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Forest cover change detection through modern applications and its environmental impacts, A review

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Abstract
There have been tremendous change in the global forest cover in the past 50 years, which has directly or indirectly exerted significant impact on the global environment change. Quantitative analysis of forest cover change in a regional area is formulated by remote sensing and GIS from past four decades throughout the globe. The core scientific issues to quantitatively analyze are the major environmental problems alarming globally. This paper widely analyzed the importance of the healthy forest cover of a region, and then it shows the effects which progressively introduce the forest cover change. The vital role of monitoring the cover change has been conducted by the Remote Sensing and GIS. The primary scientific issues about the impacts of forests cover change on the regional climate and reviewed the progress in relevant researches. Finally, this paper discussed the application of the Remote Sensing using to detect the forest cover change and its regional impacts.

Keywords: forest cover change, remote sensing, forest degradations effects, environmental impacts

Introduction

Forest means the large expansion territory that is mainly dominated by various types of trees and other shrubs. The forest survey of India (FSI) defines a forest cover. Forest is an important natural component that maintains the environmental and ecological balance (Liu *et al*., 2020; Yuan *et al*., 2020) by preventing unwanted climate change and keeping ecosystems balance between human beings, plants, animals, and other abiotic components. According to FSI, the forest is defined as the minimum 1 hectare of land area that covers more than 10% of tree canopy. Also Food and agricultural Organisation (FAO) has systematically defined that the land has at least 0.5 hectare area, minimum tree height should be 5m and covered with 10% tree canopy. With evolution of time, the definition of forest cover varies from country to country. According to Global Forest Resource Assessment (GFRA), the tropical region is being faced highest rate of deforestation due to very high population density along with high human interference over nature and natural resources in comparison to other climatic regions across the world. Forest plays a vital role in regulating climate change through sequestering atmospheric carbon dioxide and mitigates global climate change (Deng *et al*., 2013; Geng *et al*., 2015; Lark *et al*., 2017; Gibson *et al*., 2018; Ru- Mucova *et al*., 2018; Lei and Zhu, 2018) [2, 3, 4, 5, 6]. Some significant research has been done to investigate the extent of land use land cover change (LULCC) in several countries at various times. (Fokeng *et al*., 2019) [8] forest is the most threatened by anthropogenic driven deforestation investigated from the existing land use land cover class.

Keenan *et al*., (2015) [9] determined decline at global level, in forest area by 3%, from 4128 million hectare in 1990 to 3999 million hectare in 2015. Annunzioin *et al*., (2015) [10] predicted that forest area is expected to continue in declining with distressing rates in some regions. Fortunately in some places the forest coverage is slightly increased with new plantation by natural or manmade, while in other places the forest coverage indicate a declining trend.

A forest cover change analysis was conducted in Google Earth Engine using a classification of Landsat 8 imagery with ground-truthed land cover points as training data. A multi-layer perceptron neural network model was performed to expect the potential spatial patterns and magnitude of forest loss based on the regional drivers of deforestation. The assessment indicates that the agricultural frontier will continue to enlarge into recently untouched forests, as well as predicts a decrease from 75.0% mature forest cover in 2016 to 71.9% in 2026 (C Voight *et al*., 2019) [45].

Deforestation increases flooding mainly for two reasons. First, The ‘sponge’ fills up earlier in wet season, causing additional precipitation to run off and increasing flood risk with a smaller ‘tree fountain’ effect, soils are more likely to be fully saturated with water. Second, deforestation often results in soil compaction unable to absorb rain. The potential of flash flooding caused by faster response of stream flow of rainfall (Chomitz *et al*., 2007) [11].

Objectives

- To review the main causes of forest cover change
- To cumulate the techniques used in detecting the forest cover change.
- To review the impacts on environment and sustainable development of forest cover change.

Methods

The methodological approach formulated in this publication was peer reviewed significant synthesis articles and related literature. The selection of literature was mainly based on Google search engines and platforms from Research Gate, Google Scholar, Web of Science, Science Direct, and many other national and international scientific journals and publishing websites. Moreover, citations in key papers were followed to categorize additional relevant publications. This review did not coat every aspect of the natural resource management and degradation literature but paying attention on publications of most appropriate ones. As general peer-reviewed papers, source material, institutional publications, and very few unpublished sources (related Ph.D. dissertations and MSc theses) were incorporated. Though, the peer-reviewed papers and chapters ones were given higher priority in determining the conclusion of the paper, while unpublished sources served as background material and other sources of supplementary reading.

In searching English-language several keywords were used on electronic papers available up to the end of July 2020. These includes afforestation, agroforestry, conservation, conservation agriculture, consumption pattern, afforestation, climate change, environmental degradation, environmental communication, degradation, ecotourism, forest, global warming, natural resource, population growth, livestock, resource, resource use conflict, environmental pollution, management, resettlement, lifestyle, land, water, soil, rangeland, urbanization, forest cover, population growth in kupwara, natural resource degradation, reforestation, resource conflict and Wildlife.

As a result, more than 1140 papers were retrieved from the search hits. From these, a total of 270 papers were used for review and synthesis. Finally, by only 155 papers which includes original research articles (n = 106), conference proceedings (n = 5), policy documents (n = 2), and organizational reports (n = 21) reviews (n = 19), books and book sections (n = 14), and working papers were reviewed and combined.

Forest cover change impact on environment

The forest cover change, including forest disturbances, forest degradation, reforestation, and afforestation are serve major key factors in global environmental change (Ghanem *et al*., 2020; Mohamed *et al*., 2020). A reduction in forest cover area can occur through either deforestation or natural disasters whereas, an increase in forest cover area occurs either through afforestation or natural expansion of forests could relatively within a short period. Earth's terrestrial biodiversity is one of the crucial elements in forest cover change. Agricultural expansion, deforestation and forest degradation are significantly contributes to loss of biodiversity. The decrease and increase forest cover area contributes a large scale changes on environment throughout the world. Thus, characterizing and mapping of forest cover change is essential in sustainable global environment management.

Different countries are experiencing a problem of forest depletion because of agricultural expansion, timber logging, charcoal production and firewood harvesting (Erena *et al*., 2011; Declee *et al*., 2014). Forest cover change is is seemed as strongest driver of climate change and variability (Li *et al*., 2016; Winckler *et al*., 2019). LULC changes occurs due to the horticulture, sparse forest, built-up, pasture and barren land and their relation with the atmosphere in the region of kupwara (Meer and Mishra 2019), were significantly decreased the water body and dense forest over the study area. The decline in the area of dense forest, incline in the area of horticulture attributes and an increase of black carbon may contribute to global warming. The increase in the global warming has disturbed precipitation patterns over study area (Rafiq and Mishra 2018; Mishra and Rafiq 2017). Multi-layer perceptron (MLP) neural network model and spatial variables predict the most vulnerable sites for future deforestation based on recent forest cover change in the Maya Golden Remote Sens., 2019, 11, 823 14 of 17 Landscape (Voight *et al*., 2019) [45]. The MGL has remained unique, if integral landscape covers 75% of mature forest. The MGL model prediction will continue to display an expansion of agriculture into mature forest with a decrease of mature forest cover to 71.9% in 2026. Most of the mature forest cover is expected to be lost in the community zone. The areas that have been de-reserved from MMNFR are some of the most vulnerable regions with a projected future forest cover of less than 30%, which may result in unsustainable landscape management. The earth's climate dynamic plays crucial role in global environmental challenges (INCCA, 2010) [39]. Today, anthropogenic activity drastically increases the rate of climate change through natural cycle. Climate change has now taken a threat to the natural resources and humanity.

Climate change is a significant phenomenon as it is the cause of population discomfort (Rosmini and Saharuddin, 2015). Earth surface temperature change is the most significant impact of climate change. United Nations Organization (UN) and the World Meteorological Organization (WMO) have set up an institution called Intergovernmental Panel on Climate Change (IPCC). According to IPCC 2007, average rise of temperature is 2 °C to 3 °C per year. An increase of Earth's ground albedo, change the surface heat flux and the surface roughness, which may cause the decrease of precipitation and increase of temperature of the environment. However, General Circulation Model has been used to check local climate change in response of radiation on land surface, wind circulation and convection. Local climate changed is associated with change in energy equilibrium of the surface, which results changed in local and atmospheric circulation. To evaluate local land use planning capacity to climate change, the climate policy were extended to local land use level (Zhenghong *et al*., 2009) [41]. Local land use plan policy can mitigate the greenhouse gas (GHG) emissions, adaptation by adjusting land use activities and practices. Thus, its' impact associated with climate change can be overcome or reduced. In Godavari delta region, analysis of climatic data from 1970-1998 revealed some changes in climatic conditions resulting land use change (Sarma *et al*., 2001) [42]. However, Himalayan region revealed that the land cover change is accelerated by climatic change (Rawat *et al*., 2012) [43]. Land cover change is responsible to climatic change and causes socio-economic risk as well as environmental effects. GIS database management system provides land use information and climatic information.

Surface temperature can varies due to urbanized surface to agricultural land, grassland, forest cover, barren land, water logged area etc. (Weng *et al*., 2004) [40]. In urban area morphology defines building materials, density of the building and geometry of the building in a particular area, which play a significant role in variation of temperature. Albedo surface roughness length of the ground was changed with deforestation, degeneration of agricultural land and grass land. It is important to identify gaps between the local action plans, local land use plans and proper action plan for better land use for better climate. Changes in forest and forest ecosystem are also due to continuous and long-term succession. Different biotic and abiotic factors such as extreme weather conditions, anthropogenic pollution, and pathogens like fungi or insects are results of forest cover decline (Wild *et al*., 1996; Tausz *et al*., 1999) [13, 23, 14, 24]. Kharol *et al*., (2008) reported the emissions from forest fires using Multi-Satellite datasets over North East Region of India, tropical biomass burning and aerosols emissions into the atmosphere play a vital role in atmospheric perturbation and climate change. Iran under a warmer climate, the global climate impact is expected due to more fire weather, increased burned area, and longer fire season.

Banerjee and Madhurima, (2013) [17] assessed the degradation of forests leads human rights issue to dependent communities. Using secondary data, the momentum and extent of multifaceted plight leads forest degradation. Among various definitions of deforestation, it identifies that man-made deforestation either by ever increasing demand or by overexploitation as the most challenging one. The reduction in quality and quantity of resources, services associated with dependent community and the continuous increase in the emission of greenhouse gases has intensified the livelihood. This review mainly focused on framing proper benefit sharing mechanism in order to overcome the livelihood issues in REDD+ and to conserve the degrading forest cover.

Mechanism of forest covers change

Detecting forest cover change with time has become increasingly important in making decision to manage environmental resources (Kiswanto and Mardiany 2018; Mensah *et al*. 2019). Characteristics of extent and pattern of land use land cover change (LULCC) is an important supporting tool indicating the coverage or decline trends of forest cover area. The world's population is increasing, for instance, in 2015 the world population is about 7.3 billion, and expected to reach 9.7 billion in 2050, and 11.2 billion in 20100 (UN 2015). Thus, forest cover area is converting to meet the demand of growing population (Salghuna *et al*. 2018; Pellikkaa *et al*. 2018). In some places the forest coverage is slightly greater than other forest covered places. For instance, the temperate forest area increased at a rate of 2.2 million hectare per year where as tropical forest area decreased at a rate of 5.5 million hectare per year while (Keenan *et al*. 2015) [9]. Healy (2015) indicates 36.6% decreased forest area with 16.1% decrease in number of forest patches. The cause of Komto protected forest loss was analyzed by settlements, agricultural activities, cutting of tree for wood, charcoal, furniture, and construction purpose (Erena *et al*. 2011; Dinkayehu, 2006; Degife *et al*. 2018). This declining trends of open forest are associated with agricultural expansions, illegal timber exploitation, illegal harvesting from the natural forest area and charcoal production (Islam and Sato, 2012; Kissinger *et al*., 2012; Hishe *et al*., 2021). Different biotic and abiotic factors such as extreme weather conditions, anthropogenic pollution, and pathogens like fungi or insects resulted into the decline of the forest cover (Wild *et al*., 1996; Tausz *et al*., 1999) [13, 23, 14, 24].

The kupwara region experiences 35.41% increase in horticulture. The horticulture alone carried important cash crop to generate six times more income than crop in agriculture system (Meer & Mishra 2019), which has led forest degradation faster than agriculture crops. Fragmentation and anthropogenic activity degrade forest connectivity in between landscapes that causes biodiversity decline (Yadav *et al*., 2012) [19]. Khan F., *et al*., (2012) [18] determined the land cover change and urban expansion during 2006 to 2011 (within 5 years) in Rangareddy District, Ghatkesar Mandal by adopting remote sensing techniques (RST), which caused forest cover change. Most ecosystem service research has been conducted in rural agricultural, forest environments, and around marine resources. Now, a major global research agenda of scientists is to understand the mechanisms of land change and ecosystem services in forest cover change. In India according to the State of Forest Report 2003, forest cover is 67.83 M ha covering 20.64% of the geographic area with 13 per cent of the national loss (728 sq. km) of forest area (Sulaimani, 2008) [25]. Last two years, Gujarat has lost approximately 100 square kilometers (sq. km) of forest area due to human activity. The FSI report emphasized the human activity to green cover loss. Furthermore, increasing population pressures are taking a toll on the state's forest cover. Over the last few decades, the increasing population and consequent dependence on plant products have led to over exploitation of natural flora and fauna of this region (Ram *et al*., 2004) [21]. Besides human intervention, long-term succession continuous causes the changes in forest and forest ecosystem. Kumar *et al*., (2004) [21] studied various changes in the Himalayan Forests which are appearing in their density, structure, composition and regeneration due to biotic pressure of cutting of trees for wood fuel, uncontrolled lopping and fodder and grazing. Forest diversity is the main livelihood source to people in the state of Uttarakhand. The forest biomass is removed through grazing, lopping and surface burning year round and plants often do not get enough time to recover (Singh, 1998) [22].

Population growth contributes to deforestation directly by raising the demand of energy, land, and food. Ample of literature fails to even consider the role of fertility and natural population growth in situ on the loss of forest cover (Bilsborrow *et al*., 2001).

Table 1: Paper reviewed to get the main causes of forest cover change.

S. No	Main causes found in peer reviewed journals	Number of papers reviewed
1	Fragmentation and anthropogenic	23
2	Urban expansions	14
3	Deforestation and grazing	66
4	Increasing population	42
5	Natural and human induced changes	39

Forest cover change detection techniques

The detection of forest change was done through integrated GIS and RS geospatial technologies. New imaging sensors and geospatial integrated technologies has been created to detect, map and monitor forest resources. Forest change detection involves the use of multi-temporal datasets to discriminate areas of land cover change between dates of imaging (Adia and Rabiu, 2009). Singh (1986) observed the images of change detection by identifying changes in the state of an object at different times. According to the IGBP/IHDP (1999), change detection defines in terms of (i) pattern of forest cover change, (ii) processes of forest cover change, and (iii) human response to forest cover change. Understanding the use of remote sensing data in in monitoring and changing pattern extent of forest cover is an important supporting technique for decision making processes (Armenteras *et al*., 2019; Abebe *et al*., 2019; Yan *et al*., 2018; Tolessa *et al*., 2017). Spatio-multi temporal dynamics includes forest disturbances, forest degradation, reforestation, and afforestation, which discriminates area of land cover change between dates of imaging. Forest change detection pattern analysis use LULCC such as dense and open forest, agricultural land, grassland, and settlement (Miller *et al*., 1998). It provides accurate means of measuring the extent and pattern of changes over a period of time (Kiswanto and Mardiany 2018; Mensah *et al*., 2019).

This is important of mapping the pattern change of LULC because it reflects socio-economic change associated with widespread environmental problems and thus, detection and monitoring of such changes is important to reduce changes of forest cover in developing countries at the national and international levels (Bernard *et al*, 1997). Landsat imagery preprocessing and supervised classification methods were performed for forest cover change detection techniques following (Churches *et al*., 2014; Wu *et al*., 2017; Lu and Weng 2005; Lillesand *et al*., 2004), which involves the use of multi-temporal datasets to discriminate areas of land cover change between dates of imaging (Garai and Narayana 2018). Change detection involves the use of multi-temporal datasets to discriminate areas of land cover change between dates of imaging. Degife *et al*. (2018) studied that FGDs of Komto forest cover change was declined due to settlements, agricultural activities, cutting of tree for wood, charcoal, furniture, and construction purpose. different techniques has been used to detect the cover change over a period of time such as aerial photographs, satellite images, long term land cover mapping and remote sensing. The Instituto Geografico Militar (IGM, Quito, Ecuador) has aerial photographs of the country covering the period from 1942 to the present. Its archive contains about 150 000 images at different scales. Satellite imagery is a useful unbiased space borne photography as it detects the changes of land coverage in a periodic repetitive manner. Thus, forest cover changes and damages are eventually assessed by applying remote sensing technology (Zeng *et al*., 2020). Recent decades, A multi-source data integration strategy was used for land cover change mapping to reduce the imprecision and inconsistencies in the result. Five land cover types were defined: agricultural land (AL), alpine cloud forest (ACF), sub-alpine cloud forestand shrubs (NR), páramo grasslands (P), and pine plantations (PP).Due to a high spectral similarity between “sub-alpine cloud forest”. Among all technologies, remote sensing Remote sensing technology is an important new source of data that offers accurate geo-referencing information for harvest and analysis with comparatively low-cost but faster precise results (Lein, 2011).

Remote sensing relationship with forest cover

Since decades, remote sensing (RS) has been used to map forest change and quantify the corresponding climatic effects (Petropoulos *et al*., 2015; Chew *et al*., 2016; Sekertekin and Bonafoni, 2020). The spatial and temporal characteristics of land cover change map are measured easily by using remote sensors. Satellite remote sensing is viable means to, map, assess, and monitor forest cover at a range of spatial and temporal scales. However, remote sensors offer a quick, and low cost way to map and to monitor deforestation, logging, and other disturbances, as well as the recovery of forests in 1000 of acres per day (Lein, 2011). This is a potential technology for inventory and monitoring of world’s natural resources (Goetz and Dubayah, 2011; Sharma *et al*., 2021). Earth observation satellites data allow us to understand global forest loss and gain. Satellite remote sensing associated with spatial and temporal mapping to observe repeated and consistent local effects of forests from a global perspective at high resolution that leads to improve our forestry policy outcomes. Among other

branches, thermal remote sensing is the one that deals with Thermal Infrared (TIR) data of the Electromagnetic (EM) spectrum (Al-doski *et al*., 2016; Messina and Modica, 2020). Thermal remote sensors capture ground emits radiation to analysed the large scale temporal and spatial land surface temperature (LST) from local as well as global levels (Sekertekin and Bonafoni, 2020; Wan Mohd Jaafar *et al*., 2020). Remote sensing widely uesd inmulti-temporal datasets analysis (Dalmiya *et al*. 2019; Stehman and Foody 2019). Othow *et al*. (2017). Remote sensing change detection techniques used to analyze the rate of LULCC with special emphasis on forest cover change in Gog district of Gambella Regional State in Ethiopia (Zhu *et al*. 2014).
LULC classes of northern district Kupwara of Jammu & Kashmir were used integration of remote sensing (RS) and geographic information system (GIS) onscreen digitization techniques on scale 1:30000 as shown in Fig.1. The classes are categorized into Dense Forest, Pasture, Plantation, Agriculture, Horticulture, Barren land, Built-up, Scrub, Sparse forest and Water Body. A significant decrease in the area of dense forest, agriculture and water body has been experienced. However, a significant increase was seen in the area of Horticulture, Barren land, Built-up, Pasture, Plantation, Scrub and Sparse Forest. The area of dense forest, Agriculture and Water body underwent a significant decrease of 38.344%, 28.706% and 25.842% from 1979 to 2018 respectively. An increase in sparse forest, Horticulture, Barren land, Built-up, Pasture, plantation and Scrub with 45.789%, 35.407%, 9.05%, 206.22%, 29.693%, 319.226% and 61.272% respectively. Since 1979 to 2018, the agriculture area is reduced 38.34%. In study area, 1% precipitation is attributed a significant decrease in agriculture from 1980 to 2018 (Rafiq *et al*., 2018) [47].

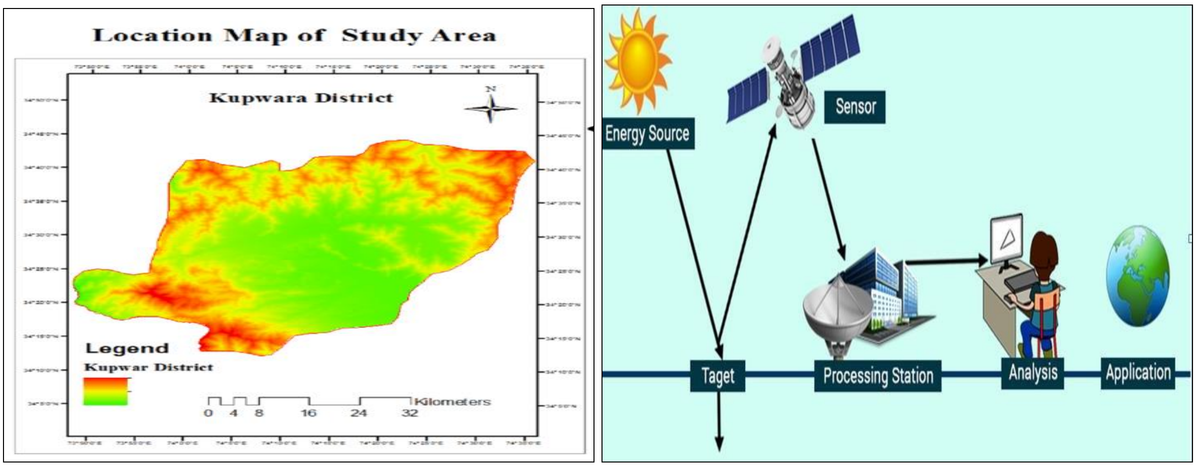

Fig 1: Remote Sensing Relationship with Forest Cover.

Satellite imageries of 1986, 1991, 1996 and 2001 were used to identify the land use patterns between the period 1986 to 2001 (Wu *et al*., 2006) [8]. RS and GIS were integrated to investigate the land use change dynamics of Beijing city, China. During the period of intense loss of the cropland in the study area rapid urban growth was detected. The process of land use change was unstable from 1986-2001 hence, degrade the land and forest cover of that area. Estimated regression model coefficients are applied to project the urban land area of Beijing for 2021. They concluded that if unchecked such unstable and rapid land use change will aggravate the environmental issues faced of Beijing. Singh and Dubey (2012) [12] concluded that the Land Use and Land Cover mapping have great significance in scientific research, in planning and in management. Regional land use pattern represent the character of interaction between man and environment, which influence the resources based on mankind's basic economic activities. Remotely sensed satellite images provide synoptic coverage & overview of the whole region. It provides coordinate relationship among transportation, residential, industrial and recreational land uses, besides providing broad-scale inventories of natural resources and monitoring environmental issues, including land reclamation, restoration, disaster management, water quality and, economic development plan. Land Use Land Cover maps help in planning to use effective and best possible way. Besides, providing a comprehensive view of the total area Land use/Land cover, utilization of its resources has been mapped through satellite imagery to uses forest land, land under cultivation (agriculture land), land not suitable for cultivation (barren or rock land) and land not available for cultivation (settlement/urban built up etc).Integrated remote sensing and GIS data could be used mutually to map and model forest conservation and modification (John Rogan and Jenifer Miller, 2006) [29]. An overview on how enhanced measurement of natural resources facilitated by remote sensing data and GIS data was provided by R K Bajpai *et al*., (2006) [30]. It might prove invaluable to forest management with importance on development made during the last one decade. They also highlighted the essential role of forest survey of India (FSI), which facilitates the tools and methods for batter accuracy data results. Jiwai *et al*., (2008) [31] proposed a spatial data mining system of prototype geo-miner which included three kinds of rules: comparison rules, characteristic rules, and association rules in geo-spatial databases. The integration of '3S' industrial technologies and methodology system have highlighted forest resources management (Yuan *et al*., 2008) [32]. It forms a dynamic monitoring technological system of forest resources with aerospace and aviation, remote sensing and ground survey. Dian *et al*., (2009) shows spatial data mining and data discovery contributing in geographic knowledge discovery such as Environments and Urban Systems.

In Ethiopia, remote sensing satellite imageries, aerial photographs and field data were used to analyze the dynamics of landscape transformation and settlement over a period of 56 years from 1957-2013 (Wondie *et al*., 2016) [26]. The forest cover and other land classes were recorded decrease in their areal coverage, while cropland had experienced a rise during the period of study. The exponential growth of population has decreased the average cropland holding size per family from 2.6 to 1.1 ha. Thus, it incorporates the scarcity of food and energy in that reduced area, which emphasizing the need for better policy and land management. Campbell and Wynne, (2011) [34] analyzed the context of digital remotely sensed data, radiometric and geometric preprocessing for preliminary atmospheric effects of a hazy. Geometric preprocessing is the vital part of image processing because it can geo-coded all the raster and vector data with a single coordinate system and overlaid each other.

Pandey (2012) [35] examined the RS and GIS techniques improve the preparation of development plans based upon various natural resources information. The information system created using RS and GIS-based methodologies facilitate to work out in generating an alternate planning scenario for sustainability of the urban environment. Prakasam (2010) [36] studied the changes in land use and land cover in Kodaikanal, Taluk over 40 years period (1969-2008) using remote sensing approach using SOI Taluk map of Kodaikanal (1969), and Land Sat imageries of May 2003 and April 2008. The GIS software was used to prepare the thematic maps. Ground truth observations were performed to check the accuracy of the classification.

Sahoo, S. (2013) [37] reported the urban LULC changes that have been taken place in Howrah city, India, for the last two decades due to rapid urbanization. His work mainly emphasizes on an understanding of LULC change detection analysis using LANDSAT (MSS in 1975, TM in 1989, and ETM+ in 2000) and LISS-III (2009) high resolution imagery for the 34 years' time span. Unsupervised classification techniques have been utilized for delineating five different classes: agriculture land, built up, vegetation, water body, and wetland. LULC changes suggesting an impervious surface of spatial change is a useful indicator of identifying spatial extent, intensity and potentially type of urban land use and land cover changes. It is inferred that land changes were analyzed in this area mainly in form of built-up land during the specified time period.

Jaiswal *et al*., (2013) [38] used satellite imageries to find out the changing pattern of land use during three cropping seasons *viz*. Rabi, Kharif, and Zaid of 2005-06 and 2011-12 in Varanasi District (U.P). In the study Geo coded ortho-rectified IRS P6 LISS-III (Resourcesat-I) satellite image of Row 54 and path, 102 are used.

Conclusion and future prospects

This paper reviewed concluded the execution of advance of the Remote Sensing technology to monitor the forest cover change as well as influence of forest change cover on the environment. The main findings are summarised as: A large number of researches have been documented the importance of healthy forest area and its effects on environment. Besides, the bio-geophysical and biogeochemical effects of large-scale, LUCC have also been studied. But the relevant researches on their mechanism have generally discussed the bio-geophysical and biogeochemical effects. The regional climate models have high resolution, which are widely used in the research to reflect the characteristics of local forcing climate and land use changes, for example, the deforestation in the tropic zone, desertification, irrigation of the cultivated land, and urbanization.

Although there have been many researches on the remote sensing monitoring the forest cover change, the relevant researches on the mechanism of forest cover change and its rate of change has been done by remote sensing. Therefore, the forest cover of regional area of different years is checked by many researchers. It not only requires the mathematical-physical models that can effectively simulate the interaction between the land surface and the atmosphere, but also needs to improve the observation techniques so as to recognize the essence of the land surface process and provide the reasonable initial value parameters for the mathematical-physical models.

Forest degradation measuring and monitoring at the national or sub-national scale is a challenge, and it can be more costly and time-consuming than assessing deforestation. A combination of remotely sensed data and on-the-ground forest inventories will provide the most consistent estimates. For assessing degradation remote sensing can be used as a cost-efficient option through proxies such as canopy cover percentage (with a decreasing trend implying degradation). Focused field surveys (e.g. biometric field observations, rapid rural assessments and biodiversity assessments) can be implied in areas where remote sensing has detected degradation to gain a more nuanced appreciative of degradation trends and their causes and possible solutions.

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