Well Recharging Through Roof Rainwater Supports Desalination of Coastal Ecosystems:

A Case Study of *Manaloor* Local Government, *Thrissur* District, Kerala State, India

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1. Introduction:

The State of Kerala, India is located in the south west coast of Indian peninsula. It is blessed with two major rainy seasons- the south west and the north east monsoons and is renowned for its water resources. The State receives an average annual rainfall of 3000 mm. It has about 200 Nos. open dug well density within a sq.km on an average across Kerala and majority of these wells go dry during summer or water quality affected due to saline ingress or iron content. The state's peculiar topography, characterized by the narrow stretch of undulating terrain that extends from the Western Ghats to the Arabian sea, triggers high run off which leads to the draining away of a major portion of the water to the sea at a higher pace. Conservation of rainwater within the homesteads mixed agricultural operations was supportive for natural ground water recharges however now remain a past wisdom. Decrease of paddy cultivation and corresponding decrease of local check dams along the paddy fields affected badly for this natural ground water recharges. Modern piped water supply systems and consequent lavish water use habit of Keralites and many such factors ignored the traditional homestead wells across the state. Attributed to this, many parts of the State still remain drought affected. A large number of households still don't have proper access to clean and safe water. Taking into account all the foresaid aspects, the State of Kerala could be considered a water-deficit State.

Various local governments have tried various water related projects. Some of them had been success while some have flopped. A large portion of the people still depend on piped water supply, public wells & taps and tanker Lorries. A comprehensive and ecologically sustainable option could never be initiated until recently "*Mazhapolima*", a community based "well recharge programme using roof rainwater" was brought to the forefront by Thrissur District Administration. It was under a special purpose vehicle by the name *Mazhapolima* Monitoring and Coordination Unit (MMCU). This witnessed a successful shift from the conventional large scale government projects towards a community based small scale eco-friendly project. *Mazhapolima* project was launched as a lasting solution to the recurring acute water scarcity in parts of Thrissur district during summer.

2. The Problem:

The case study presented here highlights the success of *Mazhapolima* in Manaloor Local Government of Anthikkad Block in Thrissur District. Manaloor is a prominent lowland region lying adjacent the coastal boundaries of Thrissur District. In Manaloor, especially in its rural fringes access to clean and sufficient drinking water was a major problem. The Local Government Administration brought in and made use a number of projects to address this issue which unfortunately failed to achieve its original objectives. It was in this context that "*Mazhapolima*" was initiated in the Government. The prime objective was to address the prevalent issue of water scarcity in the Government by creating an affordable project.

The water of the wells in the region was affected by salinity intrusion owing to its proximity to the coastal waters. Hence the *Mazhapolima* project focused its activities to enhance water security to these regions, which witnessed success in the years that followed. Thus, *Mazhapolima* became the primary fresh water source for many in the Government. Convergence of the project with Mahatma Gandhi National Rural Employment Guarantee programme resulted in a much better output, leading to the dynamic spread of the scheme to nook and corner of the Manaloor, bringing drinking water prosperity.

3. The Manaloor:

Manaloor Local Government is situated in Anthikkad Block of Thrissur Taluk in Thrissur District. Spread out in two villages, viz. Manaloor and Karamukka, the Local Government has an area of 18.22 square kilo meters. There are 19 wards in the Government. The total population of the Government is 34297 which comprises of 16978 men and 17316 women. The density of population is 1882. The literacy rate is 99%. The Government is surrounded by Enammavu backwater on the North, Anthikkad Governments on the South, Arimpur Government on the east and Canoli Canal & Vadanappilly on the West. The Government area is interspersed by a network of water bodies including rivers, backwaters and canals. Besides these the Government have a number of lakes, streams and marshy areas. The region with an average width of 7 km have elevation ranging from 1m below mean sea level to as much as 7.6 m above mean sea level.

The average annual rainfall in the region ranges between 2180.0 and 3484.0 mm and the mean annual rainfall is 2924.4 mm. The maximum rainfall occurs during the period June to September (South West monsoon) and nearly 73.7% of the total rainfall is

received during the season. 16.8% of the total rainfall is received during North East monsoon between October and December, 9.0% of the total rainfall is received during March to May and the balance 0.5% is accounted for during January and February months. The maximum temperature ranges from 29.3 to 36.20 C where as the minimum temperature ranges from 22.1 to 24.90 C. The average annual maximum temperature is 32.30 C and the average annual minimum temperature is 23.30 C. Generally March and April months are the hottest and November, December, January and February months are the cooler. The humidity is higher during monsoon months from June to October and is around 93% during morning hours and 76% during evening hours.
The type of soil is coastal sandy since this area is closer to the Arabian Sea.

4. Water Resource Potential of the Region

Manaloor has been uniquely endowed with substantial surface and groundwater resources. A dependable rainfall pattern in the region replenishes the freshwater resource after the dry periods. There are more than 4500 nos. wells across this region for above 7500 nos. of total households in the local Government. About two-thirds of the community drinks water from these wells. Apart from these, there are plenty of water resources like salty backwaters and ponds. However, these water sources depend fully on the rainfall which is highly seasonal and mostly concentrated to the monsoon season which lasts over 4–5 months only.

Since the mid-2000 the Kerala State Government has responded to water scarcity issues through promoting and constructing water supply infrastructure which are not sufficient for the total population. Water Resources of such schemes are based on dams and rivers far away from Manaloor. Since these dam resources are shared by many other local governments, adequate water supply could not be ensured always. The taps laid by Kerala Water Authority (Kerala State Water Supply Agency)- KWA covers for about 6 kms from 1 to 19 wards. The water from Peechi Reservoir is stored in the 500000 Litre Capacity storage tank in Thrikunnu which is supplied in 5 parts.There are two public wells in the Government. The wells are located in ward number 3 and ward number 18. The wells are maintained properly. The nearby people depend on these wells for water.

5. Pre Mazhapolima Scenario

The drinking water supply projects implemented by the Local and State Government and Private Tanker Water Supplies were covering almost all the wards in the Government. In spite of all these initiatives the Manaloor Local Government was only partially successful in solving the issues of water scarcity and salinity. Water scarcity in wards 1, 2, 3, 17, 18 and 19 were critical.

The well water used to exhibit excess salt content, thickness of water and change in colour to pale yellow to red during months of March and April and majority of the households faced the grim situation as the village wells gets use less. Wherever piped water supply is available, the households had to pay Rs. 360 (6 Euros) per year to the KWA .But even the KWA was unable to ensure prolonged water supply. This had also prompted the administration to supply water through tankers for human and livestock consumption and the beneficiaries were compelled to pay for additional use.

Even though there were some locations where adequate water was available, conveying that to communities that need it becomes expensive and difficult. Unsafe water sources accounted for preventable diseases in the Manaloor local government area. Most of the wells in the Government region had saline concentrations that exceeded the safe drinking water levels. The Local Government Administration has long recognized the need for a better water strategy but it was not until 2008 that the joint efforts, leadership, and forward thinking of the Local Government, resulted in concerted efforts to generate a strategy. Towards the end of 2008, many meetings were held “to receive input and advice from the community and other stakeholders to identify and communicate a vision” for finding a permanent solution to this issue and the need for implementing sustainable and affordable decentralized water management practices was identified. This demanded the Administration to think of new and better options which resulted in choosing *Mazhapolima* well recharging as a viable and environment friendly option.

6. The Mazhapolima

Mazhapolima is a community-based well recharge programme from roof rainwater which aims at recharging all open wells and ensuring sustainable access to water. The scheme is intended to satisfy a number of objectives including recharging ground water, improving drinking water availability and service level throughout the year, significantly reducing the impact of drought and the costs associated in purchasing water. The monitoring and coordination of the scheme is done through a special purpose vehicle set up by Thrissur District Administration called Mazhapolima Monitoring and Coordination Unit (MMCU) which now elevated to District Rainwater Harvesting Mission (DRHM) located in the District Collectorate Thrissur. This unit is supported by the grant given from Arghyam Trust, Bangalore. DRHM includes a Director, Liaison Officer, Programme Officer, Field Coordinator, two Community Organisers and an Accountant Assistant. Ensuring water security through rain water harvesting for well recharging is the primary objective of the scheme. Mazhapolima in its real sense implies well water conservation achieved through well water recharge from the harvested rain water. Mazhapolima utilises the

technology through which the rain water is collected from the roof (normally tiled or concrete terrace) and directs it into the well through Poly Vinyl Chloride - PVC / plastic structure embedded with filter.

It was a teacher by the name Dharmaratnam who created initial awareness at Manaloor Government regarding Mazhapolima. Mr. Dharmaratnam made the Government Administration feel the importance of rain water harvesting and well water recharge and became the initial link between Manaloor Local Government and the DRHM. The pictures given shows the status of well water before and after implementation of the project. This well belongs to Dharmarathnam, ward No. 3 of Manaloor Government.

Before Recharging **After Recharging**

The local Government Administration was clear on the problems that Manaloor faced and felt that the policy decision should be taken at a micro level to find a permanent solution to the issues of water scarcity and salinity of the wells. Hence they were open to making effective use of the concept/scheme introduced by the Thrissur District Administration effectively run by the MMCU.

Unlike traditional water plan development, the new strategy required thinking about water in the context of economic, social and environmental needs and creating acceptance among the public, which was achieved by including the public in the planning phases itself.

A consensus was established by the Local Government with *Mazhapolima* Monitoring and Coordination Unit (MMCU), Mahathma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), Local Community and other Local Partners. Awareness Programmes were organized in the Government to give awareness to the local people pertaining to *mazhapolima*, importance of well water recharge, rainwater harvesting and optimum utilization of ground water particularly along the coastal stretch. The emphasis on creating a strategy that addresses all water uses meant that

development *Mazhapolima* relied heavily on input at every stage from the public, stakeholder groups, and public agencies representing a variety of interests.

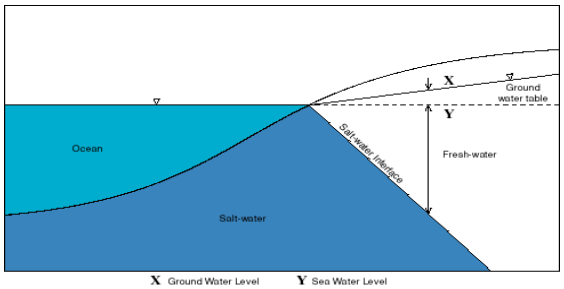
7. Implementation of Good Practice

The technique of well recharging has the theoretical underpinnings of Ghyben and Herzberg relations of Geology science. The Baden Ghyben-Herzberg relationship states that for every foot (h) of groundwater above sea level there are forty feet of fresh water below sea level (H) as shown in the picture 2 below. And when fresh ground water table of the coastal area dips down one feet, the access of saline ingress to the coastal water bodies is forty times high towards the cost as shown in picture 1. It is the based on the density of coastal ground water and sea saline water. And therefore, feeding of roof rainwater to the open dug wells tends to push back / wash back the saline water from the open dug wells making a fresh water zone beneath each well. Massive such efforts can reduce such saline ingress from the coastal water bodies.

The installations of the roof rainwater harvesting systems is merely a plumber's job of fixing pipes and gutters from the roof and leading them to the open dug wells. It has a first flush cap / valve to drain the filth / dust from the roof for first couple of rains before the rainy season. Once it is clean the roof water can be directed to the wells. A filter net is fixed at the tip of pipe drops down to the well. A scientific filtration of roof rainwater is of less use due to the contamination of well water with toilet leach pit seepages from the nearby by households which is common across Kerala. Above 80% of the wells in Kerala has the same problem as per the studies of Centre for Water Resources Development and Management (CWRDM) Kozhikode, Kerala. And therefore, the filter trap with charcoal, sand and gravels not commonly used in the present design of installations. It is the uniform design for all houses in the coastal belts. Even though, if the households themselves wish to have their own filters they are free to do so.

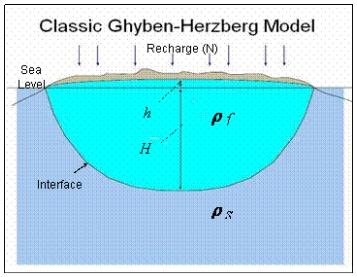
The technical labour for these installations is provided from MMCU. About 500 sq.ft to 1000 sq.ft roof is covered for the installation. This can harvest about 150000 liters to 300000 liters of roof rain water to the wells on an annual average. One plumber and one helper can complete the works of two houses on an average per day. Supervision is done by concerned local Government members, MMCU staff and the master plumber provided by the MMCU. The completion certificate is co-signed by the household, the Government member and the plumber. Indeed the installations are only for roof rainwater for open well recharging and not for collection in the tank forms. And the coastal belts do not require percolation pits due to the water logged nature of the soil conditions. Combination of these activities are appropriately employed in the mid land planes and highlands in the other parts of the Thrissur district though not in the

Manaloor local government area. In other words, site specific approaches are in use while installing the open well recharge systems.



Salt-water interface in an unconfined coastal aquifer according to the Ghyben-Herzberg relation.

Picture : 1



Picture : 2

Eligible beneciaries are selected from the local village assemblies. Local Government Secretary and recognised plumber recommended from MMCU executes agreement to take up the open well recharging installations in the selected households. Beneficiary Committees are entrusted in some locations to execute the works through the plumbers recommended by MMCU. Plumbers completes the works and submit the installation details / bills and expenditure to MMCU. MMCUstaff / Field Coordinators value the works and recommends them to Local Government to release the funds according to the value of works done as the per approved estimates based on the government orders pertaining to the Mazhapolima scheme. The plumber get the funds from the Local Government. The monitoring part is mainly entrusted to Local Government. Baseline surveys have been taken before the installation of works to asses the changes after one or two years period of time. So far 980 well recharging units have been implemented in Manaloor local government so far till January 2017.

8. The challenges:

The fund paucity is the main challenge for implementing the scheme at the Government level. MGNREGS is now restricted to BPL families. Absence of filters in the limited budget option of the present design often keep the first flush valve always opened makes it notworthy in some cases. On the other hand, breakage of pipes and gutters are noticed from the fall of coconut branchs over the installations. In some cases, the households dismatles the installed systems while they renovate / rebuild their house. Awareness gap still persists in some cases whereas preference for piped water supply over the well water makes them less importance. It is to be taken into consideration that without a long-term management the programme may ultimately fail. This requires taking care of the future sustainability aspect which is not to be left unattended by the community as well the Government Administration. The sustainability of the scheme

depends upon proper operations and maintenance of each individual unit. Maintenance is generally limited to the annual cleaning of the roof and regular inspection of the gutters and down-pipes. It consists of activities such as removal of dirt, leaves and other accumulated materials. The cleaning and maintenance process should take place annually prior to the beginning of monsoon. And indeed it is the responsibility of the households than the Government. TV scrolls and Radio information have been effectively made through All India Radio and local TV Channels before the monsoon rains in order to up keep and maintain the installed pipes and gutters leading to the wells.

9. Present Status

Even there are challenges mentioned above, *Mazhapolima* has made a big leap towards achieving its original objectives in Manaloor Government. The outcome of the scheme had been amazing in the Government. The results indicate that the project has resulted in abundance of water in the wells even in extreme summer months. The villagers confirmed that they could visualize the changes in water quality within a few rainy days. Studies revealed that the salinity content of the well water have diminished by large due to the effective implementation of the scheme. CWRDM has conducted the studies (2013) in the coastal belts and found that it is a replicable method for well recharging. Nowadays, households themselves make their own investments for well recharging at their levels learning from the lessons from Manaloor Local Government and Mazhapolima scheme of Thrissur District in particular. *Mazhapolima* Open Well Recharging model has become a model scheme in the state in improving the water levels of the open dug wells in summer while improving the water quality particularly in the coastal belts of Kerala. The number of units implemented with subsidy is beyond 25000 Nos. and without subsidy by the site specific methods in the different terrains is countless in the state.

10. **Science & Policy Dimensions**:

This innovative experiment of recharging wells with roof rainwater is successful cost effectively for less than 100 US$ or Euro for one roof structure of 1000 sq.ft. Practical application of this Gybhen-Herzberg equation based technique can be replicated in the coastal ecosystems of developed and underdeveloped countries where there exists roof rainwater harvesting structure and well /water body. Moreover, it is a climatic change adaptation technique to save the high rain/flood while storing to use them in ground when there a low rainfall period. Indeed this would reduce ecosystem degradation while improving livelihoods, moving from vicious to virtuous cycles.