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Impact of Land use and Land Cover Change on Ecosystem Services-A Case Study of Nilawande Dam Catchment, Ahmednagar, India

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Abstract:
Land use refers to human activities carried on land whereas land cover deals with natural vegetation, water bodies, soil, artificial cover and other resulting due to land transformation. The study examines long-term land use/land cover change at a finer scale in a semi-arid region of India. Land use is associated with specific use of land and land cover relates to the type of feature present on surface of the earth. Land use and Land cover responsible for several social, economic and environmental impacts. The present research will consider Land is an intrinsic part of the ecosystem. The measure changes in the ecosystem needed to be studied for the deterministic or probabilistic or reliability of land resource. This requires analysing the impact of land use and landing cover for various purposes.

Keywords: *Land use, Land cover, Sediment yield, reservoir sedimentation, Ecosystem services, sedimentation computation.*

I. INTRODUCTION

The major underlying cause of global environmental change is Land use and land cover. It is responsible for change in Management and Modification of natural resources into built environment. The total of arrangements, activities and inputs that people undertake in a certain land cover type is called as Land Use. The land utilize inventories are necessary intended for the best consumption and managing of assets in a given sub sink. The land erosion in the catchment area of a reservoir is a deciding factor for sedimentation.

Sedimentation in dam reservoirs is one of the destructive phenomena which leads to reduction of useful volume of reservoirs and also damages the installations and disturbs their functions. Thus, for various purposes of reservoir planning, such as economy promotion, operation effects, flood prevention, etc., the designer/planner needs the information on the pattern and allocation of sediment deposition in the reservoir. On the account of this matter, several empirical and mathematical methods have been developed to predict the temporal sediment distribution in reservoirs

1.2 Objectives of work

The main objective of the study is to investigate the effect of land employ and land wrap alter on bionetwork services (water) the Nilwande dam catchment.

Specific Objectives

The specific objectives of the study were:

To analyze the spatial and temporal changes in land use and land cover in Nilwande dam catchment for period of 6 years.

To review the collision of land employ and land wrap alter on water resource and sediment yields in

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the Nilwande dam catchment for the period of 6 years from the year 2014 to 2019.

To forecast future updates within land coat, water in Nilwande dam catchment.

II. Study Area

The study area is part of the upper Godavari River basin and lies between 19°32′46″N 73°54′05″E Coordinates: 19°32′46″N 73°54′05″E covering a geographical area of 202 km2 (78 sq mi)in Ahmednagar district, Maharashtra, India. The present study is conducted for Nilwande regime situated at Dist. Ahmednagar, Maharashtra in Sahyadri hill ranges.

Fig. 1 Satellite Image of Study Area

Table 1. Salient Features of Nilwande Dam

Salient Features of Nilwande Dam	
authorized name	Upper Pravara Nilwande Dam D02986
place	At-Akole, A' Nagar, Pune, India
Coordinates	19°32′46″N 73°54′05″ECoordinates: 19°32′46″N 73°54′05″E
Construction began	1999
Opening date	2011
Owner(s)	Government of Maharashtra, India
Operator(s)	Command Area Development Authority (CADA), Ahmednagar
Dam and spillways	
Type of dam	RCC
Impounds	Pravara River
Height	73.91 m (242.5 ft)
span	583 m (1,913 ft)

III. Literature Review

Land use change detection process of identifying differences of an object or phenomenon by observing it at different times (Singh, 1989)

Many change recognition techniques have been created and utilized for different applications, anyway they can comprehensively separated into two methodologies: post-characterizations and phantom change location (Xiuwan, 2002). Post groupings are the most broadly applied procedures

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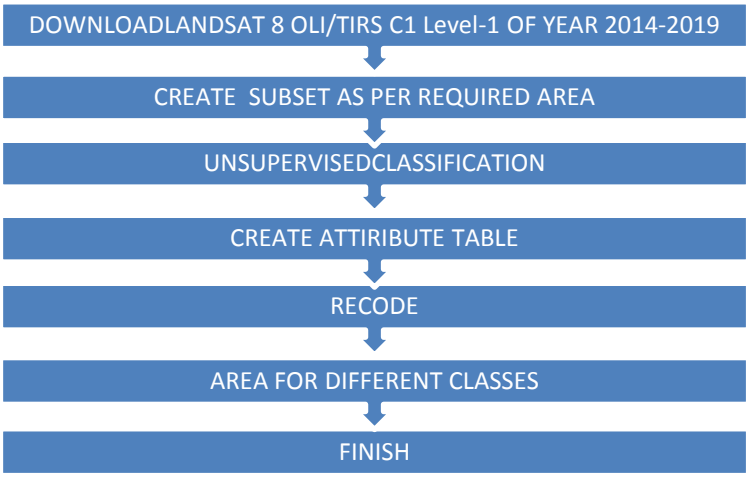
for change identification reason. Ghostly change location methods depend on essential suspicion that the aftereffect of land utilize change gives stable changes of phantom reflectance (Xiuwan, 2002). A large portion of the systems depend on certain seasons of pictures differencing or proportioning. The progressions are identified by subtracting pictures from two diverse timeframe. (Singh, 1989).

IV. Research Methodology

The writing explore for parallel work helpful for states research methodology. Kothari (1993:10) states that, "It is necessary for the researcher to design his own methodology for his problem". so, only procedure are in use from the literature to design the explore method as follows:



4.1 Software analysis data:

Step 1: Download Landsat 8 OLI/TIRS C1 Level-1 of Year 2014-2019

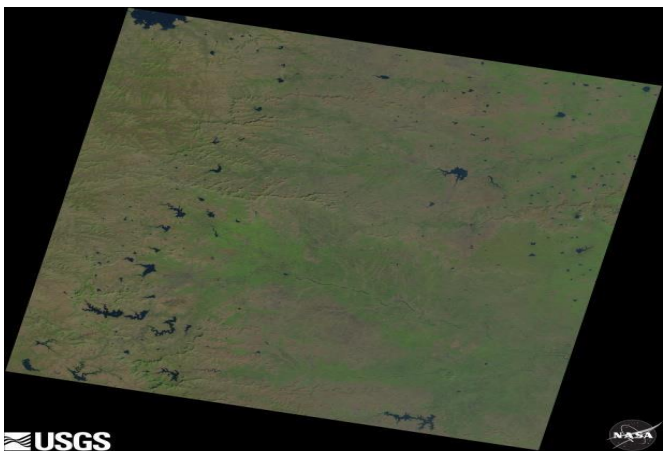


Image 1: Landsat 8 OLI/TIRS C1 Level-1 of Year 2014

Step 2: Create Subset As Per Required Area

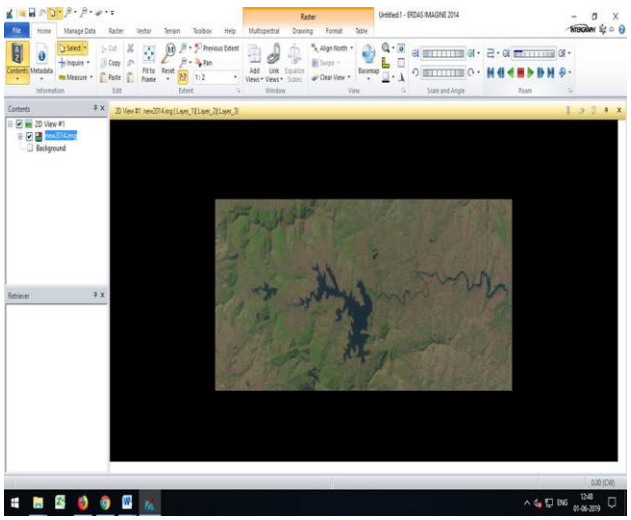


Image 2: *Subset As Per Required Area*

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Step 3: Unsupervised Classification

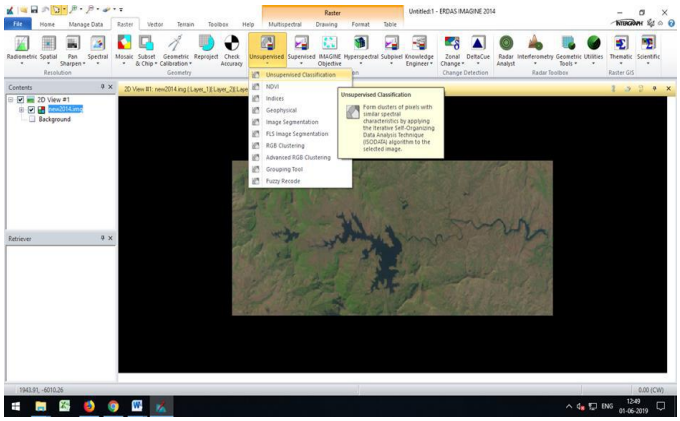

Image 3: *Unsupervised Clasification*

Step 4: Create Attribute Table

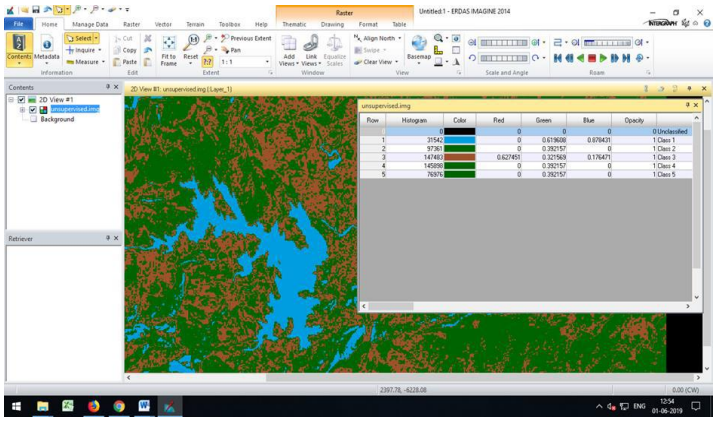

Image 4: Attribute Table

Step 5: Recode

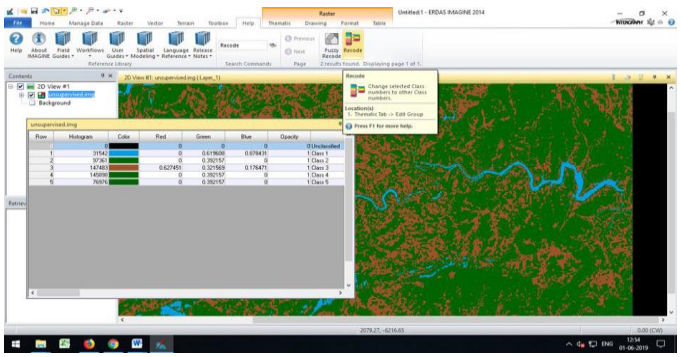

Image 5: Recode

Step 6:Area of different Classes

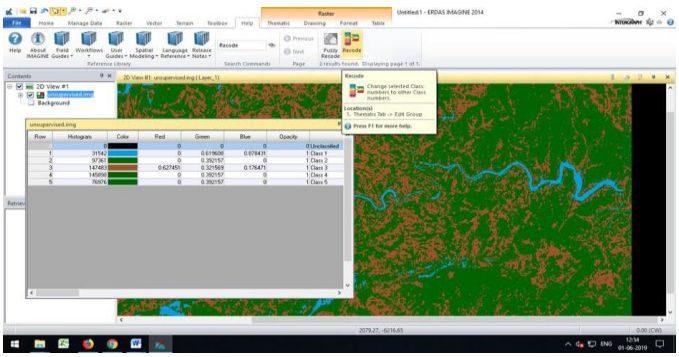

Image 6: Area of Different classes

Step 7: Finish

4.2 Computation of Sedimentation:

Computation of Silt Load for 100 Years Life of Reservoir:

1) Catchment Area = 323.95 Sq.Km

2) Catchment Area of U/S Project = 121.74 Sq.Km

3) Free Catchment Area = 202.21 Sq.Km

4) Silt Rate Considered

For Projects in Maharashtra Government of Maharashtra has proposed silt rate of 1.50 Acre feet / Sq. Mile / year OR 714.37 cum / Sq.Km / Year.

C.W.C has recommended a rate of 1.37 Acre-feet / Sq. Mile / year OR 652.46 cum/ Sq.Km/ Year.

Hence for this project the silt rate proposed by government of Maharashtra is adopted to compute the silt load of Nilwande Project.

5) Capacity Inflow Ratio :
Gross capacity - 236.01 Mcum
Average inflow ratio - 289.01 Mcum

6)Trap Efficiency - 97.22 %
(Derived From Brune‟s Curve)

7) Total Silt Load
Total Silt Load = (Silt rate X Free catchment area X Trap efficiency X no. of years)
= (714.37 X 202.21 X 0.9722 X 100) / 1000000
= 14.04 Mcum.

Average annual volume of sediment deposited
= (Silt rate X Free catchment area X Trap efficiency X No. of years)

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= (714.37 X 202.21 X 0.9722 X 1) / 1000000
= 0.140 Mcum

Ratio of common yearly volume of residue deposit to total capacity of tank (vide para 6.6.1 of IS 12182-1987).

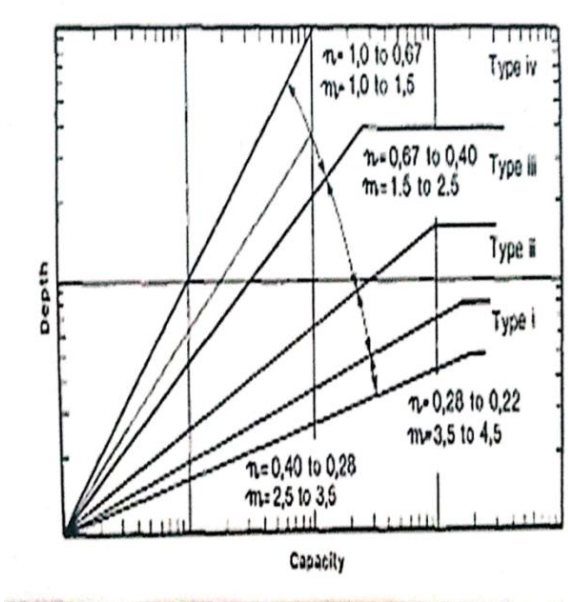
Ratio = common yearly Volume of deposit Deposited /
Total Capacity of Reservoir
= 0.140 / 236.01
= 0.05932 %
This is less than 0.1 %

4.3 Constant Coefficient by Area Reduction Method:

This method was first developed from data gathered in the resurvey of 30 reservoirs and was described by Borland and Miller (1960) with revisions by Lara (1962).

Selection of type of reservoir

The reservoirs categorization is done based on the shape factor, M , which is defined by the relationship between reservoir depth and capacity.



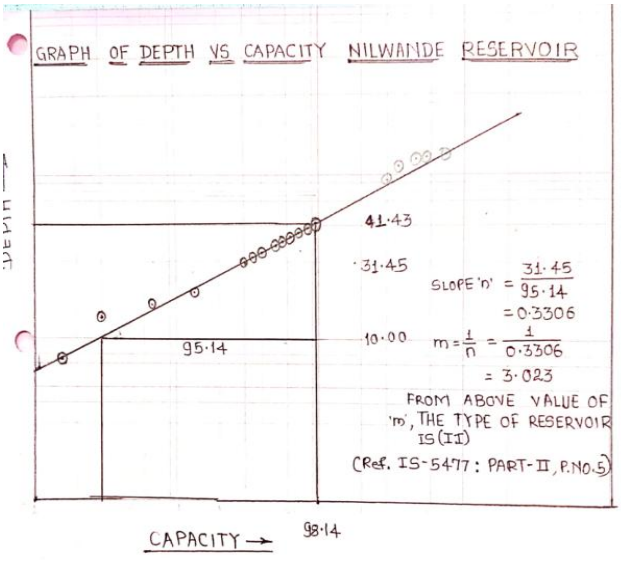


Fig. 2.1 Depth vs CapacityFig. 2.2 Depth vs Capacity

Slope = 31.45 / 95.14
= 0.03306.
m= 1/N
= 1/0.3306
m = 3.025

From above value of M, The type of reservoir is II.

These values are the modified values of Miller-Borland method and given that our reservoir is type II and a plain hill flood, so, c, m and n are equal to 2.3247, 0.50 and 0.40 respectively
F dimensionless function for different relative depths, "P", is calculated as:

$$F = (S – Vh) / (H * Ah)$$

Sediment Relative Area :

$$Ap = c P^{m} (1 – P)^{n}$$

Where c , m , n are constant coefficient, (c = 2.324 ,m = 0.50, n = 0.40)
p is sediment relative area.
We get,

$$Ap= 2.324 P^{0.50} (1 – P)^{0.40}$$

Proportionality factor to convert the relative level of sediment to the real surface :

$$K = Ao / a_o$$

Where,
Ao= is the initial level in the reservoir,

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$a_{o=}$ is the relative level of the reservoir level.

V. Result

Graphical Representation of Land utilize /Land wrap of Nilwande Catchment for Different time:

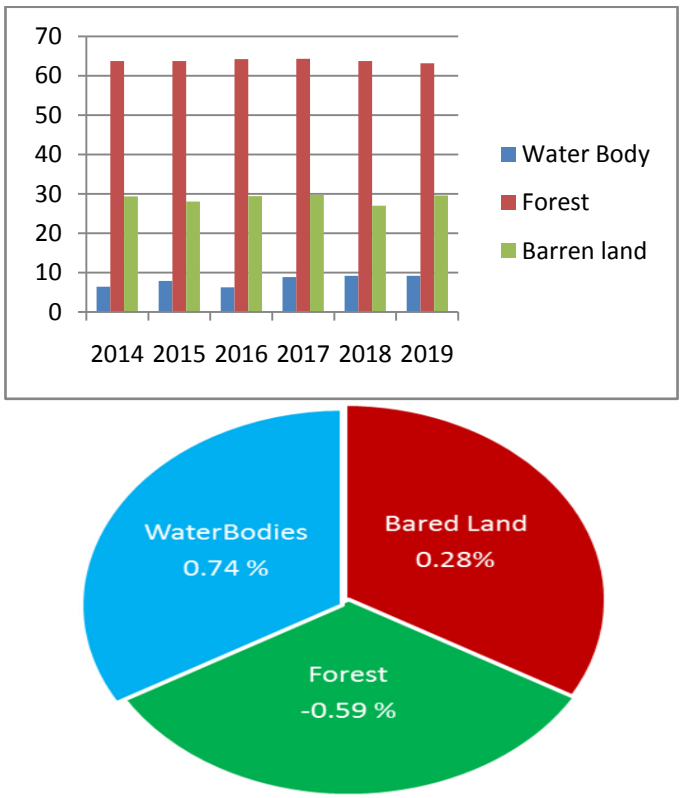

Fig 3. Land use/Land cover of Nilwande Catchment for Year 2014-2019.*Fig.4.Average percentage result from 2014 to 2019*

Silt load for Nilwande is worked out for next 100 years.

Ratio of common yearly volume of sediment deposit to total capability of reservoir (vide para 6.6.1 of IS 12182-1987).

Ratio = common yearly Volume Of Sediment Deposited / Total Capacity Of Reservoir
= 0.05932 %
This is less than 0.1 %

VI. Conclusion

Land use/Land Cover mapping of Nilwande command region is classified in various classes like water bodies, bared land and forest on the basis of all the informative details collected from various sources. The results show that there is minor change in the variation of use of land and forest cover. During the period from 2014 to 2019, there is no measure change in forest but in the water bodies and bare land has continuously changing up and down. However, these minor changes are prone to affect the hydrological cycle. The impact on climate change can be considered as major concern for maintaining the regularity in hydrological cycle. The study of LU/LC is found useful for sediment inflow computation in the reservoir for a particular period.
The sedimentation deposition is depending on land classification. In Nilwande catchment silt load calculated for next 100 years is 14.04 Mcum and average annual volume of sediment deposit is 0.140 Mcum. Accordingly the ratio for common yearly volume of sediment acknowledgment with the total capacity of the reservoir in percentage is worked out and it comes 0.05932% which is less than 0.1 %. It means the problem of siltation is insignificant and not serious according to IS 12182-1987.

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