in field productivity across the three fields, where high-yield areas produced an average yield of above 40 t ha^{-1}; while, the low-yield areas produced, on the average, less than 21 t ha^{-1}. Identifying such great variation in field productivity will assist farmers and decision makers in managing their practices.

Introduction

Achieving the maximum crop yield at the lowest investment is an ultimate goal of farmers in their quest towards an economically efficient agricultural production. Early detection of