Chapter 3
Evaluation of Multi-Temporal Sentinel-1 Dual Polarization SAR Data for Crop Type Classification

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ABSTRACT

India is one of the highly populated countries, and its economy mainly depends on agriculture. The crop type classification is an essential requirement for ensuring food security, crop monitoring, and to understand the environmental consequences of cultivated ecosystems. This study exploits freely available multi-temporal SAR data for discriminating crop types, such as wheat, gram, and mustard, over Ashok Nagar district, Madhya Pradesh, India. Nine Sentinel-1 dual-polarized data acquired from

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January 2018 to April 2018 in interferometric wide swath mode are used. Class separability analysis using Bhattacharyya Distance (BD) has been performed for multi-temporal VV and VH backscatter, log-ratio, and Radar Vegetation Index (RVI) to quantify the ability to distinguish temporal profiles of crops. RVI has shown the significant result in class separability analysis in comparison with other parameters. Crop type classification map has been generated using a support vector machine classifier with overall accuracy and Kappa coefficient of 96.32% and 0.95, respectively.

INTRODUCTION

According to the United Nations (United Nations, 2019), India is one of the top ten countries whose global population proliferate more than half of the projected growth between 2019 and 2050. It is also forecasted that India may be the highest populated country by 2027 based on the current growth rate. The steady increase in population will contemporaneously increase demand for food, which influence the future actions of mankind towards food security and nature conservation (FAO, 2009). Several studies, such as Yu et al. (2015) and Pingali et al. (2019) discussed the importance of agriculture and its need for a strategy in India to ensure future food security.

The spatial distribution of crop types and timely health status are significantly important for decision makers at regional, national and even global level (Brisco et al., 1998; Wu et al., 2015). In this regard, satellite Earth Observation (EO) data has become an essential data source. With the increase in EO satellites' operating in optical and microwave regions of the electromagnetic spectrum enable continuous land monitoring/observations. Particularly, free and open satellite data provided from Landsat and Sentinel missions have been extensively used for these applications (Wulder et al., 2012; Veloso et al., 2017; Kamilaris et al., 2017). Although, several studies (Thenkabail et al., 2005; Dheeravath et al., 2010) have shown the potential capabilities of optical multi-spectral data for crop classification. As the data is highly sensitive to the weather conditions, these approaches may not provide acceptable results over areas having frequent cloud cover or foggy conditions. Since radar remote sensing can provide data during almost all-weather conditions, this may be effectively used for un-interrupted crop growth monitoring than optical. In addition, its unique sensitivity towards structural, geometrical and dielectric properties of various components of the crop makes possible for crop identification and biophysical parameters retrieval, concurrently assess the health status (Patel and Srivastava, 2013; Gao et al., 2018; Sivasankar et al. 2018). Furthermore, the ability of radar signal to penetrate through vegetation and interact with underneath soil enables

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