International Journal of Research in Advent Technology, Vol.6, No.6, June 2018
E-ISSN: 2321-9637
Available online at www.ijrat.org

Assessment of Land Degradation and Desertification due to Migration of Sand Dunes – A Case Study in Bommanahal Mandal, Anantapur District, Andhra Pradesh, India using Remote Sensing and GIS Techniques

Pradeep Kumar. B[1], Dr. Raghu Babu. K[1*], Rajasekhar.M[1], Ramachandra.M[1], Siva Kumar Reddy.P[1]
[1]*Department of Geology, Yogi Vemana University, Kadapa, Andhra Pradesh, India.*
**Corresponding author: dr.kraghu@gmail.com*

Abstract- A new analysis of satellite images shows that nearly 32 percent of India's agriculture land is turning into desert, and the rate of soil degradation is increasing at an alarming rate. A report by the Indian Space Research Organization (ISRO) says that land degradation now affects 96 million hectors or 30 percent of India's agricultural lands effected by this problem. Most of this degradation was happening in the states of Jharkhand, Rajasthan, Delhi, Gujarat, Goa, Maharashtra, Jammu and Kashmir, Karnataka, Odisha, Madhya Pradesh, Andhra Pradesh and Telangana. Of these, the first five is facing desertification in more than 50 percent of their total area. For desertification is related to more than urban growth but also to climate change and it's a serious threat to environment. The present study deals with the identification of decertified areas and mapping and assessment of desertification and land degradation areas in Bommanahal Mandal of Anantapur district which was falling in the semi-arid regions of Andhra Pradesh state. The main goal of this work was to identify the areas that are more suitable to migration of sand and sand dunes causes desertification in a part of Bommanahal Mandal of Anantapur District, Andhra Pradesh state by using Geospatial techniques like Remote sensing and GIS. Anantapur District facing most of the land degradation problem mainly in Bommanahal and Kanekal mandalas. It's an emergency to ameliorate the environmental conditions in the affected villages by taking the actions like reduce surface wind speeds so that the sand is not carried in the affected villages further, and thus prevent the spread of the sand affected area. Rehabilitee moderately or severely decertified lands for productive utilization. Promote measures to prevent soil erosion and enable soils to retain more moisture regenerate more greenery and contribute to increased biomass productivity.
Key words: Degradation, Desertification, Geospatial techniques, Migration, Remote sensing, GIS.

1. INTRODUCTION:

Desertification or land degradation is a continuous process. The Nairobi conference of UNCOD (United Nations Conference on Desertification) describes desertification as the diminution of the biological potential of the land, which can lead to desert like condition. Most accepted definition for Desertification is "land degradation in arid, semi- arid and dry sub-humid areas resulting climatic variations and human activities (UNCCD, 1994). Drought and desertification are the common features of arid and semi-arid regions. Land degradation occurs all over the world. The impact of land degradation is much related to environment (le Houerou., H.N., 1975). Degradation seriously affects the Ecosystem. Desertification happens many of the anthropogenic reasons like; deforestation, non-sustainable land use practices, improper agricultural management, road constructions, day by day increase in urbanization and other causes disturb the natural ecosystems. In extinct to this extreme weather conditions, climate change, frequent draughts are some natural causes of land degradation desertification (UN Conference on Desertification,1978).

The present study area Bommanahal Mandal of Anantapur district is fallen under the arid climatic region. In this area the main indication for desertification is migration of sand dunes by the many of the reasons like Aeolian process or by the winds

and some natural processes. There are five types of indications climatic, physical, hydrological, biological and socioeconomic Which may be used for desertification monitoring, assessment and prediction (P. S. Dhinwa. et.al-2016) Remote sensing and Geographical Information System (GIS) techniques have capability to provide reliable information for spatial modeling of assessment and mapping of desertification status of the study area.

2. STUDY AREA:

The study area Bommanahal Mandal of Anantapur District is the southern-most district of the Rayalaseema region of Andhra Pradesh. Anantapur district lies between 13° 40' and 15° 15' Norther latitude and 76° 50' and 78° 30' Eastern longitude.

Fig 1 represents the location map of the study area. It occupies a total geographical area of 305.88 sq.km. Anantapur district is bounded by Kurnool District in the north, Kadapa District in the north-east, Chittoor District in the south-east, and Karnataka State on the West. Being located in the rain-shadow region of Andhra Pradesh, the district is drought-prone. The district has a total geographical area of 19,130 Sq.Km.
Penna, Hagari or Vedavathi rivers are the important rivers of Anantapur district. Hagari River which flows center of the present study area of Bommanahal. The Hagari River takes its origin in the neighboring Karnataka state. It is an ephemeral (Seasonal) river and thus remains as dry during most of the year. It flows through Mandal's of Gummaghatta, Brahmasamudram, Beluguppa, Kanekal and D.Herehal in Anantapur District and enters Karnataka again. There is hardly any water to flow in the river. Water flows for a week or so even in very good rainfall year because of the construction of Bhairavani Thippa (BT project) Reservoir across Hagari at Andhra Pradesh, Karnataka borders wherever little water available for flow in the river gets impounded in the reservoir. Hence persistent dryness prevails in the river throughout the year. While agriculture remains the most important economic activity of the district, it is characterized by high levels of instability and uncertainty.
Anantapur district which falls in the rain shadow area of Western Ghats, in the interior of Deccan Plateau, is the one of the chronically drought affected districts in the country. The district with an average annual rainfall of about 520 mm is lowest in the state and is identified as the second driest part of the country, next to Jaisalmer. Anantapur experience tropical climate. The summer seasons continuous from March to May. The temperature of the district varies from 24 to 46° C. Most of the Soil types in Bommanahal Mandal are Black Soils and Red soils.

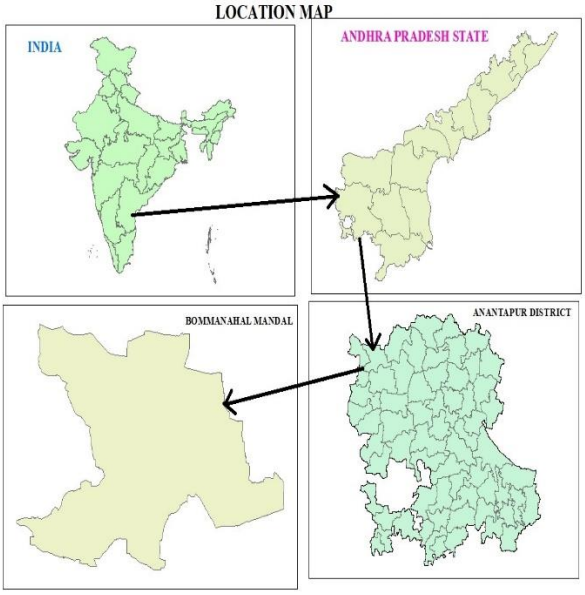


Fig 1: Location Map of the study area

2.1. Geology of the study area

Geological formations of the Anantapur district are mainly divided into distinct and well-marked groups: older groups of metamorphic rocks belonging to the Archean and younger groups of Sedimentary rocks belonging to the Proterozoic age. Fig 2 represents the geology of the study area. The major rock types present in the study area are usually felsic rocks, Hornblende – Gneiss, Hornblende – Biotite gneiss, grey and pink granites and quartzite's consist of Banded Magnetite Quartzite(BMQ)/Banded Iron Formation(BIF) ferruginous quartzite's which are shown in Geology map. The maximum study region overlying Hornblende-gneiss with Biotite gneiss. Some of the patches of ferruginous quartzite existing in the northwestern part of the study area and grey/pink granites are presented near components of southwestern part of the study area. (M. Rajasekhar.; et al 2018).

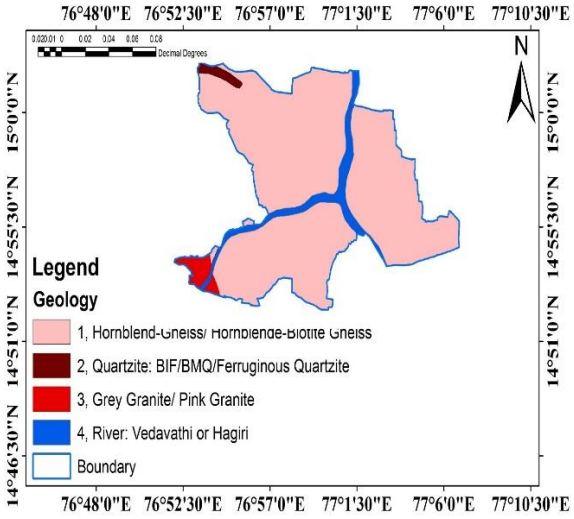


Fig 2: Geology map of the study area.

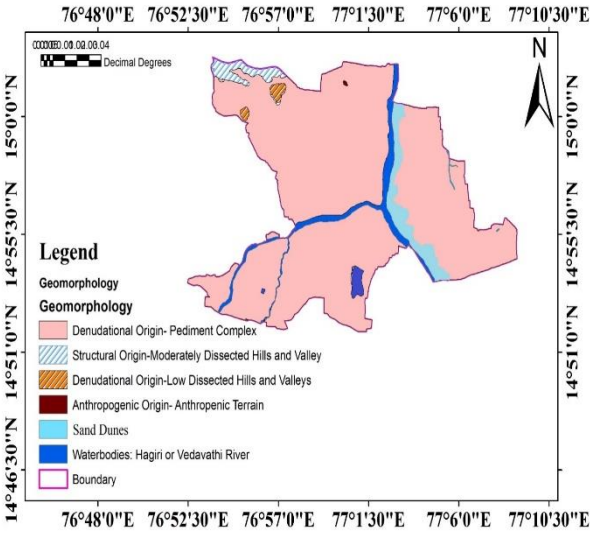


Fig 3: Geomorphology map of the study area.

2.2. Geomorphology

The study area Bommanahal Mandal is an evidence to show active geomorphic changes by the Action of Wind. Alluvium is seen along the course of the Hagari or Vedavathi River in the study area. Sand dunes or sand sheets are spread over the course of the Hagari River in study area. Sand dunes are migrated by the action of wind. There are five main types of sand dunes namely barchans, transverse, linear, blowout and composite dunes. Transverse and linear dunes are formed in Bommanahal area. Because of low rain fall in this area the soil type is sandy soil. This soil has a lower content of Nitrogen and organic matter with very high calcium carbonate and phosphate, thus making it infertile. The low moisture also means that silt and sand-sized particles are easily blown away, while the remaining particles eventually form a tightly packed layer known as desert pavement. Following fig 3 represent geomorphic features of the study area.

3. DATA AND MATERIALS USED

The Indian Remote Sensing (IRS) satellite data (IRS-P6) LISS-III was used to prepare desertification status map of Bommanahal Mandal of Anantapur district, Andhra Pradesh state. The following table shows the data used for the study area.

S.NO	Satellite	Sensor	Date acquisition
1.	IRS	LISS-III	Oct- 2008
2.	IRS	LISS-III	April-2015

3.1 Survey of India Topographical Sheets:

The following table shows the study area is covered by SOI topo sheets.

Topo sheet No	Scale of the toposheet.
57A/16, 57B/13, 57 E/4, and 57 F/1	1:50,000

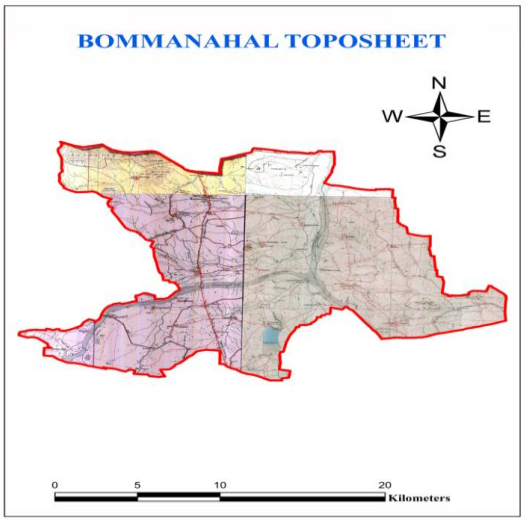


Fig 4: Topographical map of the study area

3.2 Software used

ERDAS IMAGINE 2014, ARC GIS 10.4

4. Methodology

This study aims to identify the sand migrated areas of Hagari/Vedavathi river in Bommanahal Mandal. Topographic Maps (Scale 1:50,000) are used as ancillary data for the preparation of base map. The SOI maps are georeferenced with longitude and latitudes, clip all the maps and finally done mosaic using Arc GIS 10.4 software and spatial analyst tools and demarcated the boundary of study area.

The required satellite imagery for the study area is to be downloaded from the BHUVAN. Nearly a decade of data has collected and processed. Before the preprocessing of Satellite imagery began, a sweeping field survey was done throughout the study area in and around the Bommanahal Mandal using GPS (Global Positioning System) this sweeping survey was conducted in order to attain accurate location (table-II) of sand dunes formed in the study area. IRS-LISS III (Indian Remote Sensing Satellites - Linear Imaging Self-Scanning Sensor-3) with 23.5m of MS resolution, which provides multispectral data in four bands. Detailed methodology shown in fig 4.

IRS-LISS III data collected in Oct-2008, April-2013, April-2014 and April-2015 were used to study the movement of windblown sands during the period 2008 and 2015, along the Hagari/Vedavathi river and adjoining villages Bollanaguddam, Kalluhola, Govindavada and D-Honnuru villages of Bommanahal Mandal, part of Anantapur district representing Semi-arid region of Andhra Pradesh. (Fig 5) The red color in the image along the stream shows Native vegetation. Different shades of color indicate different types of crops like paddy and cotton. Some of the sand dunes might stabilize because of cultivation (Amal Kar-2016).

SL.NO	NAME OF THE VILLAGE	LATITUDE	LONGITUDE	ELIVATION IN METERS
1	Bollanaguddam	14° 59' 42.2"	77° 02' 48.3"	432
2	Kalluhola	14° 58' 12.6"	77° 03' 09.6"	441
3	Govindawada	14° 56' 39.9"	77° 03' 20.2"	442
4	D-Honnuru	14° 54' 26.2"	77° 04' 49.2"	448

Table I: List of Villages facing desertification conditions and its coordinate's data:

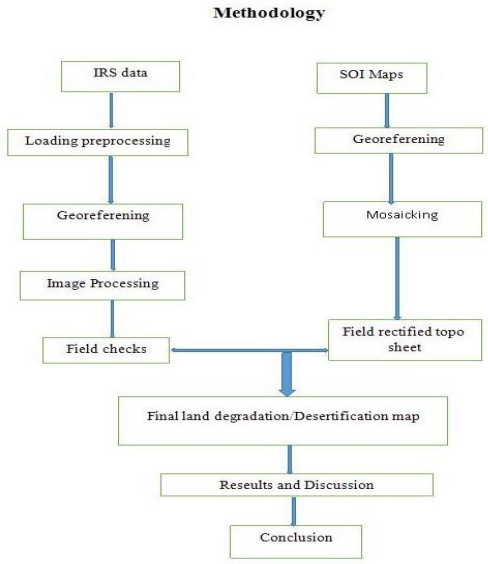


Fig.4. Methodology for Identifying the Sand and Sand dunes migrated areas

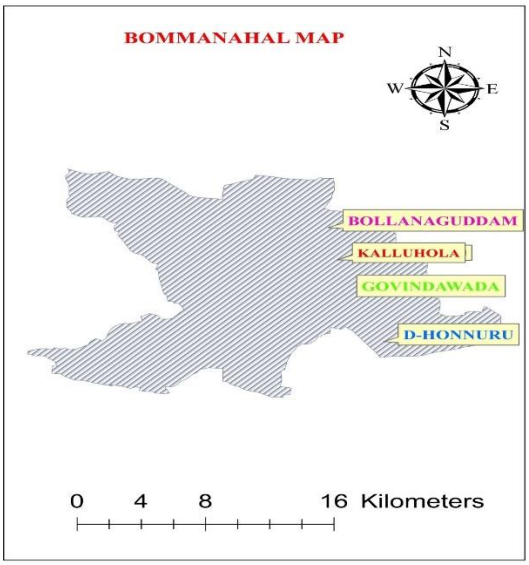


Fig 5: Map shows longitude and latitude location village wise.

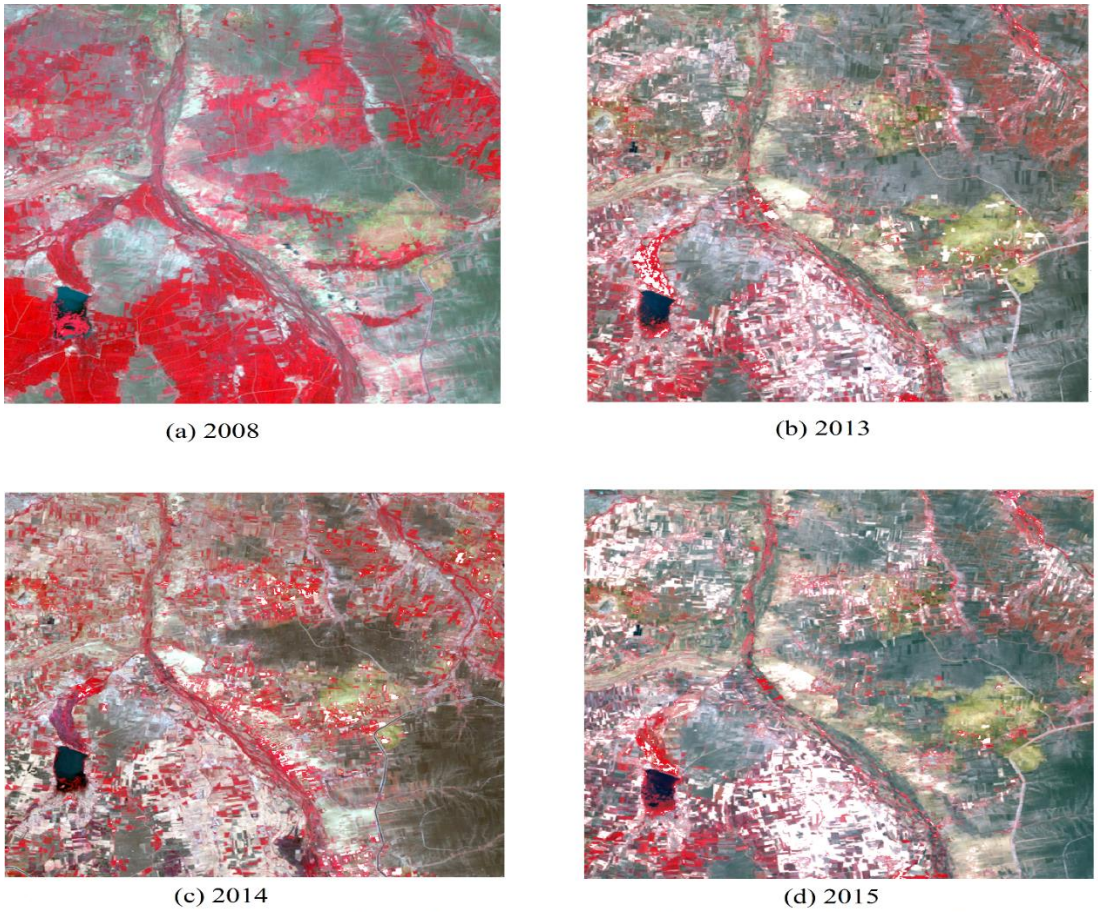


Fig 6: IRS images showing sand and sand dunes migration areas along the Hagari/Vedavathi River.

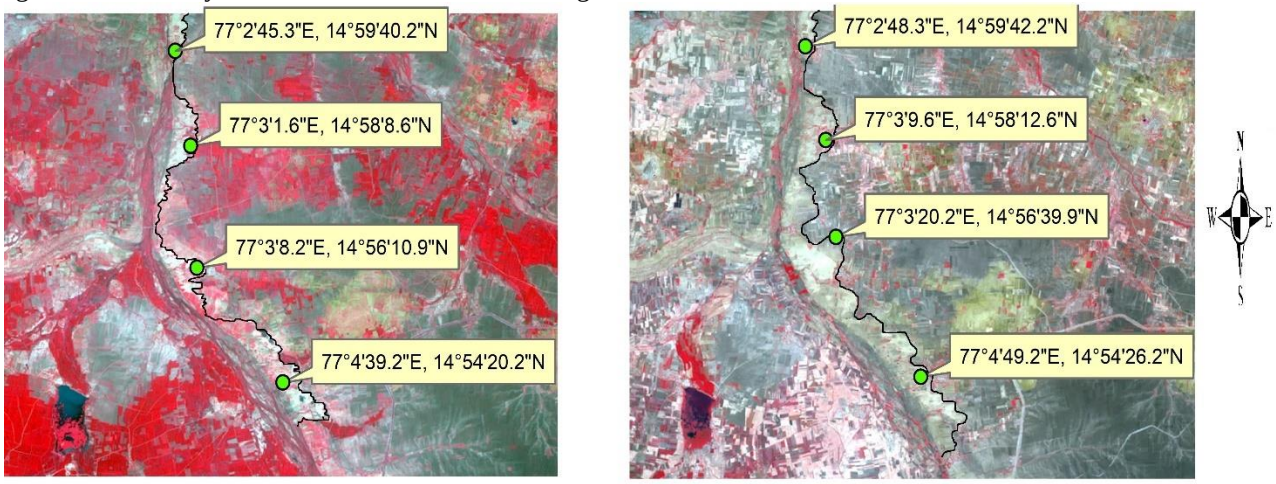
Fig 7: Field photo collections in Bollanaguddam, Kalluhola, Govindavada and D- Honnuru villages of Bommanahal Mandal.

5. RESULTS AND DISCUSSION

The study area is one of the major Mandal facing land degradation/desertification conditions in Anantapur district, lies between Northern longitudes 76 51'30" to 77 8'30" and East latitudes 14 52'0" to 15 25'30". The

total geographical extent is 305.88 Sq.km. the Hagari or Vedavathi river flows through this Mandal. It is an ephemeral (seasonal) river and thus remains as dry during most of the year. All along the Hagari River the eastern part of the riverbanks covered with sand dunes. These sand dunes are drifted of migrated from

river banks to agricultural fields and dries the agricultural fertility and becomes decertified. During the months of June to August this region experiences strong surface winds from West to Easterly directions. This wind is main reason for sand migration.(Ajai et al., 2009) The sand in this sand deposits has been derived from quartzite parent material and sand dunes of different sizes and different color like light yellow color to dark yellowish color. Fig 6 clearly shows that the migration of sand and sand dunes.



a) 2008 **b) 2015**

Fig 7: Sand and sand dune migration from 2008 to 2015.

Name of the village	2008		2015	
	LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
D-Honnuru	14° 54' 20.2"N	77° 04' 39.2"E	14° 54' 26.2"N	77° 04' 49.2"E
Govindawada	14° 56' 39.9"N	77° 03' 20.2"E	14° 56' 10.9"N	77° 03' 08.2"E
Kalluhola	14° 58' 12.6"N	77° 03' 09.6"E	14° 58' 08.6"N	77° 03' 01.6"E
Bollanagud dam	14° 59' 42.2"N	77° 02' 48.3"E	14° 59' 40.2"N	77° 02' 45.3"E

Table 2: Latitude and Longitude Readings.

The evidences show that the sand has been migrated by the past decades. According to the availing data from 2008 to 2015 the sand has migrated in abnormal rates (Table 2 shows the latitude and Longitude values of different time intervals). The land has been covered with sand and sand dunes along the Hagari River, in the Fig: 7 show the variation from 2008 to 2015 it is increased. Along the Hagari River sand and sand dunes are identified and spreading area is marked with Black polygon boundary line. In the year of 2008 the village D.Honnuru sand dunes identified up to the coordinates 14° 54' 20.2"N, 77° 04' 39.2"E, in the year 2015 sand and sand dunes are migrated up to the coordinates of 14° 54' 26.2"N, 77° 04' 49.2"E, it means the sand dunes transverses nearly 0.35 Km (350 Meters). In the village Govindawada from 2008 it is 14° 56' 39.9"N, 77° 03' 20.2"E and in 2015 it is 14° 56' 10.9"N, 77° 03' 08.2"E this results 0.89 KM (800 Meters) of sand has migrated. In the village Kalluhola from 2008 it is 14° 58' 12.6"N, 77° 03' 09.6"E and in 2015 it is 14° 58' 08.6"N, 77° 03' 01.6"E this results 0.26 KM (260 Meters) of sand has migrated and in the village Bollanaguddam from 2008 it is 14° 59' 42.2"N, 77° 02' 48.3"E and in 2015 it is 14° 59' 40.2"N, 77° 02' 45.3"E this means 0.10 KM (100 meters) of sand and sand dunes are migrated in Bommanahal Mandal of Anantapur District. In Bommanahal Mandal most of the farmers carried this sand and spreader in their agriculture fields, because they believe that the black cotton soils store the rainy water. This is also one of the reasons for this sand migration. 1501 acres of land covered by the sand and sand dunes in Bommanahal Mandal. It is increased in alarming rates; the land is degraded and decertified. At present the Government of Andhra Pradesh has taken this is a serious issue, and the District Water Management Authority (DWMA) has proposed to take up project mode to ameliorate the environmental conditions in the affected areas through massive plantations program.

6. CONCLUSION

Geospatial technologies are to different satellite imageries has taken and processed by the Software ArcGIS 10.4. The results clearly reveal that the process of migration of sand and sand dunes is showing an increasing trend and becomes decertified. Some of the following suggestions have to take for controlling desertification/land degradation and sand dunes migration. It was observed that satellite data proved to

be very useful for mapping of desertification and land degradation areas. Desertification/Land degradation status map can be helpful for the control of desertification in the study area. Reduce surface wind speeds so that the sand is not carried on the agricultural fields further and thus prevent the spread of the sand affected area. Proper irrigation water management especially in the black soils to reduce soil salinity/alkalinity. Rehabilitee moderately or severely decertified lands for productive utilization for agriculture purposes. Afforestation of the protected lands with social plantation and their protection and restore ecological balance of the region at least to some extent.

REFERENCES

1. UN Conference on Desertification, 1978. Round up, plan of Action and Resolutions, New York.
2. P.S. Dhinwa, A. Dasgupta and Ajai: Monitoring and assessment of desertification using satellite remote sensing. Journal of Geomatics, Vol 10 No.2 October 2016.
3. S.L. Budihal, K. Ganesh Raj, R.S. Reddy, A.Natarajan, M.A.Paul, S.Bandyopadhyay, J.V. Thomas. A.S. Arya and Ajai: Assessment and mapping of desertification status in Bellary district, Karnataka state, using IRS data (Anonymous).
4. Anonymous, 2003. Desertification status Mapping – Technical Guidelines. Forest, Land use and Photogrammetry group, RESIPA, Space Application Venter, Ahmadabad. p34.
5. Anonymous, 2005. Bellary district at A glance: 2003 – 2004. Directorate of economics and Statistics, Govt. Of Karnataka, Bangalore.
6. M. Rajasekhar, G.Sudarsana Raju, R. Siddi Raju and U. Imran Basha: Data on Artificial Recharge sites identified by Geo Spatial tools in Semi-arid region of Anantapur district, Andhra Pradesh. India. Data in Brief 19 (2018) 462–474.
7. V.S. Arya, Hardev Singh, R.S. Hooda and A.S.Arya: Desertification change analysis in Siwalik Hills of Haryana using Geo-Informatics. The international archives of the Photogrammetry, Remote Sensing and Spatial information sciences, volumeXL-8,2014.
8. Amal Kar: desertification (Central Arid Zone Research Institute(CAZRI) January-2016).
9. Ajai et al., 2009 Desertification/ Land degradation status mapping of India, Current Science, Vol.97:25.