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GEO-SPATIAL MAPPING OF LAND USE LAND COVER CHANGE IN KUSHAVATI RIVER BASIN, GOA (2010 -2020)

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ABSTACT:

Land Use and Land Cover Change (LULCC) is a dynamic process driven by various natural and anthropogenic factors, presenting significant implications for ecosystems, biodiversity, and human societies. This abstract provides a concise overview of the key concepts, methodologies, and implications associated with LULCC. Change detection analysis plays a crucial role in monitoring and understanding dynamic landscapes over time. The study of LULCC involves examining alterations in the utilization of land and the modifications in the physical and biological cover over time. Remote sensing, Geographic Information Systems (GIS), and socio-economic data play pivotal roles in monitoring and analyzing these changes at local, regional, and global scales. The drivers of LULCC are diverse, encompassing urbanization, agricultural expansion, deforestation, climate change, and policy interventions. This study is serves as an introduction to the multifaceted nature of LULCC, emphasizing its significance in the context of environmental science, geography, and sustainable development. The research focuses on comparing the effectiveness of Landsat Enhanced Thematic Mapper Plus (ETM+) data of the year 2000 and 2010 and Sentinel 2 satellite data of 2020 for change detection applications. The research employs a comprehensive methodology, including pre-processing, image registration, and change detection algorithms. Radiometric and atmospheric corrections are applied to standardize the multispectral imagery from both sensors. Image registration techniques are utilized to ensure accurate alignment between the different datasets. The result reveals that, between 2000 to 2010 around 11.8% forest area has been declined, 6.3 % barren land and 5.4% agriculture land has been increased. In the decade of 2010 to 2020, Vegetation cover 21% and settlement area 4.6% increased.

Key Words: Geo-Spatial, Change Detection, ETM+, Sentinel 2.

1. Introduction

Change detection analysis is a dynamic phenomenon that measure the attributes of a particular area indicating the changes taken place over a period

of time or between two or more time periods. The information related to the land use and land cover is obtained using change detection analysis. The technique helps in understanding the human environment relationship, manage and make a sustainable use of natural resources. Change detection is important to use the resources in the sustainable manner and to make proper management of the resources for the future development. The use of GIS and remote sensing technology has helped in examining the changes in the land use and land cover of the region. Accurate change detection of the earth surface is obtained which helps in the proper management facility of the region. Change detection technique helps in analysis the changes taken place in the region including land use change, rate of deforestation, urban sprawl, settlement changes trough spatial and temporal analysis using GIS and remote sensing technique. Land cover involves the physical characteristics of the earth surface involved in the rapid change of its land use and land cover majorly due to the anthropogenic activities. Regional planning is essential for the development of any region and change detection analysis plays a vital role in understanding the changes occurred in the region which leads to better the management of the region for its development and sustainable use. (T. V. Ramachandra, Uttam Kumar, September 2004) Change detection helps in managing the environment and its resources. The change detection in the watershed basin helps in the management of the watershed resources and hampers in environmental degradation. Land use change influence variety of factors as environmental, natural, ecological and anthropogenic process including soil erosion, runoff, deforestation, settlement, soil condition etc. Monitoring of the land use and land cover over an area leads to development of that area by introducing plans, schemes and utilization of the resources of the region in the sustainable manner. Today, with the boost of the economy there has been growth of population which has generated the need of planning efficient utilization of resources due to the population pressure on the earth surface. (Panhalkar S.S., Mali Sagar P.& Pawar C.T., May 2014)

2. Role of Geo-informatics for change detection

Geo- informatics includes GIS, GPS and Remote sensing. GIS helps in the precise mapping of images trough classification technique for identification of change in the basin area. GPS provides us to survey current land use and land cover areas for ground checking. Remote sensing provides vast spatio-temporal images for the land use land cover studies for the precise details. GIS provides the systematic information about the spatial and statistical data that can be used in inventorying and observing the changes taken place in the basin area. The information is utilized for the management of the basin area. GIS helps in the generation of maps using the data which is vital for spatial planning, management and sustainable utilization of land.

3. Aim and Objective

The aim of this study is to investigate and understand Land Use and Land Cover Change (LULCC) dynamics over a specific time period (2000 to 2020) using remote sensing data, with a focus on comparing Landsat Enhanced Thematic Mapper Plus (ETM+) data from 2000 and 2010 with Sentinel 2 satellite data from 2020. The study employs a comprehensive methodology that includes pre-processing, image registration, and change detection algorithms, with radiometric and atmospheric corrections applied to standardize the multispectral imagery.

4. Study Area

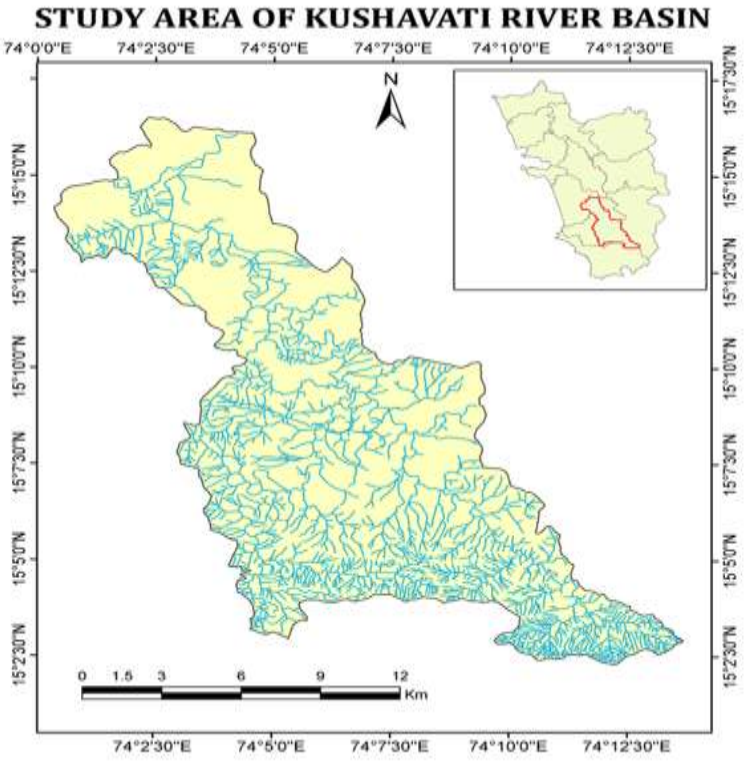

Figure 1: Location Map of Kushavati River Basin

5. Data used and Methodology

In the research the following satellite data is being used for the change detection analysis of the study area.

Table 1: Data and sources

Sl.no.	Satellite	Sensor	Data of image accusation	Spatial resolution (in mts)	Data source
1	LANDSAT 7	ETM+ multi-spectral	10/01/2000	30	GLCF
2	LANDSAT 7	ETM+ multi-spectral	5/1/2010	30	GLCF
3	Sentinel-2	MSI	31/12/2020	10	USGS

Source: (GLCF) (ESA sentinel)

The satellite data used to detect the land use land cover change include the enhanced thematic mapper data (ETM+) with multispectral bands having the resolution of 30m. The satellite data ETM+ is obtained from the Global land cover facility (GLCF). In order to detect land use land cover change two different year data from ETM+ sensor is used which include the data of the year 2000 and the year 2010. The Multi-spectral instrument (MSI) data is used to obtain the recent data of 2020. The Sentinel-2 satellite data is used to know the recent changes taken place in the land use and land cover of the basin area. The major four classes are depicted from the LANDSAT 7 (ESI+) satellite data for the year 2000 and 2010. The classes include Natural vegetation, Barren land, Agriculture, and water body. Other classes of Settlement are added in the recent satellite image of Sentinel-2 (MSI) 2020. ERDAS 9.1 and Arc GIS 10.3 IS being used to obtain the results of the land use land cover changes. A calculation has been carried out to detect the amount of changes taken place in the land use and land cover of the basin area.

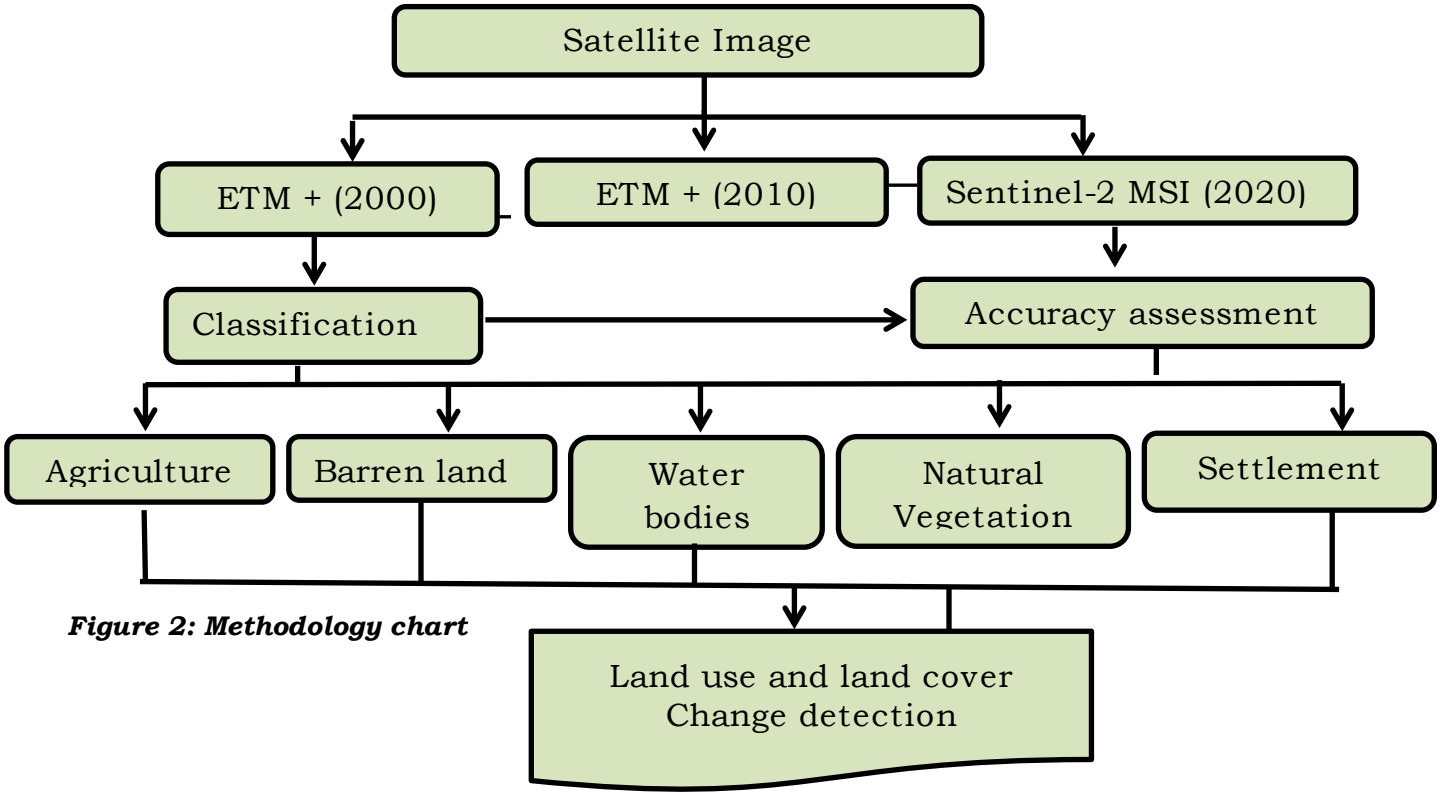

Figure 2: Methodology chart

3. Result and discussion

i) Land use land cover analysis of Kushavati River basin (2000 and 2010):

LANDSAT-7 ETM+ satellite image of the year 2000 and LANDSAT-7 ETM+ satellite image of the year 2010 has been classified using supervised classification technique in four major classes. The supervised classification has been done using ERDAS 9.1. Land use land cover analysis has been done from the year 2000 to the year 2010. The changes taken place in the basin has been determined based on the amount of land use land cover changes that has taken place in the basin area. The analysis reveals that, in the year 2000 the total area under Natural vegetation was 56.4% decreased by 11.8% from the year 2000 to 2010. The decrease of 12% in the natural vegetation is due to anthropogenic activities taken place in the basin area. Most of the land of the natural vegetation has been cleared and converted into agricultural land, settlement areas, and used for other purposes. Barren land was 37.6% in the year 2000 was increased by 6.3% from the year 2000 to the year 2010. Due to the deforestation activities taking place in the basin area the natural vegetation patches has been cleared. The land used by agriculture was 5.4% in the year 2000 which increased by 5.4% from the year 2000 to 2010. Most of the people in the basin area practice agriculture for their livelihood. Most of the people in the basin area earn by selling their products from the agricultural field. There

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has been increase in the agricultural activities because of irrigational cannels built in the region which has helped in boosting the agriculture in the basin area. Water body found in the basin area was 0.5% which has increased by 0.2% in the basin area from the year 2000 to the year 2010. This is because of increase in the rainfall in the basin area.

Table 2: ETM+ 2000 & 2010 classification

Sr.no.	Classes	ETM+2000 Area in ha	ETM+2000 Area in %	ETM+2010 Area in ha	ETM+2010 Area in %	Area increased/ decreased (In %)
1	Natural vegetation	12745.8	56.4	10073.4	44.6	-11.8
2	Barren Land	8487.9	37.6	9925.11	43.9	6.3
3	Agriculture	1238.76	5.4	2430.36	10.8	5.4
4	Water body	106.65	0.5	150.21	0.7	0.2
	Total	**22579.11**	**100**	**22579.08**	**100**	

Figure 2: ETM+ 2000 Satellite Image

Figure 3: ETM+ 2010 Satellite Image

- **Land use land cover analysis of Kushavati River basin for the year 2010 to the year 2020**

LANDSAT-7 ETM+ satellite image of the year 2010 and Sentinel – 2 MSI satellite has been classified using supervised classification technique in four major classes. The land use land cover of Sentinel satellite image is classified using Arc GIS technique. Sentinel-2 MSI satellite has a higher resolution 10m than that of the LANDSAT-7 ETM+ satellite of 30m resolution. The land use land cover map is used to determine the change analysis in the basin area. The change in land use land cover is done using the satellite images of the year 2010 and of the year 2020. The Natural vegetation of the basin area was 44.6% in the year 2010 which has been increased by 20.9% from the year 2010 to the year 2020. This is because of the public awareness and forest conservation policies of the government. The barren land in the basin area was 43.9%which has been decreased by 24.5% this is because of the usage of the land for the developmental purposes as settlement, infrastructural facilities, tertiary services ect. The agriculture in the basin area was 10.8% which had a fall by 0.7%. This indicates that people area shifting in the tertiary sector leaving the Agricultural activities

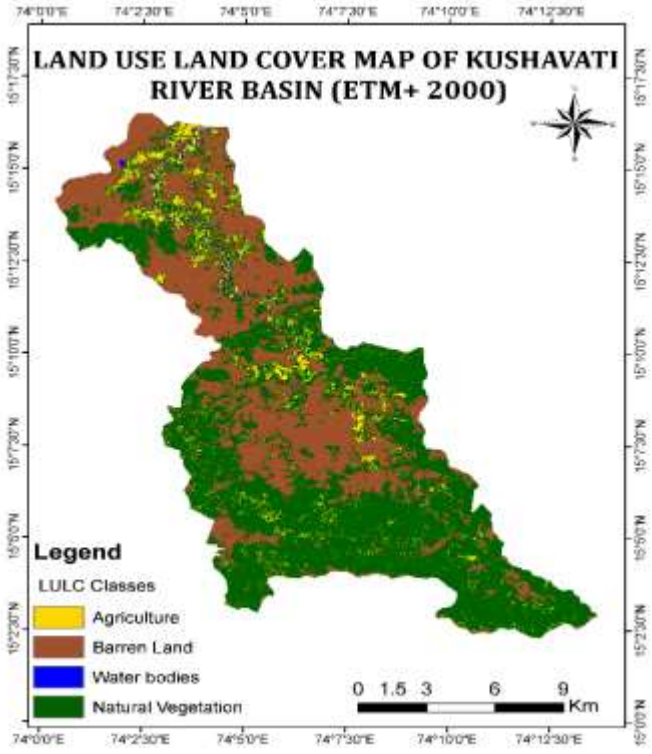

Figure 4: ETM+ 2010 classified Image

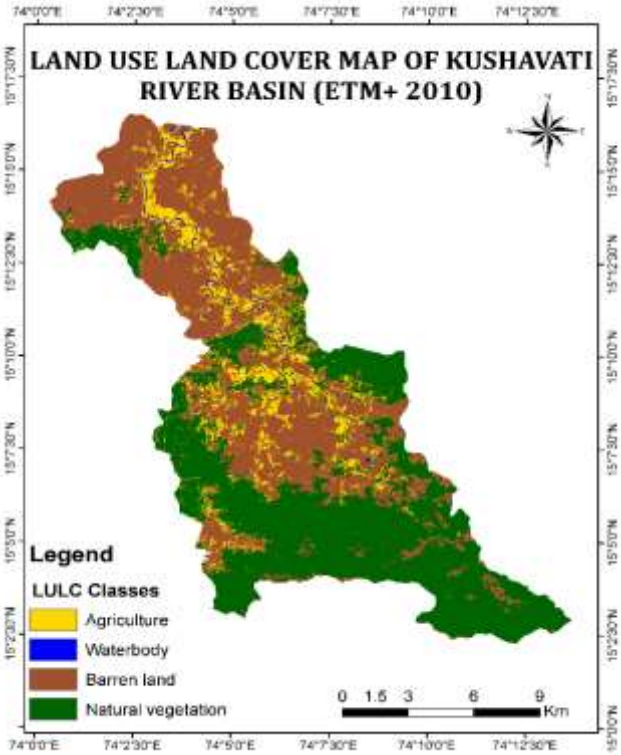

Figure 5: ETM+ 2010 Classified Image

behind. Water-body in the basin area was 0.7% which has reduced by 0.3% from the year 2010 to the year 2020.

This is resulted because of drying of the river and lakes due to pollution caused by anthropogenic factors. Most of the household waste, industrial waste, and washing of mined trucks; animals taking bath in the river are some of the causes for water pollution in the region. The water resources area not maintained properly by the government which results in water drying and pollution problems.

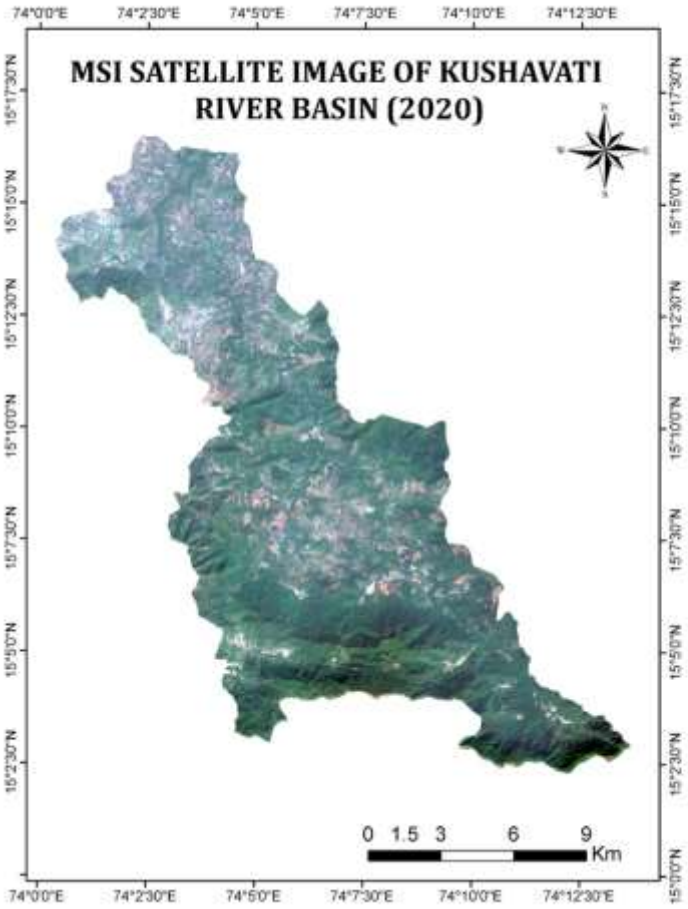

Figure 6: MSI 2020 Satellite Image

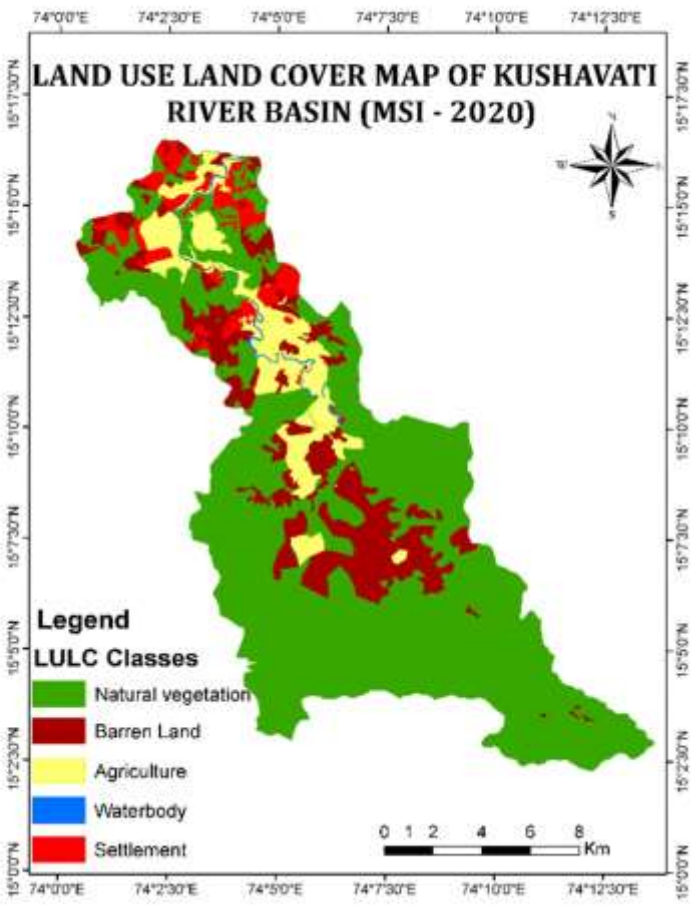

Figure 7: MSI Sentinel 2020 classified Image

Table 3: ETM+ 2010 & MSI Sentinel 2010 classification

Sr.No.	Classes	ETM+2010 Area in ha	ETM+2010 Area in %	MSI(2020) Area in ha	MSI Area in %	Area increased/ decreased (In %)
1	Natural Vegetation	10073.4	44.6	15335	65.5	20.9
2	Barren Land	9925.11	43.9	4540	19.4	- 24.5
3	Agriculture	2430.36	10.8	2343	10.01	- 0.7
4	Water body	150.21	0.7	99	0.4	- 0.3
5	Settlement	---	----	1082	4.6	4.6
	Total	**22579.11**	**100**	**23399**	**100**	

References:

1. Bruneau, Richard. Watershed Management Research. March 2005. Https://IdlBnc.Idrc.Ca/Dspace/Bitstream/10625/25832/1/122072.Pdf (Accessed 08 1, 2016)
2. Deepak Khare, Arun Mondal, Prabhash Kumar Mishra,Sananda Kundu And Pramod Kumar Meena. "Morphometric Analysis For Prioritization Using Remote Sensing And GIS Techniques In A Hilly Catchment In The State Of Uttarakhand, India." Indian Journal Of Science And Technology, Vol 7(10), , October 2014: 1650– 1662.
3. Garg, Suhas P Wani And Kaushal K. Watershed Management Concept And Principles. N.D. Http://Oar.Icrisat.Org/3914/1/1._Watershed_Management_Concept.Pdf (Accessed 8 20, 2016).
4. GERHARDT, NIKOLAUS. WATERSHED MANAGEMENT. December 1977.Https://Ir.Library.Oregonstate.Edu/Xmlui/Bitstream/Handle/1957/310 87/Ge rhardtnikolaus.Pdf?Sequence=1 (Accessed 08 1, 2016).
5. Grade Stack. N.D. Http://Gradestack.Com/CBSE-Class-8th-Complete/Land-SoilWater-/Water/14829-2938-2355-Study-Wtw (Accessed 8 20, 2016).
6. Kassa Teka,Van Rompaey And Poesen J. Land Suitability Assessment For Different Irrigation Methods In Korir Watershed,. November 25, 2010. Http://Www.Mu.Edu.Et/Jd/Pdfs/V3I2/6%20Kasa's%20final%20E1%20214-219.Pdf (Accessed 08 1, 2016).
7. MELAK, SLEHAK. Land Capability, Irrigation Potential And Crop Suitability Analysis Using GIS And Remote Sensing In Upper Kesem (Awash Basin). July

2007. Http://Etd.Aau.Edu.Et/Bitstream/123456789/922/2/SLEHAK%20MELAK.Pdf (Accessed 8 20, 2016).

8. Mondal, Puja. Watershed Management: Aspects, Objective And Various Measures. N.D. Http://Www.Yourarticlelibrary.Com/Essay/Watershed-ManagementAspects-Objective-And-Various-Measures/30216/ (Accessed 7 30, 2016).
9. Puja, Mondal. Management:Aspects, Objective And Various Measures. 7 30, 2016. Http://Www.Yourarticlelibrary.Com/Essay/Watershedmanagementaspectsobjectiveandvariousmeasures (Accessed 8 10, 2016).
10. Sachin S. Panhalkar, Sagar P. Mali, C.T. Pawar. "Land Capability Classification In Hiranyakeshi Basin Of Maharashtra (India): A Geoinformatics Approach." International Journal Of Engineering And Technical Research, Volume-2, Issue6, 2014: 18-21.
11. Sonali Bhandari , Santosh T. Jhadav, Suresh Kumar. LAND CAPABILITY CLASSIFICATION AND CROP SUITABILITY ASSESSMENT IN A WATERSHED USING RS AND GIS – A CASE STUDY OF WATERSHED IN DEHRADUN, UTTARAKHAND. 2013. Http://Www.Esri.In/~/Media/EsriIndia/Files/Pdfs/Events/Uc2013/Proceedings/Papers/UCP032.Pdf (Accessed 08 1, 2016).
12. TANAKA, Tadashi. Methodology Of Integrated Watershed Management For Sustainable. October 2007. Http://Www.Ied.Tsukuba.Ac.Jp/Wordpress/WpContent/Uploads/Pdf_Papers/Tercbull08s2/T8supple2_18.Pdf (Accessed 08 1, 2016).
13. Tiruneh, Gizachew. "Land Capability Classification Using Geographical Information System In Shinfa Watershed, Highlands Of Ethiopia." Journal Of Physical Science And Environmental Studies Vol. 1 (2), 2015: 17-20.
14. Tschinkel, Carlos Perez And Henry. IMPROVING WATERSHED MANAGEMENT IN DEVELOPING. July 2003. Https://Www.Odi.Org/Sites/Odi.Org.Uk/Files/OdiAssets/Publications-Opinion-Files/5196.Pdf (Accessed 08 1, 2016).
15. V.Thangamani And M. Sambasiva Rao. "Land Capability Of Palar River Basin Using Remote Sensing Technique." The Deccan Geographer , June,2007: 9-18