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Study of Water Storage in Existing and Predicted Small Dams on Gadhi and Kasardi Rivers of Panvel Tahsil

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Abstract

Water is an important natural component on the earth. We can't survive without water. Therefore, it is necessary to conserve and use it properly. Panvel tahsil of Raigad district in Maharashtra receives a lot of rainfall during the monsoons, while the rural areas experience severe water scarcity during the summer. To overcome the water scarcity in the rural areas of Panvel tahsil, this research has been done to build small dams on the Gadhi and Karsardi rivers. For these ten sites have been inspected for construction of small dams on Gadhi and Kasardi rivers. At present, Chota Morbe and Gadheswar are two dams constructed on the Gadhi River. These dams supply 3,40,956 cubic meters of water to Panvel City and rural areas. When small dams have been constructed at the planned site, the water storage will increase to 6,80,052 cubic meters. If Small dams constructed on the Gadhi and Kasardi rivers, water would percolate under the ground and water supply will be available to the farmers in winter and summer season also. Due to increases in the water level, Borewells that supply water to villages will also have plenty of water till the summer season which will eradicate the scarcity of water.

Keywords: Gadhi and Kasardi river basin, locations for construction of predicted small dams, Water volume, Water management.

1. Introduction

The significance of water and its management worldwide has been the subject of numerous studies. Watershed management is useful for storage and collection of water. Watershed management includes preventing floods, restoring damaged land, controlling pollutants, sedimentation, and protecting land from all sorts of deterioration.
A watershed is a region of land that has a shared system of streams and rivers that empty into a single, bigger body of water, such as an ocean, lake, or larger river.

"The notion of watershed management acknowledges the prudent management of the three fundamental resources soil, water, and vegetation in order to achieve specific goals for the welfare of plant, animal, and human groups within a watershed border."
India is primarily covered with rainfall by monsoon winds. Assam, Kerala, Coastal Karnataka, and the Konkan Region have different amounts of rainfall. Overuse of water is also a result of urbanization, industrialization, and population growth. The seriousness of the situation highlights how crucial it is to protect natural resources. Sustainable watershed development and management (SWDM) projects are implemented using a multidisciplinary, scientific, and holistic approach to improve land and increase water availability for agriculture growth, livestock, and human optimum production. The projects are necessary to address the issue of watershed degradation. The socioeconomic environment and land and water resources are closely intertwined.
In order to preserve and maximize the use of degraded land, water, and vegetation, the current study's watershed management method makes use of contemporary technologies such as remote sensing and GIS.

2. Conceptual framework and review of literature

Watershed management is a very valuable and significant area of research. We have employed numerous literature reviews for this investigation. In the Hirakund, Machkund, and Rengali river valley projects, Kedareshwar Pradhan (2000) used GIS and remote sensing techniques for watershed modelling and sediment control. He has determined the crucial watersheds to create a thorough plan for soil conservation based on runoff and sediment output.
Narendra Kumar Agrawal (2007) examined the creation of successful management plans for the crucial regions of small watersheds using the SWAT Model and GIS. He stated that in order to construct conservation structures that lessen the detrimental effects of soil erosion and to prioritize watersheds in order to carry out and assess watershed management programmes, it is imperative to estimate runoff and sedimentary yields. Additionally, he believes that the SWAT Model works well in big basins with lots of smaller watersheds.
In his comparative analysis of two watersheds in the Mahendergarh district of Haryana, Gulshan Mehra (2015) found that the Krishnawati watershed had constructed the most conservation structures in comparison to the Dohan watershed. Controlling gully erosion is the main purpose of conservation buildings.
G.H. Najar (2019) worked on the management planning and watershed characterization of the Hirike wetland using remote sensing and GIS techniques. He stated that the watershed's altitude, slope, rainfall, soil, geography, and geology all have an impact on its surface processes. The wetland area has shrunk as a result of extensive conversion to other land uses. Additionally, he has mapped and evaluated the Harike catchment's risk of soil erosion using the RUSEL Model.

3. Study Area

The two main rivers that flow through the Panvel tahsil region in the Raigad district are the Gadhi and Kasardi. Kalundre River is another name for the Gadhi River. The Raigarh district is located in Maharashtra State's Konkan area. The district is split up into fifteen Tahsils for administrative purposes. The Raigarh district comprises 1909 villages and 42 cities.
One of the most populous tahsils in the Raigarh district is Panvel Tahsil. There are 5,70,216 people living in Tahsil overall. The Panvel tahsil is bounded to the northwest by the Mumbai Suburban district, to the north by Thane district, to the east by the tahsils of Karjat and Khalapur, to the south by Pen, to the west by Uran tahsil, and to the north-west by the Arabian Sea. Panvel tahsil has a total size of 576.04 square kilometers.

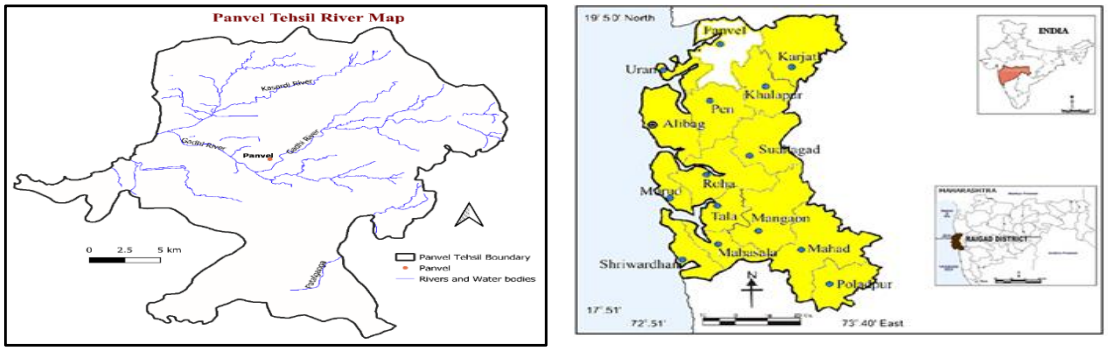

Figure-1: Location Map of Study Area

4. Objectives of the Research

The following are the main objectives of the study.
1. To find out the locations for construction of predicted small dams on Gadhi and Kasardi rivers.
2. To calculate the volume of water storage in existing and predicted small dams on Gadhi and Kasardi rivers.
3. To make recommendations for managing watersheds for water storage.

5. Data Source and Research Methodology

The present research study is based on primary as well as secondary data.
The primary data, such as field surveys conducted to gather ground data that GPS has adopted. Research groups, non-governmental organizations, and government departments will provide secondary geographical and non-spatial data. The primary census abstract, the census handbooks for Maharashtra and India, and the district census handbook for the Raigarh district would be the sources of secondary data collection. The Raigarh District, 2011 Socio-Economic Review and District Statistical Abstract will be referred to. In addition to these, a few more population-related data points will be gathered from gazetteers, yearly reports, and other state and federal government publications. Ph. D. theses, journals, and publications that are pertinent to this research topic will also be consulted for the study.
The research areas of the Gadhi and Kasardi Rivers are identified and further subdivided into 5 and 3 sub-watersheds, respectively, using digital elevation model (DEM) data from the Shuttle Radar Topographic Mission (SRTM) and the ArcGIS tool. The procedures and formulas are applied to get the morphometric parameters of both rivers.
Terrain is calculated using a variety of formulas, and illustrations are prepared using computer, statistical, and cartographic methods. Data analysis, diagram analysis, and map analysis will be used to interpret the results. maps created using a GIS programme.

6. Existing and Predicted small dams on Gadhi and Kasardi River

To build small dams on riverbeds for water storage and management, the researcher visited different locations in the Gadhi and Kasardi river basins. How small dams could be built was determined using a digital elevation model. Triangulated irregular networks (TINs) and digital elevation models (DEMs) are widely used in hydrology and hydraulic modelling to predict river water quantities. For the study area, an SRTM Digital Elevation Model (DEM) with high resolution was acquired. created a TIN model based on the pre-processed DEM. determined the river channel of the TIN model. This would be achieved by locating the river's centerline and constructing cross-sectional profiles perpendicular to the flow direction. Google Earth provides information regarding the elevation of the water's surface. Using the Surface Volume (3D Analyst) and the reference planes above and below, determine the volume between the riverbed and the water's surface along each cross-section.
Chota Morbe and Gadheshwar are currently two major dams of Panvel Tahsil, as seen in Table No.1 and Figure No. 2. Chota Morbe is 88 meters above mean sea level, with a capacity of 128071.15 cubic meters of water and an area of 10280.67 square meters. Gadheshwar Lake is 96 meters above mean sea level, with a capacity of 212885.12 cubic meters of water and an area of 29307.76 square meters.

Table-1: Existing and predicted small dams and water volume, Gadhi and Kasardi River

Sr. No.	Name	Altitude Mode (m)	Shape Length	Shape Area	Volume (m^3)	Area (m^2)
1	Chota Morbe	88	0.104943	0.000047	128071.15	10280.67
2	Gadheshwar Lake	96	0.079166	0.000067	212885.12	29307.76
3	Dam-1	40	0.020949	0.000003	37789.57	18093.87
4	Dam-2	42	0.011062	0.000021	16127.52	23601.05
5	Dam-3	44	0.029367	0.000014	22129.10	11897.66
6	Dam-4	53	0.031372	0.000014	12481.56	1626.17
7	Dam-5	48	0.031835	0.000010	44076.48	25618.72
8	Dam-6	62	0.018219	0.000003	54135.35	34236.66
9	Dam-7	73	0.019144	0.000004	13249.87	1665.04
10	Dam-8	57	0.038843	0.000004	85868.78	18057.03
11	Dam-9	63	0.032434	0.000004	26660.98	24957.78
12	Dam-10	68	0.015325	0.000002	26577.13	15218.22
				Total	**680052.61**	**294560.60**
Source: Calculated with GIS software by Researcher						

Ten possible small dams with a three-meter height have been anticipated for the Gadhi and Kasardi rivers. These dams are intended for water management and storage. The size of Dam 1 is 18093.87 square meters, its capacity is 37789.57 cubic meters, and its observed altitude is 40 meters above mean sea level. The size of Dam 2 is 23601.05 square meters, its capacity is 16127.52 cubic meters, and its observed altitude is 42 meters above mean sea level. The size of Dam 3 is 11897.66 square meters, its capacity is 22129.10 cubic meters, and its observed altitude is 44 meters above mean sea level. With a volume of 12481.56 cubic meters and an area of 1626.17 square meters, Dam 4 is located at a height of 53 meters above mean sea level. The size of Dam 5 is 25618.72 square meters, its capacity is 44076.48 cubic meters, and its observed altitude is 48 meters above mean sea level. Dam 6 is located 34236.66 square meters in area, 54135.35 cubic meters in volume, and 62 meters above mean sea level. The size of Dam 7 is 1665.04 square meters, its capacity is 13249.87 cubic meters, and its observed altitude is 73 meters above mean sea level. The size of Dam 8 is 18057.03 square meters, and its volume is 85868.78 cubic meters. Its location has been determined to be 57 meters above mean sea level. The area of Dam 9 is 24957.78 square meters, and its volume is 26660.98 cubic meters. It is 63 meters below mean sea level, according to recorded data. The surface area of Dam 10 is 15218.22 square meters, its capacity is 26577.13 cubic meters, and its observed altitude is 68 meters above mean sea level.

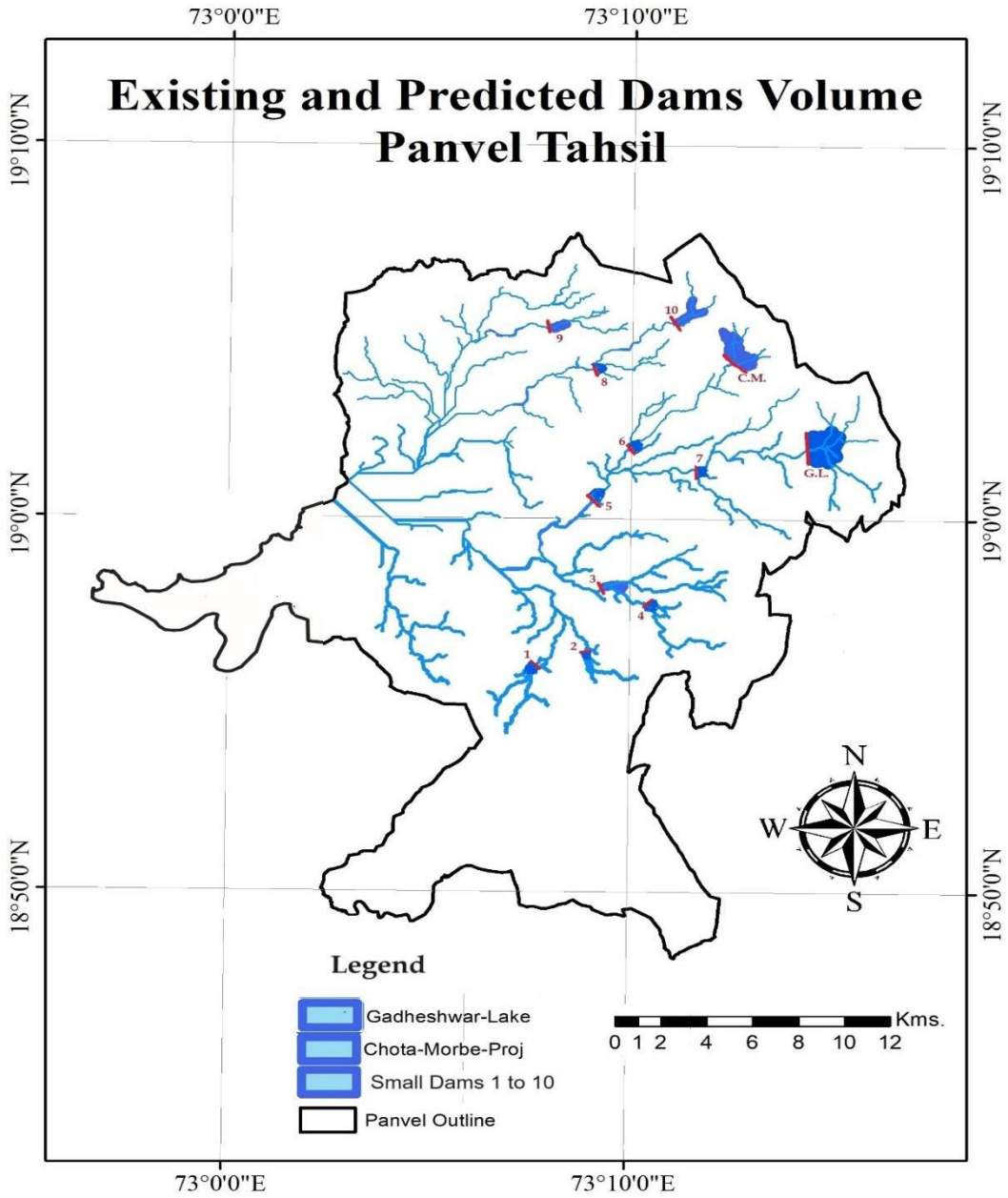

Figure-2: Existing and predicted small dams and water volume, Gadhi and Kasardi River

The present Gadheshwar Lake has a high-water volume capacity of 212885.12 cubic meters, according to observations. The river can hold more water when predicted dams force the river's bottom to erode and release water. Due to internal muck build-up, the current lake's capacity to store water is less than that of the projected dam.
In the Gadhi and Kasardi river basin, watershed management will have several advantages, including decreased runoff, decreased soil erosion, increased soil moisture, elevated ground water levels, improved land productivity, and perennial water supply for the basin region. Therefore, to store water and control watersheds, tiny dams must be built across the Gadhi and Kasardi rivers.

7. Conclusion and Suggestions

In accordance with the stated objectives, the researcher conducted fieldwork at several locations and gathered data for watershed management from sites in the Gadhi and Kaardi River basins. The following results have been found.
1. The Gadhi and Kasardi River Basin is separated into three and five sub-watersheds, correspondingly.
2. The length of the basins has been determined, and the Gadhi basin is 20.36 km long while the Kasardi basin is 13.46 km long.
4. There are presently two notable dams in Panvel Tahsil. The Chota Morbe Dam, which has a capacity of 128071.15 cubic meters and an area of 10280.67 square meters, has been found to be 88 meters above mean sea level.
5. The present Gadheshwar Lake has a high-water volume capacity of 212885.12 cubic meters, according to observations. 96 meters above mean sea level is the height at which the lake was discovered. The Gadhi and Kasardi river basins have projected ten possible dams for the purpose of managing watersheds and storing water.
The following recommendations have been helpful in strengthening the role of watershed management for preserving the long-term security of the drinking water supply in the study area and other regions.
1. Given the significance of water to the development of the Panvel Tahsil region in the Raigarh district, greater focus should be placed on the percolation of water in rural areas. Constructive planning is required to enhance the number of water sources and rainfall storage.
2. In order to finance watershed management over Panvel Tahsil, a sufficient and reliable source of money needs to be found.
3. It is recommended to build small dams along the Gadhi and Kasardi rivers. As a result, water will seep through the earth and farmers will have access to it both in the summer and the winter. There will be an abundance of water in the borewells that supply villages with water till summer.
4. In order to boost water storage and benefit the villages along the river as well as Panvel City, the government and non-governmental organizations should cleanse the silt that has accumulated in the Gadeshwar and Morbe dams.
5. It should be strictly prohibited to utilize the riverbank for open restrooms.
6. Given the significance of water in the development of the Panvel Tahsil region in the Raigarh district, the research suggests that more focus should be placed on the percolation of water in rural areas and that strategic planning is required to increase the number of water sources and rainwater storage.
The government ought to embrace a fresh, comprehensive plan for managing watersheds and storing water after considering all the above recommendations. Thus, the study will help the Panvel Tahsil region's water facilities development in the Gadhi and Kasardi river basins.

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