HYDROGEOLOGICAL SURVEY IN ARACODE, COONOOR, OOTY AND SIGUR REGIONS OF THE NILGIRI DISTRICT, TAMIL NADU

OCTOBER 2017

CONDUCTED BY

Advanced Center for Water Resources Development And Management

FOR

Hydrogeological survey in Aracode, Coonoor, Ooty and Sigur regions of the Nilgiri district, Tamil Nadu

Submitted to

Keystone Foundation, Kotagiri

Prepared by

October 2017

Technical Report Number: ACWA/Hydro/2017/H60

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BACKGROUND

The Nilgiri district of Tamil Nadu forms a part of the Western Ghat mountain range (District Statistical Handbook, 2015-16). The district comprises six blocks namely, Pathalur, Gudalur, Udhagamandalam, Kundah, Coonoor and Kotagiri. Most of the southern and central parts of the district covering the blocks of Udhagamandalam, Coonoor and Kotagiri districts are characterised by rolling topography with alternating hills and valleys and elevations greater than 2000 meters above msl. These hills grade rather abruptly into the plains of the north in the district with elevations close to 1000 meters.

Keystone Foundation in Kotagiri has been passionately working with tribal communities in The Nilgiri district on the theme of water resource management. ACWADAM has been partnering and facilitating their water project by carrying out hydrogeological surveys that embed groundwater management aspects into their larger goal of water security. Based on ACWADAM's previous engagements with Keystone, the critical role played by springs in these dominantly tribal hinterlands has emerged as an area that requires crucial hydrological and hydrogeological inputs.

During the current visit, four regions of the Nilgiris, namely Aracode, Coonoor, Ooty and Sigur were surveyed with the primary purpose of developing a broad geological understanding of these locations and in deciphering the complexity of groundwater dynamics. The following report compiles field observations pertaining to geology and hydrogeology and integrates static and long term dynamic groundwater data collected by Keystone from various springs and wells. Based on these observations and field interactions, recharge areas for selective springs along with some recommendations and a possible way forward has been provided at the end of this report. Many of these observations are broad-based given that this survey was based on a single visit forming a rapid hydrogeological appraisal of the region rather than a detailed research study that is often used in such circumstances.

REGIONAL GEOLOGY

Geologically, the Nilgiri hills fall under the Southern Granulite Terrain of India. The Southern Granulite Terrain (SGT) is a region that exposes high grade crystalline metamorphic rocks that were formed more than 2500 million years ago deep inside the earth. Geographically the region covers the states of Tamil Nadu, Kerala and parts of south-eastern Karnataka. The Nilgiri hills are dominated by hard, crystalline metamorphic rocks mainly comprising charnockites and gneisses. Numerous tectonic activities[1] in the SGT has resulted in the development of shear zones[2]. The region, known as the Nilgiri massif, is a triangular portion of the SGT with the Moyar Attur Salem Shear Zone to the north and the Bhavani Shear Zone to the south. Intense shearing in the region is manifested in the form of

[1] Tectonic activities are movements and processes that occur inside the earth which result in the formation of features such as fractures and faults

[2] Shear Zone is a region where movement of rocks has taken place due to tectonic activities and is characterised by intense crushing of rocks.

regional and local fractures of varying dimensions which are easily traceable on satellite imageries.

Both, charnockites and gneisses are foliated and banded in nature and exhibit fracturing and jointing in the study area. Since the district receives high rainfall (annual average greater than 1800mm, IMD) the rocks show weathering, although such weathering is usually quite local in scale. At the same time, weathering is variable across the region and its depth typically varies between 1 metre and 5-7 metres. Road cut sections reveal the subsurface strata which can be broadly generalised by the presence of deep brown to black soils in the top 1 metre, followed by 2-5 metre thick friable light brown coloured weathered rock. The weathered profile is underlain by semi-weathered rock exhibiting weak impressions of the rock foliation and fractures. Underlying this is a hard, either massive or fractured charnockite or gneiss.

SPRINGS IN THE NILGIRIS

The landscape is dotted with springs and a few old open wells. Springs are the life line of the rural population in this part of the Nilgiris. The region's domestic requirement, including drinking water and agriculture is met from springs. In a few places, springs also provide water for industrial activities. Some of the springs have an infrastructure around them, in the form of spring boxes and pipelines that connect it with nearby habitations. In the recent decade or so, however, Nilgiris has witnessed the emergence of bore wells. These bore wells were primarily promoted and drilled by the government to mitigate droughts faced by the region in the last 3 to 5 years.

SECONDARY DATA ANALYSIS

Secondary data analysis from various sources was carried out in order to understand the regional groundwater scenario and groundwater dependency in the Nilgiris. According to the Indian Meteorological Department (IMD), the district's average annual rainfall is 1846.5mm (IMD, 2012). A seasonal rainfall analysis for 110 years between 1901 and 2016 shows that the region receives bimodal rainfall between June to September (56%) and from the returning monsoon from October to December (27%). A long term trend of the annual rainfall shows that rainfall is steeply declining over the years (Figure 1). The decline is sharpest between January and September but the period from October to December is showing a gradual rise (Figure 2).

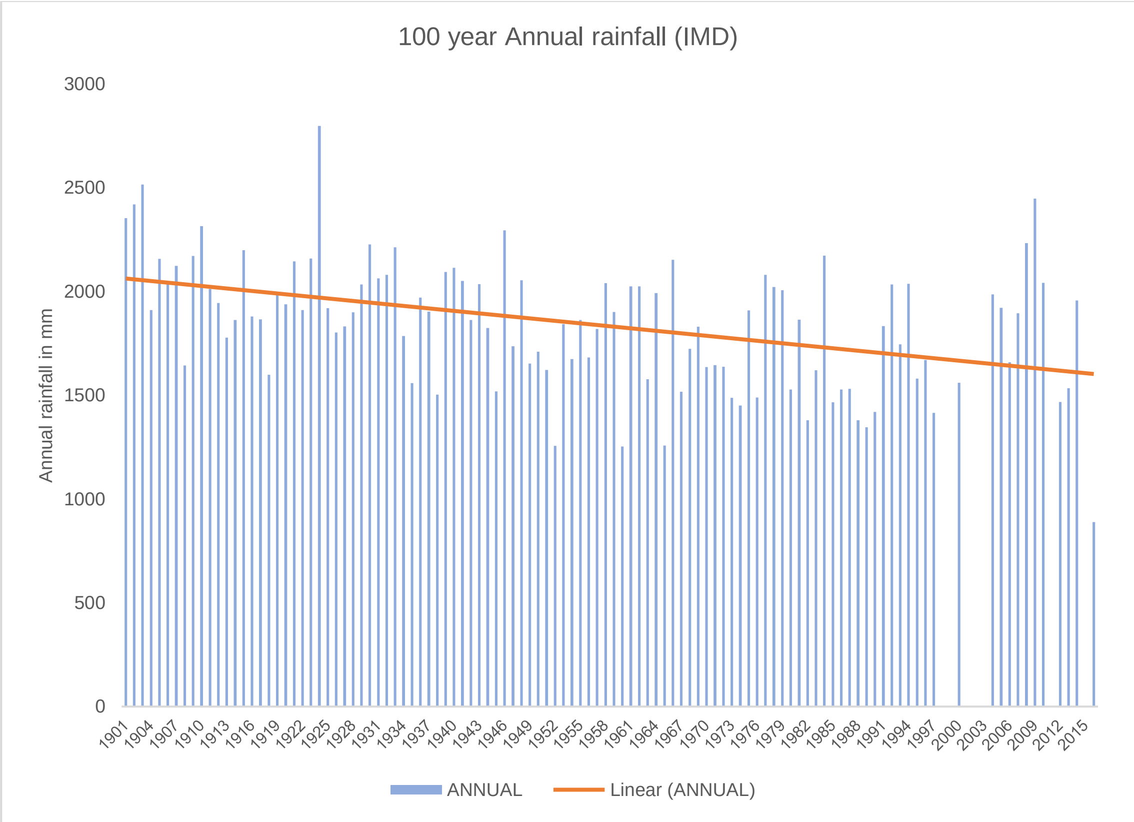

Figure 1: 110 years of district level annual rainfall trend depicting a sharp decline (IMD, 2012)

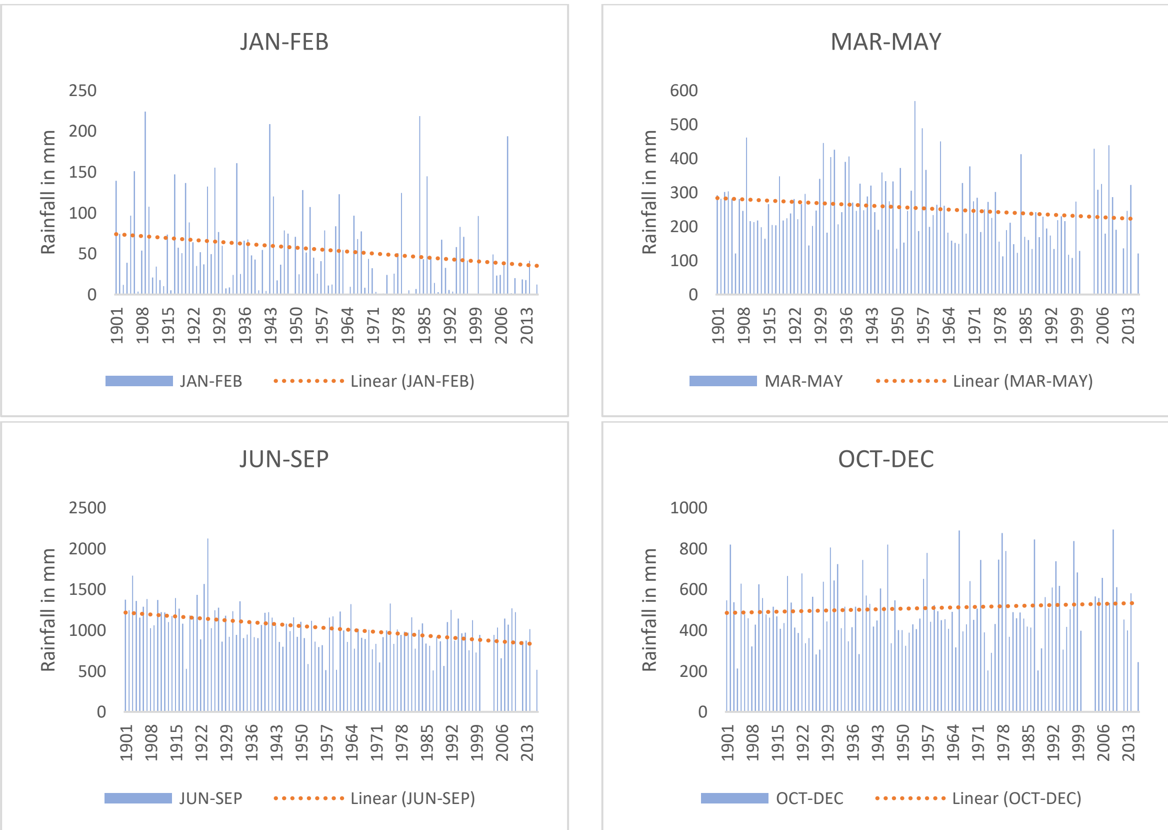

Figure 2: 110 years of district level seasonal rainfall analysis depicting declining rainfall between January to September and increasing trend from October to December

To understand the status of groundwater, the Central Ground Water Board's assessment of 2011 (CGWB, 2014) was used. This report states that the Nilgiri district has a stage of groundwater development of only 10%. This implies that all the blocks are in the safe category and groundwater withdrawal for all uses is very little compared to the net annual groundwater availability. The dependency on groundwater was assessed with respect to drinking water and agriculture. Under the National Rural Drinking Water Programme (NRDWP) nearly 75% of the drinking water schemes are sourced from groundwater. Of these, deep tube wells and open wells account for the highest. The Agriculture Census 2010-11 reveals that 85% of the total agricultural land area is dominated by plantations such as tea and coffee which are primarily unirrigated.

ARACODE REGION

Geology

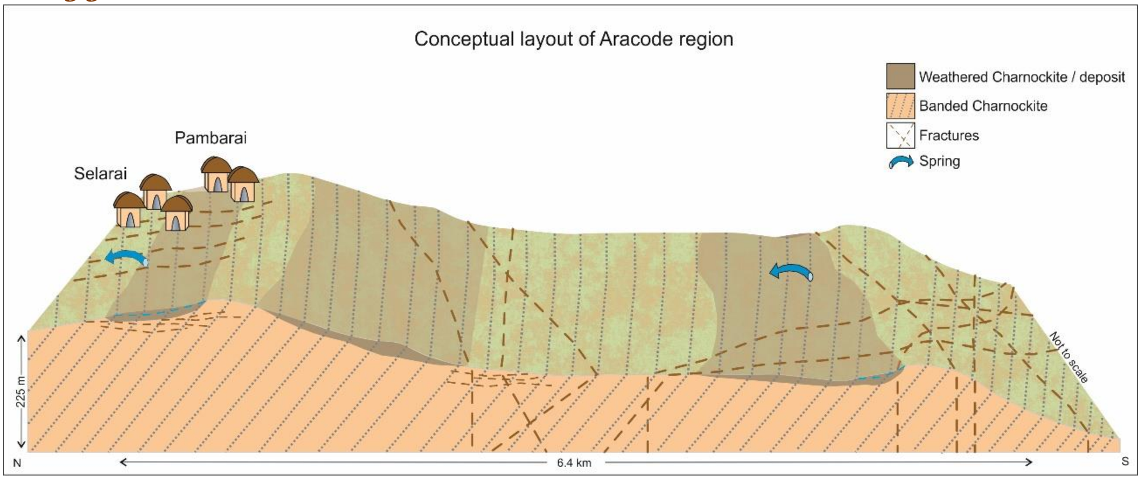

Figure 3: A conceptual layout depicting the geology and hydrogeological framework of Aracode region

The geology of Aracode region comprises of charnockite and banded gneiss. The rocks are foliated with the major trends for the foliation being in the east-west direction and dipping by 30° to 70° to the north and north-west (Photo 1). In some regions the foliations are folded and run in the NNE-SSW, NE-SW and NW-SE directions with dips to the north-east and west. Although some of the rock exposures are massive or without any fractures, numerous others show the presence of fractures that trend in several directions. The most prominent run along the north-south, east-west and northwest-southeast directions. While many of the fractures are vertical in nature, few were observed to have dip angles lower than 50°. The intensity and openness of fractures is highly varied. On a general basis, the sub-horizontal fractures were more open (as seen in Photo 2) than those with high dip angles (Photo 3). In several locations, intense horizontal fracturing along road side profiles was observed. In addition to this, well sections were also used to understand the subsurface strata. All the wells that were studied in the Aracode region, having an average depth of 4-5 metres, were completely lined till the base. This implies that in the top few metres the rock is highly weathered and friable. At the base of the well, often hard, fractured rock was seen exposed.


Photo 1: Road cut exposure of charnockite exhibiting dipping foliation and fractures

Photo 2: A charnockite or gneiss roadside outcrop showing two sets of fractures; several nearly horizontal and a few high angle dipping fractures

Photo 3: Near vertical fractures without any openings in charnockite (Photo courtesy – Keystone Foundation)

Photo 4: A cross sectional profile revealing the different degrees of weathering - top black coloured soil underlain by reddish-brown weathered rock which overlies a semi-weathered rock

Hydrogeology

Photo 5: Two small perennial depression springs whose water is collected in a small collection box (located between the two wells) provides drinking water to Kokode village. The two old wells are also perennial and are used for domestic and drinking purposes by two other villages. Effectively, a spring box and two wells tap the same springs in this case (Photo courtesy – Keystone Foundation)

Different groundwater sources such as springs and wells were surveyed to understand the hydrogeological setting of the region. Of the numerous sources, 10 springs and 7 wells spread in the Aracode, Denad and Kengarai panchayats were chosen for detailed observations. Based on the surrounding rock characteristics and structural patterns, most of the springs are classified as depression type (Photo 5) which are fed by groundwater residing in the loose, unconsolidated sediments formed due to in situ weathering, transport and deposition of weathered material that constitutes the main aquifer. Others are fracture springs. Combination types such as contact along with depression springs was also observed where the contact spring emerges at the interface between the overlying soft, weathered material and the underlying hard rock. Based on the data collected by Keystone for these 10 springs, a majority of the springs are perennial with varying discharge in different seasons. These springs cater to the daily drinking and domestic water needs of humans, livestock and wildlife with a few also used for agricultural activities. Most of these springs fall under private or community ownership. Although discontinuous, slightly long term data of discharge is available for two of the surveyed springs – Vaagaigundi / Eetimarabendu (ARA002) and Pulimava bavi (ARA007) located in Garikyur and Bangalapadigai village respectively. For both the springs, the lowest discharge was approximately 1 lpm while the highest was 14 to 15 lpm. Data related to in-situ water quality analysis for the 8 surveyed springs shows variability in quality between springs and across different seasons. Along with five parameter quality test, the spring water was also tested for bacterial contamination. Only one of the 8 springs, namely Pulimavakere, showed the presence of coliform in the month of October 2016. Therefore groundwater in this region is generally free of pathogenic contamination.

Table 1: In situ seasonal water quality analysis for 8 springs

Spring name	Spring ID	pH range	TDS range	EC range	Salinity range	Temperature range
Vaagaigundi / Eetimarabendu	ARA002	7.45 - 8.56	110 - 145	155.4 - 205	77.4 - 100	24 - 28.7
Pulimavakere	ARA007	6.3 - 8.43	32.4 - 241	45.6 - 341	27.6 - 165	21.2 - 30.1
Dhonikkerai	ARA008	7.25 - 8.7	150 - 217	212 - 305	88 - 147	22.3 - 24.6
Sanakkapadigai	ARA013	7.2 - 7.53	115 - 134	162 - 189	80 - 93.6	25.2 - 32.1
Uoolierai	DEN006	6.11 - 6.35	23.5 - 38.5	33.7 - 53.7	20.7 - 30	16.7 - 20.4
Puttalamarabavi	DEN007	5.37 - 5.8	36.6 - 39.1	51. - 54.8	26.2 - 30.3	19.4 - 21.5
Thogabavi	KEN103	6.85 - 8.5	71.2 - 85.5	100.9 - 123	50.8 - 62.1	18 - 24.5

Analyses of 52 springs that have been inventoried by Keystone shows that nearly 80% of the springs are perennial. However, in the last 3-5 years the region has witnessed a decrease in the average discharge rate of the springs, with some observed to have gone dry in the peak summer season. Decrease in rainfall or change in land use pattern in the upper catchment areas of the springs are the commonly perceived reasons by the locals. As a remedy to this the government has been promoting bore wells by subsidising the total cost of drilling, thus increasing the probability of drilling of individual bore wells. ACWADAM's earlier studies in similar geological terrains of east India have shown that aquifers in the weathered crystalline rocks are local in nature having limited storage and transmission capacities (Patil *et al.* 2017). Thus drilling bore wells for drought mitigation seems to be an unsustainable option because of the uncertainty of long term availability of water and secondly, the quality of water compared to that of spring water which receives annual replenishment.

The in-situ water quality analysis of one hand pump located in the Garikyur village shows that values for salinity, TDS and EC are twice as high as that detected for spring water. Along with this, a qualitative method of testing iron which involves immersing crushed guava leaves into the sample (knowledge passed down by Mohammed Murtaza from Supaul district, Bihar) was carried out on two samples. Change in colour of the sample from light pink to shades of purple indicates increasing levels of iron contamination. One rain water sample and the other from a hand pump showed that the colour of rain water sample remained unchanged (Photo 6a) while the hand pump water sample turned into a shade of purple indicating the presence of iron (Photo 6b). Also despite the fact that the springs do not show presence of bacteria, the region is vulnerable to contamination due to the close proximity of villages and practice of open defecation.

Photo 6a: Colour of rain water remained unchanged after emersion of guava leaves

Photo 6b: Deep purple colour od sample indicating presence of iron in water collected from a hand pump located in Garikyur village.

Most springs are connected to nearby habitations through pipe lines. However, only some springs have spring boxes and small collection or storage tanks along the route to the village.

Along with springs, open wells were also studied. The wells are not very deep, typically varying between 5-7 metres in depth and 3-5 metres in diameter. All the observed wells were lined or constructed till the base with stones or cement, thus implying that the rock profile is loose and weathered (Photo 7). This top weathered portion constitutes the main aquifer for the wells. Similar to springs, wells are also used by locals for drinking and domestic uses. While some of the wells have pumps (usually 1-2 HP motors) installed in them for abstracting water, in others it is done manually with the help of buckets.

Photo 7: An abandoned well in a tea estate near Pambarai village (Photo courtesy – Keystone Foundation)

COONOOR REGION

Geology

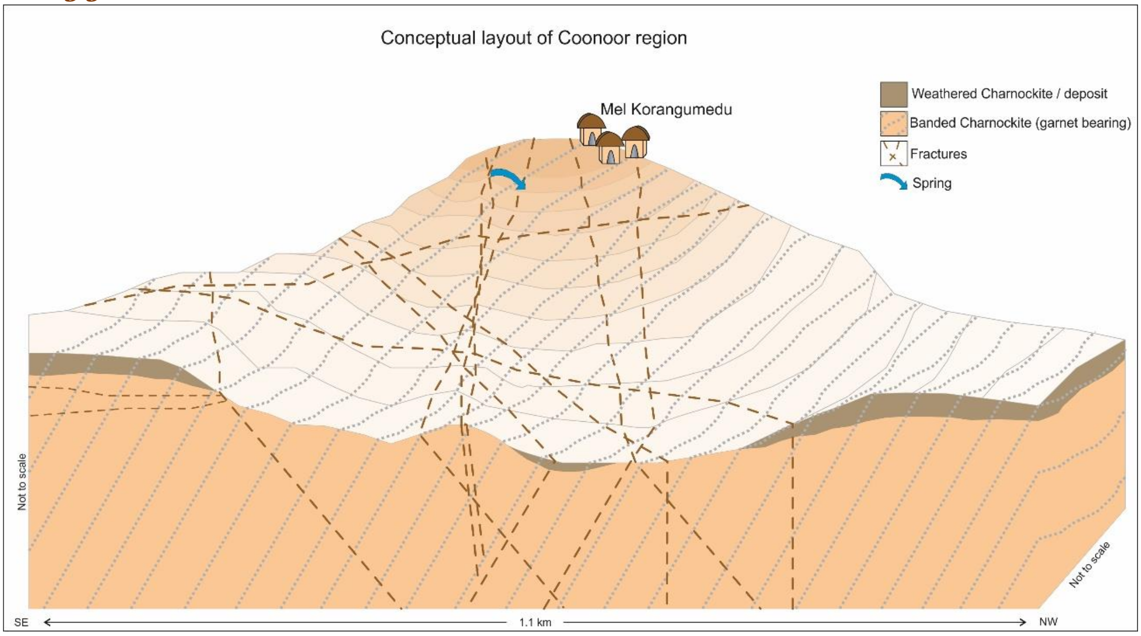

Figure 4: Conceptual layout of the complex geological framework and groundwater dynamics in Coonoor region

In the Coonoor region of the Nilgiri hills, mapping was conducted in two regions – the Pillurmattam and Archedan Estate areas. The study was confined to the top hill portions of the mountains as the many of the valleys are forested with very few rock outcrops.

Rocks of Coonoor region show a gradation between charnockites (without garnet) and garnet bearing charnockites. The grain sizes in the rock are also variable. While some of the rock outcrops are un-weathered, massive and un-fractured, road cuttings reveal that in many places the rock is semi-weathered to highly weathered. Unlike the completely weathered rocks, traces of foliations and fractures can be observed in the partially weathered rocks (Photo 9). The general foliation trend observed here runs along the northeast-southwest, east-west and northwest-southeast directions. Like in Aracode, the rocks here too are fractured in various directions, most prominent being along northwest-southeast and north-south.

Photo 8: Charcnokite outcrop with fractures

Photo 9: Traces of parallel fracture sets visible in a highly weathered rock

Hydrogeology

Photo 10: Two springs emerging at an elevation of 1568 metres above msl that is collected in a spring box.

In Coonoor catchment, two springs, one in Hulical panchayat and the other in a village close of Jogheecombai village along with two wells in Bambalacombai village were studied. While the one situated in Hulical panchayat is categorised as a fracture spring that is perennial, the second could be a depression type spring. The fracture spring has a small spring box constructed around it with a system of pipelines that takes water to Korangametla village to meet their daily domestic and drinking water requirements (Photo 10).

The two wells located in Bambalacombai village in the Archedan estate area are large diameter wells, 5-7 metres deep with water throughout the year. Water from one well is pumped every alternate day and stored in a Ground Level Reservoir (GLR) located in the uphill village to supply for their domestic needs.

In the Coonoor region, Keystone has mapped nearly 24 springs out of which data pertaining to discharge and water quality is available for 9 sources. The following points emerge from this dataset:

- Majority of the springs emerge in either private lands or in areas under the forest jurisdiction
- Springs are dominantly used as drinking and domestic water sources by community, livestock and wildlife. However four springs also provide water for agriculture and one for industrial use as well.
- Most of the springs are perennial in nature
- The discharge data for 8 springs as measured in the months of July and August of 2017 varies between 1.8 lpm to 4.8 lpm
- In-situ water quality test suggests that the overall quality is good with salinity values between 40 and 84ppm, TDS in the range of 56 and 127ppm, EC ranging from 81 to 174 µS and pH varying between 5.8 and 8.6

SIGUR REGION

Geology

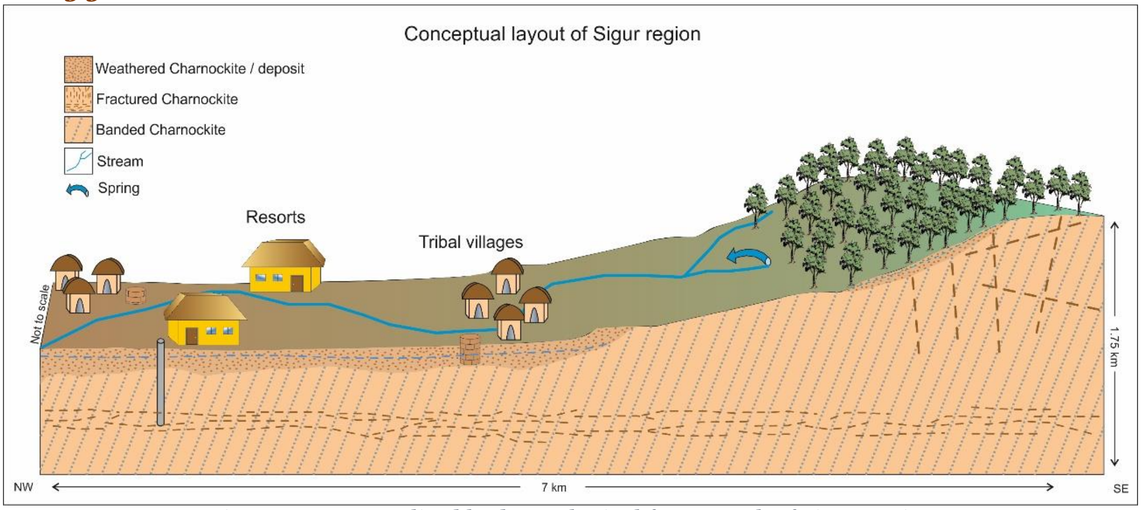

Figure 5: A generalised hydrogeological framework of Sigur region

Geological mapping in Sigur region was restricted to a small portion of the hills and a few villages. With the help of limited rock outcrops, limited exposed well section and interactions with the local community, a broad conceptualised sketch of the region has been developed (Figure 5). In general, the southern portions of the region are relatively hilly and mountainous where rock exposures are seen. These portions grade to the north into the flat plains. Here, intermittent outcrops are visible along stream beds and around a few villages.

The main rock type is banded charnockite or gneiss that is seen exposed in the southern hill slopes. They are steeply dipping in the northeast, west and northwest direction striking north-south, northeast-southwest and northwest-southeast. Few exposures are vertically fractured with strikes in the north-south and east-west directions.

In the northern slopes of the Nilgiri hills, few rock exposures along stream beds and in wells can be seen. The wells here are lined in the top 3-4 meters concealing the highly weathered and friable rock which is underlain by slightly weathered and fractured charnockite. This soft, weathered rock could be either weathered material formed by the in-situ weathering of charnockites and gneisses or it could be loose sediment material brought down from the hills and deposited at the foothill (Photo 11).

Some information from bore wells through narratives from the community suggested that the rock till a depth of nearly 200 – 250 feet is hard after which soft, whitish coloured, weathered rock is found from which water is said to flow into the bore well. This could be due to fractures in the rock.

Photo 11: A large rectangular well located in Chemmanatham village reveals the weathered subsurface strata (Photo courtesy – Keystone Foundation)

Hydrogeology

Photo 12: Sakot spring emerging at an elevation of approximately 1360m above msl in the southern hillslopes of Nilgiris

Sigur region, located to the north of Nilgiris hills is a complex region with several externalities influencing the dynamics of groundwater. The northern parts of the region that are characterised by hills and mountains are home to several springs that emerge at various elevations and are still unexplored and untapped. The plains that fall under the Mudumalai Tiger Reserve consist of open wells, a few springs and even bore wells.

Numerous streams originate in the hills that flow down north into the plains, thus providing water for the downstream villages. Some of the streams are seasonal but numerous others remain perennial as they are fed by springs. Spring water is used by wild animals and also by villagers located to the downstream from the stream that emerges from these springs. One such spring named Sakot spring (KAD104) emerges at an elevation of 1366m (Photo 12). The spring has a perennial discharge and is categorised as a depression type. It is fed by an aquifer that comprises unconsolidated or weathered material deposited along the slope. Located in the forest area, presently it provides water for wildlife but soon this spring water will be tapped with the help of pipelines to supply drinking water to 50 households in Chokkanalli village. It is thought that many similar springs emerge from these mountains but are yet to be explored. Along with the high elevation springs, a few others such as springs SOL001 and SOL002 (at elevations of 920 metres) near Kurumbarpallam village emerge in streams that have a seasonal flow. The seasonal stream is usually observed to go dry after six months after the monsoon, post which water from these small springs is consumed for drinking water needs.

Along with springs, wells are the next most prominent groundwater source for villages. Nearly every village has at least two to three common wells used by the village community. A total of four wells in Kurumbarpallam, Thottilingi and Chemmanatham were studied. Three of the four had water throughout the year. While one well is used by a private owner for agriculture and drinking purposes, the other is used for domestic and drinking water by the community. One of the wells that is perennial has been abandoned by the villagers for two reasons; in the summer season, the well has only one foot of water column which is said to be insufficient to meet their drinking water needs and secondly, livestock and wild animals that come to drink water from the well often fall into it. Thus, now the well has been abandoned and is used as a dumping pit.

Originally a region scattered with tribal villages, wildlife safaris and camping in the reserve forest has boosted the tourism industry thus increasing the occurrence of legal and illegal jungle lodges and resorts. Numerous such resorts are situated on tribal land. The tourism pressure has also meant an increased demand for water. Therefore, the tribal community which were originally forest gatherers who were dependent on the forest for their livelihood and springs and wells for their daily use, are now working as labourers in these resorts. These luxury hotels have drilled private bore wells to provide water to customers and for other purposes in the hotel. It is suspected that the recent drying up of springs and wells is due to this uncontrolled and unmonitored digging of bore wells. Drying up of these sources has further led to new bore wells even in the tribal villages.

Considering the rock characteristics and its inherent hydrogeological properties, as well as the gradual increase in the groundwater abstraction through bore wells by resorts, the region will soon run into a groundwater crisis, with respect to both quantity and quality. Therefore, the way forward in Sigur region will be to strike a balance between *ecology* that helps maintain the dense pristine forest, *wildlife* that is dependent on the springs and streams emerging at high elevation, *tribals* who were earlier spring and well water users and the recently proliferated *resorts* that have uncontrollable access to bore wells. This will happen only if all the stakeholders sit down together to discuss how a limited resource can be managed efficiently and distributed equitably to ensure sustainable supply of water.

THALAIKUNDA WETLAND – OOTY REGION

Photo 13: The main Thalaikunda wetlands of Ooty

A wetland can be formed either due to the water logging of surface water (primarily due to poor drainage of saturated soil) or it could also occur due to complete saturation of the shallow unconfined aquifers, resulting in groundwater flowing onto the surface in the form of base flows through numerous springs and accumulating as a wetland. However in the case of the Thalaikunda wetlands a classification cannot be made yet due to limited understanding and insufficient data.

The main Thalaikunda wetland (Photo 13), situated in the heart of Ooty town is a large wetland spread over nearly 2 km² and fed by numerous other smaller wetlands located in smaller valleys of the surrounding hills (Figure 6). This wetland had been dammed in the west by a small, approximately 250m dam wall. The smaller wetlands are located in streams that drain into the main wetland. The southern and south-eastern portions of the catchment cannot be accessed as the area falls under private lands or under the forest jurisdiction. However, certain northern and eastern parts of the catchment could be traversed. Nearly 5 smaller wetlands were recognised that feed the Thalaikunda wetland. Some of the wetlands had small rivulets flowing through them during the time of visit, while some others didn't show the presence of any surface flow. However, the marshy appearance suggests the presence of subsurface flow.

Figure 6: Streams and small wetlands that feed the main Thalaikunda wetland of Ooty marked on google earth

Rock exposures are rare in this wetland. Outcrops were visible in a small stone quarry to the north-east. The rocks strike in the northeast-southwest direction dipping at a low angle of 35° towards the southeast. Apart from this, along the road 5-10 feet of weathered rock is exposed. A few fractures running in the north-south and east-west direction can also be traced in a few locations.

Photo 14: Weathered charnockite rock exposed along a ridge between two wetlands

Parameter	Value
Salinity	394 ppm
Total Dissolved Solids (TDS)	575 ppm
Electrical Conductivity (EC)	805 µS
pH	7.29
Temperature	18.8 °C

Two among the five wetlands are small in areal extent compared to the others. Most wetlands have open wells situated in the central valley portions (Photo 15). All the wells have water throughout the year and are primarily used for drinking and domestic purposes. However, in some of the valleys, they are used for irrigating mainly carrots and potato which is the main produce from this region that is later sold to Mettupalayam town. One of the valleys situated to the north-east of the main wetland has been completely altered into an agricultural area with large scale cultivation of potato and carrot (Photo 16). A simple in-situ water quality test conducted on one of the wells used for domestic and drinking suggests that it is of good quality.

Photo 15: An old well located in one of the small feeder wetlands

Photo 16: Large scale farming of carrots and potatoes in one of the wetlands

Based on the topographical changes and weathered rock profiles it can be inferred that the wetland valleys are small, shallow unconfined aquifers having limited surficial extent and vertical thickness (Figure 7). Simple observations and measurement of water levels in wells suggest that the water in the surrounding wetland is groundwater.

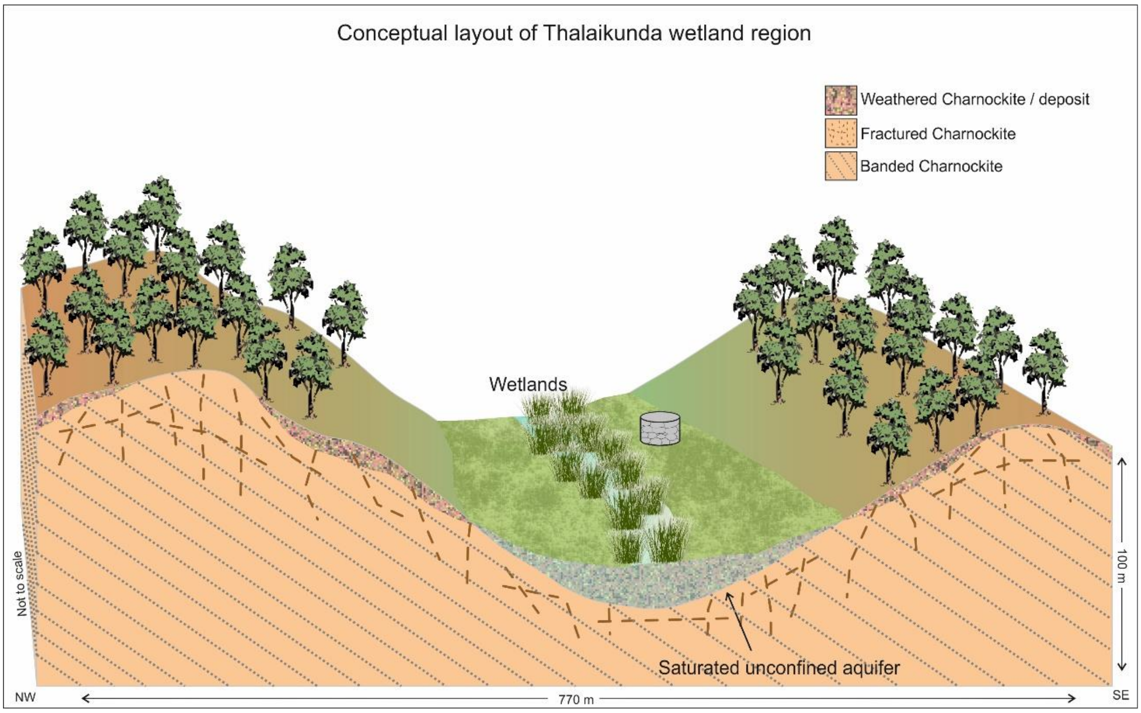

Figure 7: Conceptual hydrogeological layout of the Thalaikunda wetland in Ooty

RECHARGE AND PROTECTION AREAS OF SPRINGS

It is imperative to conserve and protect springs in regions where springs form the main source of water for basic needs. Scientific and systematic study of the area surrounding the spring can help in identification of the recharge zones of the aquifer. Although detailed mapping of the rocks along with data for at least one hydrological cycle of discharge will help in accurate demarcation of such zones, the following section attempts to do so based on the rock structure of the surrounding areas and general direction of water inflow. In doing so, two zones have been demarcated - protection areas and recharge areas. Protection area is the larger area from which recharge to the underlying aquifers is likely to occur. Hence, protection areas have been marked as a larger area than the recharge zone in order to keep the area devoid of over-grazing or open defecation such that it does not impact the quantity or quality of spring water. Recharge areas are smaller areas within the protection zones where specific recharge activities like artificial recharge (through soil and water conservation efforts) can be attempted.

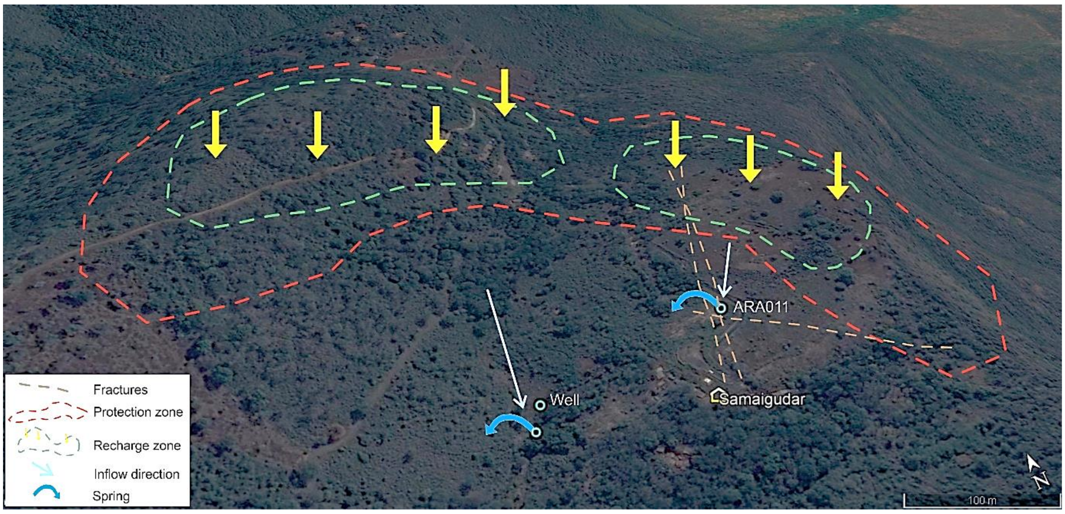

Figure 8: Google earth image showing the protection and recharge areas of two springs in Samaigudar village, Aracode

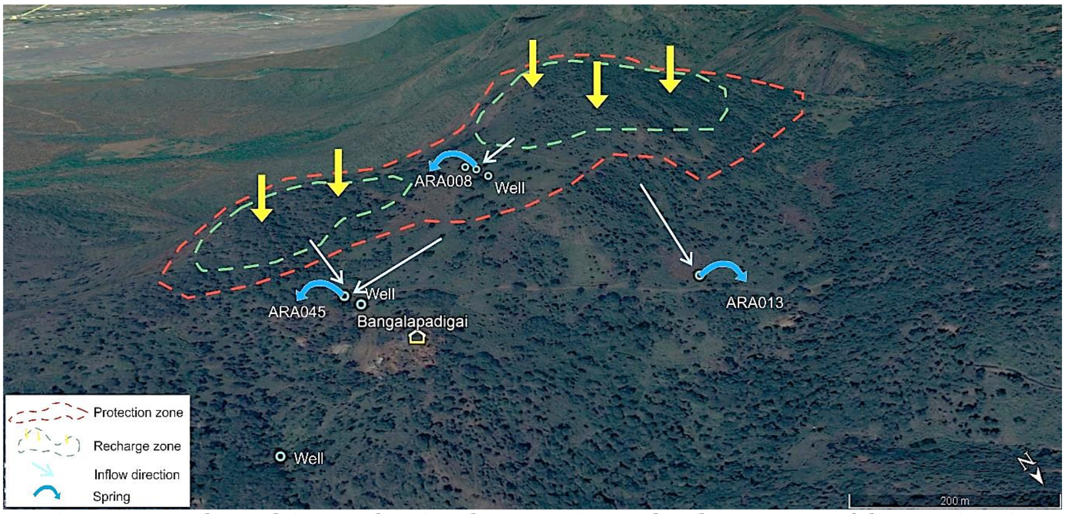

Figure 9: Google earth image showing the protection and recharge areas of three springs in Bangalapadigai village, Aracode

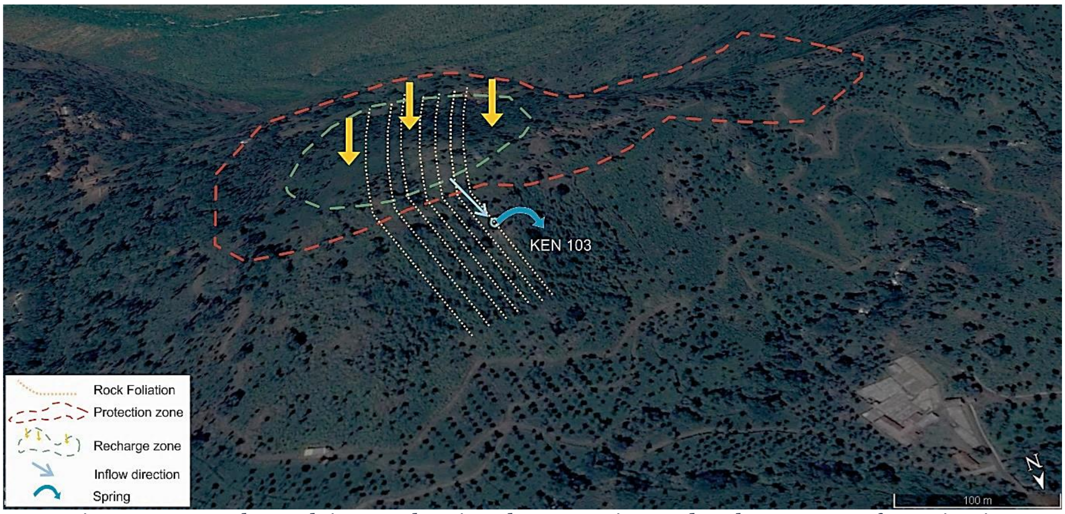

Figure 10: Google earth image showing the protection and recharge area of a spring in Kambaiyur village, Aracode

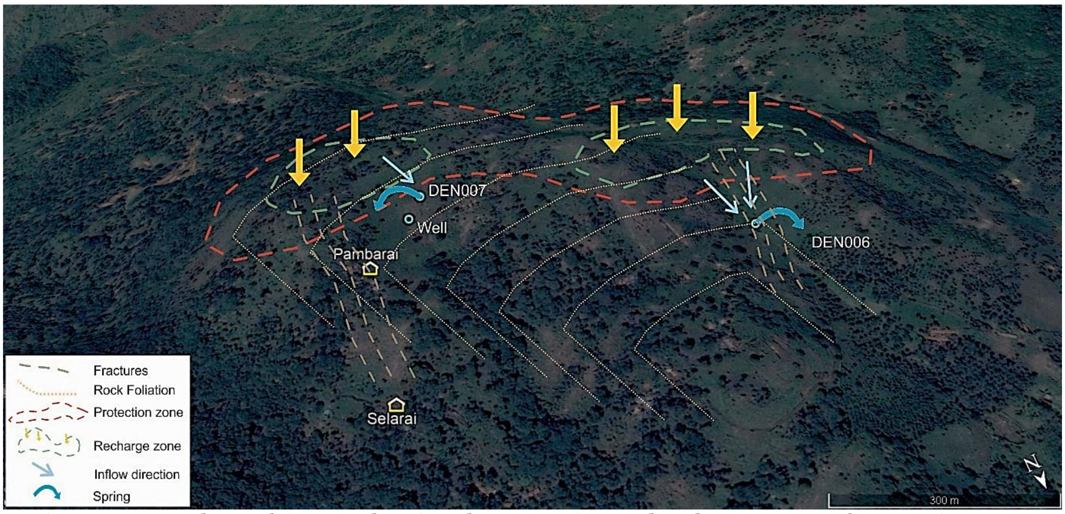

Figure 11: Google earth image showing the protection and recharge areas of two springs near Pambarai and Selarai villages, Aracode

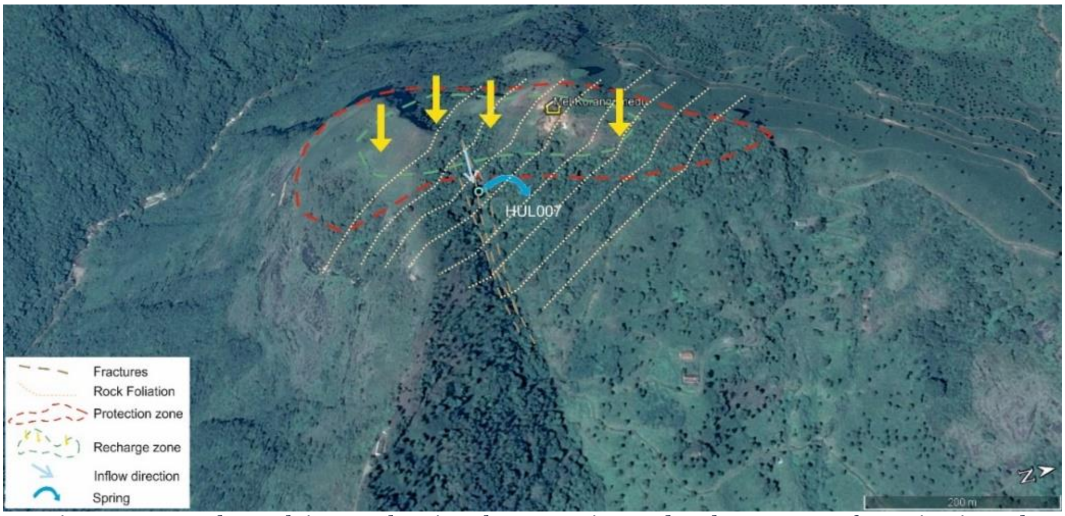

Figure 12: Google earth image showing the protection and recharge area of a spring in Mel Kurangumedu village, Aracode

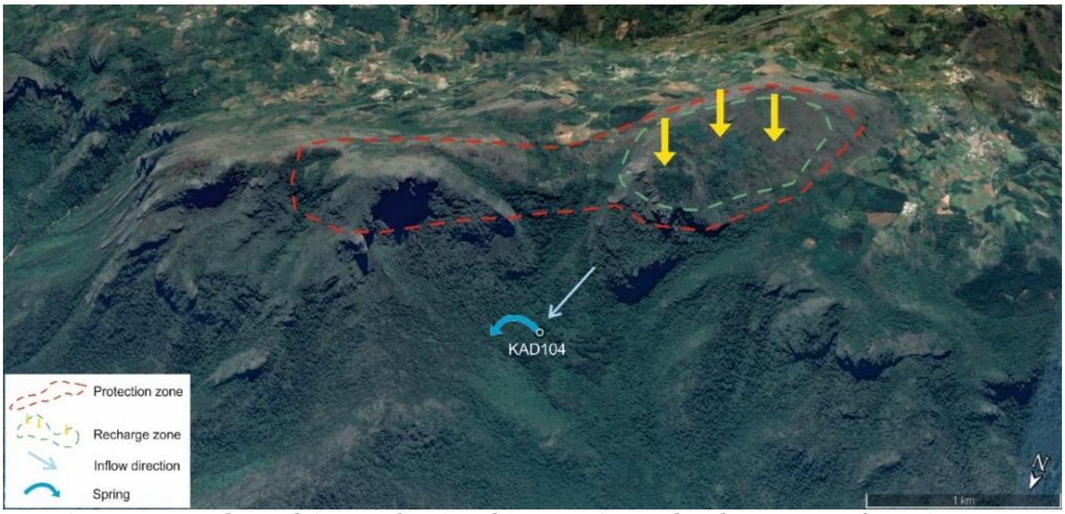

Figure 13: Google earth image showing the protection and recharge area of a spring near Chokkanalli village, Aracode

RECOMMENDATION AND WAY FORWARD

Situated in the southern region of the Western Ghats, the Nilgiri district is blessed with good annual rainfall and healthy ecosystems with perennial springs and wells. However, climate change, change in land use pattern, alteration of forest land into agriculture, urbanisation, increase in tourism, advent of bore wells etc. has significantly impacted spring discharges. Secondary data suggests that the Nilgiris are experiencing a deficit in annual rainfall in the last few years. This decreasing rainfall trend will have significant impacts both on the spring discharge and on base flows that feed the numerous streams that drain the district. Since most of the tribal pockets are dependent on springs for their basic necessities, reducing discharge will directly affect the drinking water security of the communities.

In the last few years the Nilgiri district has witnessed the emergence of bore wells. These bore wells are being promoted by the government to mitigate water scarcity. ACWADAM's research in parts of east India have shown that aquifers comprising of crystalline rocks such as those exposed in the Nilgiris, have limited storage and transmission capacities. Unmonitored and excessive pumping from such aquifer systems soon results in a state of over-exploitation. Given the geological setting, the Nilgiris are prone to groundwater contamination. Deep aquifers that are tapped by bore wells and hand pumps are vulnerable to iron and even fluoride contamination as evident even from preliminary investigations. While this aspect needs further probing through systematic research, spring and open wells on the other hand, although tending to be relatively free of chemical contamination are highly susceptible to bacterial contamination. This is due to the occurrence of open defecation or construction of toilets in the recharge areas of springs and wells, a fact that is neither explored nor considered in water resources planning.

In Aracode and Coonoor, reviving springs by protecting the recharge zones is important. Also it is equally important to keep the recharge areas free of contamination. From field investigations it is observed that spring water may get contaminated due to heavy use of fertilisers and pesticides in agricultural fields and plantation as the system from farm to aquifers and back to farms is in clear continuum. Since open defecation is a common practice, there is also a high risk of bacterial contamination especially in the case of fracture springs where groundwater movement is quite rapid leading to low probability of attenuation.

It becomes critical to understand both the supply and demand of groundwater to achieve sustainability in regions such as Ooty and Sigur, especially, where groundwater is being sourced by multiple users through different sources. This would require improving and reviving the traditional groundwater systems and at the same time dialoguing and collaborating between different stakeholders, such as community members, farmers and resort owners to jointly improve the groundwater scenario.

Under such varied scenarios, understanding the complex hydrogeological setting of springs and wells holds the key to resolve water issues. Along with detailed geological mapping of the region, regular monitoring of spring discharge and assessing the spring water quality is essential. Therefore, before setting up of distribution systems or carrying out any intervention on springs and spring boxes, it is extremely important to first assess the spring sustainability, that is, whether it can provide water for the required purpose for a prolonged period, and secondly, perform a water quality analysis to ensure its suitability for drinking purpose. In addition to this, demand management may also become important in order to attain long term sustainability.

REFERENCES

- 100 year rainfall data, Indian Meteorological Department, 2012
- Agriculture Census, Department of Agriculture and Cooperation, Ministry of Agriculture 2010-11
- District Statistical Handbook, 2015-16
- Dynamic Groundwater Resources, Central Groundwater Board, March 2011
- Format B6 - National Rural Drinking Water Programme, Ministry of Drinking Water and Sanitation
- Patil, S., Kulkarni, H., and Bhave N (2017) Groundwater in the Mahanadi river basin. Forum for Policy Dialogue on Water Conflicts in India, Pune