



***Assessment of Traditional Water Harvesting Systems and  
Measures for Restoration and Rejuvenation in Different  
Agro-Climatic Zones of Karnataka State using Geo-Spatial  
Technologies***

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**Abstract**

The main objective of this paper is to assess the hydrological and physical status of Traditional Water Harvesting Systems to suggest scientific measures for restoration and rejuvenation of these ancient water bodies. Traditional Water Harvesting Systems were constructed to store rainwater for domestic use such as drinking, bathing, washing and irrigation purposes along with recharging of groundwater. At present most of these ancient water bodies have become dry and non-functional. Some of these became dump yards resulting into the decline in their potentials due to various reasons. Kalyanis, Gokattes, Kuntas and (Pushkaranis) are some of the Traditional Water Harvesting Systems. The temple tanks too which enjoyed protection from humans because of attracted religious sanctity have also become non-functional and disappeared in course of time.

Keeping this in view, a pilot study had been taken up to assess the hydrological and physical status of Kalyanis in 3 districts representing 3 different Agro-climatic zones of Karnataka state to suggest various measures for their restoration and rejuvenation using Geo-Spatial technologies. Under this pilot study, around 655 Kalyanis were studied to assess the hydrological and physical status along to suggest the scientific measures for rejuvenation. The study concludes that, 25% of Kalyanis are in good condition and are under use and more than 70% of Kalyanis are not under use. Around 25% of Kalyanis are in bad condition where structures have been damaged and 40% of Kalyanis have water and 60% does not have water. Around 30% of Kalyanis are polluted with physical and chemical components. Most of the Kalyanis are filled with silt which needs to be taken up for de-silting on priority basis.

The results of which might serve as a first hand information on current status of these ancient water bodies to user agencies like Panchayath Raj Institutions, rural communities and District administration to undertake the Restoration and Rejuvenation works of these water bodies for sustainable development of water resources in the rural areas of the state to cater to an ever growing population and maintain the ecology of the rural area.

**Key words:** *Traditional Water Harvesting systems, Geo-spatial technologies, Rejuvenation, Panchayath Raj Institutions, Agro-climatic zones*

**1. Introduction**

Water is one of the most commonly used substances on our earth. We need water for all our activities in day-to-day life. Access to water has been the basic factor which determines the location of habitation sites of human civilization. Water supply in urban area is always short against the total demand. Surface water is inadequate to meet our demand and we have to depend on ground water. Due to rapid urbanization, deforestation and change in landuse pattern have decreased the percolation of groundwater and recharging of ground water has diminished. This scenario requires an alternative

source to bridge the gap between demand and supply. Rainwater, which is easily available and is the purest form of water, would be an immediate source to augment the existing water supply by "catching water wherever it falls to increase the storage capacity of surface water bodies".

In the context of increasing water scarcity, competitive demands and widespread pollution, water resources have become one of the critical imperatives for livelihood, particularly to the vulnerable poor who reside in the rural areas. Drinking and Domestic water needs get the first priority among the various demands of water. In the

region where ground water is either not available or polluted due to human activity and the rainfall is either scanty or unpredictable, people have to depend upon Traditional Water Harvesting Structures like Ponds, Kalyanis and Tanks to store the seasonal rainfall for various uses round the year. Traditional Water Harvesting Systems were constructed to store rain water for domestic use such as drinking, bathing, washing and irrigation. Kalyanis which are constructed near temples called Pushkaranis plays very important role in socio-religious and cultural activities of Indian tradition and as a storage reservoir to supply water for temples. Apart from the sanctity attached to them, these ponds helps to recharge the wells in and around the area. That was one of the reasons for the ancient rulers to allot funds for their maintenance. Traditionally, where the rainfall was relatively low, every effort was made to retain all the water that fell on the ground through appropriate water retention and conservation strategies such as Kalyanis, temple tanks and ponds. Traditionally, these Kalyanis seem to have played 4 important hydraulic roles such as :

- As a storage reservoir to store rain water for domestic use and as source of waters supply for houses and temples
- As a storage, which acted as insurance against low rainfall periods and also recharges groundwater in the surrounding area,
- As a flood control measure, preventing soil erosion and wastage of runoff water during the period of heavy rainfall, and
- As a device which was crucial to the overall eco-system.

At present most of these water bodies have become dump yards and become invariably orphans resulting into the decline in their potentials. The temple tanks too which enjoyed protection from humans because of attracted religious sanctity have disappeared in course of time.

Keeping this in view, KSCST had taken up the research project on assessing the status of Kalyanis in 3 districts of Karnataka state representing 3 different Agro-climatic zones to suggest various measures for their rejuvenation. KSCST had completed the project by studying 655 Kalyanis and submitted the technical report to the DST, GOI and respective Panchayath Raj Institutions containing the hydrological and physical status along with measures for rejuvenation.

## **2. Objectives and Scope of the study**

The following primary objectives have been set for the study

- To survey and map the Geographic location of Traditional Water Harvesting Structures using GPS technology
- To Assess the hydrological status, Physical status, Usage, Storage capacity, Source of water, Catchment area and Siltation etc., during Pre and Post-monsoon seasons

- To ascertain the status of water quality on various parameters for different uses
- To create digital database on both spatial & non-spatial database on various parameters and hyperlink the present photographs using Geospatial technologies
- To study the hydrological behavior of Kalyanis by integrating the data on Drainage network, Soil, Land use/Land cover, Geology, Hydro-geomorphology, Topography, Rainfall and Ground water level of the surrounding area in GIS Environment
- To provide suggestions and scientific measures for restoration and rejuvenation based on its location, Physical status, geo-hydrological status and usage.

### **2.1 Aspects covered in the study**

To assess the status of Kalyanis, the following important aspects are studied thoroughly for achieving optimum surface water storage to enhance storage capacity and groundwater recharge.

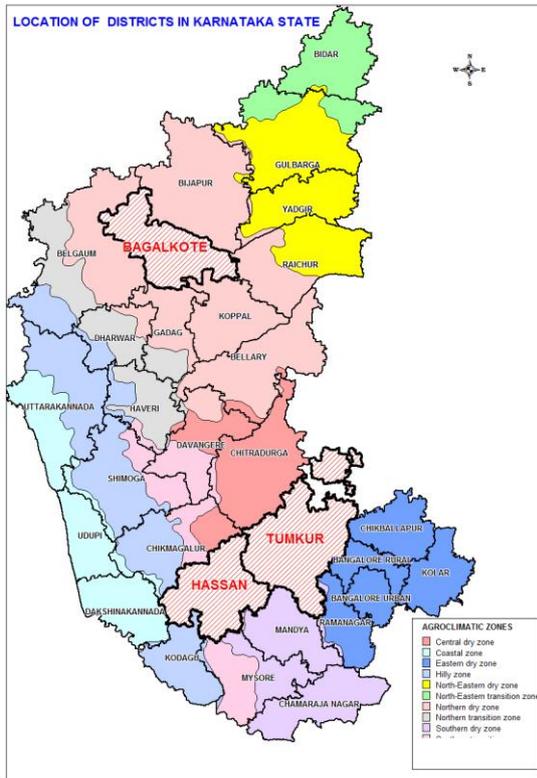
- Geographical location of Kalyanis
- Physiographic or Topography of the Area (Slope, aspect and altitude).
- Geo- hydrology and geomorphology of the area.
- Land use and land cover of the area
- Drainage network and surface water bodies of the area
- Soil type, depth and erosion.
- Rainfall and Climate of the area
- Ground water depth and fluctuation in the area
- Runoff inflow and Storage capacity
- Water quality analysis as per standards

### **3. About the Study area**

Karnataka state has an area of 190,490 km<sup>2</sup> covering 4 divisions with 29,000 villages spread across 30 districts which are divided in to 176 taluks. It has been broadly categorized into 10 different ecological Agro-climatic zones. There are considerable number of Traditional Water Harvesting Systems exists in different size, shape, storage capacity and usage spread across the rural and urban areas in different agro-climatic zones of the state as shown below. 3 districts which are having considerable number of Traditional Water Harvesting Structures with varying in Geographical location, Temperature, rainfall, soil type representing different agro-climatic zones have been taken up for this study as shown in figure no.1. The study involves Physical survey, GPS survey, hydro-geological data collection, capturing photographs on the one hand and creation of Geo-spatial database on various themes and hyper linking the photographs in the other hand in GIS Environment. GIS database creation, Digitization and mapping of location of ancient water bodies, Linking, Hyper linking, integration and Superimposition of different layers for Analysis-Rainfall-runoff analysis, Assessment of surface

water, water quality analysis, have been carried out to suggest scientific measures to undertake Restoration and Rejuvenation of Traditional Water Harvesting Structures to maintain over all ecological and environmental sustainability of the area.

- Based on water quality analysis parameters on  $p^H$ , TDS, Nitrate, Iron, EC and Fluoride, the Kalyanis were categorized
- Scientific measures have been suggested based on the results obtained on physical status, water storage capacity, water availability and water quality
- Discussion about the results with RD &PR officials and created the awareness on restoring these ancient water bodies.

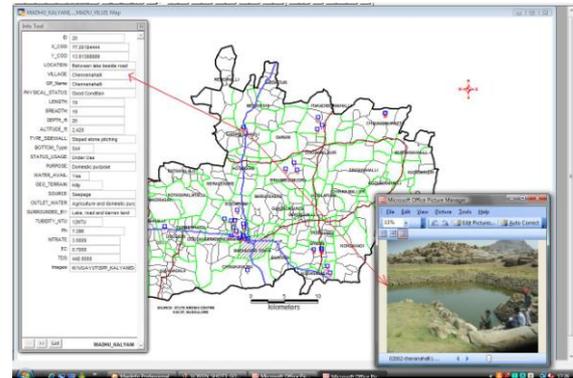


**Fig 1: Karnataka State map with selected 3 Districts representing different agro-climatic zones**

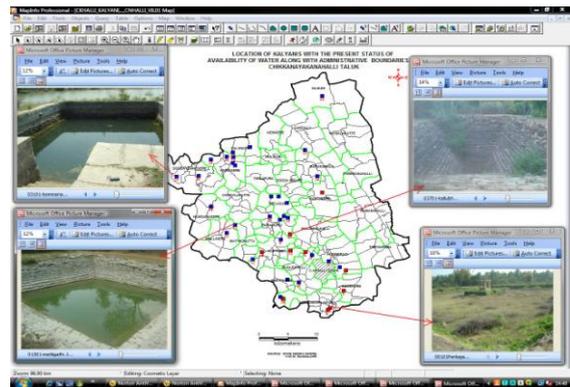
**4. Methodology:**

The following steps are followed as part of the methodology of the study

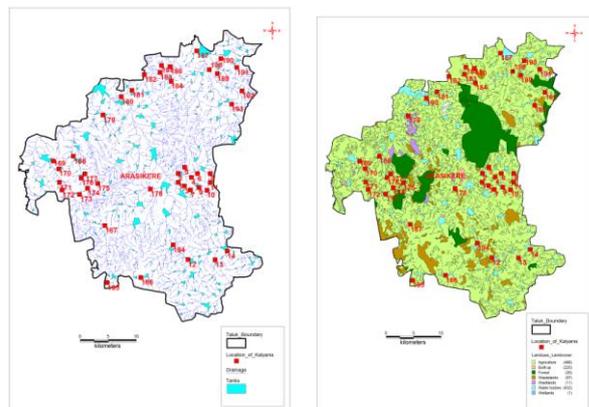
- Collecting and collating relevant data on village wise Traditional Water Harvesting systems of all districts
- Field Surveying and mapping the geographic location of these water bodies using GPS
- Creation of digital database on both spatial and non-spatial data along with Geo-tagging of photographs and attribute data using GIS as shown in fig 2.
- Linking, integration and Superimposition of different thematic layers for Analysis-Rainfall-runoff analysis, Assessment of Yield, etc.
- Evaluation of Morphological and geo-hydrological parameters to assess the status of catchment area
- Ascertain the status of the quality of water which involves the analysis of physio-chemical parameters
- Categorized the Kalyanis based on their physical status, functionality, type of usage and water availability as shown in fig.3



**Fig 2: Geo-tagging of Photos and non-spatial data of Kalyanis in Madhugiri taluk, Tumkur district**



**Fig 3: Location of Kalyanis with their physical status in Koratagere taluk, Tumakuru district**



**Fig 4: Superimposition of Kalyanis with Drainage network/LULC of Arasikere taluk, Hassan district**

**5. Data used**

The following Spatial and Non spatial data has been collected from different sources

- Topographical Maps: 1:50,000 scale maps prepared by the Survey of India were used

- Drainage and Surface water bodies map with Road network maps from Survey of India and PWD, Bangalore
- Thematic maps like Soil, Slope, Geology, LU/LC, Hydro-geomorphology and Administrative boundary maps from District NRDMS centre of Tumkur/Bagalkot/Hassan
- Data/Details on Kalyanis from Zilla Panchayath/Taluk Panhayaths, Tumkur/Bagalkot/Hassan districts
- Statistical data collected from DSO Office, Tumkur/Bagalkot/Hassan and District NRDMS centre, Zilla Panchayath Tumkur/Bagalkot/Hassan districts.

## 6. Results and Discussions

The following are the results obtained from the field study and analysis

- Most of the Kalyanis Neglected by the Community and Government(PRIs)
- Encroachment of surrounding areas of most of the Kalyanis
- Blockage of inlet from Natural catchment and outlets is observed in some Kalyanis
- Most of Kalyanis are not under use due to easy accessibility of Public water supply facilities
- Damages by the natural hazards and Lack of security and maintenance
- Lack of awareness, knowledge and commitment from the community
- Kalyanis does not have water due to Low Rainfall and Ground water depletion
- High nitrate, high Fl and high TDS observed in some Kalyanis
- Use of excess Fertilizers & Pesticides in agriculture land of catchment area affected the quality of water as shown in fig.5



**Fig 5: Kalyani in Seebi, Tumkuru taluk & district**

The following observations are also made.

- Physically covered - 655 Kalyanis have been studied in 3 districts representing 3 different agro-climatic zones
- 39 Kalyanis in Bagalkote district, 233 Kalyanis in Hassan and 383 in Tumkur
- About 25% of Kalyanis are in good condition and are under use in these 3 districts.

- More than 70% of Kalyanis are not under use
- Around 20% of Kalyanis are in bad condition-structures damaged
- Around 40% of Kalyanis have water and 60% does not have water as shown in fig 6
- Around 30% of Kalyanis are polluted with physical and chemical components
- Most of the Kalyanis are filled with silt
- Around 25% Kalyanis are being used as dump yards



**Fig 6: Kalyani in Madalu, Arasikere taluk, Hassan district**



**Fig 7: Kalyani in Madhugiri, Tumkur district**

## 7. Conclusions

Though these water harvesting systems play a vital role in domestic water supply, a decline of these traditional systems has set in as a result of neglect of their maintenance due to State interventions in the form of Piped water Supplies, Hand Pumps, Shallow and Deep Bore wells. These are age-old systems and have specific response to ecology and culture. Not only they stood the test of time but they have also satisfied certain local needs in an environment friendly manner. These systems emphasize ecological conservation in contrast to environmental overuse of modern systems. Traditional systems have benefited from collective human experience and local management since time immemorial and those lies in their great strength. The results of which might serve as a first hand information on current status of these water bodies to user agencies like Panchayath Raj Institutions and District administration to undertake the Restoration, Rejuvenation and Revival works of these water bodies for sustainable development of

water resources in the rural areas of the state. An emphasis on the technical evaluation of the performance of these existing structures and scientific revival of these Traditional water harvesting systems is essential so as to enhance the water resources to cater to an ever growing population as mentioned below.

- Clean the inlet and outlet and bail out contaminated water
- Remove the weeds, Alga, garbage, bushes and slush as shown in fig 8 and 9
- De-silting of Kalyanis which have silt
- Restore the damaged steps, side walls, pitching, Parapet etc
- Provision should be made to allow the runoff and surface water flow during rainy season wherever possible
- Roof water/Rain water harvesting system can be adopted wherever possible
- Rearing of fish in some Kalyanis to enhance the aquaculture
- Community should start using the water for domestic use, secondary purposes in order to prevent the stagnation of water
- Panchayath Raj Institutions and community should own up the Kalyanis for proper maintenance and security
- At least these structures can be preserved as Monuments



**Fig 8: Kalyani in Thovinakere, Tumkur district before rejuvenation**

### 7.1 Impact:

The present study is an attempt to investigate the hydro-geological, lithological, geo-morphological status of Traditional Water Harvesting Systems in all districts representing different agro-climatic zones of the state by using advanced scientific tools like Geographic Information System (GIS), Global Positioning System (GPS) and Remote sensing. The results of which might serve as a first hand information on current status of these water bodies to user agencies like Panchayath Raj Engineering department, Zilla panchayath and District administration for better Planning, Monitoring and implementation of various developmental activities to undertake the Restoration, Rejuvenation and Revival works of the Traditional Water Harvesting Systems for sustainable development of the area. This would help to augment the water supply for



**Fig 9: Kalyani in Thovinakere, Tumkur district after rejuvenation**

various uses for rural people of the state and also helps to prepare plans for proper management, development and utilization of the potential water resources of these ancient water bodies for overall environmental and ecological sustainability.

### 8. References

1. Rural Development Department Government of Tamil Nadu, "Renovation of Traditional Village Ponds"
2. Madhavi Ganesan "The Temple Tanks of Madras city, India; Rehabilitation of Ancient Technique for multipurpose water storage" Centre of Water Resources, College of Engineering, Chennai, India.
3. Centre for Water Resources, College of Engineering, Chennai 'Rehabilitation of an ancient technique for multipurpose water storage - The Temple tanks of Madras, India'
4. Keshab Das, Gujarat Institute of Development & Research, Ahmedabad 'Traditional water harvesting for domestic use - Potential and Relevance of village ponds in Gujarat' .
5. K.A maranayana, ' Ancient water harvesting system and its relevance today increasing ground water' - a success story of Chitradurga