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Agro-Ecological and meteorological management in semi-arid zone of the Western Maharashtra, India: using Geospatial Technology

Rajaram A. Jadhav

Department of Geography, MGV's, L.V.H. College, Panchvati, Nashik, M.S., India

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ABSTRACT

Geographic information, geospatial and communication technologies (Geo-ICT's) have a valuable role to play in agro meteorological management the techniques, processes and structures through which decisions are made about wise agricultural practices and use of all natural resources. A lot of multifarious challenges the world faces at the moment, such as adjustment to and improvement of climate transform, speedy urbanization, rising food and energy uncertainty and augmented incidence of natural disasters, farmer's suicide, so far, no widespread accepting presently exists about the way in which the development and upcoming direction of Geo-ICT for agro-meteorological projects and initiatives should be appraised. At this juncture, will try to review inter- disciplinary research to present a crisp impression of three exacting inter-disciplinary viewpoints that can be used for the estimate of Geo-ICT for agro meteorological management.

Key words *: Geo-ICT, Remote Sensing, Agroclimatic, Agro ecology, Agrometeorology.*

Introduction

Geo-ICT (Geospatial and information communication technologies) encompasses various aspects of spatial data management in agriculture, including data acquisition, analysis, and decision support. Agriculture, which is the largest employer globally, is highly dependent on weather conditions and is under pressure from changing climates. In developing countries, around 70% of the population depends on agriculture. Annual crop losses are primarily due to weather impacts such as droughts, floods, frost, hail, and storms. Agriculture is dynamic and diverse, with wide spatial variation. The increasing global population requires high agricultural potential, which is still largely dependent on environmental conditions. Meteorology, the study of atmospheric phenomena, plays a crucial role in agriculture (Singh and Dhillon 2008, Agricultural Geography page no.27; A modern dictionary of geography - 2007 Page no.304).

Study Area

The study area is with heavy cultural and socio-economic diversity. In the western region of the study region mostly people belong to the tribal community having the low standard of living and they are far away from the modern world of technology with this these people also economically and socially not forward as compare to the rest of the Maharashtra. In the eastern region of the study area is having moderate condition of the socio economic and cultural development.

Assistant Professor and Research Guide

Objectives

- To Use Geospatial Technology (Geo-ICT) for detecting crop failure at any stage.
- Understanding hydro metrological characteristics.
- Setting up proper agro-ecology.

Hypothesis of the study

"If Geographic information and communication technologies (Geo-ICT's) is used for wise agricultural practices and utilization of all natural resources, then the proper agro- meteorological management will possible"

Data base and methodology

Agricultural data and Climatic data were collected by various Governments and Non-govern met sources like, District Gazetteer of Nashik, Agricultural Departments, Socio-Economic abstract, IMD, HDUG and Satellite data used for NDVI calculation. Open-source GIS software and various statistical methods were used for the analysis.

Results and Discussion

Remote sensing for detecting crop failure

Hyperspectral Remote Sensing is a powerful tool used in various fields to identify targets based on spectral behavior. Recent research investigated the impact of BPH damage on rice plant reflectance using hyperspectral remote sensing, revealing influences in the visible and near-infrared regions. Correlation coefficients identified sensitive wavelengths in the glasshouse (1986 nm, 665 nm, 1792 nm, and 500 nm) and field (961 nm, 1201 nm, 764 nm, and 1664 nm). Plant reflectance varied across different wave bands, with smaller variations at shorter wavelengths and larger variations at longer wavelengths. This suggests potential for detecting BPH stress and issuing timely warnings. Estimated yield loss in the study area ranged from 21 to 51 percent due to insect pests. Hyperspectral remote sensing has the potential to be a valuable tool for monitoring and managing crop health and pest damage in agriculture.

Hydro- Agro Meteorological analysis

Rainfall regime

Rainfall determines economic development of regions, especially agriculture. Study shows crop yield, production, and cropping patterns are affected by rainfall variation. Study region experiences high rainfall during monsoon season (June-October).

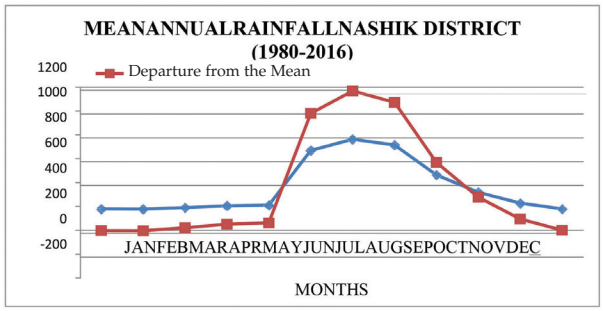

Fig. 1. Mean Annual Rainfall Nashik District from 1980-2016

Highest proportion of the study region is under the scarcity of the rainfall. When we are discussing about the average monthly rainfall tahsilwise then it would be observed that the tahsils Surgana, Peth, Trimbak, Igatpuri and Nashik having highest rainfall than other tahsils in the last 36 years. (Figure 2).

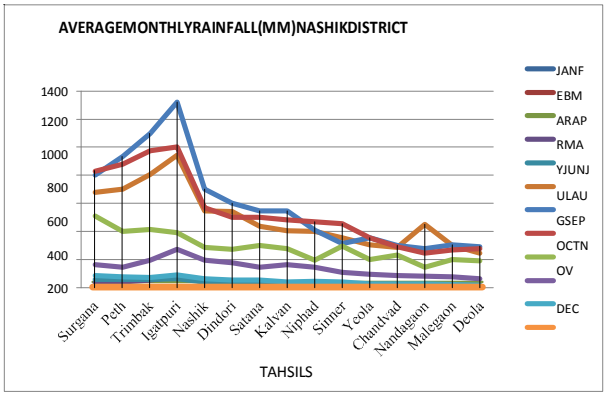

Fig. 2. Tehsil wise monthly average rainfall from year 1980-2016

The graph shows that the trend of the rainfall is decreasing yearly as well as year wise fluctuations are observed for many of the years having normal monsoon distribution while some of that are observed wet monsoon and few are observing scarcity of the rainfall (Figure 3).

Occurrence of depressing NDVI values shows weak plant life situation. The above figures shows the NDVI and rainfall relation, Occurrence of depressing NDVI values shows weak plant life condition this situation in the study area ocurred in the year 1992, 2000, 2002 and 2003 (Figures 4) and Oc-

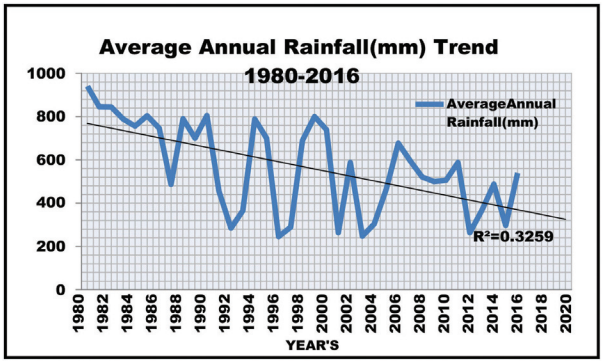

Fig. 3. Linear regression & average rainfall from the year 1980-2016

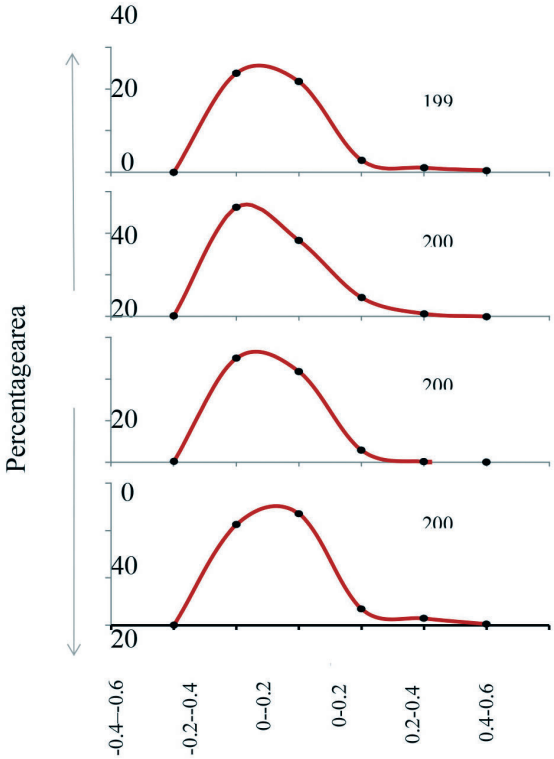

Fig. 4. NDVI and Rainfall relation

currence of affirmative NDVI values shows good plant life condition this situation in the study area ocurred in the year 1996,1999 and 2009. (Figure 5)

Setting up proper agro-ecology

Agroecology combines conventional farmer's knowledge with current ecological, social, and agronomic sciences, resulting in a discourse of wisdom for managing biodiversity and resilient farms. It includes elements such as abiotic surroundings, anthropology, sociology, biological control, ecological

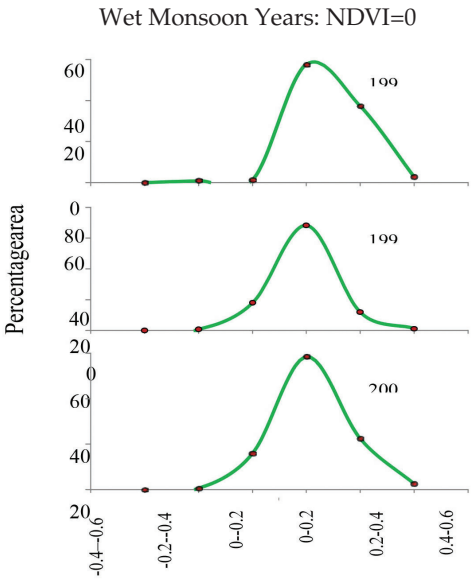

Fig. 5. NDVI and Rainfall relation

economics, and knowledge from agricultural sciences. GIS and remote sensing tools, such as hyperspectral remote sensing and GIS mapping, play a crucial role in agroecology by providing essential data on agricultural resources. Soil and water testing, as well as easy access to new agricultural tools and techniques, are also important for farmers. Agroclimatic zone-specific cropping patterns and proper marketing strategies for crops can be suggested using agricultural and climatic data combined with GIS and remote sensing techniques. These approaches enable the establishment of an ideal agroecology system that considers all these elements comprehensively.

Occurrence of affirmative NDVI values shows good plant life situation

Relevance and Recommendations

Knowledge of available environmental resources and the interactions that occur in the area below the soil surface, the soil–air interface and the boundary layer of the atmosphere provides essential guidance for strategic agro meteorological decisions in long-range planning of agricultural systems. This applies to both favorable and unfavorable conditions – and these may vary a great deal. Typical examples are the design of irrigation and drainage schemes, decisions relating to land-use and farming patterns, and within these choices, selections of crops and animals, varieties and breeds, and farm machinery.

Agro meteorological information should be distributed to all users, including: (a) Agricultural administrations; (b) Research institutions and laboratories; (c) Professional organizations; (d) Private crop and weather services;

- Government agencies; (f) Farmers, ranchers and foresters.

Recommendations

- Arrangement of Agroclimatic observatories have to be improved. Currently, the system of surface weather stations of IMD in the district is limited; however, it has fine figures of rain gauge locations. Therefore, around is vital need to provide a better depiction of temperature and rainfall changeability over the district climate change situation.
- Primarily crops are extra susceptible to small conditions inconsistency somewhat than lengthy period climate changes, the confrontation of climate inconsistency on crops has to be recognized. Comprehensive analysis is necessitating being aware of the little and extended periods possessions of climate change for the growing of particular crops.

A number of following explanations will be helpful for enlarge agricultural outcomes in different agro- climatic zones.

- Development and finishing of main and small irrigation amenities within the definite phase of period.
- Dry cultivation methods can be practiced in drought prone areas.
- The uniformities of land possessions would be approved.
- Up gradation in conventional cropping pattern and replacement of crops as per the adaptation of specific agro-c1imatic characteristics.
- Market and bank amenities, HYV's, and organization of agricultural service centers at tahsil centers would be rewarding to improve up agricultural growth.
- Improvement of Floriculture, Horticulture, Greenhouse farming and traditional forest based medical crops plantation.

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