RESTORATION AND REJUVENATION OF MINOR IRRIGATION TANKS IN KARNATAKA USING GEOSPATIAL TECHNOLOGIES

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Abstract

All surface water storage structures having culturable command area up to 2000 hectares individually are considered as Minor Irrigation (MI) Tanks in the southern Indian State of Karnataka. In recent times, MI Tanks in Karnataka has shown a steady decline in its irrigation potential due to poor monsoon rains; silting; encroachment and inappropriate maintenance procedures, though has a potential to irrigate large areas of 6,85,000 hectares. An effort to restore the Minor Irrigation tanks has been planned by mostly all the State governments and especially so in the state of Karnataka due to large areas coming under drought prone areas compared to the national average. The government is looking into the development of tank irrigation system to meet the growing demands of rain-fed agriculture in areas where the range of rainfall is mostly seasonal. In this paper an effort is made to propose variety of treatment methods to restore and rejuvenate water bodies using geospatial technologies based on available information with Government of Karnataka.

Keywords: Restoration/Rejuvenation of Tanks, Prioritization of Tanks, Minor Irrigation, GIS

1. Introduction

In Southern India, Tank Irrigation system has contributed significantly in agricultural production sector and especially in Karnataka where tank irrigation has a long history of small scale irrigation. Since olden days, management of water bodies is predominantly done in the form of irrigation tanks. The decline in these multipurpose minor irrigation structures in recent decades assumes greater significance in Karnataka due to large parts of the state is susceptible to drought compared to other states and the state has only 20% of its net cropped area under irrigation. The utility of irrigation tank system is critical to improve the crop production in the dry areas for supplementary irrigation. This will also help meet the growing drinking water problems as well as recharge of ground water.The

reasons for the neglect of tank system in Karnataka can be summarized as follows: access to alternative source of water for irrigation; silting; poor community participation; lower allocation for operating and maintenance cost: poor management etc. Recognising the importance of tank irrigation and to improve the agriculture potential in rain fed areas, Karnataka State has started allocating funds to revive tank based irrigation. In this context a study was made to prioritise the minor irrigation tanks for allocation of funds.

2. Study area

Karnataka is located in Deccan plateau and is eighth largest state in India. Total geographical area of Karnataka is about 5.83% of total area of country, which accounts to 1, 91,976 sq. Km^2. Karnataka state boundary extends from 74^0 05'18" to 78^0 35'34"E longitudes and 11^0 35'25" to 18^0 28'54" N latitudes in southern India. Karnataka is surrounded by the Arabian Sea in West, Maharashtra in North, Kerala in Southwest, Goa in Northwest, Tamil Nadu in Southeast and Andhra Pradesh in East. Elevation trend in the state varies from 450 to 900 m above mean sea level. Diversity in climate of Karnataka varies from West Coast, the Ghats and Malnad areas (High rainfall areas) as very humid rainy monsoonal climate to semi-arid warm dry climate on the East. Rainfall varies from 4000 mm in Western Ghats to about 500 to 600 mm in the Eastern plains.

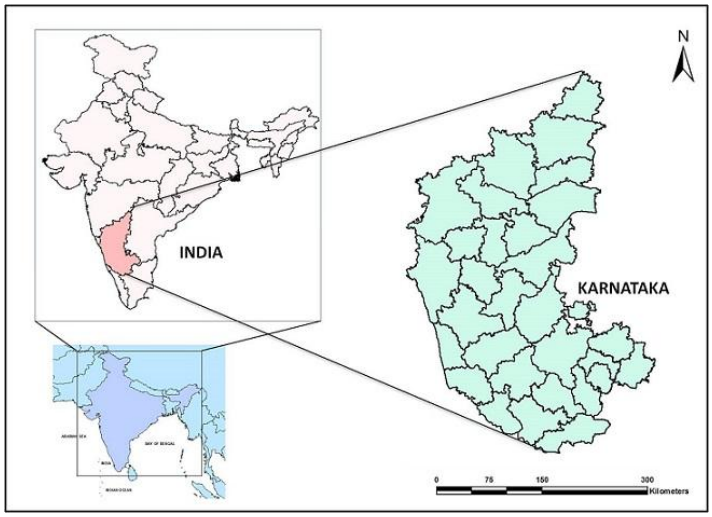
Table 1: Tanks in Karnataka according to Command Area (Source: JSYS, Karnataka)

Sl.No.	Command Area (hectares)	% of Tanks	Managing Authority
1	Below 4	41%	Taluk Panchayath
2	4 to 20	42%	Zilla Panchayath
3	20 to 40	9%	
4	40 to 2000	7%	Dept. of Minor Irrigation
5	Above 2000	1%	Dept. of Major Irrigation

Minor irrigation tanks in Karnataka as per records are around 36,672, possessing a potential command area of 6, 85,000 ha. M.I. Tanks having a command area of 40 to 2000 ha are managed by Minor Irrigation Department of Government of Karnataka. Nearly 92% of tanks are being managed by Rural Development and Panchayath Raj Department through Panchayath Raj Institutions and there are 33,374 such Minor Irrigation Tanks. There is a steady decline in Irrigation potential of these tanks due to various socio-economic parameters. Distribution of minor irrigation tanks in Karnataka are based on command area and the managing authorities as given in Table 1.Depending on agricultural activity, soil types are broadly classified as red, lateritic, black, alluvio-colluvial, forest and

coastal soils. Major crops cultivated in Karnataka are rice, jowar, maize, pulses, oilseeds, cashew nuts, coconut, areca nut, cardamom, chilies, sugarcane, cotton, coffee, tobacco, etc. Location map of Study area is represented in Figure 1.

Figure 1: Location map of Study area



3. Materials and Methodology

Initially identification of tanks for rejuvenation and restoration is taken up for MI tanks having command area of more than two hectares and later extended to all the tanks listed in the records. This paper provides utilisation of geospatial technologies in the restoration of MI tanks and its ability to analyze and visualize spatial and non spatial data. GIS ready data for analysis is sourced from various State government departments including Karnataka State Remote Sensing Applications Centre (KSRSAC), Jala Samvaradhana Yojana Sangha, Department of Rural Development and Panchayath Raj Department etc. Geospatial analysis is carried out under ArcGIS 9.3 and MapInfo environment.The earlier studies and field survey of both spatial and non-spatial made by the state government provides information of minor irrigation tanks such as bund condition, turbidity, aquatic weed, status of tank, qualitative silt deposition and independent/intercept catchment areas. These are broadly classified as follows:

a) Catchment area and the feeder channel.
b) Extent of command area.
c) Existing cropping pattern in the Command Area.
d) Water spread area in the tank and depth of water including extent of silt formation.

e) Encroachments in the catchment area and the command area.

Table 2: Tanks classified based on the available parameters.

Sl No	Criteria
1	Poor bund condition & Dry Tank.
2	Bund medium to good, Low to medium turbidity, low siltation
3	Poor bund & High turbidity
4	High turbidity & bund condition moderate to good
5	High siltation, bund medium to good & low to medium turbidity
6	Dry land
7	Information relating to aqua weeds & encroachment
8	High turbidity, High siltation, Poor bund
9	High turbidity, moderate to good bund, high siltation
10	Low to moderate turbidity, poor bund, high siltation

Minor Irrigation Tanks of 177 Taluks are prioritised by studying the available parameters and were ranked accordingly. Tanks are ranked from 1 to 10. Rank 1 for dry tanks with poor bund condition and rank 10 for low to moderate turbidity, poor bund and high siltation. Ranking of the tanks based on the available parameters criteria is given in the Table 2. Minor Irrigation Tanks of the state were classified based on the available criteria and are depicted in Table 2

4. Results and Discussion

About 36,672 minor irrigation tanks are scrutinised and studied for restoration and rejuvenation activity. The spatial and attribute data acquired from the departments provided a base for prioritising the tanks. Each tank is prioritised based on the available criteria such as, bund condition, turbidity, aquatic weed, status of tank, qualitative silt deposition and independent/intercept catchment areas. After studying the status of the each tank, relevant restoration activity was envisioned. The restoration activities are put to force only in places where tank irrigation is predominant and the dependency is high, to give justification for the investment on restoration activity. Restoration activity proposed to be undertaken are desilting, catchment area treatment, strengthening of bund, raising bund/waste weir etc. Table 3 gives information on the relevant restoration activity to be undertaken for each tank. This information needs to be updated by contacting the agencies involved in managing of tanks. Ranking of the tanks will be modified accordingly by conferring with the concerned agencies. Tanks are

Table 3: Suggested restoration & rejuvenation activity

Criteria	Classification type
Poor bund condition & dry tank	Strengthening of bund (Dry tank)
Bund medium to good, low to medium turbidity, low siltation	Tank status (Moderate to good & presently requiring no treatment)
Poor bund & high turbidity	Strengthening of bund & catchment area treatment
High turbidity & bund condition moderate to good	Catchment area treatment
High siltation, bund medium to good & low to medium turbidity	Desilting
Not being used	Dry land
Information relating to aqua weeds & encroachment	Inadequate information
High turbidity, high siltation, poor bund	Desilting, strengthening of bund & catchment treatment
High turbidity, moderate to good bund, high siltation	Desilting & catchment area treatment
Low to moderate turbidity, poor bund, high siltation	Desilting & strengthening of bund

Table 4: Classification type for each tank

Type	Tanks	Classification	Tanks (%)
1	11970	Strengthening of Bund	33
2	8359	Tank Status Moderate To Good	23
3	816	Strengthening of Bund & Catchment Area Treatment	2
4	3515	Catchment Area Treatment	10
5	5316	Desilting	14
6	28	Not Being Used	0.1
7	2639	Inadequate Information	7
8	670	Desilting, Strengthening of Bund & Catchment Area Treatment	2
9	2629	Desilting & Catchment Area Treatment	7
10	734	Desilting & Strengthening of Bund	2

classified into 10 types. Each classification is a combination of the tanks restoration activities to be carried out and is presented in Table 4 & as a bar chart in Figure 2. About 11970 tanks require restoration in the form of strengthening of

bund; 8359 tanks status are moderate to good; 816 tanks require both strengthening of bund and catchment area treatment; 3515 tanks require catchment area treatment; 5316 tanks are to be restored by desilting; 28 tanks are not being used; inadequate information for 2639 tanks; 670 tanks require de silting, strengthening of bund and catchment area treatment; 2629 tanks require

Figure 2: Total tanks in each classification type

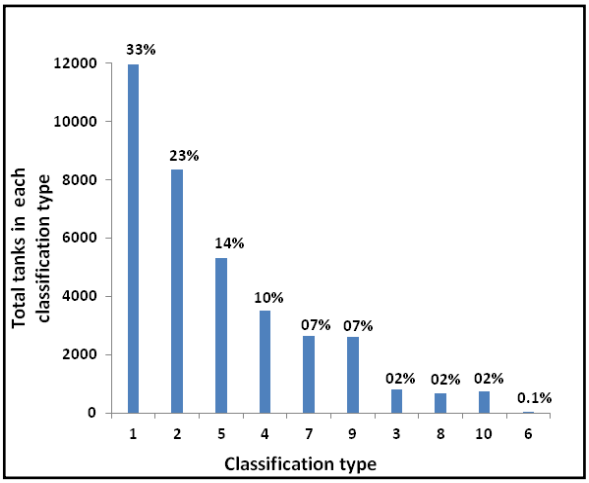


Table 5: Selected classes for each tank

Sl. No.	Tanks	Classification Type	Tanks (%)
1	14190	Strengthening of Bund	39
2	8359	Tank Status Moderate to Good	23
3	7630	Catchment Area Treatment	21
4	9349	Desilting	25
5	28	Not Being Used	0.1
6	2667	Inadequate Information	7

both desilting and catchment area treatment; 734 tanks require strengthening of bund and desilting. Tanks are further regrouped into selected classes to serve the purpose of restoring the tanks which are of high priority and are shown in Table 5 and as bar chart in Figure 3. Highest priority is given to tanks which require strengthening of bund and are ranked as 1, tanks which are having status

Figure 3: Total tanks in selected classification type

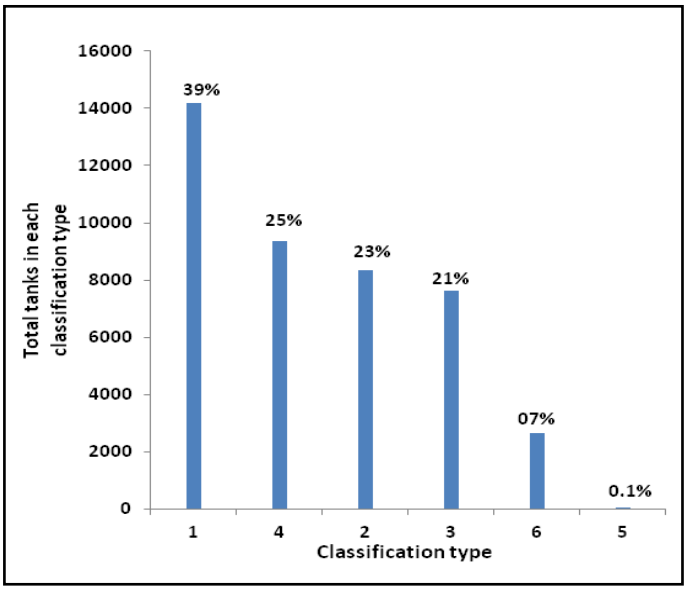
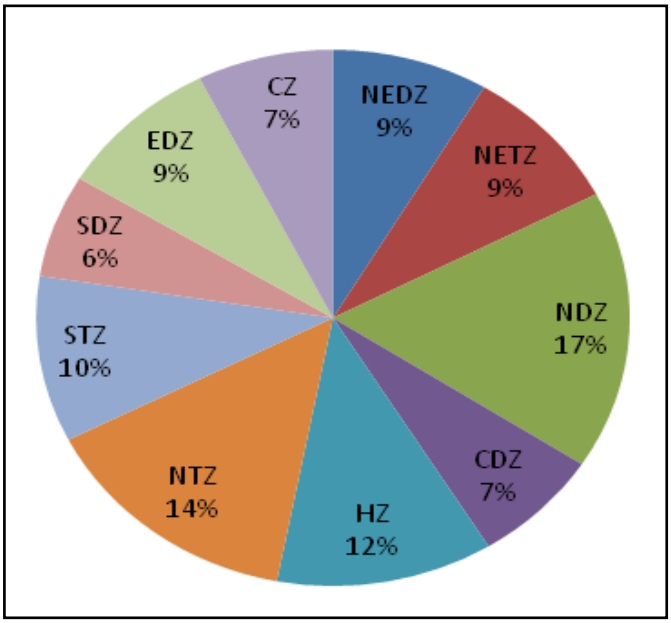
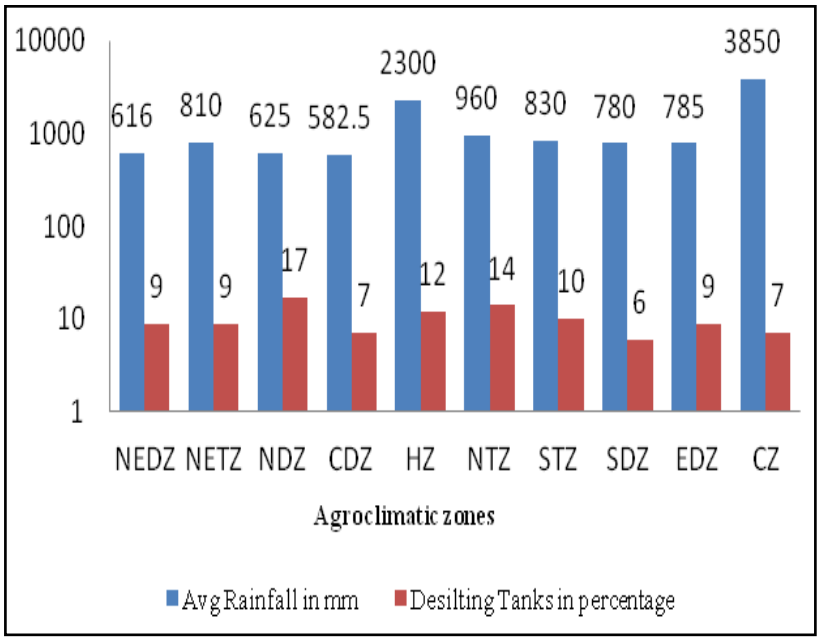


Figure 4: Desilting tanks in each Agro climatic zones



moderate to good are ranked 2, tanks requiring catchment area treatment are ranked as 3, tanks requiring desilting are ranked as 4, tanks which are not used are ranked as 5 and tanks having inadequate information are ranked as 6. About 39% of tanks counting to 14190 require strengthening of bund, 23% of tanks covering 8359 are of moderate to good status. Catchment area treatment is required by 7630 tanks accounting to 21%. Desilting is to be carried out for 9349 tanks covering 25%. 7% of tanks accounting to 2667 fall under the class of inadequate information. And the remaining 0.1% covers 28 tanks which are not being used.

Figure 5: Average rainfall & desilting tanks in the each Agro climatic zones



Agro-climatic Zones: Karnataka has 10 Agro-climatic zones namely, North-Eastern Dry Zone(NEDZ), North-Eastern Transition Zone(NETZ), Northern Dry Zone(NDZ), Central Dry Zone(CDZ), Hilly Zone(HZ), Northern Transition Zone(NTZ), Southern Transition Zone(STZ), Southern Dry Zone(SDZ), Eastern Dry Zone(EDZ) and Coastal Zone(CZ). Number of Desilting tanks in each Agro-climatic zone is represented in the form of pie chart and bar graph in Figure 4 and 5. Northern Dry Zone has the highest percentage of tanks to be desilted i.e.17% and about 14% of desilting tanks come under Northern Transition Zone;

12% of desilting tanks come under Hilly Zone; on an average 10% of desilting tanks come under Southern Transition Zone; 9% of desilting tanks come under each North- Eastern Dry Zone, North-Eastern Transition Zone and Eastern dry zone; 7% of desilting tanks come under Central Dry Zone and Coastal Zone; and lowest percentage of desilting tanks of about 6% are found in Southern Dry Zone. The Bar chart also represents the average rainfall in each Agro-climatic zone. Highest average rainfall is in Central Zone of 3850mm and lowest average rainfall of about 582.5mm is in Central Dry Zone.

5.Conclusion

The results conclusively demonstrates the potential of geospatial technologies for governance in the governmnet sector at a shotest possible time leading to near real-time informed decision-making. The methodologies evolved through this is expected to accessed through Karnataka State Spatial Data Infrastructure (KSSDI) i.e., a web geoportal developed by KSCST to access and discover spatial data and information. The council under KSSDI program is currently working on developing geosaptial applications for providing better governance.

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