Available online at www.sciencedirect.com

ScienceDirect

Procedia Food Science 6 (2016) 235 – 241

Procedia Food Science

International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015)

Extraction of agricultural phenological parameters of Sri Lanka using MODIS, NDVI time series data

W.G.N.N Jayawardhana[a]*, V.M.I Chathurange[b]

[a]*Space Application Division, Arthur C Clarke Institute for Modern Technologies, Katubedda, Moratuwa, 10400, Sri Lanka.*

[b]*Department of CPRSG, Faculty of Geomatics, Sabaragamuwa University of Sri Lanka, Belihuloya, 70140, Sri Lanka.*

Abstract

Management of crops is an essential part in the food production procedure. Having a thorough knowledge of growth stages of each crop is of paramount importance in this respect. Phenology (transplanting, panicle formation, flowering etc) is the study of cyclic and seasonal natural phenomena that are controlled by environmental and climatic factors. Monitoring the crop condition manually in the field is difficult and time consuming. Therefore recently, several methods have been introduced by using satellite derived vegetation indices. Extraction of phenological parameters is helpful for the purposes like irrigation management, nutrient management, health management, yield prediction and crop type mapping. Easily extracted parameters will be the important data base for agricultural researchers. This research is an attempt to extract paddy phenological parameters of Sri Lanka by using 16 years' (2000 to 2015) Time series MODIS Normalised Difference Vegetation Index (NDVI), which is highly sensitive for the green vegetation and the data were analysed using SPIRITS and TIMESAT software's. Periodicity converter in SPIRITS and Savitzky Golay filtering in TIMESAT and SPIRITS are helpful in smoothing the time series which are perturbed by noise due to missing values and Clouds. Phenology is considered as a sensitive climate change indicator but, it is very essential to have a comprehensive familiarity about the method of water supply that the study area is irrigated or rain fed so as to eliminate the wrong interpretation. As results, average of long time series of NDVI profile for a few agro ecological zones of Sri Lanka with extracted seven parameters (Start of the season, End of the season, Length of the season, Booting date, Base value, Maximum NDVI during the Season, Amplitude) and generated phenological parameter maps are presented here. The crop phenology is a very important element of agricultural monitoring, to ensure the security of the food crop production.

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).

* Corresponding author:*E-mail address:* nilushika.n.jayawardhana@gmail.com

Peer-review under responsibility of International Conference of Sabaragamuwa University of Sri Lanka 2015 (ICSUSL 2015).
doi:10.1016/j.profoo.2016.02.027

Keywords: Phenology; MODIS; NDVI; SPIRITS; TIMESAT

1. Introduction

The staple food of Sri Lankans is paddy. Growth and development of the plant involve continuous change. This means important growth events occur in the rice plant at all times. If the plant is unhealthy during any stage of growth the overall growth, development and grain yield of the plant are limited. It is important to have a comprehensive understanding of the growth and development of the plant[1]. Individual factors such as genes, age and rice variety and environmental factors such as weather and climatic conditions, water supply and diseases influence plants phenology (emergence, tillering, maturity etc)[2]. Understanding the phenology is very much essential for irrigation management, fertilization, and yield prediction. Crop distribution and acreage provide the basic information necessary for agricultural management and policy planning. In order to map crop areas, extracted phenological parameters are useful. Phenology is crucial for identification of factors influencing to crop stress, Monitoring farming activity, crop damage disaster monitoring, analysing seasonal ecosystem carbon dioxide (CO2) exchanges[3] and wide range of end users including, government, farmers, and researchers. Phenology is a cost efficient instrument for the early detection of changes in the climate[2].

The phenological stage of crop can be measured using field observation by the farmer, but it is difficult to maintaining the same method in large areas. Therefore, remotely sensed time series data are essential for the estimation of crop phenology stages across large areas and it's also cost effective. Historical crop calendars can be easily made and it may be an important database for food security information systems.
NDVI (Normalized Difference Vegetation Index) plays an important role in agriculture. Higher NDVI values usually represent greater vigor and photosynthetic capacity of vegetation canopy. Time series analysis of MODIS 250m surface reflectance 16 day composite data can be used to gain information on seasonal vegetation development. Here, the paddy phenological stages were detected. The main objectives of this study are extracting phonological parameters and preparing Seasonality Parameter maps for different agro ecological zones in Sri Lanka. To fulfill the agriculture application requirement, researchers are encouraging to make benefit from time-series remote sensing data[4].

2. Methodology

In Sri Lanka there are mainly two cultivated seasons namely yala and Maha. Yala Season is effective during the months of April to September whereas Maha Season is effective from October to March in the next year. MODIS Vegetation Indices 16-Day L3 Global 250m (MOD13Q1) is the basis of study, for the period 2000 to 2015/July. Two tiles which covered the Sri Lanka are h25v08 and h26v08. MOD13Q1 has different spectral bands including, NDVI, EVI (Enhanced Vegetation Index), Red, NIR, Blue and MIR .For this study NDVI layer is used which is a normalized reflectance difference between the near infrared (NIR) and visible red bands. The downloaded MOD13Q1 data are in HDF-EOS data format, and sinusoidal projection. Firstly the downloaded MODIS tiles which cover the Sri Lanka are mosaicked and reprojected using MODIS Reprojection Tool (MRT).MRT is freely available software Tool for all registered users. Here used the periodicity converter of SPIRITS (Software for the Processing and Interpretation of Remotely sensed Image Time Series) software to construct decadal time series using existing 16 days series. SPIRITS is the windows based software aiming at the analysis of remotely sensed earth observation data[5].
In order to extract phonological parameters (Figure 1) Pixel wise NDVI time series were generated from 2000 to 2015/July, using TIMESAT Program. TIMESAT is primarily designed to process time series of vegetation index derived from satellite spectral measurements[6] .To derive the NDVI Profile the averaged pixel values for each agro ecological zones are used. Long Time series were made as an input of TIMESAT Program. TIMESAT implements three processing methods based on least squares fits to the upper envelope of the vegetation index data. The first