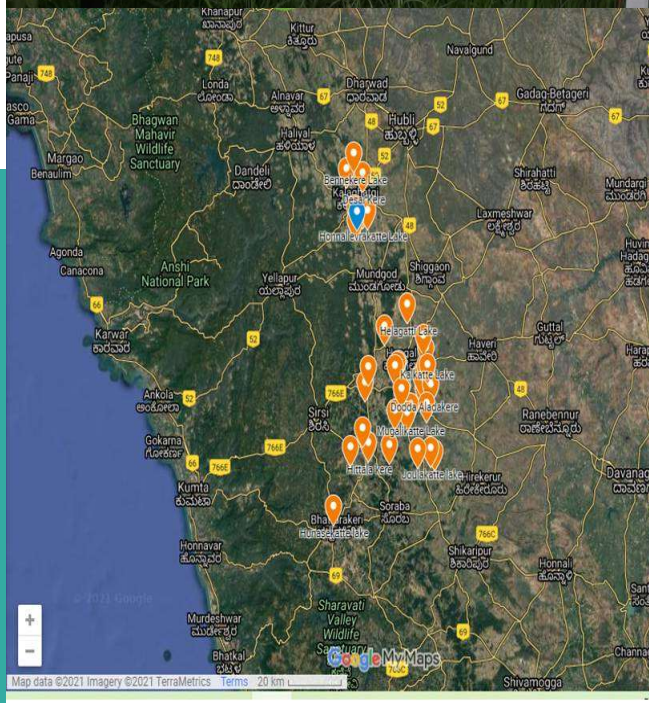
# Impact of Rejuvenation of Lakes and Water Conservation Structures – A Study Report


*Submitted to:*
**MANUVIKASA**
**KARJAGI**

**Dr. R. Vasudeva**
**College of Forestry, Sirsi,**
**University of Agricultural Sciences, Dharwad**

# Contents

# EXECUTIVE SUMMARY

In South India, lakes / tanks are inextricably linked to the socio-cultural aspects of rural communities and have historically been an indispensable part of the village ecosystem. In southern Indian drier areas, it is estimated that rain-fed tanks receive full storage only in two years in a decade; they get half filled in three years and less than one third filled in three years. They go dry in the remaining two years. With this precarious condition, the marginal farmers have to work in other fields to earn their livelihood during years of less rainfall and deficit inflow to the tanks. Over several years, the existing lakes in this region are subjected to several adversaries such as siltation, non-maintenance, encroachment, broken embankments, infested by weeds and shrubs etc. Net result is that the most of the lakes are in degraded conditions. There was an urgent need to rejuvenate these lakes in this region.

Manuvikasa, a non-governmental organization, is actively undertaking a yeoman service of tank rejuvenation apart from working towards alleviation of poverty, awareness activities on different social problems; and various other issues for rural development. This study has been conducted to evaluate the impact of lake rejuvenation / different water harvesting systems undertaken by Manuvikasa in Uttara Kannada, Shimoga, Haveri, and Dharwad districts.

A total of 40 lakes have been rejuvenated under the Ajim Premji Philanthropic Initiative (APPI) programme. These are spread in four taluks of four districts of Northern Karnataka. Further, a total of 100 farm ponds / water harvesting structures have also been constructed under the same programme. These are spread in two taluks of Uttara Kannada district in Northern Karnataka. Economic impact is measured in terms of changes in area under irrigation, productivity (yield) of land, livestock holding, income and consumptions. Ecological impact is measured in terms of changes in perceived groundwater, fodder and fuel wood.

The tanks that were rejuvenated were spread in four districts, of them 26 tanks of Dharwad and Haveri districts were in eastern plains and bio-climatically were drier than other sites; while those from the Shivamogga district were situated in the transition zone with an annual rain fall around 1500 mm. The four tanks in Uttara Kannada were in hilly zone with over 1700 mm annual rain fall. All the study sites for the farm ponds and other structures studied were situated in Uttara Kannada district. All the lakes have been rejuvenated keeping engineering and geological aspects in mind.

Tank rejuvenation is highly relevant for improving livelihoods and alleviating poverty in drought-prone regions. Tanks restore the ecological balance between surface and groundwater resources. Collective action is possible in resource management, provided there are incentives for cooperation. The lake rejuvenation has brought in socio economic changes among the villagers. A detailed study is required to completely map the beneficiary landscape.

A total of 1345 families were directly benefitted from these interventions, of which rejuvenation tanks contributed more benefits to the communities of 1199 families in all the four districts. The recharge pits and farm ponds were implemented in Uttara Kannada district, of which 46 families were benefitted by Percolation pits and about 100 families were directly benefitted due to the farm ponds. However the positive influence of tank rejuvenation can reach over an agricultural area spread up to few kilometers. This aspect needs deeper understanding.


*Tank Rejuvenation Work in Progress*

It was estimated that about 330 million litres of additional storage was achieved (water storing capacity of the lake has increased by estimated 60% after rejuvenation). This has a cascading positive influence on all agricultural activity. It was also observed that least in four lakes, water was overflowing. It was evident by functioning of defunct bore wells that ground water was recharge in six lakes. Nevertheless lakes are going to increase the ground water and ensure supply of water availability for the lakes. It is noticed that at least 25% of the change in the cropping pattern towards growing cash crops such as Maize and Arecanut. Such effects would go a long way in alleviating poverty.

Application of tank silt to the dry land farms is an effective way to boost the water holding capacity of the soil thereby contributing to the agriculture productivity. Through the rejuvenation of 40 lakes a massive amount of silt (over 10,000 tractor loads) has been added to the nearby lands, which itself is massive ecological benefit. The whole operation of lifting of the tank silt has generated about 20,000 man hours of labor and an estimated transaction of over 498 lakh INR. This was crucial for the livelihood of the people during the period of COVID. However the positive influence of tank rejuvenation can reach over an agricultural area spread up to few kilometers in the '*achcut* area'. This aspect needs deeper understanding.

Due to participatory approach, a community mobilization for lake rejuvenation was achieved. Common understanding was arrived among the community members thereby smoothened the efforts of Manuvikasa and ensured in effective implementation of lake rejuvenation initiatives. Every individual farmer interviewed, has expressed great satisfaction about the initiative and the work of Manuvikasa in tank rejuvenation.

Due to rejuvenation, the tanks are re-gaining their old glory of hosting huge bio-diversity. Over a period with a protection from community, these lakes would be home to several life forms such as birds, insects, reptiles. The lake would also help in absorption of heat generated in the region. The roosting of birds in the lake do help in the pest control of the agriculture crops in the surrounding region on a long run. There is an indication that at least one are two lakes would turn into congregation of water birds such as egrets, cormorants.

Market strategies such as beneficiary contribution are necessary for strengthening and sustaining the collective strategies. Considering the increased benefits and from point of equity, it is also important to improve the livelihood of the rural community through increasing the gross tank product in future tank rehabilitation and rejuvenation projects. Tank rejuvenation which has been started purely as a physical rehabilitation to increase agricultural productivity should in future focus on institutional strengthening and poverty alleviation.

# Data Summary

Districts Covered……**= Four**

Taluks Covered……..**= Four**

| | | |
|---|---|---|
| Uttara Kannada | = | Sirsi |
| Shivamogga | = | Soraba |
| Haveri | = | Hanagal |
| Dharwad | = | Kalaghatagi |

Number of Tanks rejuvenated……= **40**

Number of Water Harvest Structures constructed……= **100**

Total Expanse (acres) of tanks de-silted ……= **318.84 acres**

Total additional water storage achieved:

Through Lakes ……= **330.487 million liters**

Through ponds ……= **80 million liters**

Through water harvesting structure in Betta Land……= **13 million liters** every year

Estimated Per cent increase in water storage increased due to rejuvenation……= **60**

Number of bore well / open wells rejuvenated due to rejuvenation……= **4,000**

Per cent cropping intensity increased……= **25 per cent**

Major crops that are leveraging an additional water harvested:

Conventional crops: Paddy, Areca nut, Maize, Groundnut,

Newly adapted crops: Areca nut, Banana, Ginger, Mango, sugarcane, maize etc.

Number of villages with cascading positive by tank rejuvenation……...= **106**

Lake rejuvenation ……..... = **36**

Farm pond development ……..... = **59**

Water harvesting structures ……= **11**

Number of families directly benefitted by tank rejuvenation…….. = **1345**

Through lake rejuvenation in plain and low land……= **1199**

Through farm ponds in mid land……= **100**

Through water harvesting structures in community forest land……..= **46**

Estimated number of families indirectly benefitted by tank rejuvenation……..= **16,000**

Number of acres benefited……=**4705 acres**

Number of tractor loads of silt lifted from tank bed……..= **99,783**

Number of Man-Days of work for lifting silt from tank bed……= **19,956**

Estimated cash transaction among villagers for lifting silt……= **498 Lakh INR**

# Introduction

In South India, lakes / tanks are inextricably linked to the socio-cultural aspects of rural communities and have historically been an indispensable part of the village habitat. Lakes in rural areas play an important role in providing various ecosystem services to human kind. They are the lifeline to our agriculture, livestock, and other domestic needs. It is commonly stated that “there is no place left in India, where lakes can be constructed as the lakes have been constructed at all the places in the country where it should be constructed”. Hence India is known as land of lakes. As small-scale irrigation systems, these tanks are easily adaptable to the system of decentralized village administration they have.

However, over hundred years of existence of these lakes, they are under estimated as key resource that needs to be maintained and protected. There may be several reasons attributed to it such as ignorance, centralized regulations, change in the ownership, urbanization *etc*. In a current scenario of water scarcity, frequent drought like situations, flash flood, depleting ground water table, a need is being felt by a people to relook at these water resources. This scenario of lakes is evident in most part of the country. In this part of the country, lakes are also called tanks. In this report the phrases ‘lake’ and ‘tank’ are inter changeably used. The number of tanks rehabilitated effectively is negligible compared to the total number of tanks. With limited water resources, vagaries of the monsoon, and looming water scarcity in many parts of India, the need for rehabilitating and restoring the tanks assumes significance.

Statistically, the rain-fed tanks receive full storage only in 2 years out of 10. They get half filled in 3 years and less than one third filled in 3 years. They go dry in the remaining 2 years. With this precarious condition, the marginal farmers have to work in other fields to earn their livelihood during years of less rainfall and deficit inflow to the tanks. More over in the years of poor storage, farmers have to switch over to rain-fed dry crops. If the tanks do not get filled regularly, maintenance works of the tank systems is poor, thus reducing tank flow. The wells in the command area are also not getting sufficient recharge and poor distribution network adds to reduced irrigated area. As a result, agricultural labor availability and income from tank-irrigated systems are reduced. India has thousands of tanks and ponds that, if rejuvenated, will contribute significantly to not only increasing food production but also provide a variety of livelihood options to the rural poor and women.

Karnataka has 36,672 tanks with a command area of around 690,000 ha distributed in 27 districts. About 90% of these tanks have a command of less than 40 ha. The administrative perception

of a tank seems to be purely in engineering and technical terms while expertise from other fields (e.g., agronomy, hydrology, watershed and social sciences) for a holistic management of tanks is woefully missing.

The government of Karnataka has recognized the importance of tank rehabilitation. However, holistic planning or management has not been contemplated for the sustainability of the benefits. Detailed water accounting/auditing of each watershed has to be carried out. Issues such as improving the groundwater regime to enable conjunctive use, catchment area treatment to reduce further silting, integrating programs like fisheries, strong irrigation-agriculture extension, etc., have not been considered in the planning process.

Though Karnataka is known for tank management by the local communities, maintenance and management practices introduced by the State in recent years have undermined the importance of community participation. The consequence is that a large number of tanks in Karnataka today become ineffective or in some cases defunct, the area irrigated by tanks has declined, and the local ecosystem deteriorated. The tank was meant not only for agriculture but also served as a resource base for many other activities like collection of fodder and fuel, making of bricks, pots, and baskets, etc., with women always offering their assistance in these processes. Hence, the tank and its surroundings used to be the common property of the village and its people. In Karnataka, districts like Uttar Kannada, Shivamogga, Dharwad and Haveri generally receive good rains annually compared to other part of the state. The undulating and plain topography in these districts enable to have good number of lakes. Over several years, the existing lakes in this region are subjected to several adversaries such as siltation, non-maintenance, encroachment, broken embankments, infested by weeds and shrubs etc. Net result is that the most of the lakes are in degraded conditions. There was an urgent need to rejuvenate these lakes in this region.

## About Manuvikasa

Manuvikasa is a non-governmental, non-political, voluntary organization committed for the advancement of education, environment and rural folk. It was registered in the year 2003 and working in Uttara Kannada, Dakshina Kannada, Shimoga, Haveri, Dharwad and Davanageri districts of Karnataka, India. The organization is addressing the issues such as alleviation of poverty, awareness activities on different social problems; water conservation, publicize human rights and child rights, employment creation, proper management of natural resource and various other issues for rural development. An assessment study has been conducted to evaluate the different water harvesting systems adopted for improving groundwater recharge and associated benefits for the farming community in Uttara Kannada, Shimoga, Haveri, and Dharwad where Manuvikasa has created rain water harvesting structures in different eco-regions.

*Newly Rejuvenated Tank after First Seasonal Rains*

## Purpose of the Survey

The key objective of the survey was to assess the efficacy of the lake restoration endeavor taken up by the MANUVIKASA in the taluks of Sirsi, Sorab, Hangal, Mundgod and Kalghatagi spread across Uttar Kannada, Dharwad, Haveri and Shivamogga district. The key aspects that were taken up into account in this assessment was to know the:

- Historical relevance of the lakes
- Technicalities of the lake
- Role of participatory approach and engagement of various stakeholders
- Ecology and environmental aspects
- Change in the ground water and irrigation
- Improved cropping pattern and yield enhancement
- Socio economic aspects
- People's perception and Sustainability aspects
- Lake ecosystem services

*Rain Water Harvesting Structures in Betta Lands After First Seasonal Rains*

## Methodology

A total of 40 lakes have been rejuvenated under the APPI programme during the year 2020-2021. These are spread in four taluks of four districts of Northern Karnataka. The geospatial details of these lakes are provided in the Table 1. Out of these, thirteen lakes were small with less than 5 acres are water spread, thirteen lakes were of medium size that had an expanse of 5 to 10 acres and ten lakes were large with 10 acres of extent.

**Table 1 Details of the Lakes that have been rejuvenated under APPI fund by Manuvikasa**

| Sl. No. | Lake Name | Village | Taluk | District | Latitude (N) | Longitude (E) |
|---|---|---|---|---|---|---|
| 1 | Mugalikattekere | Agasanahalli | Soraba | Shivamogga | 14.60373463 | 75.15466023 |
| 2 | HittalaKere | Kalakoppa | Sirsi | Uttara-Kannada | 14.50629698 | 75.01316421 |
| 3 | Koraganakattekere | Neralagi | Soraba | Shivamogga | 14.58390303 | 75.14357176 |
| 4 | GodaumballikatteKere | Gangavalli | Soraba | Shivamogga | 14.48613347 | 75.23751342 |
| 5 | DoddaAladakere | Arishinaguppi | Hangal | Haveri | 14.66612823 | 75.19683371 |
| 6 | HunasikatteKere | Guduginkoppa | Soraba | Shivamogga | 14.34482688 | 74.89354699 |
| 7 | JanattikattiKere | Honkana | Hangal | Haveri | 14.64405182 | 75.19926739 |
| 8 | SankappanaKere | Dyavasa | Soraba | Shivamogga | 14.49504322 | 74.95216421 |
| 9 | BolagattiKere | Lakkolli | Soraba | Shivamogga | 14.58844404 | 75.10155241 |
| 10 | KesinkatteKere | Hirekumsi | Hangal | Haveri | 14.65249762 | 75.12745031 |
| 11 | HolagattiKere | Arishinaguppi | Hangal | Haveri | 14.66858268 | 75.19921867 |
| 12 | GorakattiKere | Gadiyankanalli | Hangal | Haveri | 14.71354583 | 75.1147452 |
| 13 | TeppadaKere | Kantraji | Sirsi | Uttara-Kannada | 14.544624 | 74.99139473 |
| 14 | MalammanaktteKere | Hiruru | Hangal | Haveri | 14.71091337 | 75.11124074 |
| 15 | Hunasikattikere | Shadaguppi | Hangal | Haveri | 14.68078926 | 75.18930506 |
| 16 | MudlerkattiKere | Hanumanakoppa | Hangal | Haveri | 14.70359918 | 75.10286179 |
| 17 | KalkatteKere | Balambeed | Hangal | Haveri | 14.74958202 | 75.2064695 |
| 18 | LokavvanakattiKere | Hirekumsi | Hangal | Haveri | 14.6440228 | 75.12461264 |
| 19 | Government GergattiKere | Kalveyallapura | Hanagal | Haveri | 14.7802216 | 75.19870242 |
| 20 | Konanakere | Nittakki | Sorab | Shivamogga | 14.49987833 | 75.08291000 |
| 21 | KontageriKere | Shadaguppi | Hanagal | Haveri | 14.67766271 | 75.19051017 |
| 22 | Kadankattekere | Yattinalli | Hanagal | Haveri | 14.70349965 | 75.20280881 |
| 23 | HonnallevarakattiKere | Tavarageri | Kalaghatagi | Dharwad | 15.10261235 | 74.99251839 |
| 24 | Badagikatte | Kuppagadde | Sorab | Shivamogga | 14.66003178 | 75.00140942 |
| 25 | DesayiKere | Dastikoppa | Kalaghatagi | Dharwad | 15.19349739 | 74.99253689 |
| 26 | JoulakatteKere | Tattur | Sorab | Shivamogga | 14.492445 | 75.22736333 |
| 27 | Oddinakere | Aralihonda | Kalaghatagi | Dharwad | 15.09744685 | 75.00905924 |
| 28 | Hirekere | Aladakatti | Kalaghatagi | Dharwad | 15.10917 | 74.96655333 |
| 29 | DoddaKere | Kopparsikoppa | Hanagal | Haveri | 14.80528333 | 75.06802333 |
| 30 | Hosakoppa | Hoskoppa | Sirsi | Uttara Kannada | 14.655497 | 75.00893 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 31 | KadlekattiKere | Kalgudde | Hanagal | Haveri | 14.58853162 | 7522404645 |
| 32 | Tarekattikere | Sirinayakanakoppa | Sorab | Shivamogga | 14.4910239 | 75.18055828 |
| 33 | Jondikere | Tumarikoppa | Kalaghatagi | Dharwad | 15.20360114 | 74.9370773 |
| 34 | BidaramuliyavaraKere | Bommigatti | Kalaghatagi | Dharwad | 15.07432833 | 74.96891833 |
| 35 | BalageriKere | Malagunda | Hanagal | Haveri | 14.70613566 | 75.2131718 |
| 36 | BalagattiKere | Kirawada | Hanagal | Haveri | 14.60688315 | 75.21061448 |
| 37 | Bennikeri | Hullambi | Kalaghatagi | Dharwad | 15.24448068 | 74.96319048 |
| 38 | Hire kere | Badangod | Sirsi | Uttara Kannada | 14.700225 | 75.012722 |
| 39 | Basappanakere | Tavarageri | Kalaghatagi | Dharwad | 15.09615333 | 74.97225500 |
| 40 | HelagattiKere | Yalavatti | Hanagal | Haveri | 14.860185 | 75.14404946 |

Further, a total of 100 farm ponds / water harvesting structures have also been constructed under the APPI programme during the year 2020-2021. These are spread in two taluks of Uttara Kannada district in Northern Karnataka. The geospatial details of these structures are provided in the Table 2. Out of these, 13 lakes were small with less than 5 acres are water spread, fifteen lakes were of medium size that had an expanse of 5 to 10 acres and about ten lakes were large with 10 acres of extent.

*A Well- Laid Percolation Tank in a Betta Land After First Seasonal Rains*

Table 2: Details of the farm ponds and water harvesting structures that have been constructed underAPPI fund by the Manuvikasa

| Sl. No. | Name of tank owner | Village | *Panchayat* | Taluk | Holding size (acres) | Latitude (N) | Longitude (E) |
|---|---|---|---|---|---|---|---|
| 1 | Vasanth Ganapati Bhat | Hasanagi | Hasanagi | Yellapur | 1 | 14.85247276 | 74.83074269 |
| 2 | Ratnakar Timmayya Hegde | Heepanalli | Yadalli | Sirsi | 3 | 14.61339 | 74.80567167 |
| 3 | Rajeev Krishna Hegde | Heepanalli | Yadalli | Sirsi | 3 | 14.6088333 | 74.80605833 |
| 4 | Subray Ganapati Hegde | Hittalsara | Hasanagi | Yellapur | 3.2 | 14.85765134 | 74.8660399 |
| 5 | Madhukar Seetaram Hegde | Hare Hulekal | Hulekal | Sirsi | 5 | 14.68128711 | 74.76992239 |
| 6 | Gopal Ramakrishna Bhat | Nirnalli | Itaguli | Sirsi | 1 | 14.6466944 | 74.79318357 |
| 7 | Ganapati Ramachandra Hegde | Kottigemane | Hulekal | Sirsi | 2 | 14.68021312 | 74.76621309 |
| 8 | Satish Ramachandra Hegde | Kottigemane | Hulekal | Sirsi | 2 | 14.68202414 | 74.76728069 |
| 9 | Ganapati Krishna Hegde | Hiresara | Hitlalli | Yellapur | 9 | 14.81523987 | 74.82481141 |
| 10 | Vinayak Vighneshawar Bhat | Motinsara | Yadalli | Sirsi | 3 | 14.59954564 | 74.83415728 |
| 11 | MablaBeera Gouda | Karaguli | Analebail | Siddapur | 2 | 14.4522384 | 74.78672078 |
| 12 | Yadav Vaman Bhandari | Hulibarakanjaddi | Hitlalli | Yellapur | 2.05 | 14.81350824 | 74.7638081 |
| 13 | Ganesh Shantaram Bhat | Kargadde | Targod | Sirsi | 2.05 | 14.66190125 | 74.82208074 |
| 14 | ShanmukhHuliya Gouda | Mundgehalli | Gudnapura | Sirsi | 6.1 | 14.54599552 | 74.94336729 |
| 15 | ShivuMastiKanade | Morigadde | Unchalli | Sirsi | 1.2 | 14.56315089 | 74.93021825 |
| 16 | Venkatramana Manjunath Hegde | Varlegadde | Mundgehalli | Sirsi | 4 | 14.54212676 | 74.95074391 |
| 17 | Omkar Suresh Gouda | Hallikoppa | Korlakatta | Sirsi | 3.23 | 14.62901839 | 74.98118195 |
| 18 | Nagaraj Annappa Gouda | Hallikoppa | Korlakatta | Sirsi | 2.2 | 14.62901238 | 74.98120126 |
| 19 | Krishna Madev Naik | Hondagadde | Upleshwara | Yellapur | 1.2 | 14.89391053 | 74.77383284 |
| 20 | Subray Narayan Kalmane | Kalmane | Dehalli | Yellapur | 3 | 14.94143278 | 74.61006604 |
| 21 | Shankar Krishna Siddi | Balagar | Dehalli | Yellapur | 1 | 14.95100818 | 74.60483188 |
| 22 | Babu Krishna Siddi | Balagar | Dehalli | Yellapur | 2 | 14.9555208 | 74.60690271 |
| 23 | Shantaram Ramakrishna Hegde | Narsgal | Nilkund | Siddapur | 2 | 14.48532807 | 74.7277032 |
| 24 | Shambhuling Chandrashekar Hegde | Dodnalli | Dehalli | Sirsi | 1 | 14.64976568 | 74.9015834 |
| 25 | Ramachandra Jattappa Naik | Belladda | Bisalakoppa | Sirsi | 1.4 | 14.74691558 | 74.89658685 |
| 26 | Malini Suresh Hegde | Hiriyal | Dehalli | Yellapur | 3 | 14.96641693 | 74.60587492 |
| 27 | Shripad Babu Marathi | Lingadabail | Idagundi | Yellapur | 1 | 14.94817824 | 74.62870102 |
| 28 | Chandrakant Rama Siddi | Hiriyal | Dehalli | Yellapur | 2 | 14.96390634 | 74.60450356 |
| 29 | Kamala Suresh Siddi | Lingadabail | Idagundi | Yellapur | 1.2 | 14.95341651 | 74.63350293 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 30 | Suresh Manjunath Hegde | Hiriyal | Dehalli | Yellapur | 3 | 14.96597704 | 74.60884832 |
| 31 | Gopalakrishna G Hebbar | Hamsanagadde | Idagundi | Yellapur | 3 | 14.93497871 | 74.64677048 |
| 32 | Vijayananda B Chappalagavi | Hiriyal | Dehalli | Yellapur | 3 | 14.96581305 | 74.60504025 |
| 33 | Anjana Raghavendra Ganvkar | Hiriyal | Dehalli | Yellapur | 5 | 14.96824502 | 74.60925484 |
| 34 | Narayana Nagappa Naik | Achanalli | Dodnalli | Sirsi | 2 | 14.65940788 | 74.91233117 |
| 35 | Pandu Putta Naik | Byagadde | Dodnalli | Sirsi | 6 | 14.64074524 | 74.90515014 |
| 36 | Nagaraj Parameshwar Bhat | Dodnalli | Dodnalli | Sirsi | 5 | 14.48532807 | 74.7277032 |
| 37 | Ramachandra Ganapati Hegde | Bannimane | Nilkund | Siddapur | 2 | 14.49690604 | 74.71329266 |
| 38 | Prabhu Kyatannavar | Rangapura | Badanagod | Sirsi | 2.08 | 14.70448863 | 75.02627366 |
| 39 | Venkatraman Ganapati Hebbar | Hamsanagadde | Idagundi | Yellapur | 3 | 14.93726743 | 74.64636404 |
| 40 | Vivek G Hebbar | Hamsanagadde | Idagundi | Yellapur | 3 | 14.95735854 | 74.75746706 |
| 41 | Ramakrishna TayiParameshwari | Kumbrigadde | Nilkund | Siddapur | 2.05 | 14.48209713 | 74.71929235 |
| 42 | Mahalaxmi V Hebbar | Hamsanagadde | Idagundi | Yellapur | 3 | 14.93848591 | 74.64583104 |
| 43 | Anant Krishna Devali | Tanyanakumbri | Dehalli | Yellapur | 2 | 14.97940372 | 74.63688922 |
| 44 | Narayana M Bhat | Kanchanalli | Chandaguli | Yellapur | 1 | 14.91138416 | 74.76874494 |
| 45 | Narayana M Bhat | Kanchanalli | Chandaguli | Yellapur | 1 | 14.91168209 | 74.76904753 |
| 46 | JockyD'souza | Dehalli | Dehalli | Yellapur | 2.2 | 14.96993825 | 74.62937074 |
| 47 | Narayana Subray Bhat | Totadamane | Dehalli | Yellapur | 2 | | |
| 48 | Rajaram Krishna Hegde | Baggisara | Dodnalli | Sirsi | 4 | 14.63486483 | 74.91524683 |
| 49 | Manjunath V Hegde | Honnekoppa | Nilkund | Siddapur | 2.05 | 14.49206022 | 74.73197759 |
| 50 | Rama SadiyaDevadiga | Korse | Bisalakoppa | Sirsi | 1 | 14.73362914 | 74.90361605 |
| 51 | KrishnamoortiShripati Hegde | Boppanalli | Isloor | Sirsi | 3.2 | 14.70320738 | 74.8841396 |
| 52 | Adarsh M Madival | Boppanalli | Isloor | Sirsi | 1 | 14.70542414 | 74.88375354 |
| 53 | Arun HanumantDevadiga | Hemmadi | Kundaragi | Yallapur | 1.24 | 14.74694833 | 74.87610833 |
| 54 | VasulingaMarathe | Hemmadi | Kundaragi | Yallapur | 1 | 14.754775 | 74.883415 |
| 55 | Jagadeesh M Naik | Kumbrimatti | Kulave | Sirsi | 2 | 14.5811649 | 74.87058975 |
| 56 | Vighneshwar M Naik | Kumbrimatti | Kulave | Sirsi | 2 | 14.581493 | 74.87304255 |
| 57 | Rama SukraPoojari | Hemmadi | Kundaragi | Yallapur | 2 | 14.75018833 | 74.881015 |
| 58 | Basavaraj G Mattigatti | Hemmadi | Kundaragi | Yallapur | 1 | 14.751705 | 74.87069667 |
| 59 | Ramachandra Durga Naik | Shivalli | Bisalkoppa | Sirsi | 1.2 | 14.74361 | 74.89294833 |
| 60 | Ganapati M Naik | Oudala | Sonda | Sirsi | 1.07 | 14.72745365 | 74.73341579 |
| 61 | Umesh Hegde | Hemmadi | Kundaragi | Yallapur | 1.2 | 14.75768 | 74.868255 |
| 62 | Rama Madev Marathi | Kabbingadde | Chandguli | Yallapur | 3.2 | 14.94180355 | 74.77659015 |
| 63 | Nagesh Yalla Marathi | Kabbingadde | Chandguli | Yallapur | 2.2 | 14.93926036 | 74.77536396 |
| 64 | Ishwar Govind Hegde | Koppa | Unchalli | Sirsi | 5.2 | 14.54043154 | 74.89377892 |
| 65 | AnanduMadurDevadiga | Hitlasara | Hasanagi | Yallapur | 3.25 | 14.84548463 | 74.86463623 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 66 | Darshan Bhat | Bisalkoppa | Bisalkoppa | Sirsi | 2.2 | 14.70752333 | 74.93212667 |
| 67 | Parameshwar Ganapati Hegde | Gangeri | Isloor | Sirsi | 3 | 14.66104 | 74.90623333 |
| 68 | Keshav Nagesh Arer | Landakanahalli | Dodnalli | Sirsi | 1.32 | 14.6278506 | 74.86909635 |
| 69 | Manjunath Subray Naik | Yankanajaddi | Hulekal | Sirsi | 2 | 14.7237825 | 74.72969144 |
| 70 | R M Hegde | Gangeri | Isloor | Sirsi | 3 | 14.66308333 | 74.90919333 |
| 71 | Kumar Gopalkrishna Bhat | Malalgav | Chandguli | Yallapur | 3 | 14.89885674 | 74.73168239 |
| 72 | Mahesh Hegde | Hemmadi | Kundaragi | Yallapur | 12 | 14.74804167 | 74.87503833 |
| 73 | Madhura Naik | Hemmadi | Kundaragi | Yallapur | 4 | 14.75181667 | 74.85101667 |
| 74 | Gopalkrishna Bhat | Malalgav | Chandguli | Yallapur | 3.2 | 14.90169145 | 74.75174091 |
| 75 | Vittal M Shet | Bugadipal | Chandguli | Yallapur | 4 | 14.89773762 | 74.74879484 |
| 76 | V S Naik | Bilaki | Hasanagi | Yallapur | 4 | 14.90278848 | 74.85554139 |
| 77 | Mahesh Naik | Bilaki | Hasanagi | Yallapur | 2.2 | 14.90272276 | 74.85562555 |
| 78 | Krishna Subray Hegde | Hutakamane | Angod | Yallapur | 1.22 | 14.9586442 | 74.65871091 |
| 79 | Mahadev Ganesh Marathi | Hutakamane | Angod | Yallapur | 3.2 | 14.95973216 | 74.64958781 |
| 80 | Narasimha Hangari | Hutakamane | Angod | Yallapur | 1 | 14.96028977 | 74.65601736 |
| 81 | MahabaleshwaraSubray Hegde | Hutakamane | Angod | Yallapur | 1.22 | 14.96059755 | 74.65615974 |
| 82 | Tammanna Ganesh Marathi | Hutakamane | Angod | Yallapur | 4 | 14.9653389 | 74.64455609 |
| 83 | Nikhil Ishwar Hegde | Koppa | Unchalli | Sirsi | 5.2 | 14.54132961 | 74.89293401 |
| 84 | Gopalakrishna Ganapati Sabhahita | Hutakamane | Angod | Yallapur | 1.29 | 14.96596458 | 74.65348865 |
| 85 | Ramachandra Gopal Ganvkar | Hutakamane | Angod | Yallapur | 2.3 | 14.96787845 | 74.65089162 |
| 86 | Narayana Ganapati Bhat | Hiriyala | Dehalli | Yallapur | 8 | 14.96601569 | 74.63918515 |
| 87 | Manjunath Marathe | Kabbingadde | Chandguli | Yallapur | 3 | 14.93881647 | 74.76626987 |
| 88 | Raghavendra R Bhat | Kabbingadde | Chandguli | Yallapur | 5 | 14.938739 | 74.7685188 |
| 89 | Vinayak R Pai | Krishnagadde | Kannigeri | Yallapur | 3 | 15.00543816 | 74.71952506 |
| 90 | Ganesh HanumantappaBovivadder | Bendigeri | Hasanagi | Yallapur | 3 | 14.93095301 | 74.86123731 |
| 91 | Sumant Naik | Bharani | Kundaragi | Yallapur | 1.2 | 14.78569073 | 74.86065335 |
| 92 | Girish Poojari | Bislkoppa | Bislkoppa | Sirsi | 1 | 14.75354167 | 74.86654833 |
| 93 | Markos Siidi | Kalanjikoppa | Hasanagi | Yallapur | 2.2 | 14.70752333 | 74.93212667 |
| 94 | Subrahmanya Bhat | Hulimane | Chandguli | Yallapur | 4 | 14.91298016 | 74.75207951 |
| 95 | Shivaram G Bhat | Hulimane | Chandguli | Yallapur | 4 | 14.91376445 | 74.75148878 |
| 96 | Mahabaleshwar Naik | Kalanjikoppa | Hasanagi | Yallapur | 1 | 14.90382938 | 74.85264586 |
| 97 | Ganesh Poojari | Hemmadi | Kundaragi | Yallapur | 2 | 14.75354167 | 74.86654833 |
| 98 | BangarappaSiddana Gouda | Kupagadde | Badanagod | Sirsi | 5.2 | 14.66821011 | 74.99785821 |
| 99 | Pramod Hegde | Nisargamane | Nisargamane | Yallapur | 1 | 14.96568921 | 74.69430618 |
| 100 | Vinayak Bhagwat | Sirsi | Sirsi | Sirsi | 2 | 14.55952167 | 74.72897167 |

Of the 40 lakes constructed, 10 lakes were randomly selected in 5 taluks spread across 4 district for the survey assessment. Further among 100 farm ponds / water harvesting structures constructed by Manuvikasa a sample of 25 sites were visited. Both qualitative and quantitative information was elicited. Group discussions, transect walks and discussions with local were conducted to obtain an overview of the situation. Following methodology to collect the information from the visit was adopted:

- A questionnaire was prepared to collect the information
- Field observations on the rejuvenation of lakes
- Interaction with local *panchayath* representatives and its members
- Informal discussion with farmer beneficiaries and other community members
- Mapping of the lakes was done
- Farmland visits
- Photo documentation of lakes

Impact was measured in terms of changes in various indicators because of the tank restoration program. It is measured across different size classes of holding in order to examine the distributional aspects of the impact. Impact indicators were grouped under economic and ecological categories. Economic impact is measured in terms of changes in area under irrigation, productivity (yield) of land, livestock holding, income and consumptions. Ecological impact is measured in terms of changes in perceived groundwater, fodder and fuel wood.

***On-site Discussion with Farmers about Lake Rejuvenation***

## Results and Discussion

This study presents the results of the impact analysis of adopting different rain harvesting structures implemented in the study area by Manuvikasa. For a rain harvesting project to be sustainable, multidimensional impacts should be considered, mainly social, economic, ecological and environmental well being. Both qualitative and quantitative approaches have been used for the evaluation. Data were collected through group discussion with different categories of farmers. However, the study mainly relies on the data collected by using an interview schedule. Key informant interviews and focus group discussions with multiple stake holders to find out strength and constraints of the rain harvesting systems adopted in different eco-regions of the study area. Analysis involved assessment of quantity of water recharged into the ground, crop pattern change, change in agricultural income and also expected improvement in biodiversity of surrounding area before and after implementation of the rain water harvesting systems.

## Common Profile of the Sample Villages


All the study sites for the farm ponds and other water harvesting structures studied were situated in Uttara Kannda district. This is the district with highest forest cover in the state and only 11% of the area is under cultivation. About 70 percent of the population (14.37 Lakhs) reside in rural areas. Communities belonging to SC / ST category work as agricultural laborers. Two major soil types the coastal alluvial soil and the lateritic soil in the Upper Ghats predominantly occur. A patch of black soil in Yellapur taluk is also found.

**Fig. 1**. Water bodies of Uttara Kannada
(Source: Ramachandra, T.V., Subash Chandran, M.D., Joshi, N.V., Vinay, S., Bharath, H.A., Ganesh Hegde and Gouri Kulkarni, 2014. Water Bodies of Uttara Kannada, Sahyadri Conservation Series 44, ENVIS Technical Report: 81, November, 2014, CES, Indian Institute of Science, Bangalore-560012, India.)

Another unique tenure system exists in the Uttara Kannada district called Betta land. More than 23,000 ha of geographic area are under this system. It is a unique privilege granted by the Govt. for the purpose of collecting leafy biomass for to be used in Arecanut cultivation. Water harvesting structures and ponds were constructed in these betta lands for in the farm lands. There is no other means of irrigation is available to these villages and they need to use surface water for irrigation. The four tanks in Uttara Kannada were in hilly zone with over 1700 mm annual rain fall.

The tanks that were rejuvenated were spread in four districts, of them 26 tanks of Dharwad and Haveri districts were in eastern plains and bioclimatically were drier than other sites; while those from the Shivamogga district were situated in the transition zone with an annual rain fall around 1500 mm. Haveri is relatively smaller district of the state with 770 per square kilometer of geographic area. A Total 15 per cent of the population in the Hanagal Taluk belongs to SC and ST community. The annual average rainfall is 1063mm and 03 times this Taluq has received less than 800 mm rainfall in a year and affected by draught in last ten years. About 9698 ha is irrigated through lake water and around 10530 ha are irrigated through bore wells.

Shivamogga district covers an area of 8477.84 sq. km and lies in the Western part of the Karnataka state between 130 27' to 140 14'39" north latitude and 740 38'to 750 45' east longitudes with a population of 1,752,753. The Scheduled Caste population contributes 17.6 percent to the total population of the district and the Scheduled Tribe population contributes 3.7 percent. The district has 276855 ha. of forest, which constitutes 32.66 per cent of the total geographical area of the district. The fallow land in the district is around 38831 ha. Net area sown during the year 2006-07 was around 223695 ha, out of which, 36212 ha of land was sown more than once.

There are wide variations between the sample villages regarding their socio-economic features. The average farm size ranges from 1to12 acres; the population ranged from 200 to 2000. The selection of beneficiary villages was based on larger proportion of socially and economically weak sections as well as the need for the rejuvenation. This is in line with the criterion adopted by the government while implementing programmes such as watershed development. In all these villages, there is no institutional mechanism that exists for tank rejuvenation and hence it is currently un organized.

## Selection criteria and protocol for tank for rejuvenation

Based on the need and interest expressed by the communities the site selections were done. Villages with small and marginal farmers and with SC/ST population were selected. Water conservation in Betta Land was based on farmers interest and not based on economic conditions of the farmers.

## Protocol for Selection of Lakes for Rejuvenation adopted by Manuvikasa

1. Group meeting and discussion with the community and ice braking meting as well as expression interest for lake rejuvenation.
2. Confirmation by the community to lift the tank silt obtained during rejuvenation and contributing about 50 percent of the excavation cost.
3. Getting appropriate permission from the Gram Panchayath and local administration.
4. Thrashing of issues pertaining to the lake boundary / encroachment, if any, through dialogues in open community meeting.
5. Assessment of impact of the work and potential beneficiaries/ benefits.
6. Investigations into the technical part of construction, silt accumulation status, bund status etc.
7. Developing ground rules for lifting of silt and proper disposal to the farm lands / common lands / road as desired by the communities.
8. Slating the dates for rejuvenation and execution of work

*Village – Level Meeting about Lake Rejuvenation by the staff of Manuvikasa*

## Percolation Tanks

Percolation tanks are in semi-circle shape in the flat valleys of *Bettaland* and open hills where water from hills collect at one place and later it flows as stream. Mud bund built in one side across the valley to store water. The excess water of filled tank is discharged separately by drainage channel which is made above the filled mark on either side of the bund. To fill completely it takes on an average two to three rainy days and percolates completely in 3 to 4 days. This has boosted the moisture availability in the nearby old ponds, old tanks etc.

**Table 3**. Details of the water harvesting structures and rejuvenation of tanks undertaken by Manuvikasa in different districts

| Sl. No. | Type | Uttara Kannada | Shimoga | Dharwad | Haveri | Total |
|---|---|---|---|---|---|---|
| **1** | Percolation tank | 23 | 0 | 0 | 0 | 0 |
| **2** | Farm Ponds | 100 | 0 | 0 | 0 | 100 |
| **3** | Rejuvenation of Tanks /Lakes | 04 | 10 | 8 | 18 | 40 |

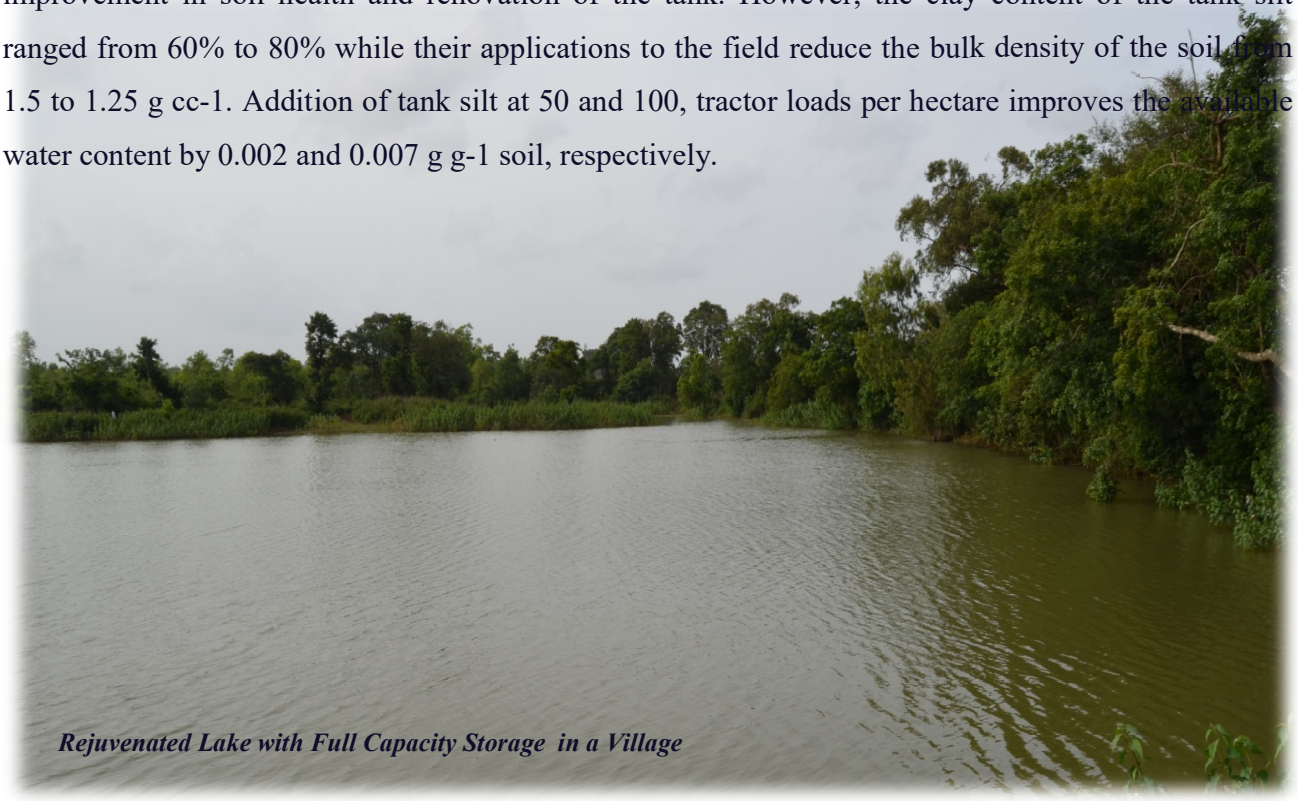
## Farm Ponds

Farm ponds were made on farm lands where enough source of water is available. The average size of each farm pond is 30x30x10 ft. The depth of the ponds varies as required by the farmers. These ponds are rectangular in shape. Total 100 farm ponds were constructed by Manuvikasa in two taluks (Sirsi, and Yellapur) of Uttara Kannda and cover a total cultivated area of 270 acres. The stored water is mainly used for cultivation. In other way it also helps in recharging ground water.

*Farm Pond constructed in Farmer's Field after First Seasonal Rains*

## Rejuvenation of Lakes

From pre-historic times, the rain dependent state of Karnataka has been witness to continuous efforts by the rulers and the people to set up efficient systems to harness and collect water. In fact, during the Bronze Age and the Megalithic Age, the people of South India were regarded as leaders in constructing waterharvesting systems, especially at places where rivers were not present. A rock inscription of the 4th century which is in the reign of the Kadamba King Mayura Varma describes a tank built by the king in the village of Chandravalli in Chitradurga District. Another inscription of the same dynasty record details of a tank built near the Pranaveswara Temple of Talagunda in Shimoga District. There are ten historic tanks (‘*Kere’ as they are called*) reported in Banavasi region of Sirsi taluk. Most of these are located in the eastern part of the taluk where the rainfall is scanty. These tanks were built during Kadamba period (1654 AD). Unfortunately over the days, most of the historical tanks are dying and on the verge of drying up due to silt deposition. In view of giving rebirth to the historic tanks, Manuvikasa have come forward with the contribution of local people and other funding agencies for de-silting historic tanks. People who contributed for de-silting of tanks have got tank silt for their agricultural fields, farm lands etc. Recycling of tank silt provides a win-win situation to both, improvement in soil health and renovation of the tank. However, the clay content of the tank silt ranged from 60% to 80% while their applications to the field reduce the bulk density of the soil from 1.5 to 1.25 g cc-1. Addition of tank silt at 50 and 100, tractor loads per hectare improves the available water content by 0.002 and 0.007 g g-1 soil, respectively.



***Rejuvenated Lake with Full Capacity Storage in a Village***

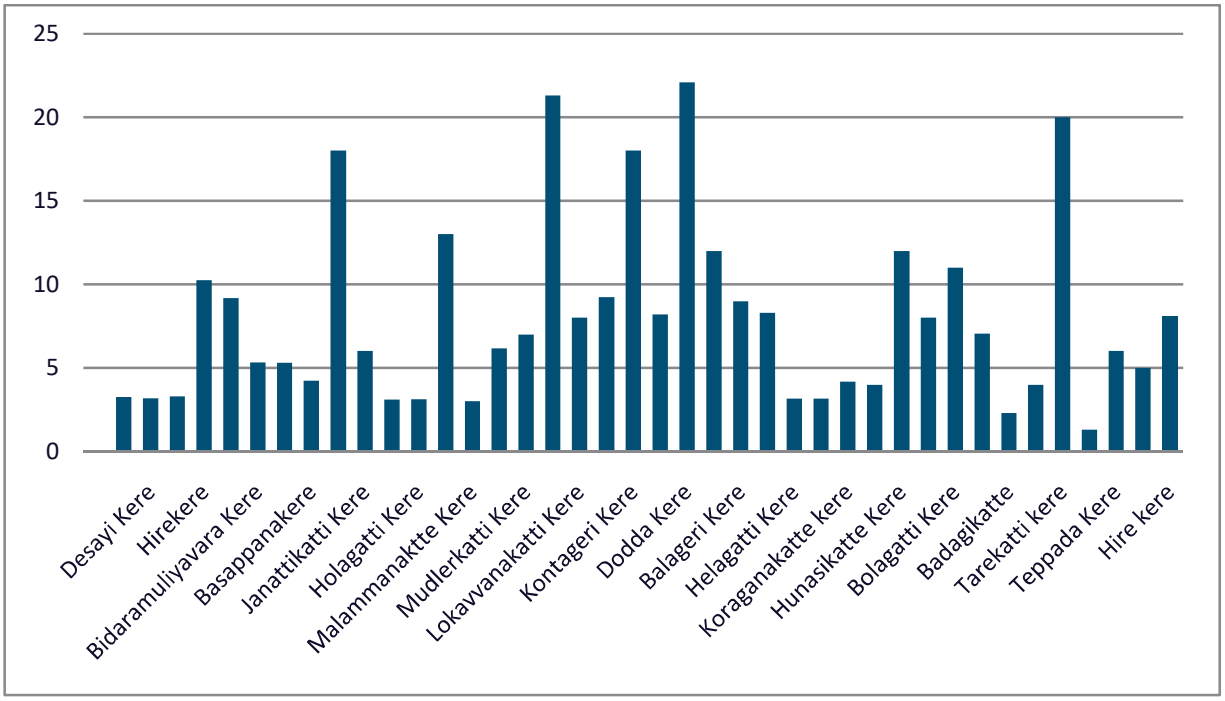
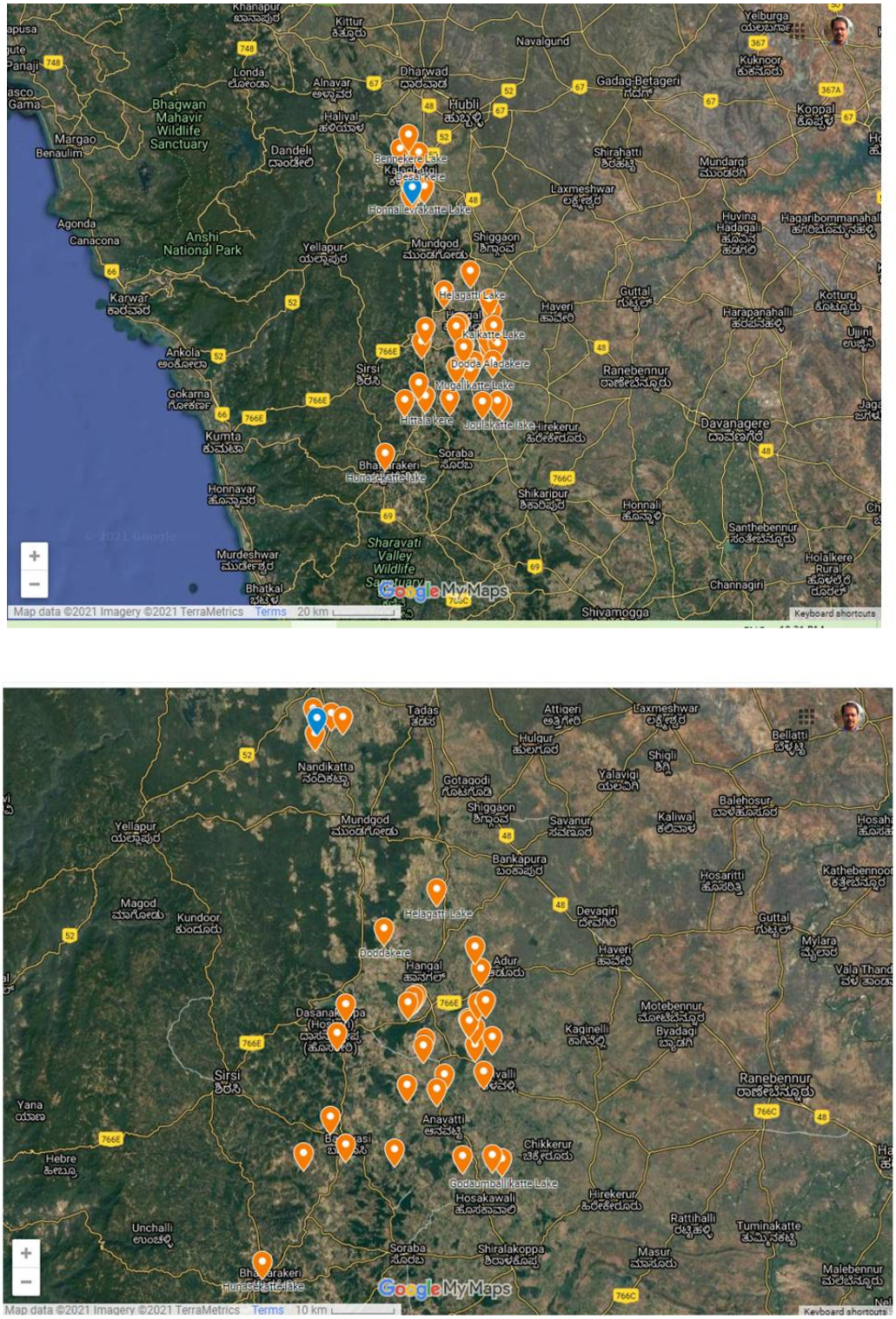



**Fig. 2 Expanse (in acres) of the tanks /lakes rejuvinated**

**Bars 1-8 from Dharwad district; bars 9 – 26 from Haveri district; bars 27-36 are from Shivamogga district; bars 37 to 40 from Uttara Kannada district**

**Table 4**. Details of the number of families benefitted by different water harvesting structures and rejuvenation of tanks undertaken by Manuvikasa

| Sl. No. | Type | Uttara Kannada | Shimoga | Dharwad | Haveri | Total |
|---|---|---|---|---|---|---|
| **1** | Percolation tank | 23 | 0 | 0 | 0 | 23 |
| **2** | Farm Ponds | 100 | 0 | 0 | 0 | 100 |
| **3** | Rejuvenation of Tanks | 129 | 264 | 297 | 509 | 1199 |







Map 1: Location map of 40 tanks (lakes) rejuvenated by Manuvikas in Dharwad, Haveri, Shimoga and Uttara Kannada districts. (source: GoogleMaps)

The ultimate beneficiaries of implementation of rain water harvesting structures are different communities of the villages. It is calculated that a total of 1346 families are benefitted from these interventions. Of which rejuvenation historic tanks contributed more benefits to the communities of 1199 families in all the four districts. The recharge pits and farm ponds were implemented in Uttara Kannada district, of which 46 families were benefitted by Percolation pits and about 100 families were directly benefitted due to the farm ponds.

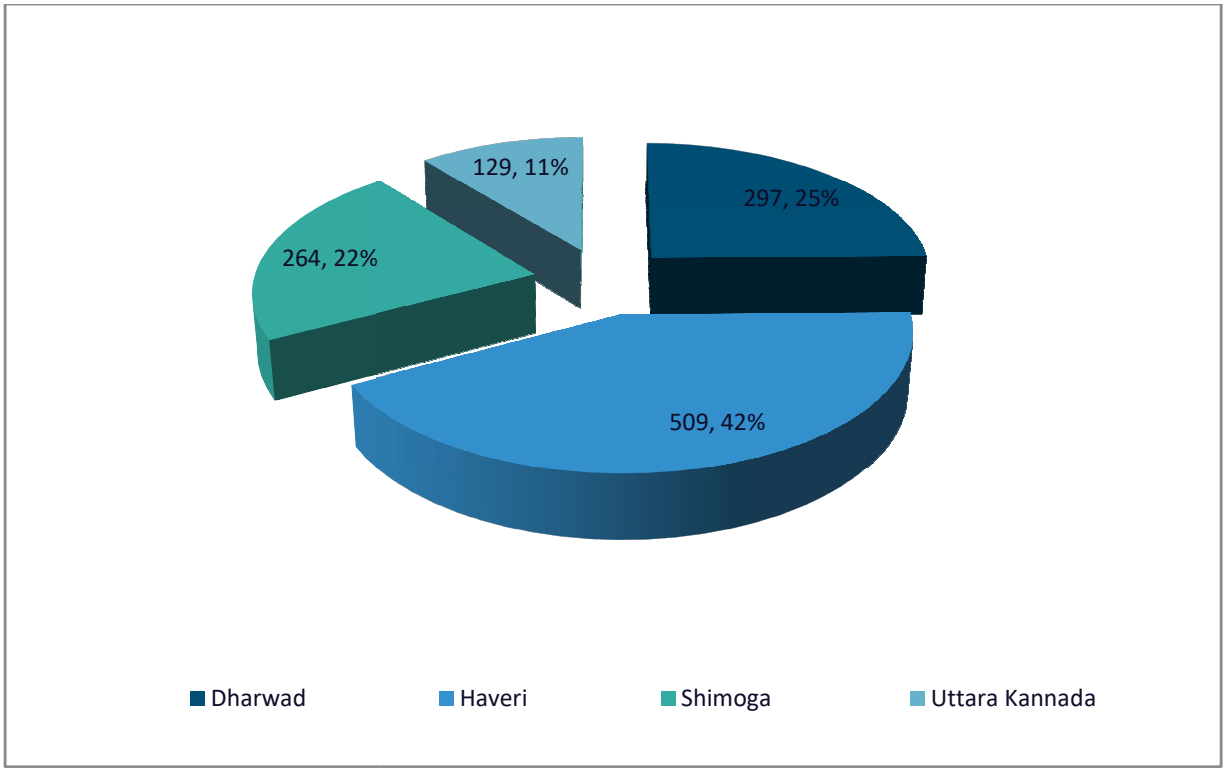



Fig. 3 Number of families directly benefitted by tank rejuvenation in four districts of Northern Karnataka.

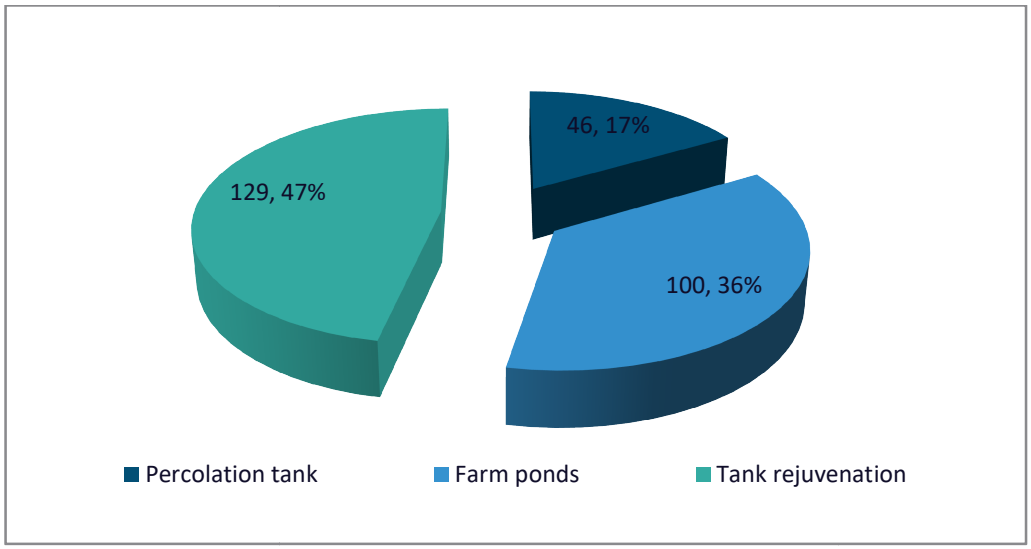



**Fig.4** Number of families directly benefitted by percolation tank, farm ponds, and tank rejuvenation in Uttara Kannada district.

## Historicity of the tanks and their rejuvenation

During the visits to lakes, an effort was made to know the historical aspects of these lakes so as to know by whom and when the lakes were constructed. Incidentally there no evidence or records that could avail the details in this regard. It appears that most of these lakes were constructed either pre British period or during the British period. This is because the survey and the maps of these lakes referred were that of British era. An effort was made to gather information from the elders of the villages. The eldest person of the nearby villagers who were interacted and asked to tell about the lake and it's usage in the past. None of the villagers had any historical evidence to share when the lakes were constructed. However, they had stories to tell how these lakes were the lifeline for their agriculture practices, domestic usage and for their cultural importance in the past. From the information gathered from the villagers, each lake is no less than 100 years old. The oldest villager whom we interacted with was 80 years old. He expressed that the lake has been in existence since his grandparents. Assuming this, the lakes have been in this region and are no less than 150 years old. This information is of quite significance to know how and why these lakes were constructed. It is evident quite way back, people know

1. The significance and the need for lake construction and its usage
2. In spite of getting more rain in these areas the lakes were constructed to hold the rain water to be used during off monsoon season
3. Financial Investments were made to construct these lakes. Then it would have cost hundreds of rupees to construct, today it would require lakhs of rupees

Impact: Historically the lakes were existent and no comprehensive efforts were made to revive them to bring back alive. It's a great effort by Manuvikas in this endeavor and has set a bench mark for coming years.

## Increased water storage and associated benefits to the farming communities and nature

Lakes are rejuvenated taking all engineering aspects into consideration such as proper mapping, ensuring saucer shaped lake structure, optimum desilting by maintaining the required depth of the lakes, creating strong embankment, letting appropriate outlet for excess water to flow. The layout, structure, and construction of these tanks bring out the ingenuity of past generations who constructed the tanks suitably fitting to the gradual fall of the contours. The precise shape and size of each tank

seem to have been determined by the terrain. The overflow of one tank moves into the lower down tank and so on up to the sea or drain. Building this highly interconnected system would have also required civil engineering skills of a high order. Maintaining such an extensive dispersed system and sharing the waters need extraordinary social and managerial skills. The sharing of tank water and other usufructs is perhaps the essence of democratic functioning that prevailed then.

All the lakes that were visited are geographically located at appropriate contours. Each lake has a watershed that feeds to the lake with an outlet at one point. This outlet is connected with the channel that enables the excess water to drain off to the next connecting lake. The water running in the channel is used by the farmers to irrigate their land. Scientific aspects are taken into account while constructing these lakes such as its size, shape and location. The lakes rejuvenated are in a saucer shape with the depth ranging 5 feet to 12 feet. The strong embankment with a masonry work of the lake is a testimony to indicate how good these lakes were planned and constructed. While rejuvenation, the efforts were made to have strengthened embankment and bunds. Today, each lake has a bund with a walking path that facilitating easy maintenance.

Each lake after rejuvenation is inspected by the engineers from the Government and surveyed. This is a testimony that lakes are engineering redrawn on the map and approved by the concerned authority.

Impact: The lakes are rejuvenated keeping engineering and geological aspects in mind. Approval from the concerned authority to this initiative is testimony to the work executed by Manuvikasa.

Ecologically, it is noticed that water storing capacity of the lake has increased by 70%. At least in four lakes, water was overflowing while three lakes due to scanty rainfall, water collected was less. An agricultural activity in the farms around the lake is intensified. It is noticed that at least 25% of the change in the cropping pattern.

Change in area under irrigation is the prime indicator of any impact on rural livelihoods, especially where the major livelihood activity is farming. Major benefits are for the farmers having lands in the command area of the tank. Nevertheless, renovation and rehabilitation of the tank would benefit other sections of the society by way of using excavated silt as organic manure, recharge of groundwater, and increased opportunities for employment. It was observed that the proportion of area under irrigation has increased, though marginally, among all the households in the programme villages after restoration of the tanks.

Apart from the quantitative changes in the area, qualitative changes in the availability of irrigation in terms of throughout-the-season regular and assured supplies are equally, if not more,

important for improving the economic conditions of the farmers. This aspect is reflected in the changes in land productivity.

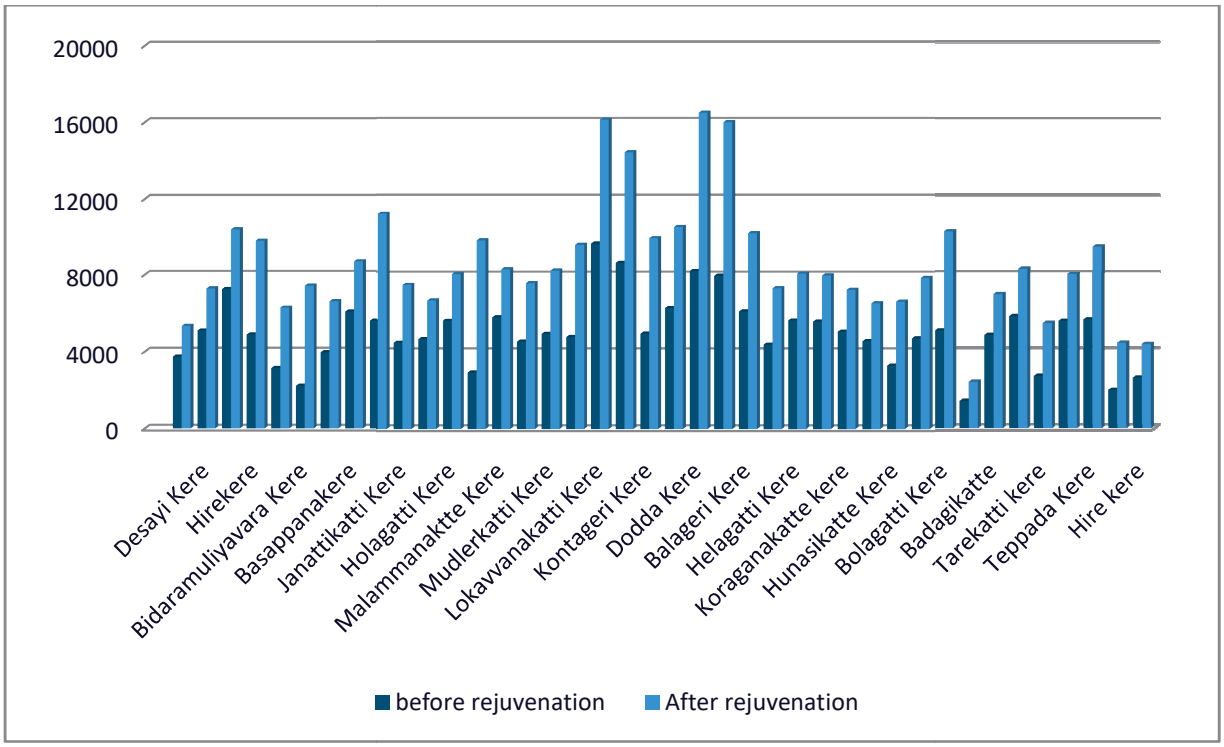



Fig. 5. Water storage (cubic feet) in tanks before and after rejuvenation (estimated).

Bars 1-8 from Dharwad district; bars 9 – 26 from Haveri district; bars 27-36 are from Shivamogga district; bars 37 to 40 from Uttara Kannada district.

Major benefits are for the farmers having lands in the command area of the tank. Nevertheless, renovation and rehabilitation of the tank would benefit other sections of the society by way of using excavated silt as organic manure, recharge of groundwater, and increased opportunities for employment.

Most of the time, silt removed from the tank bed is disposed as manure to the nearby farms. There was no improper disposal of silt which otherwise created environmental problems. Increasing the full tank level of a tank sometimes may cause submergence of foreshore lands, impact on the downstream use of water in a cascading system, and may cause conflicts. However no major conflicts were seen.

Tank rejuvenation has lead to the self eviction of encroachment on feeder channels and foreshore areas in some cases which is positive. Rehabilitation interventions are expected to contribute to reasonable environmental conservation, and improve the productivity of land in the project area.

The beneficiaries benefitted immensely by way of getting nutrient rich silt from the lakes to their farmland. Farmers of the opinion that they need not to apply any inorganic nutrients to their soil for the next 4-5 years

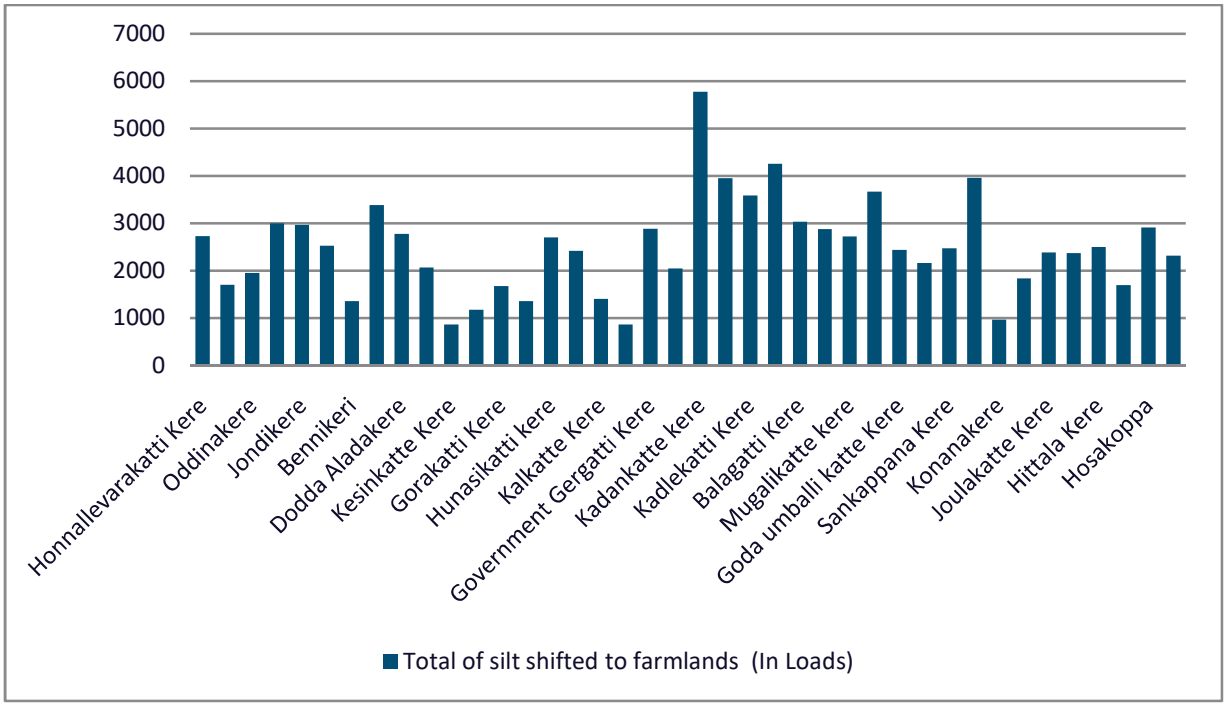



Fig.6_ Tractor loads of silts lifted from the tanks during rejuvenation.

Bars 1-8 from Dharwad district; bars 9 – 26 from Haveri district; bars 27-36 are from Shivamogga district; bars 37 to 40 from Uttara Kannada district.

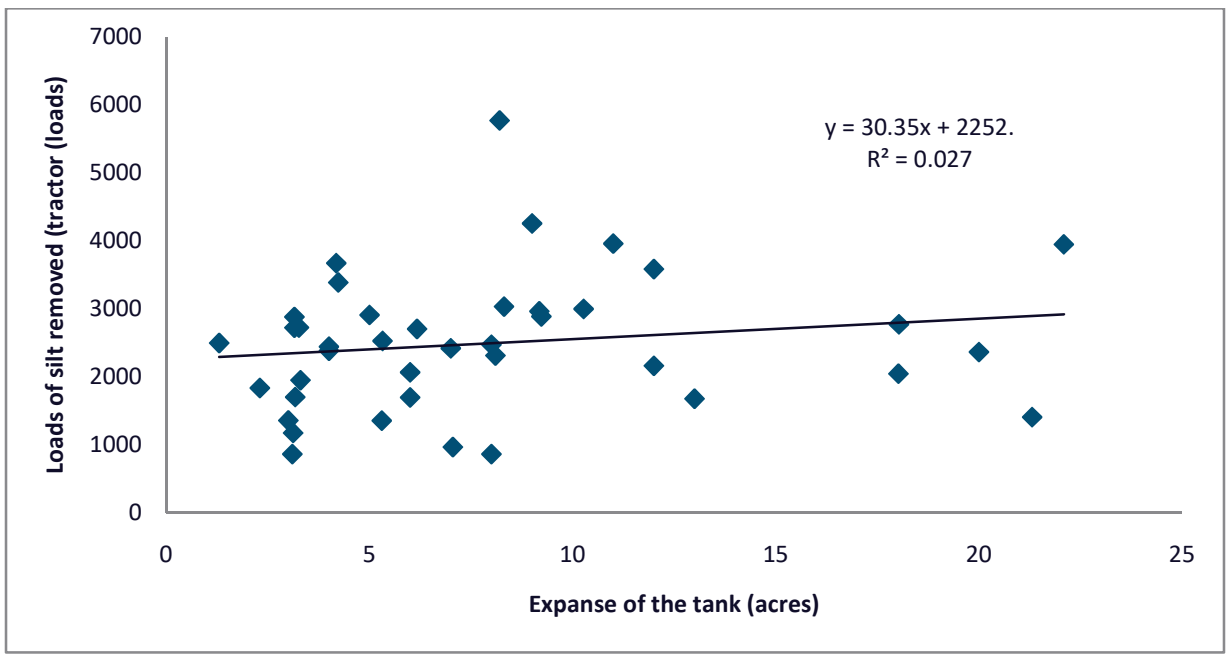



Fig.7 Association between the expanse of the tank and the amount of silt lifted by farmers

At least in two lakes there is considerable change in its ecology and functionality. Water birds have started roosting here. Aquatic plants and insects are profusely seen. It was noticed that in all the lakes visited, due to adoption of scientific means of desiltation, the ecology of the lake has improved. This can attributed to the cleaning of weeds and shrubs that was grown, plugging of lakes leakages if any, strengthening of embankments, desilting to the point without altering lake bed. This is noticed in all the lakes. This intervention has enabled to store optimum quantity of water in the lakes. In two the lakes it was noticed that roosting of birds have started. Aquatic plants and insects are profusely seen. Considering the quality of the water lake, in one lake fish spawns are introduced. None of the lakes had any waste dumps such as domestic and farming except one lake. This is also enabling the ecological health of the lake.

Impact: Ecology of the lake has improved in most of the lake and in few it is changing considerably. Over a period with a protection from community, these lakes would be home to several life forms such as birds, insects, reptiles. The lake would also help in absorption of heat generated in the region. The roosting of birds in the lake do help in the pest control of the agriculture crops in the surrounding region on a long run. There is an indication that at least one are two lakes would turn into congregation of water birds such as egrets, cormorants.

***Lifting of Silt from the Lake Rejuvenation Site***

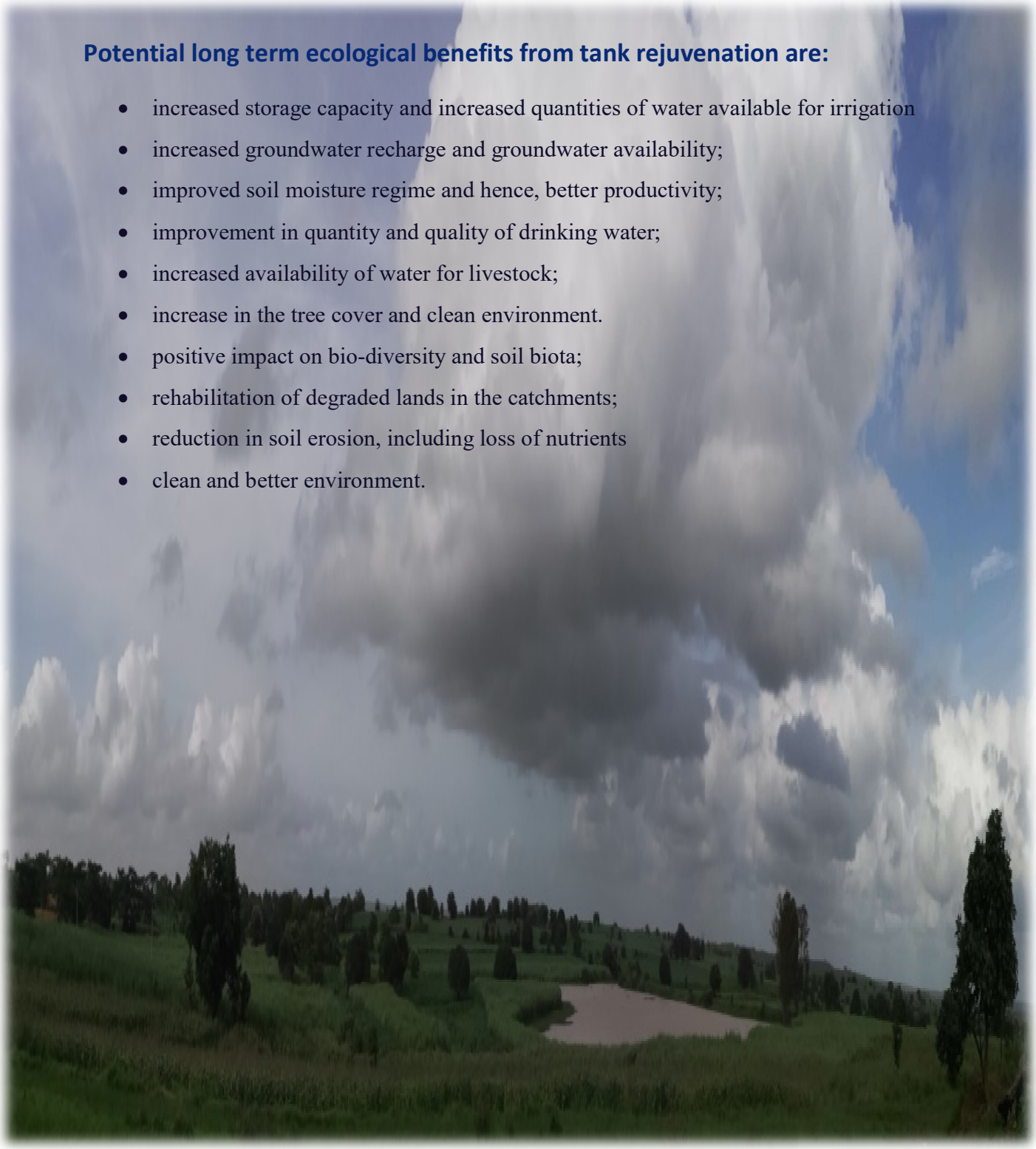
## Biological Impact in Uttara Kannada District

Being a hilly zone there will be pronounced influence of lae rejuvenation in Uttara Kannada district Wild plants in the forest areas get replenished by improvement in the soil moisture content during summer. The percentage of natural germination status of the wild plants would be improved. In due course of time, moist deciduous forest would slowly convert into to semi-evergreen forest if there would not be any disturbance in the surrounding forests of low rainfall regions. There are several *Kaan* (community managed forests in the historic time) forests in low and moderate rainfall area. Kaans are semi-evergreen forests and these are abode of several *Kaan* specialist species like *Dysoxylummalabaricum* (White cedar), *Myristica malabarica* (wild nutmeg), *Diospyros crumenata* (Ebony tree), *Artocarpus hirsutus* (wild jack) and different varieties of wild pickle mango varieties. Now there is a greater chance to spread these species into other open forests near to these historic tanks because of retaining of soil moisture in the open forests like *Kaan* forests due to increase in the water storage capacity of the historic tanks. The places where historic tanks are present, the wildlife population would improve to a considerable extent due to storage of large amount of water in the tank. Growth of herb layer in forest area facilitates the herbivores and carnivores in the area. Rejuvenated historic tanks become breeding ground for many water birds in turn bird population will increase drastically. The visit of migratory birds and local birds to the historic ponds increases and thereby it controls the pest and diseases to the surrounding agricultural crops. The productivity of crops also increases by increase in the natural pollinators such as butterflies, honey bees and other insects. Indigenous fish species could also be restored in the rejuvenated tanks owing to the growth of large number of host plants.

The present study documented the biodiversity in around the tanks. About 44 terrestrial and 19 aquatic plants were recorded. Plant species like *Terminalia paniculata, T. tomentosa, T. bellarica, T. chebula, Buchnanialanzan, Butea monosperma, Aporosalinledyana, Haldina cordifolia, Holigarnaarnottiana, Strychnosnux-vomica, Lagerstroemia microcarpa*etc., are commonly found in most of the studied locations. Aquatic plants like *Nymphaea rubra, Nelumbo nucifera, Nymphoides indicum, Rotaladensiflora, Baccopamonneiri, Aponogeton crispus* etc., were recorded in few historic tanks. These aquatic plants were in the fear of locally extinction owing to the drying up of most of the tanks in summer and also because of siltation. Now all these aquatic plants could be restored in future days because of tank rejuvenation. Birds such as Moorhen, Little cormorants, Cattle egrets, Water hen, Ibis etc., were documented during the study

## Potential long term ecological benefits from tank rejuvenation are:

- increased storage capacity and increased quantities of water available for irrigation
- increased groundwater recharge and groundwater availability;
- improved soil moisture regime and hence, better productivity;
- improvement in quantity and quality of drinking water;
- increased availability of water for livestock;
- increase in the tree cover and clean environment.
- positive impact on bio-diversity and soil biota;
- rehabilitation of degraded lands in the catchments;
- reduction in soil erosion, including loss of nutrients
- clean and better environment.



## Lake Ecosystem Services

The lake rejuvenation is enabling several ecosystem services that can be classified into supporting, provisioning, regulating and cultural services.

- Supporting services: Ensuring supply of food in terms of agricultural products, creation of habitat for flora and fauna, supporting local biodiversity etc.,
- Provisioning services: These services include ground water recharging, supply of drinking water, water purification, cooling of temperature and supply of fishes etc.
- Regulating services: Comprises of water purification, carbon sequestration, clean air, nutrient recycling etc.
- Cultural services include aesthetic value, recreation, education, and etc.


**Fig.7** Schematic representation of the ecosystem services generated by the tank rejuvenation and their relevance to the Global conservation Goals.

## Employment Generation through lake rejuvenation activities

Socially and culturally the lakes were of great importance to the villagers. Apart from irrigation, lakes were used for the purpose such as worshipping the water body, creation of temple or installing the deity near lakes. The decapitated condition of the lake discouraged the community members to visit the lakes. Today, the lake revered with great respect and is being looked as sanctity.

Economically, due to harvesting of water from the lake, yields from cropping have increased by one and half fold. Farmers opinioned that they are able to fetch more money from the excess sales of agriculture produce.

Due to intense farming activities as well as due to lifting of silt, an estimated 19956 man-days employment has been created. Considering all the 40 tanks, the active silt lifting form the tanks alone has generated an estimated transaction of over 498 lakhs. This was critical for the village setting because of the COVID conditions.

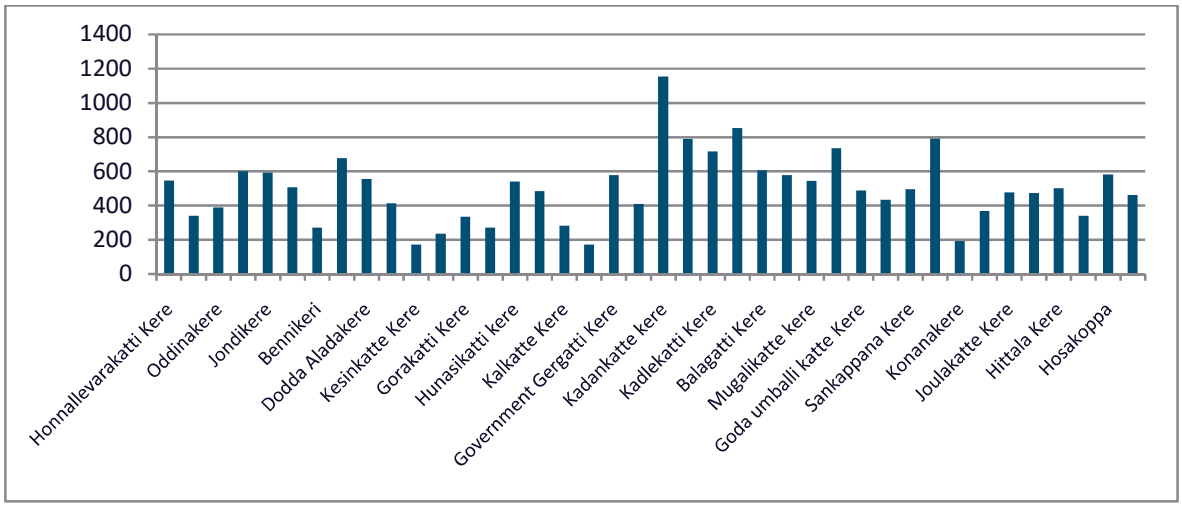



Fig. 9 Estimated number of man-days of work generated due to lifting of silt from the tank.

Bars 1-8 from Dharwad district; bars 9 – 26 from Haveri district; bars 27-36 are from Shivamogga district; bars 37 to 40 from Uttara Kannada district.

Impact : The lake rejuvenation has brought in socio economic changes among the villagers. A detailed study is required in this regard to quantitatively arrive at the actual benefits which could be huge.

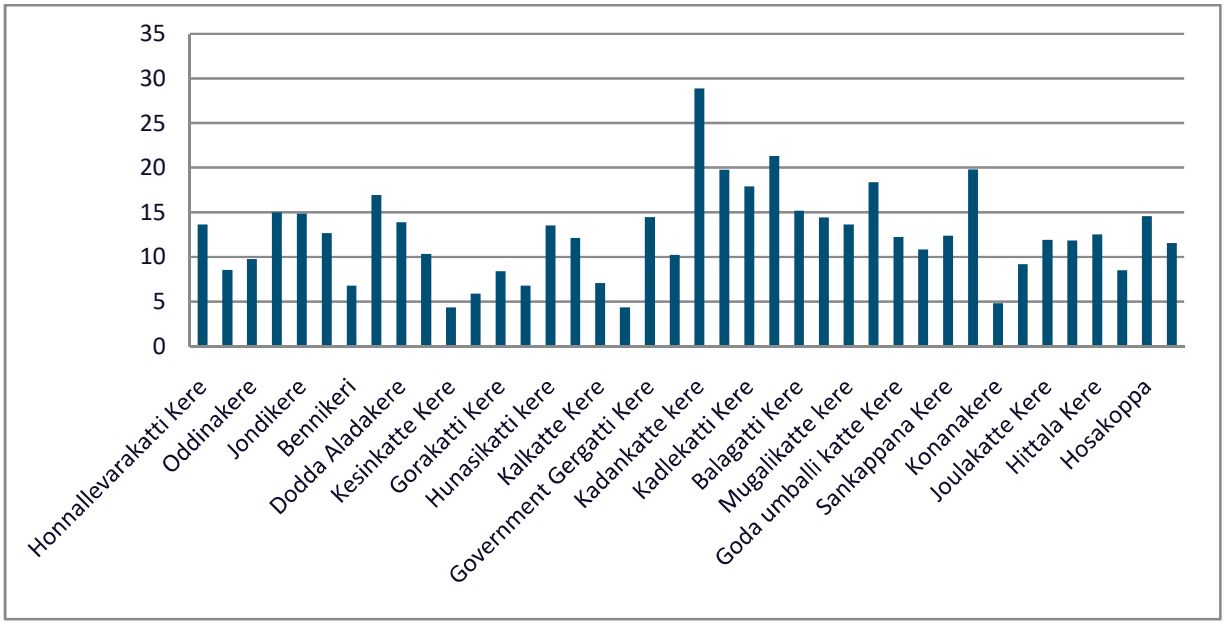



Fig.10 Estimated cash flow in the village due to lifting of silt from the tank (in Lakh Rupees).

Bars 1-8 from Dharwad district; bars 9 – 26 from Haveri district; bars 27-36 are from Shivamogga district; bars 37 to 40 from Uttara Kannada district.

The interaction with villagers indicated that the lakes constructed were of great social and economic importance.

*Lifting of Silt from Lake Rejuvenation Site*

## Change in ground water and irrigation

Increased groundwater table through recharge is another important impact of tank rejuvenation. Both irrigation and drinking water wells are benefited through rejuvenation. Though it is too early to say the quantum of recharging of ground water due to lake rejuvenation, from the interactions with the farming community it is noticed the ground water recharging has happened from 3 three lakes. Computation from first principle considering the density of bore wells, average distance to which the lake This is evident from the fact that the bore-well near the lakes are not dried up in spite of access extraction ground water. The farmers also opinioned that excess water from the lakes is used for irrigation purpose and due to excess moisture in the atmosphere from lake crops are getting benefitted. An average of 50 hectares of farming land is benefitted due to water availability. Thus, the augmented recharge directly benefits the landholding farmers and indirectly benefits the poor and landless through an increase in employment days. The availability of drinking water was made possible by increased storage. Due to water in the tank, drinking water wells that are constructed both in the tank bed and tank bund are recharged throughout the year. This reduces the drudgery of women who otherwise need to walk a long distance to get a pot of water. Women, who are saved from this drudgery, are able to use the time for personal health care, children's development, and income-generating activities. Moreover, good quality of drinking water available throughout year cuts down waterborne diseases.

Impact: From the lake rejuvenation, the evident of ground water recharge is noticed in 6 lakes. While in other lakes, a study needs to be taken up. Nevertheless lakes are going to increase the ground water and ensure supply of water availability for the lakes.

## Improved cropping pattern and area

Profuse farming activities are being taken up in the farms surrounding the lakes. It was noticed that the cropping pattern has changed in these farm lands. Instead of regular crops, commercial crops such as maize, paddy and sugarcane are preferred by the farmers. The farming area was also increased with a hope that water will be available for farming. From four lakes the farmers expressed that they have taken up and or planning to take up three crops in a year. Such a mindset among the farming community is an indication that cropping pattern is changing and willing to extent the farming area.

Impact: Cropping pattern and the cropping area is changing due to lake rejuvenation initiatives. A comprehensive study is required in the endeavor.

## Potential long term economic benefits from tank rejuvenation are:

- improved production and higher family income and improved quality of life;
- equitable distribution of water for command farmers;
- increased opportunity for gainful employment;
- reduction in the risk of crop failure;
- improved nourishment (through fisheries development);
- improved interaction among different communities;
- improved livestock and milk production;
- reduction in seasonal migration by landless and poor households;
- increased family income;
- improved quality of life;
- improved interaction among different communities;
- Building sense of ownership of village tanks.

## Participatory approach of the lake rejuvenation

Farmers' involvement with their contribution with labor and cash in the rejuvenation processes is important. The approach followed by the Manuvikas team was to visit the concerned panchayats and locate the lakes that need to be rejuvenated. Old maps were tracked to locate the lake and were validated by the concerned officials. Upon narrowing the lake to be rejuvenated, a meeting is organized with all the stakeholders. In a participatory approach, consultations are held with community members. An appeal is made in this deliberation on the process that will be adopted by Manuvikas on how lake will be rejuvenated and how community members needs to extend their support by arranging their vehicles to lift the dredged silt from the lake.

This open deliberation had lot of debates in 70% of the cases. In few there where the issues of lake encroachment, the issue became quite heated up. Due to participatory interaction, a consensus was arrived among the community to resolve such issues. While rejuvenation it was the community members who took care of the labours logistics such as stay and food.

Impact: Due to participatory approach, a community mobilization was able to achieve. Differences were sorted out if any. Common understanding was arrived among the community members thereby not only augment the efforts of MANUVIKASA but also ensured in effective implementation of lake rejuvenation initiatives.

- Engaged participatory approach of involving various stakeholders of the community while planning, executing and post rejuvenation of the lake initiatives
- Once the lakes that were forgotten are brought back onto the maps. Lake boundaries are demarcated. Encroached lakes are evacuated through community consensus and dialogues.
- Engaged participation has resulted in the ownership of the lakes by the community. Due to ownership, the lake sustainability is being assured by the community members
- Interaction with the community members reveals due to use of silt from the lake has increased production of crops thereby enhancement in the economy among the farmers

With the implementation of water harvesting systems, the drinking water and domestic water problems would be solved in future days in the study area particularly in the low rainfall areas. The communities managed not only to secure sustained supplies of water for domestic consumption, but

also able to embark upon producing high value crops like ground nuts, arecanut, coconut, pepper etc. They managed to increase their agricultural yield and work availability has also increased for landless labourers. As it has become beneficial, the momentum for rainwater harvesting continue in the village as is evident from community's interest to increase the number of ponds, tanks by constructing new ones. At the same time it enhances the aesthetic value of the tanks among societies. It is proved from the results of other studies showed that, participatory projects combined with sound technical inputs performed better as compared to technocratic, top-down counterpart.

- Socially, the rejuvenation activity has enabled all types of community members to come together to support this rejuvenation initiatives irrespective of caste, creed, gender and economic status

## People perception and sustainability aspects

Interaction with various stakeholders was held to give their realistic perception about the lake rejuvenation initiatives. Following are the feedbacks from the people:

- Several initiatives are taken by the Govt and Non-governmental organization to revive the lakes. All their efforts were half-heartedly done and never had logical completion
- The approach adopted by Manuvikas in this initiative was quite genuine. Their team were very supportive and accommodative.
- Their efforts can never be matched with any other Govt schemes
- We want all our other lakes to be rejuvenated so that our economy is sustained for years together
- A demand is created to locate and rejuvenate the remaining lakes


***Setting Ground rules with Farmers about Lake Rejuvenation***

# Case Studies

Manuvikasa has constructed 123 different rain water harvesting structures and rejuvenation of 40 tanks. Of the different water harvesting structures, farm ponds are mainly used for irrigation where as recharge pits and percolation tanks are meant for rain water harvesting. The water of historic tanks is used for domestic as well as for irrigation purpose. Hence, we have chosen and approached farmers of some of the villages of water harvesting adopted villages to get their opinion and perception on implementation of rain harvesting systems and their impacts as a case study.

## Farmers' opinion

### Village: Kallagaddakere, Taluk: Haveri, District: Haveri

Over 25 farmers of this small remote village narrated how since 1947 there was no desilting done of their village tank. This village has the largest SC ST population. Following the desilting of the tank the District Collector also visited this village for the first time after independence. The farmers feel that desilting and increasing the capacity of the tank is like some kind of dream coming true. Most of the farmers narrated how there were increases in the yield level because of spreading the silt to the two their forms; they also felt that over a period of time inland fisheries can be taken up.

## Village: Bummighatti, Mundgod Taluk District: Uttara Kannada

Mr Manjunath Dholappannavar of Bummigatti village in Mundgod Taluk narrated how desilting of tank has contributed to the improvement of the village and how the farming community has been benefited. Firstly, the increase in water storage has led the people to go for cash crops like Maize and cotton. Secondly, by applying tank silt every farmer has saved a minimum of Rs. 2000 per acre, which otherwise would have been spent on inorganic fertilizers. He added that more than 50 bore wells in and around the village have already been rejuvenated and the water table has been raised because of the increased water storage capacity of the tank. He is of the opinion that farmers from five adjustment villages have also lifted the silt from the tank to apply to their dry lands and have been benefitted.

## Village: Kopparasi Koppa Mundgod Taluk District: Uttara Kannada

Sri Ganapati Elivar said that an old "Tank Users' Association" which was existing in the village was defunct and only because of the interventions from Manuvikasa, the tank has been rejuvenated after 60 years. He opined that It has helped in increasing the water availability for their crops and today farmers are able to raise cash crops such as corn with the water available from the tank thereby earning quite a good livelihood. He is of the opinion that because of application of tank silt to their farms the water holding capacity has increased which could be seen in the crop conditions. He stressed that more than hundred tractor owners participated for 15 days of desilting activity which actually coincided with the during the COVID conditions there by generating cash income which was very critical.

## Village: Dasti Koppa Mundgod Taluk District: Uttara Kannada

The tank in the village is called "Benne Kere" (Butter Tank) since the silt of this tank is just like butter. Shri Shivappa Guru Sadar narrated how the whole village was united irrespective of political lineance, caste because of the desilting done by the Manuvikasa. He is of the opinion that about 60 to 70 defunct borewells around the village have been rejuvenated because of increased water table after desilting. Application of silt to some of the farms has increased stickiness of the soil, however he said that it now retains a good amount of water in the soil. He immensely thanked Manuvikasa for their help in desilting their tank after 75 years.

## Village: Malagunda, Hangal Taluk, Haveri District

In another case study from low rainfall area, Mr. Chidananada expressed happiness over the de-silting of tank. According to him now onwards more water will store for longer time and the water table in the surrounding wells and bore wells also going to increase. He also expressed that increase in water availability in downstream of their village will change the cropping pattern with high level of crop productivity in the future days. However, paddy is their main crop in this village but in due course they shifted to sorghum cultivation in 20% of the land due to scarcity of water. Increased crop productivity enhance the household 26 income in the village as well as from diversified vegetables and fruits increase gradually parallel to Maduravalli micro-watershed.

## Village: Thotadamane, Sirsi Taluk Uttara Kannda District

The beneficiary farmer was Mr. Veerendra Gowda of Thotadamane village of Hulekal panchayat in Sirsi taluk. He owned 5 acres of arecanut orchards and 3 acres of paddy field with about 15 acres of Bettalnd. Small farm pond was built in his farm long back to feed his arecanut garden. Till recently he used to harvest water for his arecanut garden from his farm pond. He constructed 75 recharging pits and one percolation tank in his Bettalnd and widened and deepened his old farm pond. The dried farm pond in 2015 got recharged by the structures made in Bettalnd and now 10 ft water was stored in the farm pond even in Summar months. By adopting rain water harvesting systems his farm pond became restored and at the same time his arecanut plants all came back to normal. Now he is planning to rear fish in his pond.

## Village: Shanuvalli, Sirsi Taluk Uttara Kannda District

Mr. Shekar Marate and Mr. Gopal Marate from Shanuvalli village had constructed farm ponds in the paddy field and recharge pits and percolation tanks in the Bettaland. According to them before 2015 total 30 borewells were drilled and only 5 borewells got enough water and rest of them were failed. After the rain water harvesting structures were made, they again drilled 7 bore wells with 5 inches of water in all the borewells. They expressed that, this is all happened due to the effect of rain

water harvesting systems in the surrounding areas by Manuvikasa. They also opined that bigger percolation tanks and recharging pits are more effective than smaller check dams in terms of groundwater recharge based on their observation on open wells around these structures. Farmers in this watershed stated that the water harvesting structures constructed in Shanuvalli village has benefited them in terms of increased groundwater recharging by 25% over earlier years. They also planned to grow sugarcane from the next year.

## Opinion of elected members and officers

The sitting member of legislative assembly Mr. Shivaram Hebbar who is also the hon'ble district minister-in-charge has praised the work of Manuvikasa in rejuvenating the historic tanks of this region. In an open meeting with the farming community held at Sirsi recently, he mentioned that the revival of the age old chain link historic tanks in the Banavasi region could impetus to the agricultural growth and enable the recharge of ground water and thereby it solve the domestic water supply to some extent in the region. He also assured that government will take steps to bring Varada river water to fill major tanks of this region in summer is their future agenda of the government. Another opinion from Mr. Ganesh Lambani, Panchayat Development Officer of Gudnapur Panchayat was happy about the determination showed by the Manuvikasa in rejuvenating tanks is all set to deliver longterm dividends. Panchayat encouraged Manuvikasa by putting extra effort in identifying the tanks that were heavily silted and also joins the hand with Manuvikasa in the civic body took up de-silting of inlet and outlet channel reconnecting the water bodies, which receives excess water flowing out of the tanks. The support extended by the Panchayat authorities, engineers, taluk and district administrative indicates the project initiatives as an acceptance for the welfare of the community.

The lake rejuvenation contributes to Lake / Wetland protection India by various Acts and Rules which includes:

- The Indian Fisheries Act - 1897;
- The Indian Forest Act - 1927;
- Wildlife (Protection) Act - 1972;
- Water (Prevention and Control of Pollution) Act - 1974;
- Water (Prevention and Control of Pollution) Cess Act - 1977;
- Forest (Conservation) Act - 1980;
- The Environment (Protection) Act - 1986;
- Wildlife (Protection) Amendment Act - 1991;

- National Conservation Strategy and Policy Statement on Environment and Development - 1992;
- The Biological Diversity Act - 2002;
- National Water Policy - 2002;
- National Environment Policy - 2006;
- Environment Impact Assessment Notification - 2006;
- Wetlands (Conservation and Management) Rules - 2010,
- Government of India; National Water Policy - 2012;
- Wetlands (Conservation and Management) Rules - 2017,
- Government of India; Karnataka Lake / Tank Conservation and Development Authority Act, 2014.

## Application of this study

This assessment would provide vital information for development practitioners and policymakers so to understand the cumulative impacts of the rejuvenation lakes; gaps if any; document all innovations adopted that helps in the course correction while implementing such rejuvenation of lakes initiatives. It would also help to prepare an approach paper to influence the policy makers for taking up such comprehensive rejuvenation activities at a large scale using the existing government machinery.

## Conclusions

Farming communities in the drier part of Northern Karnataka require a reliable water supply in the face of population growth, expansion of agriculture, biodiversity conservation and climate change. Rain water harvesting is being recognized not only as a viable decentralized water supply option for augmenting modern centralized water infrastructures that are costly and resource intensive but also as a green infrastructure strategy for climate change adaptation. As a result of adoption of water harvesting systems and rejuvenation of tanks hydrological behaviour of the sub-watersheds have improved. This resulted increase in base flow, reduction in sediment load to tanks, raised ground water level in the wells and bore wells, crop yield improvement due to soil moisture enrichment, vegetation cover improvement and increased availability of forage for livestock. Based on the successful results of this massive joint effort of Manuvikasa and other agencies and also with the participatory approach of the local people in the measures of harnessing, recharging and maintaining the quality of water and water bodies could be taken up as pivotal project in other areas of the district on a wider scale.

# Recommendations

Strengthening or formation of tank development committee (*KereAbhivraddi Sangha*) needs to be initiated to maintain the percolation tanks as well as historic tanks. Micro-climatic conditions of the forest area have improved by increase in the soil moisture. Hence, these conditions could be utilized for the restoration of more number of trees in the forest area to improve vegetation cover. It is recommended that construction of more and more rain water harvesting structures in open lands as well as in *bettaland* as a barrier for heavy runoff water to control flood during heavy downpour. Bund planting with Khus-grass, *Citronella* grass, and other hybrid fodder grass to check bund erosion as well as to encourage livelihood options for the local people. Planting riparian species such as screw-pine along the banks on either side of the bunds to check erosion and also to facilitate bird population in the area. Planting wild pickle mango varieties (Appemidi) along the bund to earn extra cash income. Agro-forestry should be popularized in the area. Pisci-culture could be encouraged in the historic tanks. Tree Park or garden could be established along with boating in the tanks in association with Forest Department/tourism department in the historic tank villages to attract tourists to promote eco-tourism. Aesthetic value of the historic tanks could be enhanced by promoting traditional feast or folk rituals like "*KereBete*" (Festive community programme for fish hunting) once in a year.

Tank rejuvenation is highly relevant for improving livelihoods and alleviating poverty in drought-prone regions. Tanks restore the ecological balance between surface and groundwater resources. Collective action is possible in resource management, provided there are incentives for

cooperation. Market strategies such as beneficiary contribution are necessary for strengthening and sustaining the collective strategies. Considering the increased benefits and from point of equity, it is also important to improve the livelihood of the rural community through increasing the gross tank product in future tank rehabilitation and rejuvenation projects. Tank rejuvenation which has been started purely as a physical rehabilitation to increase agricultural productivity should in future focus on institutional strengthening and poverty alleviation.