Sustainable Development Practices using Geoinformatics

Edited by
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Scrivener Publishing

WILEY

Table of Contents

List of Illustrations

Chapter 1

List of Tables

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This edition first published 2021 by John Wiley & Sons, Inc., 111 River Street, Hoboken, NJ 07030, USA and Scrivener Publishing LLC, 100 Cummings Center, Suite 541J, Beverly, MA 01915, USA

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Library of Congress Cataloging-in-Publication Data

ISBN 978-1-119-68711-5

Cover image: cyber background - Sergey Gavrilichev | Dreamstime.com planet earth - Alexandr Yurtchenko | Dreamstime.com

Cover design by Kris Hackerott

Set in size of 11pt and Minion Pro by Manila Typesetting Company, Makati, Philippines

Preface

The sustainable development refers to the qualitative and quantitative stability in the use of natural resources. It involves equilibrium between anthropogenic activities as influenced by social activities, acquired knowledge, applied technology, and food production. Sustainability attempts to address the issues such as resource degradation, deforestation, ecosystem loss, and environmental deterioration from global to local scale. The sustainable use and management of essential natural resources cannot be done without considering the direct and indirect impacts of human. It is required to apply an interdisciplinary approach in order to ensure long-term conservation of natural resources and its sustainable use at ecological and socioeconomic perspectives.

Geoinformatics, including Remote Sensing (RS), Geographical Information System (GIS), and Global Positioning System (GPS), has tremendous potential to effectively monitor the natural resources and addressing the concerns related to sustainable development and planning of society. RS is a quick and cost-effective technique to measure the location and spectral properties of earth surface features in comparison to traditional ground-based surveying. It provides reliable geospatial information for comprehensive sustainable development plans, policy making, and decision. GIS is a computer-based system used to digitize remotely sensed data matched with various ground-truth data, which are geo-coded using a GPS. It is able to manipulate, analyze, and display spatial database. Applications of Geoinformatics include land use change and planning, agriculture and soil, water resource management, forest resource mapping and

management, glacier mapping and monitoring, climate change, disaster management, and many more.

Sustainable applications of Geoinformatics have become more essential in understanding various characteristics of Earth surfaces with the launch of Landsat mission in the 1970s. Many studies of direct relevance to the sustainable development and management have been reported. However, few studies have been reported using the harmonized approach of core science and research basics, as there are larger concerns of capacity building to use Geoinformatics in sustainable development practices and management. This could be overcome by taking the advantages of Geoinformatics into consideration to the scientific and research communities. The book entitled “Sustainable Development Practices Using Geoinformatics” contains chapters written by well-known researchers, academicians, and experts. The potential readers of this book are scientists, environmentalists, ecologists, policy makers, administrators, university students, urban planners, land managers, and professionals working in the field of sustainable development and management of natural resources.

In Chapter 1, multi-temporal Landsat images are used to investigate the change in variability of surface temperature in the Barasat municipal area, West Bengal, India. A correlation analysis is performed between Normalized Difference Vegetation Index (NDVI), and Land Surface Temperature (LST) to show the urban growth and its pattern and trend in relation to surface temperature variation. This study is very useful for investigating the changes in environmental condition due to human activity in an urban area.

In Chapter 2, attempts are made to estimate the geo-environmental hazards and risks in South Karanpura

Coalfield region using information on land use/land cover (LU/LC), aerosol optical thickness (AOT), precipitable water vapor (PWV), and temperature conditions integrated with socio-economic vulnerability using Geoinformatics approach. Most of the risk-prone zones are found to present in the vicinity of industry and mining areas with higher population density. This study provides a basis to allocate resources for risk mitigation, improve community preparedness, and prepare cost-effective emergency planning.

In Chapter 3, a co-polarized radar system is investigated for the estimation of soil moisture along specular direction. The data are collected by indigenously designed ground-based scatterometer system for 20°–60° incidence angles at steps of 10° in the specular direction for HH- and VV-polarizations at L-band. In this study, a hybrid machine learning algorithm combined with fuzzy inference system and artificial neural network called neuro-fuzzy inference system were evaluated for the estimation of soil moisture. The performance index Root Mean Squared Error (RMSE) was used to evaluate the estimation efficiency of the algorithm. This study is very useful for accurate and timely soil moisture estimation for agricultural practices.

In Chapter 4, a study is conducted for detailed morphometric analysis of Tapi basin using Geographic Information System (GIS) technique. Different morphometric parameters analyzed, *viz.*, stream order, stream length, bifurcation ratio, drainage density, relief ratio, drainage density, stream frequency, texture ratio, form factor, circulatory ratio, elongation ratio, etc., are calculated. The stream order of the basin is mainly controlled by lithological and physiographic conditions of the area. The present study will be helpful for sustainable water resource management and agricultural applications.

In Chapter 5, the demand for fossil fuels is increasing speedily with the rapid population growth and development. It is a leading factor of greenhouse gases emission, global warming, and climate change. There are some satellites are available to monitor the concentration of these gases in the atmosphere. This chapter described the importance and capacity of GOSAT satellite to observe and monitor the global distribution of carbon dioxide (CO_2). The kriging method is applied to analyze the global distribution of CO_2 during 2009 to 2020 for the months of December, January, February, and March.

In Chapter 6, a study is performed for micro-level planning and development of natural resources available in Jangal Aurahi village, Gorakhpur district, using high resolution satellite images like CARTOSAT-I, LISS IV merged, and DEIMOS. The basic objectives are to map, monitor, and manage existing resources, facilities, and infrastructures of a village. This kind of study will be very useful for the decision makers and planners to prepare the action plans for all the resources available within the rural area

In Chapter 7, land suitability evaluation has been performed for potato crop in the Sagar Island using multi-criteria decision-making (MCDM) and Analytical Hierarch Process (AHP) methods. To find out more accurate suitability for potato crops, the derived suitability zones for the have been veteran by compared criteria-based suitability map and present land-use map using weighted sum overlay techniques in spatial analysis method. The techniques employed in this study provide valuable information that could be utilized by farmers to choose the suitable cultivation areas for potatoes at local level.

In Chapter 8, a geospatial technology assisted overlay and index approach is applied to derive a landslide susceptibility zonation map for Western Ghats, India.

Different thematic layers responsible for landslide are developed in GIS platform. The sub-class weightage indexes are feed in to the respective thematic layer in the GIS platform to generate landslide vulnerability zonation map into very low, low, moderate, high, and very high categories. An accurate spatial mapping of landslide vulnerability is important for disaster mitigation and regional planning.

In Chapter 9, the underground mining activities may have devastating effect on the forest land and its soil. This chapter provided the review of existing information of the subsidence impacts on forest lands. It showed that there are reasonably impacts on the topography, hydrology, and soil properties of the area. These multiple impacts need to be considered at local level with particular concern to the interaction of subsidence disturbances with the forest ecosystems. This work can be useful to suggest appropriate adaptation strategies during subsidence for the suitable sustenance of healthy forest environments.

In Chapter 10, an approach based on GI Science is demonstrated for Morphometric analysis of Gomati watershed from the lesser Himalaya terrain in district Bageshwar, Uttarakhand. Several morphometric parameters are calculated and analyzed. The drainage density for Gomati river basin is found to be 0.81 km/km^2 which show the high runoff in the channels. The methods utilized in this study will be helpful for the planners and decision makers in the development and management of the basin.

In Chapter 11, water is an essential natural resource for human being. The adequate supply of water is of highest importance for survival. In this paper, water audit has been attempted for the campus of Birla institute of Technology, Mesra, Ranchi with case studies of two hostels. The water

audit is assessed lobby wise to conclude the gaps. Water harvesting potentials was assessed for the study area, and recommendations were made for water management and planning.

In Chapter 12, this study is conducted to analyze LULC changes during the period of 2006 to 2017 in Durg block of Chhattisgarh state, India using multi-temporal Landsat satellite imageries. Thematic layers and maps for the year of 2005 and 2016 (post-monsoon) and 2006 and 2017 (pre-monsoon) are prepared. A map is generated for LULC change analysis with the help of the intersection tool. The LULC categories showed changing patterns during the period. This type of study can be very useful for policy makers and planners for the management of land resources.

In Chapter 13, this study attempts to apply livelihood vulnerability index (LVI) for the assessment of the livelihood risks of the vulnerable communities because of climate change. The socio-economic vulnerabilities suggested by IPCC's three contributing factors such as exposure, sensitivity, and adaptive capacity of the region are taken into consideration. The study revealed that livelihood options in the region are limited and mainly dependent on agriculture and labor sector. The communities in the region are highly vulnerable due to changing climatic conditions.

In Chapter 14, this work is carried out for suitable site selection for the sustainable urban groundwater management in the Dhanbad Block in Jharkhand state, India. Different datasets such as Landsat 8 satellite image, DEM, Toposheet, and secondary data are used in this study. It facilitated to know the complexities of a dynamic phenomenon like suitability site sustainable water management, land use/land cover benefits, and urban

development planning pattern. The weights have been assigned to different layers as per the need for the acceptable site selection for the sustainable groundwater management planning.

In Chapter 15, this paper presents a study to detect changes in land use and land cover over a period of 30 years from 1988 to 2018 in the Kamrup district of Assam, India. Multi-temporal Landsat satellite images of year 1988, 1998, 2008, and 2018 are used in this study. The images are classified into different categories using visual interpretation and manual digitization methods. The change matrix approach is used for evaluating the net loss and gain of different land use and land cover classes. This study can be useful for sustainable urban management and land use planning in the region.

In Chapter 16, on May 03, 2019, a rare summer cyclone named "*Fani*" hit Puri, a small coastal town of Odisha, India. This cyclone resulted into the loss of 64 human lives and affected about 16.5 million people in 18,388 villages of the entire state. It also severely affected power, telecommunication infrastructure, and road services. The damage to housing has been extensive, particularly in the Puri district of Odisha. This examines how climate resilient houses with "Build Back Better" features can save valuable human lives through use of eco-friendly, durable, cost effective, and non-pollutant building materials.

In Chapter 17, disasters resulting in substantial loss of deaths, disruption of normal life, and the developmental process for years to come. This paper systematically describes the application Geoinformatics technique for disaster management. It has robust data handling capabilities that is ideal for disaster risk reduction, mitigation, and management from global to local scales. This technique is capable to create awareness to

dissemination of information during disaster mitigation, preparedness, and response as part of disaster management measures.

In Chapter 18, the food processing industries play a key role in economic development of any country. This work analyzes the locational factors how favored in rice mill clustering in Ernakulam district, Kerala state, India. The environmental concerns were identified through field and house hold survey in the select areas or panchayats of Kalady, Okkal, and Koovappady. The physio-chemical analysis of waste water effluent carried out revealed the organic and inorganic presence of the pollutants and its extent.

In Chapter 19, this study demonstrates the importance of the Digital Elevation Model (DEM) and satellite images for evaluation of drainage and extraction of their relative parameters for the Wainganga River watershed area of the Godavari River, India. Several hydrological parameters including drainage analysis, topographic parameters, and land use patterns were evaluated and interpreted. The climatic condition based on hydrological investigation, of the basin is characterized by hot summer from March to May followed by a rainy season from June to September using.

This edited book entitled “Sustainable Development Practices Using Geoinformatics” contains chapters written by prominent researchers and experts. The key focus of this edited book entitled “Sustainable Development Practices Using Geoinformatics” is to replenish the available resources on the topic by integrating the concepts, theories, and experiences of the experts and professionals in this field.

Acknowledgement

The completion of this edited book entitled “Sustainable Development Practices Using Geoinformatics” could not have been possible without the grace of almighty God.

We are grateful to Hon’ble Sunil Sharma, Chairperson, Suresh Gyan Vihar University, Jaipur for his encouragement and support. The words cannot express our indebtedness to Hon’ble Dr. Sudhanshu, Chief Mentor, Suresh Gyan Vihar University, Jaipur for his continuous guidance, expert suggestions and motivation during the completion of this edited book.

Special thanks are due to all the reviewers for their time to review the chapters. The editors would like to express heartfelt gratitude to all the members of editorial advisory board for their endless support and valuable instructions at all stages of the preparation of this edited book. We would like to mention the names of the members of editorial advisory board as Prof. M. S. Nathawat, IGNOU New Delhi, India; Dr. (Mrs) Tapati Banerjee, NATMO, Kolkata, India; Prof. Milap Punia, JNU, New Delhi, India; Prof. Rajendra Prasad, IIT (BHU), Varanasi, India; Dr. Devendra Pradhan, IMD, Government of India, New Delhi, India; Prof. Manoj K. Pandit, University of Rajasthan, Jaipur, India, Dr. Snehmani, SASE, DRDO, Chandigarh, India, Prof. Shakeel Ahmed, Jamia Millia Islamia, New Delhi, India; Prof. Suresh Prasad Singh, Himalayan University, Itanagar, India; Mr. Peeyush Gupta, NMCG, Ministry of Jal Shakti, Government of India, New Delhi, India

To all the colleagues, friends, and relatives who in one way or another shared their constant and moral support. The