

## Analysis of Drought Conditions for Sindh Province: January - July (2012)

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**Abstract.** Drought is a creeping hazard that needs to be monitored on continuous basis. Occurrence of drought is related to the failure of southwestern monsoon which usually brings the heavy rainfall in all regions of Pakistan. The occurrence of drought in the country during the year 2012 caused the serious threat to livestock and human health. In this study, the drought condition during the period of January 2012 to July 2012 was analyzed for Sindh province. MOD13A2 version 5 product was used for analyzing the vegetation index. The relationship between the Normalized Difference Vegetation Index, number of rainy days and total monthly rainfall was obtained. The number of rainy days was less than one during the months of study in all areas of Sindh region. NDVI was not found to be affected by the less amount of rainfall, whereas less than normal rainfall was recorded in Sindh region during the study time period.

**Keywords:** Drought, NDVI, total monthly rainfall, rainy days, Sindh.

### 1. Introduction

The average drought occurrence in Pakistan is about 1 event in 10-15 years. The major drought that hit Pakistan was during 1998-2000. Drought occurrence in Pakistan is because of the failure of rainfall pattern of southwestern monsoon and El Nino Phenomena, which occurs usually every 2 to 7 years. NDVI was first formulated by [1] to differentiate between the reflectance levels of visible and near-infrared. Because of the chlorophyll a and b, absorption of energy takes place, thus the reflectance in the red (670 nm) and blue (450 nm) range of the spectrum is much small in the plants which are healthy [2]. NDVI tells about the abundance of vegetation level with the help of data that is remotely sensed [3]. Satellite based indicators have large and frequent coverage that they can monitor temporal and spatial variations of droughts regionally, continent wide and at global scale [4]. Many studies suggest that NDVI is a powerful tool to study the droughts from satellite data sets and also provides the basis for analyses to observe the relationships among several factors that include soil water conditions, rainfall, and the NDVI [5]-[7]. Seasons are of substantial importance with regard to vegetation activity. The NDVI increases as vegetation grows and vice versa. The increase and decrease of NDVI over specific period of time in a specific area is the consequence of vegetation growth and amount of rainfall received in the area [8]. The objective of this study is to analyze the rainfall trend from January 2012 to July 2012. This time period was chosen as there observed the drought conditions in Pakistan particularly in Sindh province during this period.

### 2. Methodology

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The MOD13A2 v5 product at 1 km of MODIS was used for the period of January 2012 to July 2012, which tells about the vegetation indices and provides data for every 16 days. MODIS Re-projection tool was used for mosaicking of images. ENVI 4.7 was used to get the band math. The band images were transformed for the extraction of NDVI values. NDVI calculation was done using the equation:

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

The raster values were then put together with the total monthly rainfall and the number of rainy days for the period of January 2012 to July 2012 and the relation of these variables were shown by the graphical form.

### 3. Results and Discussion

#### 3.1. January 2012

In the month of January 2012, Sindh province remained dry due to less rainfall and the number of rainy days observed was also less than 1. The NDVI remains constant as mostly the vegetation in this area is cotton, or other crop which may be mature. The increase in the amount of rainfall in Hyderabad cause the NDVI to remain at the same point, but rest of the areas showed no relation between the three variables as shown in Fig. 1.

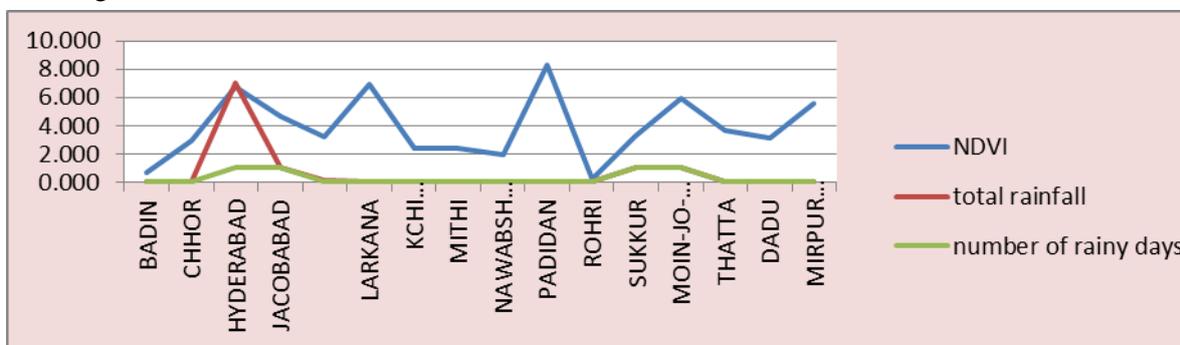


Fig. 1: Relationship between NDVI, number of rainy days and total monthly rainfall during January 2012.

#### 3.2. February 2012

Sindh region remained dry with 0 numbers of rainy days. The NDVI remained continuous as shown in Fig. 2.

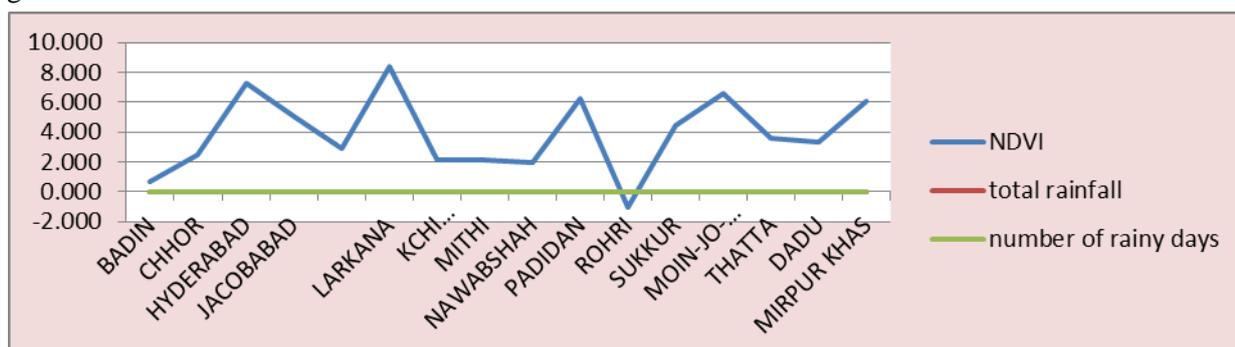


Fig. 2: Relationship between NDVI, number of rainy days and total monthly rainfall during February 2012.

#### 3.3. March 2012

The total monthly rainfall remained below normal in Dadu whereas all other areas remained dry and NDVI shows its continuous trend during March 2012 as shown in the Fig. 3.

#### 3.4. April 2012

Below normal total monthly rainfall was observed in Dadu and Badin and number of rainy days remained less than 1. NDVI remained continuous in April 2012; hence no relationship was acquired between the three variables as shown in the Fig. 4.

#### 3.5. May 2012

Number of rainy days was less than 1 during May 2012, the amount of rainfall remained below Normal in Dadu, rest of the areas remained dry and NDVI showed continuous trend shown in Fig. 5.

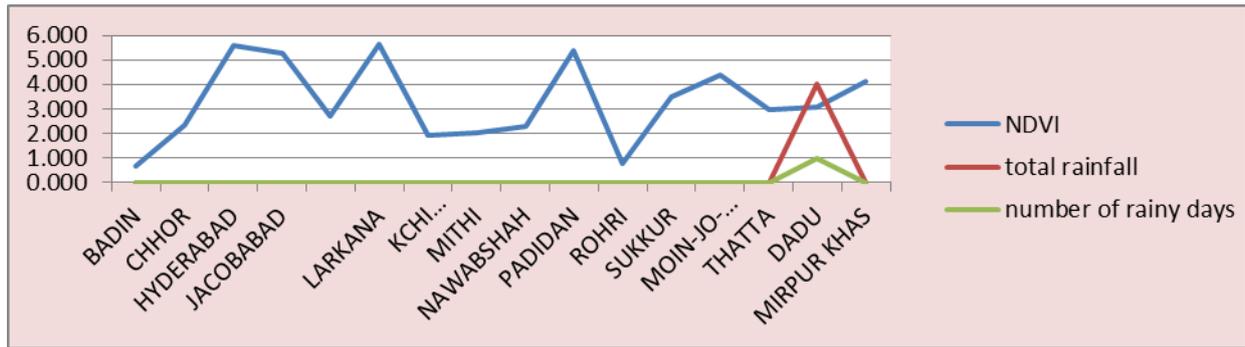


Fig. 3: Relationship between NDVI, number of rainy days and total monthly rainfall during March 2012.

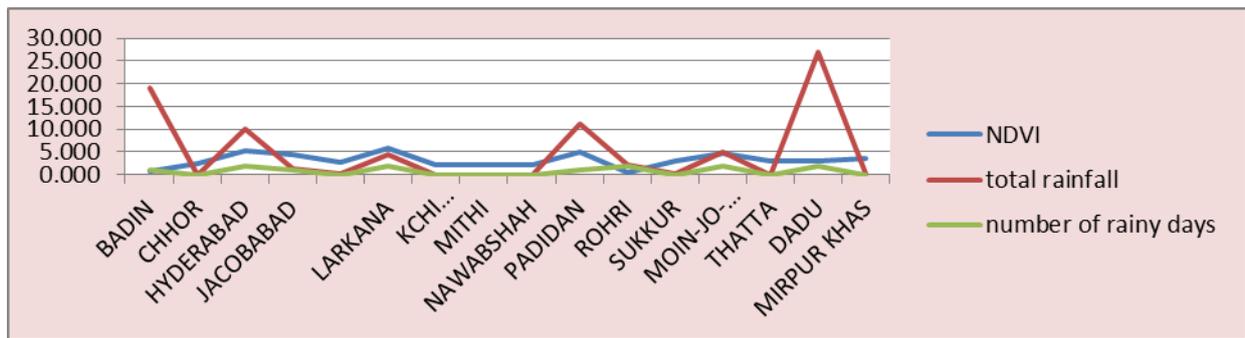


Fig. 4: Relationship between NDVI, number of rainy days and total monthly rainfall during April 2012.

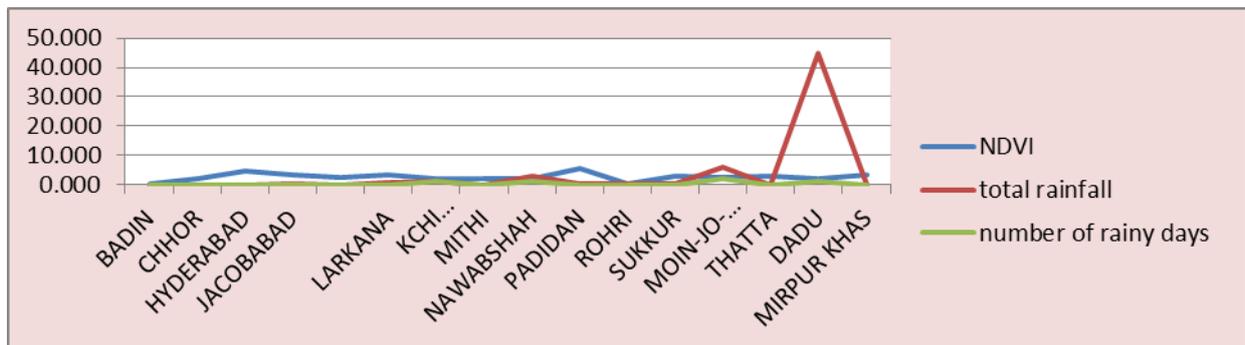


Fig. 5: Relationship between NDVI, number of rainy days and total monthly rainfall during May 2012.

### 3.6. June 2012

The month of June resulted to be a driest month, very little rainfall was observed in few areas of Pakistan, Sindh remained extreme dry, only Mithi received small amount of rainfall but NDVI was not affected by the amount of rainfall and the number of rainy days remained less than 1 during June 2012. Thus no relationship was observed between the variables as shown in the Fig. 6.

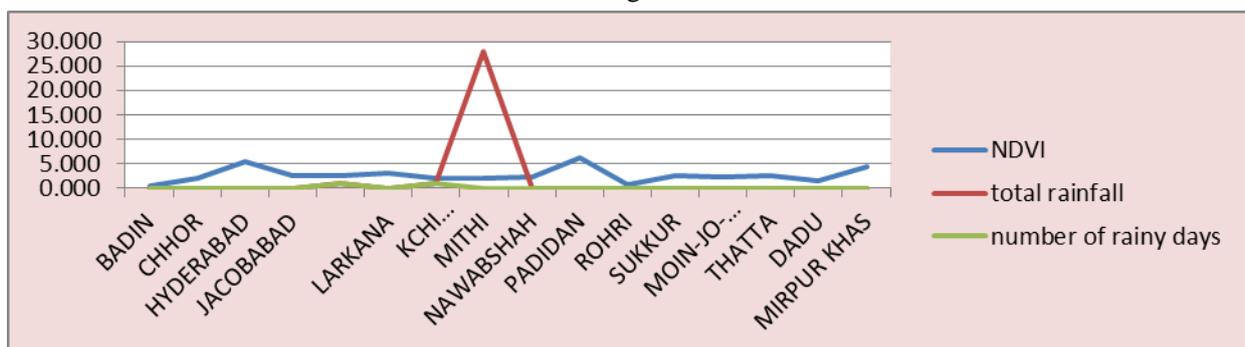


Fig. 6: Relationship between NDVI, number of rainy days and total monthly rainfall during June 2012.

### 3.7. July 2012

The month of July also remained dry in year 2012, Sindh remained extreme dry, only Mithi received some amount of rainfall but NDVI was not affected by the amount of rainfall thus these three variables showed no relationship as shown in the Fig. 7.

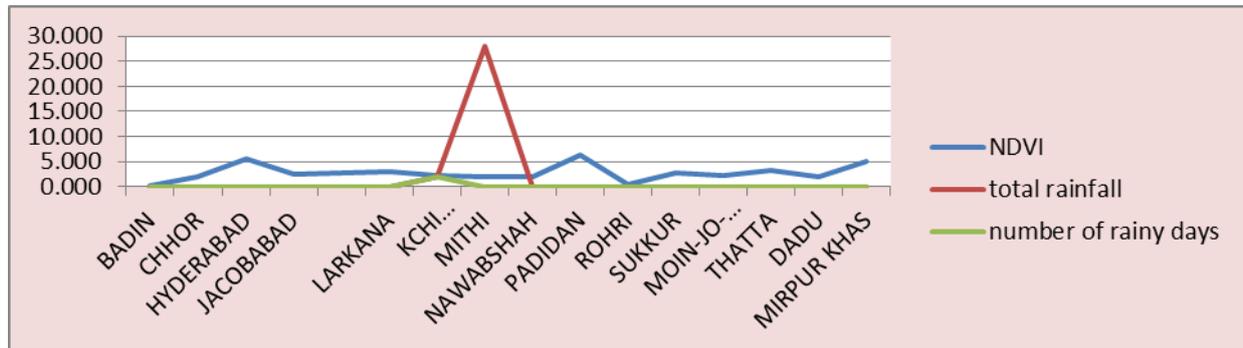


Fig. 7: Relationship between NDVI, number of rainy days and total monthly rainfall during July 2012.

The results show that the drought conditions prevailed from January 2012 to July 2012 in the study area. There occurred very small amount of rainfall which did not affect the trend of NDVI, this is because the vegetation was mature, and this maturity period does not require the rainfall. Sindh remained the driest region. It received only 10% of the rainfall during monsoon season and hence declared to be the drought prone region of Pakistan. The trend of rainfall remained below normal throughout the year until July in 2012. This study was carried out because of a major drought event occurred in 2012 in the history of Pakistan. The organizations worth mentioning in this context that predicted this drought are the world Meteorological Organization (WMO), Japan Meteorological Agency (JMA), China Meteorological Administration (CMA), and Pakistan Meteorological Department. There was very little amount of rainfall during the year 2012 from January till July due to the failure of south western monsoon.

## 4. References

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