Design and Development of a New Minor Irrigation Tank (A Case Study over Proposed Irrigation Tank)

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Abstract— The minor irrigation tank plays a very important rule in irrigation as well as local ecosystem in the arid and semi arid regions of south India. Tank irrigation is considered as one of the ancient irrigation system. Since the south Indian tanks are century years old and not being used due to inadequate rainfall, silt deposition, improper maintenance of tank components. The tank irrigation system follows a declining trend so that proper utilization of existing old tanks has to be done by using them as a irrigation land. The main objectives of this project is to irrigate Cultural Command Area (CCA) of about 508.5033 ha and the silted area of existing old tank and also to recharge ground water table. This paper focused on proposal of new irrigation tank on the upstream side of existing irrigation tank so that proposed tank will irrigate the land, mainly silt deposited area of the old existing tank. In this study, area behind the upstream side of the Muchkandi minor irrigation tank near bagalkot, Karnataka is taken as a study area. In this study a new minor irrigation reservoir was proposed and new minor irrigation tank was designed.

Key words: Irrigation Tank, irrigate Cultural Command Area (CCA)

I. INTRODUCTION

Irrigation is the process of artificially supplying water to soil for rising crops. India is basically an agricultural country and its economy depends on the agricultural output to a great extent. Water is normally supplied to the plants by nature through rains. In order to get the maximum yield, it is essential to supply the optimum quantity of water and to maintain correct timing of watering. This is possible only through a systematic irrigation system that is collecting water during the periods of excess rainfall and releasing it to the crop as and when required. So this can be achieved by constructing a tank. Tanks are basically small reservoirs built of earthen walls across the rivers, streams and drainage channels to impound and store water to irrigate fields through channels. The word tank is often used in common parlance to describe small irrigation reservoirs or minor irrigation tanks.

Minor irrigation schemes include ground water and surface water projects. The ground water schemes include dug wells, shallow tube wells and pump sets and surface water schemes include diversion of water from tanks and reservoirs to farms. Lift irrigation from rivers and streams, sprinkler irrigation, drip irrigation etc. also come under minor irrigation. One of such minor irrigation project was carried out in Muchkandi near Bagalkot. The Bagalkot district has faced a lot of drought years which adversely affected people, sometimes continuously for a couple of years. The main reason for this frequent drought is because of its location in the rainfall shadow area. The government is trying to overcome the problem of drought by many minor irrigation scheme and trying to bring more of drought area under irrigation facilities. The District's main sources of irrigation are wells, tanks, small, medium and large reservoirs, gravity canals by diversion of water through inundation, canals, rivers, etc. Major, medium and minor irrigation systems have been tried, but in view of the growing disadvantages of large projects, the emphasis is slowly shifting towards the minor irrigation.

The Muchkandi tank was constructed to store the water. But due to heavy silt deposition, live storage capacity of tank has been reduced. So the new tank project is being proposed. The new tank project has been proposed on the upstream side of existing dam. The proposed tank will irrigate the land, mainly silt deposited area of the old existing tank.

II. STUDY AREA

The Bagalkot District is situated entirely on the North Karnataka Plateau, which is part of the larger Deccan Plateau, located in north-central Karnataka. It is positioned at 16°12′N 75°45′E and covers an area of 6593 km². The average elevation in this area reaches approximately 610 m. The climate is warm and dry throughout the year and rainfall is scarce. The district receives the lowest rainfall annually of whole Karnataka. The average rainfall in the region is approximately 318 mm annually. The months of September and December account for about 52% of the total annual rainfall.

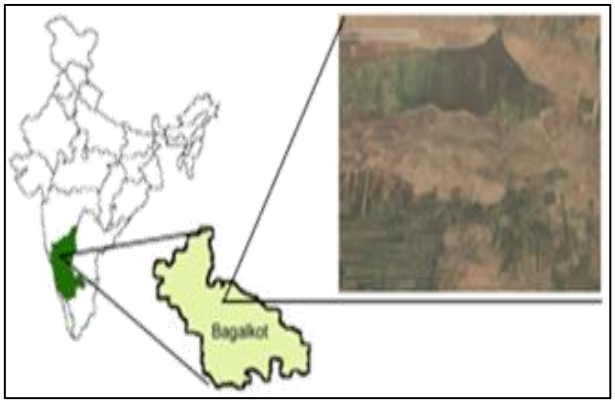

Fig. 1: Study Area

Fig. 2: Aerial view of proposed tank

III. METHODOLOGY

The whole project is presented in four parts. The first part deals with the study of the project area. It includes rainfall, climate, topography and crop pattern of the region. In second part presents the design of bund or embankment. The third part describes the design of canal. The fourth part includes the design of sluice gates.

A. Rainfall

The catchment area receives monsoon rainfall from June to November months, in addition to monsoon rainfall; the cyclonic rainfalls are recorded in the months of November to December. The nearest Rain Gauge station of the catchment area is located in Badami. The rain gauge stations which influence the catchment area is at Badami. The rainfall records of Badami rain gauge station are collected for a period of 112 years i.e. from 1901 to 2012. From the record of 112 years, 50% dependable rainfall is calculated and is 495.6mm.

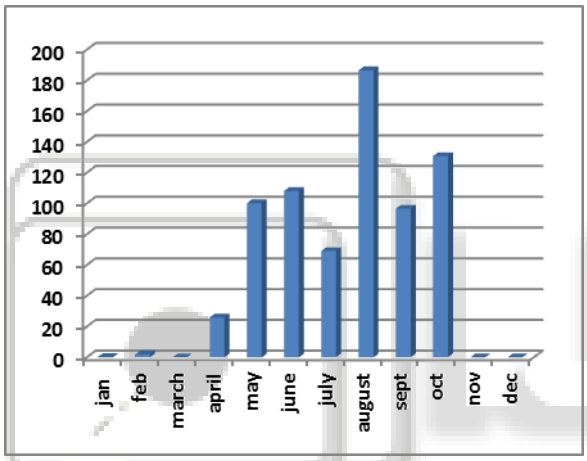

Fig. 3: Precipitation (mm)

B. Climate

The temperature of the Bagalkot varies from 16˚C minimum and 41˚C maximum. The observed temperature varies from 16˚C to 27˚C in winter 27˚C to 41˚C in summer.

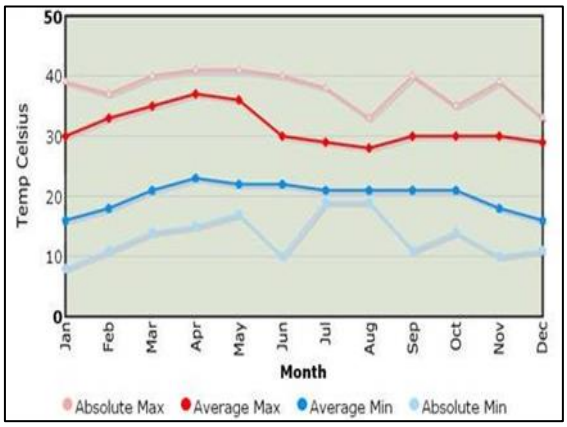

Fig. 4: Average and extreme temperatures.

C. Topography of Catchment Area

Topography of the catchment area is almost plain with hillocks here and there. Soil in this region is Black Cotton and red sandy soil. The ground slope is towards Malaphrabha valley S-N. It also has some streams falling into the region.

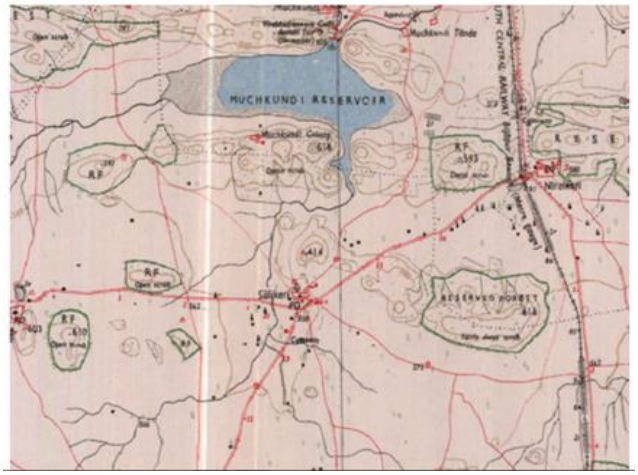

Fig. 5: Toposheet of proposed site

D. Catchment Area

For calculation of the catchment area toposheet Plot No. 47P/12 is used and its scale is 1:50000. The catchment area is delineated with the help of contours on toposheet and area is obtained by importing toposheet with given scale in to Autocad software. The total independent catchments area calculated for the proposed site is 42.64 sq km.

E. Survey Details

Detailed survey has been carried out throughout the study area, using digital Survey instrument total station. The purpose was to find out reservoir submerged area, capacity of reservoir, height of the bund and to determine the cutting and filling along the length of the canal.

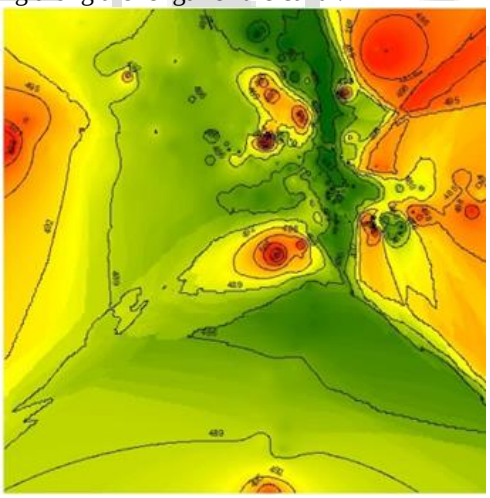

Fig. 6: Contours with digital elevation model

F. Crop Pattern

The existing crop pattern in command area is mostly Kharif and hence it is proposed to irrigate semi dry kharif only, the duty of 3456 ha/cum for Kharif crop is adopted and with this duty irrigable area is formed to be 508.5033hectares which is served by a single main canal LBC having irrigable area of 508.5033 hectares (1256.539 acres).

G. Materials for Construction

Sufficient quantity of material is available for the construction of earthen dam. The material used is silted soil in existing tank. The sand for the construction is to be

obtained from Kamatagi (River bed) with lead of 26.00 km. The stones required for revetment and masonry can be obtained from Jamkandi quarry which is 4.50 km away from the proposed dam site. The homogenous type of earthen dam is proposed for the present project.

IV. RESULTS AND DISCUSSION

Storage capacity of proposed irrigation tank was calculated with the help of contours by using Trapezoidal Formula and Cone Formula. Height of the bund was decided by using capacity curve as shown in fig. 7. Yield has been calculated with the help of catchment area, rainfall data and stranger's table. Corresponding calculated values are shown in table 1.

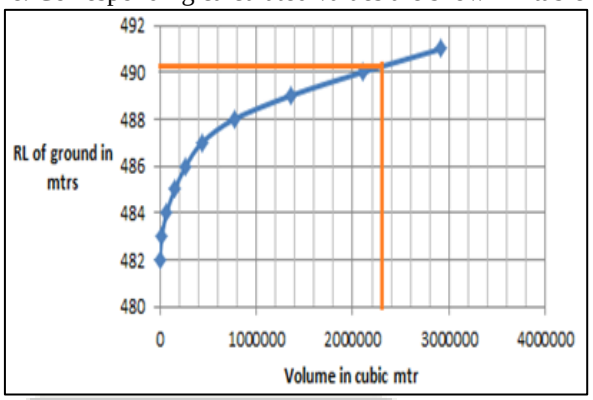

Fig. 7: Capacity curve

Sl. No.	Description	Calculated values
1	volume by trapezoidal formula	2936628.97 m^3
2	volume by cone formula	2918503.06 m^3
3	Total yield	2.2943895 m^3
4	dead storage	0.114 m^3
5	Live storage	2.1793 m^3
6	Water available for irrigation	1.52551 m^3
7	duty	3456ha/ m^3
8	Irrigation area	508.5033 hectares

Table. 1: Calculated parameters required for design of tank

A. Design of Earthen Embankment

Dimensions of the earthen dam were decided based on the field conditions as shown in table 2, and cross section of the embankment is shown in the fig. 8.

Sl. No.	Description	Calculated values
1	Top width	2.74m
2	Free board	1.83m
3	Upstream Side Slope	1:1.5
4	Downstream Side Slope	1:2
5	Max height of Bund	10.43
6	Dead Storage	0.6m

Table 2: Dimensions of proposed earthen embakment

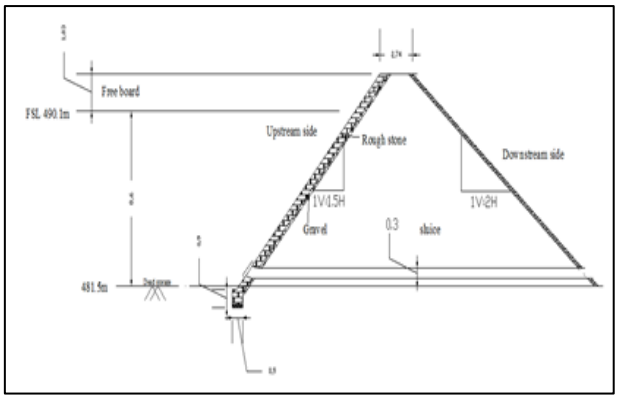

Fig. 8: Cross Section of Earthen Bund

B. Design of Left Bank Canal

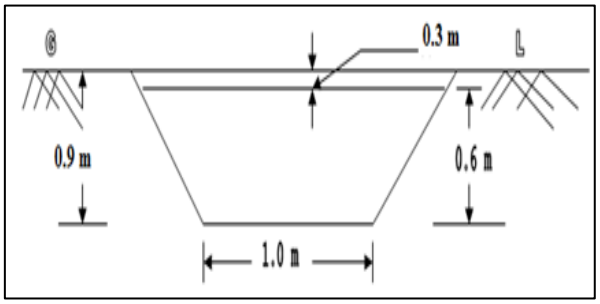

Fig. 9: Cross section of canal

C. Design of Sluice Pipe

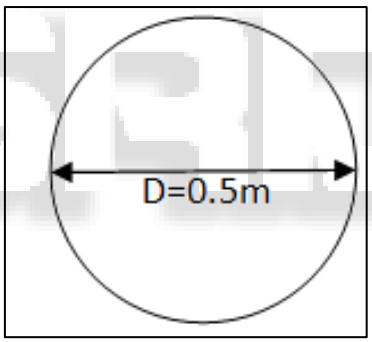

Fig. 10: Cross section of canal

V. CONCLUSIONS

The new irrigation reservoir has been proposed and irrigation tank has been designed effectively by considering all hydrological aspects.

The proposed New Tank is in Malaphrabha sub-basin on the upstream side of the Muchkandi tank. The proposed project consists of an earthen dam 120m long. The project includes a canal network which is aligned to irrigate Cultural Command Area (CCA) of about 508.5033 ha. The maximum height of the dam is 10.43m above the nala level. The reservoir formed will have total storage capacity of 2.2943895 m^3 and the dead storage of 0.1147m^3 with a live storage of 2.1793 m^3. The proposed canal networks consist of Left bank canal covering 508.5033 hectares of Cultural command area.

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