

Ambikapuram Valley in Hubbathalai Panchayat

- A Case Study highlighting interlinkages between groundwater, sanitation and other domains

Introduction

Ambikapuram valley is located in Hubbathalai Panchayat of Coonoor taluk in the Nilgiris district of Tamil Nadu. The Panchayat has 31 habitations with a total population of 10,852. The area has people from badaga and other communities living in separate habitations. The area was traditionally inhabited by the Badaga community in habitations called '*hatties*'. Over the last few decades, there has been resettlement of Tamils from Sri Lanka in the area by the government as part of a larger programme, leading to a number of new habitations being developed in the area. These habitations are now developed with infrastructure such as electricity, houses, roads, schools, drainage systems etc.

The area has growing settlements located close to each other with tea plantations around them. The Panchayat is adjacent to the Coonoor Municipality area and can be characterised as peri-urban. This is also reflected by the fact that only 9% of the total workers in the Panchayat were involved in agriculture and allied activities. In general land ownership is common in the Badaga settlements and less common in the other habitations. Upon resettlement, most of the Tamils worked in the tea fields of the Badagas. Over the decades their livelihoods have diversified to include many non-farm activities, although daily wage work is still an important source of income.

We focus in a smaller area within the Panchayat that is typical of any other part of the Nilgiris. We have defined the area as the watershed of the drainage that flows out of the valley Ambikapuram habitation (See map below). The water sources of these habitations are mostly located in this valley. The total area of the watershed is approximately 238 acres.

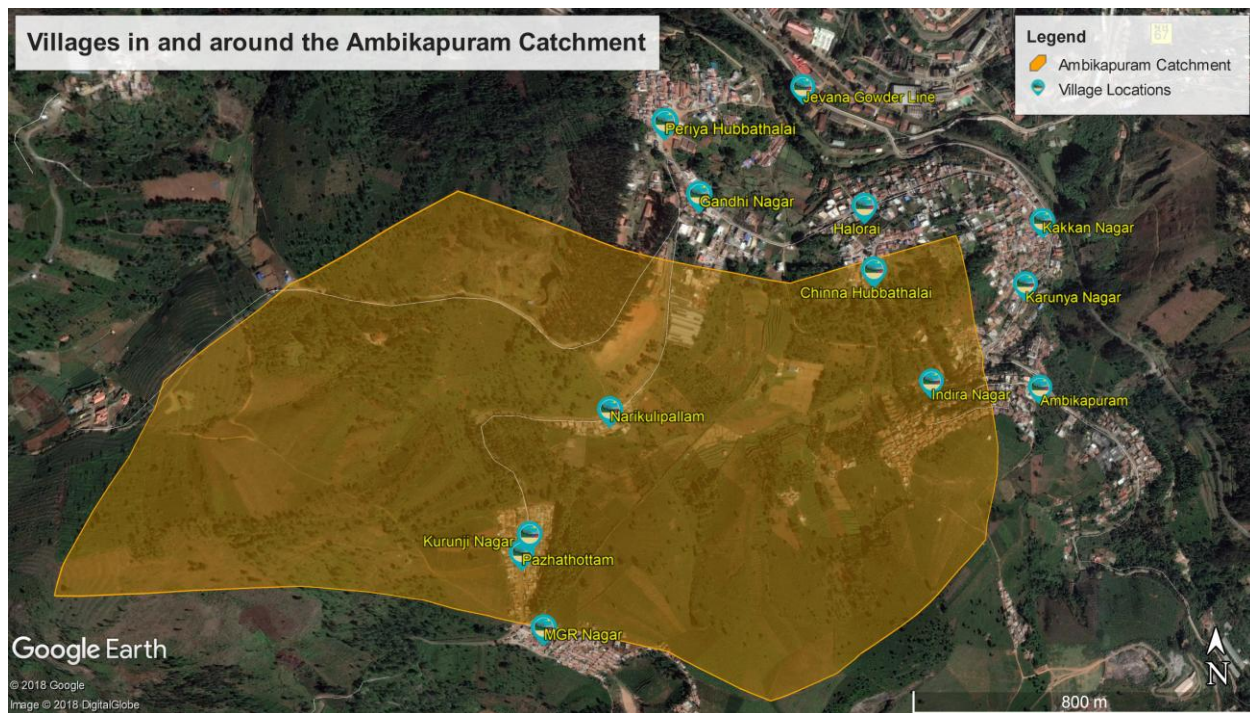


Figure 1: Context map of Ambikapuram Valley

The area pertains to the following habitations,

1. Ambikapuram
2. Chinna Hubbathalai
3. Halorai
4. Indira Nagar
5. Kakkan Nagar
6. Kurinji Nagar
7. MGR Nagar
8. Narikulipallam
9. Pazhathottam
10. Gandhi Nagar
11. Jevana Gowder Line

In addition the government school in Hubbathalai also draws water from a well in this valley.

Water Supply and Sanitation Situation in the Area in 2015

These communities receive water supply through springs and/or open wells located in this valley. MGR Nagar has an open well and spring outside this catchment that also provide water to it. The situation as captured in our baseline survey in 2015 is given below.

Table 1: Summary of water supply situation in Ambikapuram Valley

S No.	Habitatio n Name	Sources	Source Type(s)	Supply	Issues reported in surveys
1.	Ambikap uram	Ambikapura m valley – 2 wells	Well	Daily supply for some households. Once in 2-4 days for some depending on the season. Well water alternate days 0.5-1 hr.	Reduced supply in summer. Muddy water
2.	Chinna Hubbath alai	Sengarani Thottam Ambikapura m Valley	Spring Well	24/7 2 hrs a day daily	Muddy water from well.
3.	Halorai	Sengarani Thottam – overflow	Spring	1.5-2.5 hrs a day throughout the year	-
4.	Indira Nagar	Ambikapura m Valley	Well	3 hrs every two days throughout the year.	Muddy water
5.	Kakkan Nagar	Narikulipalla m Spring Ambikapura m valley	Spring Well	Min. 1 hr a day throughout the year	Reduced supply in summer. Oily film in well water due to Iron.
6.	Kurinji Nagar	Narikulipalla m Spring	Spring	2 hrs a day throughout the year	-
7.	MGR Nagar	MGR Nagar Spring Bengalmatt am well Ambikapura m Valley	Spring Well Well	Alternate days throughout the year	Insufficient supply in Summer.
8.	Narikkuli pallam	Narikulipalla m Spring	Spring	1.5- hrs for most households; 15-30 minutes per day for a few of the	Insufficient water supply.

S No.	Habitatio n Name	Sources	Source Type(s)	Supply	Issues reported in surveys
				families.	
9.	Pazhathottam	Narikulipallam	Spring	Alternate days in summer; 24/7 remaining seasons.	Pipes get blocked during monsoon season. Muddy water during rains. Oily water.
10.	Gandhi Nagar	Gandhi Nagar Jevanagowder Line Pororai	Well Well Well	1.5 hrs a day throughout the year	Muddy water during rain, drainage mixed
11.	Jevana Gowder Line	Jevana Gowder Line	Well	24/7 throughout the year	Some households report alternate day supply

Open defecation was reported in 2015 in Pazhahottam, Kurinji Nagar, MGR Nagar, Indira Nagar and Gandhi Nagar to varying degrees. Only in Chinna Hubbathalai and Jevana Gowder Line are the Community Toilets being used, whereas in MGR Nagar it had been unused for a few years since the women's group in charge of maintaining it handed it back to the panchayat. Since then this toilet has been revived by the panchayat alongside the springs project's intervention of building a spring box and setting up a water supply system based on it. It was initially planned that the overflow water from this spring would feed the toilet. But given that the spring flow has reduced considerably since the box was constructed, due to lack of sufficient rainfall, the pipeline was not laid. In the other habitations, there are no community toilets.

Land Use

The analysis of land use changes in the region over a period of five years shows that there is a trend towards conversion of farm land, be it vegetable or tea, to built up area. This is borne by observation of hectic construction activity on the ground in these habitations as well. The graph below shows the quantum of these changes.

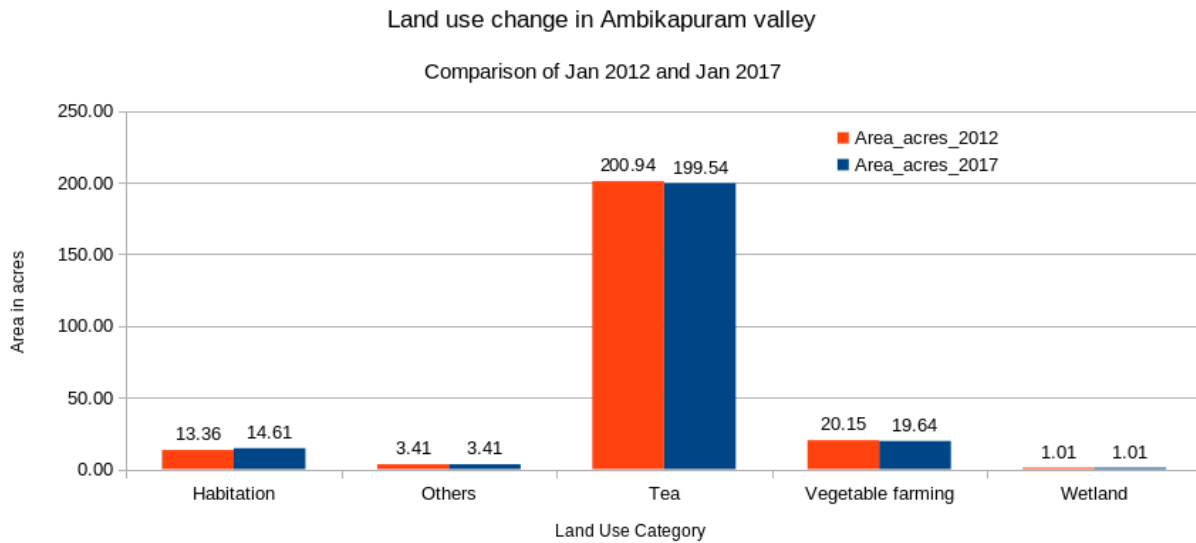


Figure 2: Land use change in Ambikapuram Valley from 2012 to 2017

The overall increase in built up area (habitation) is about 1.25 acres, which is at the cost of tea and vegetable farming. In the coming years, this trend will only intensify as tea is an ailing industry and real estate is going through a boom. The proximity of this area to Coonor town is a major factor in this development. The increase in built up area also brings with it an increase in demand for water supply. In about 10 cents of land above the depression spring in Sengaranoi thottam area, the community has undertaken fencing of the land and restoration activities to conserve the spring and ensure that it provides good water flows in the future. This piece of land is a small island in a catchment full of tea plantations owned by community members.

Land Use change in the valley

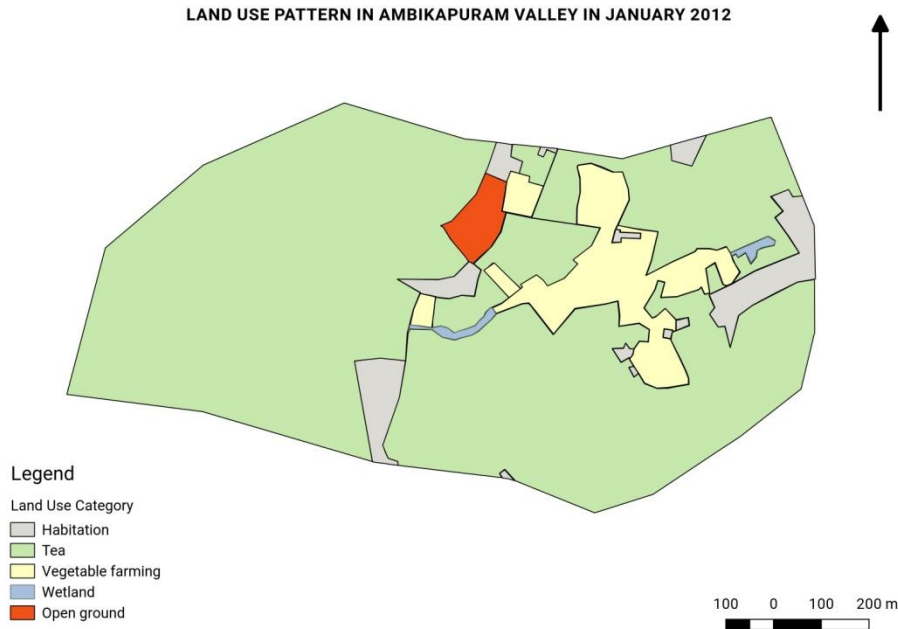


Figure 3: Land use/cover in 2012

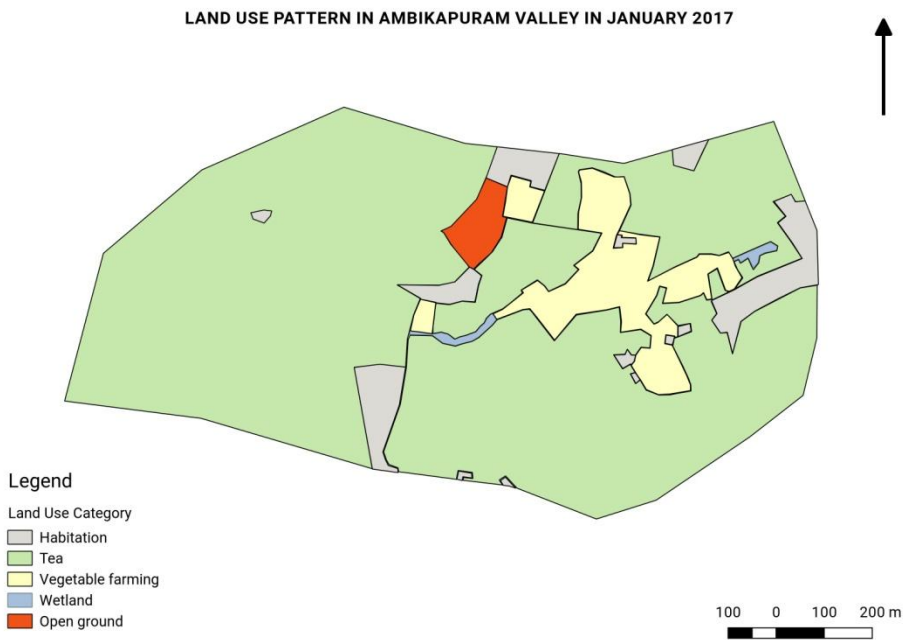


Figure 4: Land use/cover in 2017

The hill tops and slopes right up to the valley portion are covered by tea fields belonging to local Badaga families. Some portion of the valley is under vegetable farming. It is a common practice in this region to use chemical fertilizers, pesticides and herbicides in these fields. The sewage from some habitations is also let out into the tea fields, which are part of this catchment. The testing of a sample of open wells in the valley has shown that faecal coliform is present in the water. While Open Defecation is practised in some habitations, grazing of goats and cattle and presence of Gaur also add to the faecal matter in the catchments. Where toilets have been built and are being used, the tanks are single leach pit models, which let the septic waste seep into the ground, with possibility of contaminating the groundwater.

The massive storage tank inside the Ambikapuram valley catchment is also an important source of drinking water for the Coonoor Municipality area. The tank has 3 levels of filtration tanks built before it enters into the pipeline for distribution. The tank water has not been tested, but however from our observations we see the silt accumulation in the tank has increased due to intensive vegetable cultivation in the catchment leading to high run off of soil and other chemicals after each harvest. The coliform in the tank tested positive. The stream is treated as waste carrier once it enters the Ambikapuram town where you can see sewage water from households let directly into the stream which flows down to join the Coonoor river.

Geology of Ambikapuram valley

Rocks are mostly exposed near the Hubbathalai springs and as we go towards the outlet of the valley thick layer of sediments and weathered rock is observed. Whole valley has again single type of rock, which is Charnockite. North-South trending vertical fractures are seen near a quarry outside the valley. The foliation of the rock observed is same as observed in other two catchments. The thickness of sediments and weathered rock seems to be more than 9 meters (based on well depths) along the valley. The thickness of this layer gradually decreases as we go towards the hill tops. Sediments and weathered rock are mostly composed of clay.

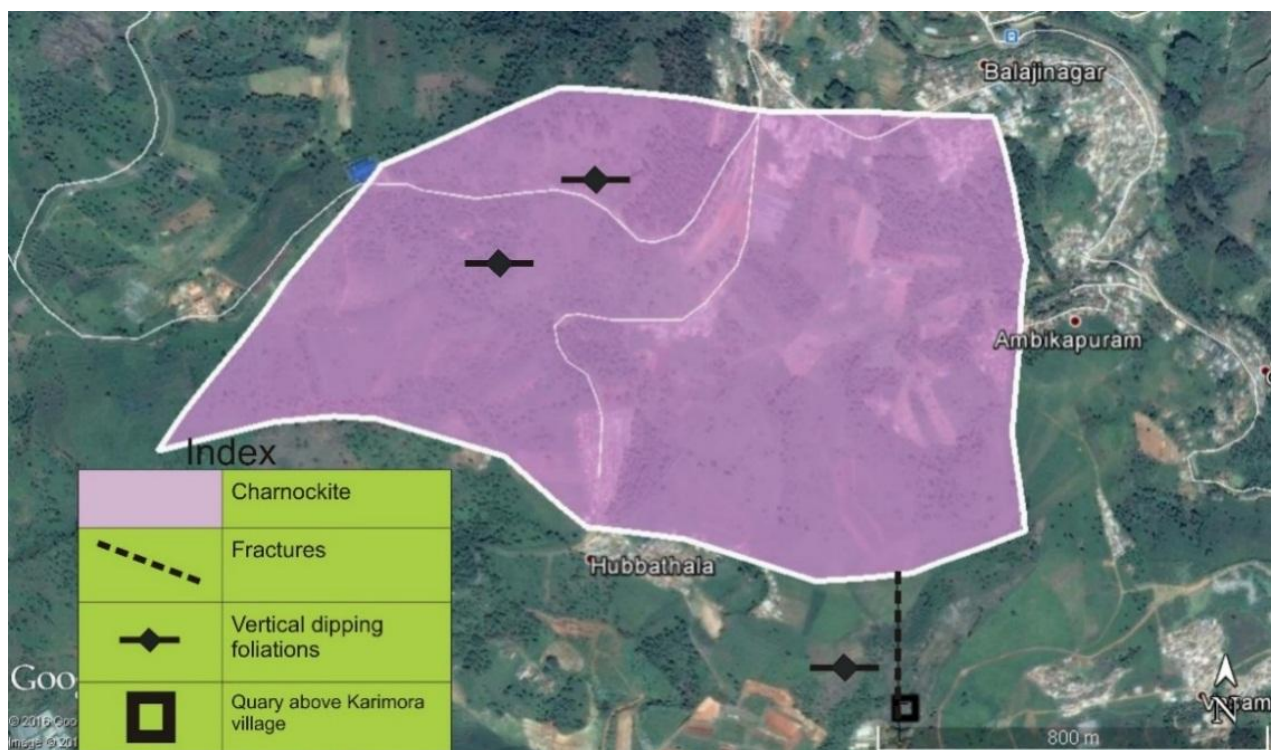


Figure 5: Geology of Ambikapuram Valley

Hydrogeology of Ambikapuram Valley

Ambikapiram is an east-west trending valley. Elevation in the valley ranges from 1988m-1877m. The valley has gentle slope and greater thickness of sediments and weathered material. This unconsolidated material forms the unconfined aquifer in this valley. The depths of wells indicate that, the thickness of aquifer is greater than 10 meters. Two springs (Hubbathalai springs) have been identified in the valley and these springs are the major source of water for the stream the valley. These two springs are depression type springs. These are very old springs and have a very high discharge. The rocky outcrops are hardly seen in the valley but quarry to the south of the valley has rock outcrops. The major vertical fractures are north-south trending.

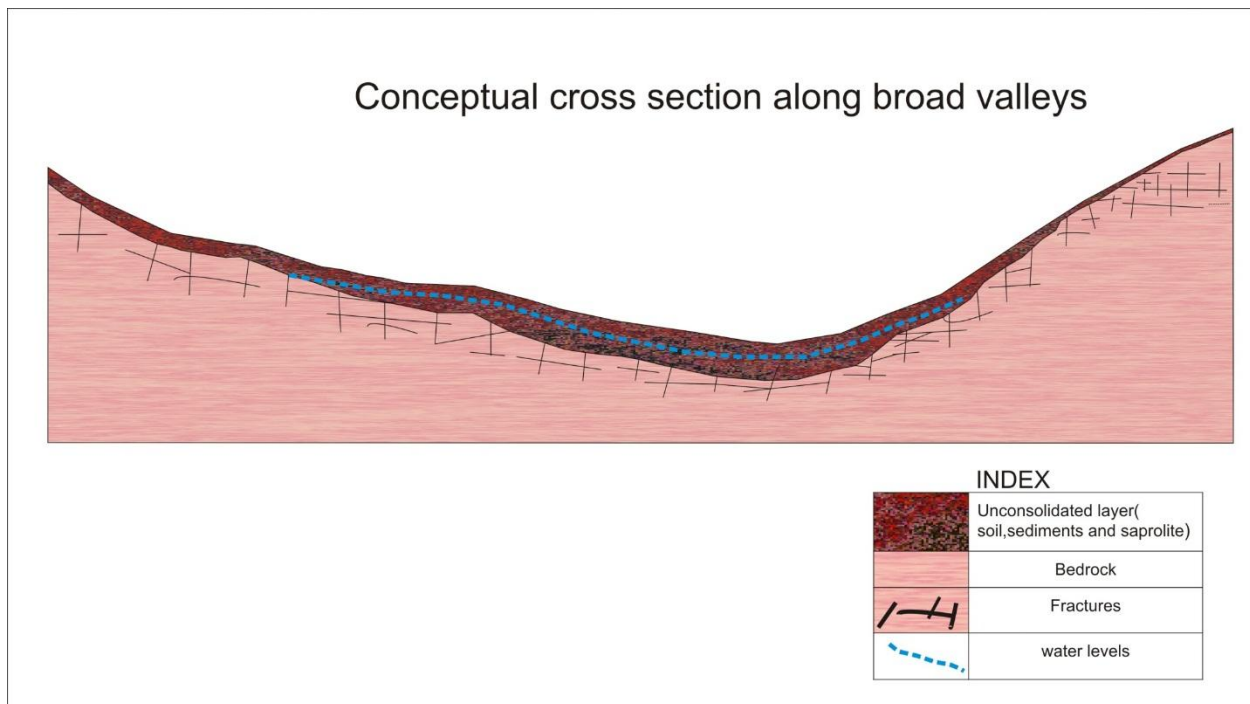


Figure 6: Cross section along the gentle slope gradient

Hubbathalai spring

The entire spring shed of the HU spring system comprises of soil, unconsolidated debris and weathered and hard-compact quartzite/Charnockite. The soil layer is relatively thin at higher elevations than in the valley. Underlying the soil is the unconsolidated debris which comprises of rolled and deposited rock material of varying sizes. Huge boulders of quartzite are also observed in between the valley. The debris deposit is thick in the central part of the valley and relatively thins out as we move up on the flanks. Massive Quartzite/Charnockite is present at the base. The rock is hard and compact and exposed on to the surface at the northern part of the ridge. The Quartzites/Charnockites are exposed only at 1-2 locations and hence is difficult to map out their spread of extent, vertically and laterally (Fig.11).

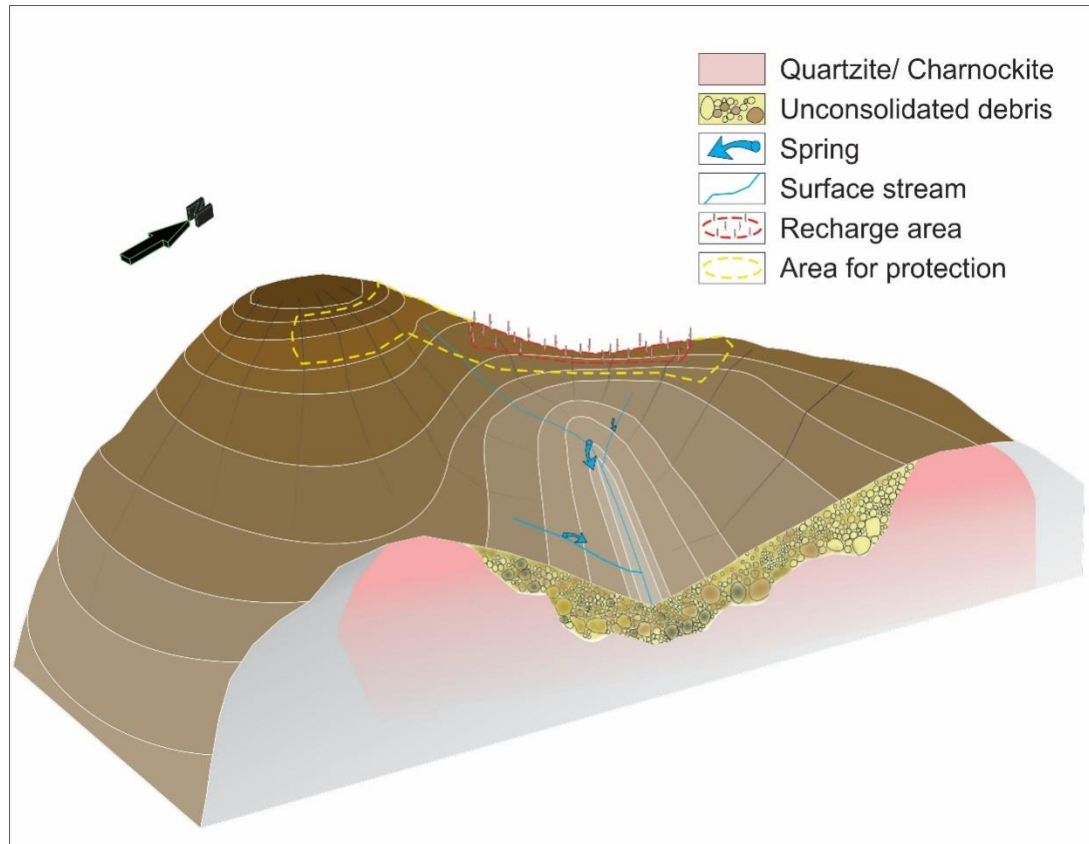


Figure 7: Conceptual hydrogeological diagram of Hubbathalai spring

Recharge areas

Hubbathalai springs are the main natural discharge points in Ambikapuram valley. Recharge and protection areas demarcated for these springs mostly comprise of

private tea plantations. The hill tops all along the valley also form the recharge areas for the aquifer present in the valley.

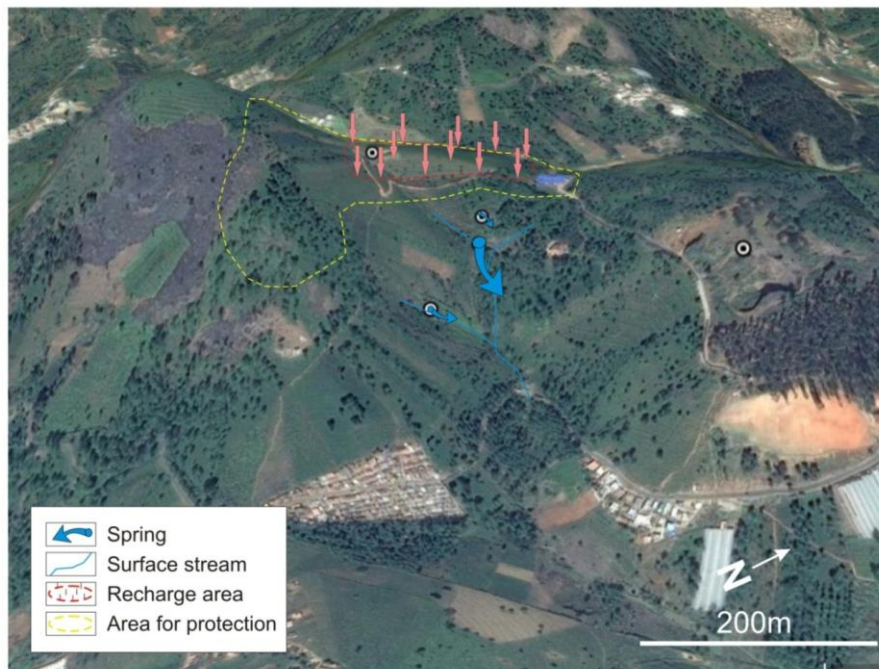


Figure 8: Recharge area of Hubbathalai springs

Spring Discharge

There are two main springs in the upper area of the catchment. These are Sengarani thottam spring and Narukulipallam spring. These are already being tapped by 5 habitations and water being supplied to GLRs there. Given the high pressure on water resources there and occasional disputed between villages over water sharing, the villages are reluctant to set up T-junctions at the source. Therefore we had set up T junctions in each habitation. However over the last three years there have been frequent repairs of pipelines in these villages leading to disruption in measurements. The result being that we don't have reliable spring discharge data for the area.

The water quality data indicates constant presence of faecal coliform, very low TDS of below 60 ppm and pH within the acceptable range. Villages like Chinna Hubbathalai, Aalorai and Pazhathottam escape the chemical and geogenic pollution from well water as it is only used for other purposes and not drinking.

Well Dynamic Data Analysis

In order to understand the dynamics of groundwater in the valley, we measured the depth to water level in open wells along with water quality on a monthly basis. The rainfall is also being recorded on a daily basis at Ralliah Dam using an automated rain

gauge. This reduced water level is normalised with respect to sea level and this is plotted against rainfall to compare the status of wells across the topography. The depth to water level is also plotted against rainfall to understand the extent of fluctuation in a well compared to the others.

Analysis these graphs shows that Ambikapuram (HUBW001), Kakkan Nagar (HUBW003) and to some extent Pazhathottam & MGR Nagar (HUBW009) wells experience high level of fluctuation, whereas the Kil Ambikapuram (HUBW002), Indira Nagar (HUBW004), Hubbathalai government school (HUBW005) and a private irrigation well (HUBW006) show moderate fluctuation. Two irrigation wells (HUBW007 and HUBW008) and an unused private well (HUBW010) show low levels of fluctuation in water levels.

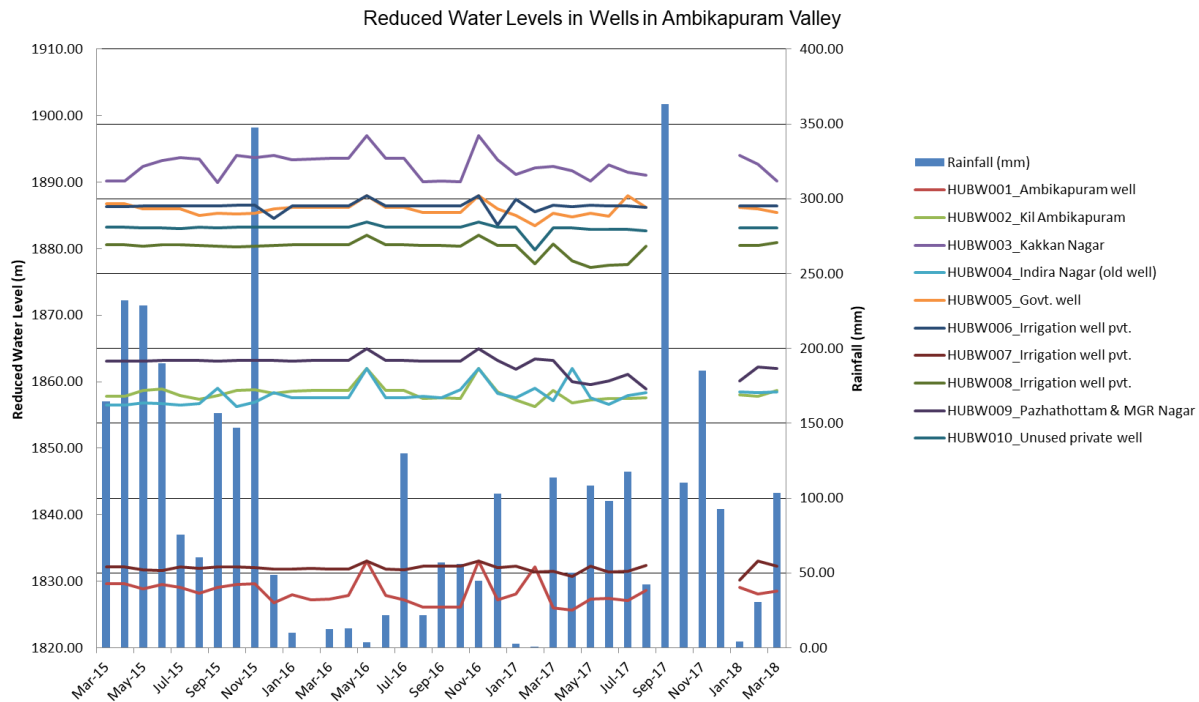


Figure 9: Reduced Water Level in open wells in Ambikapuram Valley

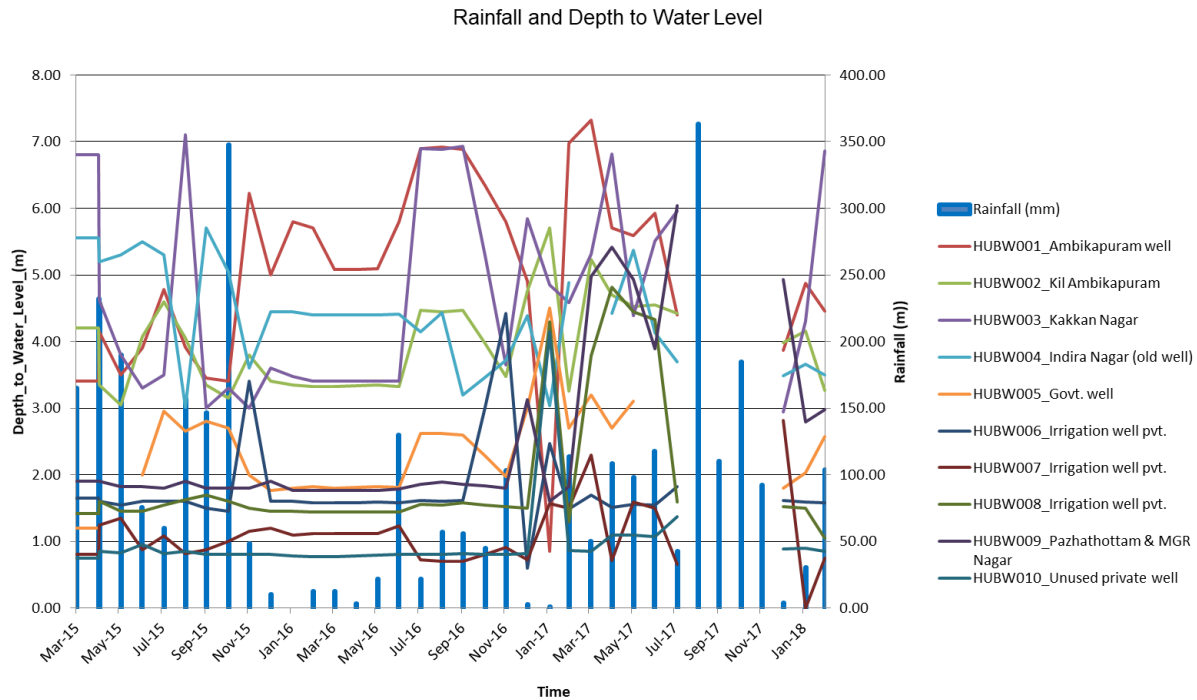


Figure 10: Depth to Water Level in open wells in Ambikapuram Valley

From the level of fluctuation of water levels, we could infer that the wells HUBW001 to HUBW006 are in the recharge zone, whereas wells HUBW007 to HUBW010 are in the discharge zone. However we must keep in mind the fact that the wells are being pumped out nearly daily and this may be affecting the readings of water levels.

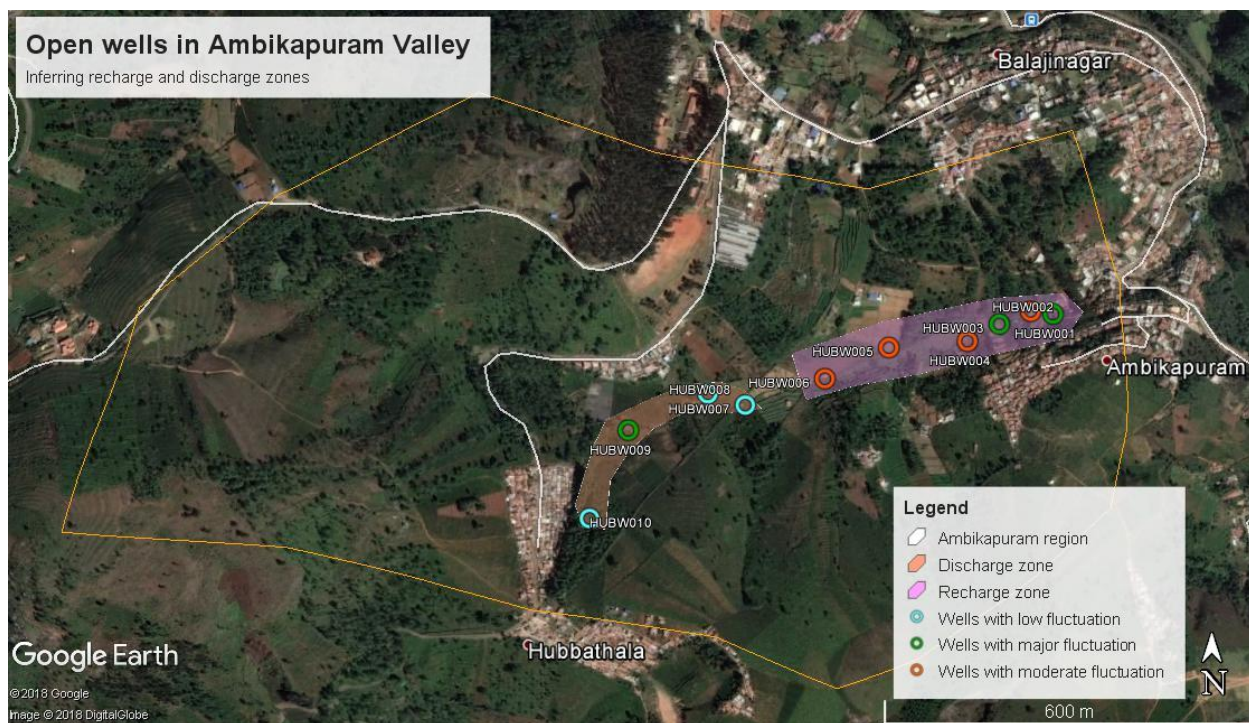


Figure 11: Potential recharge and discharge areas in Ambikapuram valley

In terms of water quality, there are seasonal fluctuations in all the wells with regard to pH, although nearly all the wells have acidic water at times. This is to be expected given the lateritic soils in the catchment.

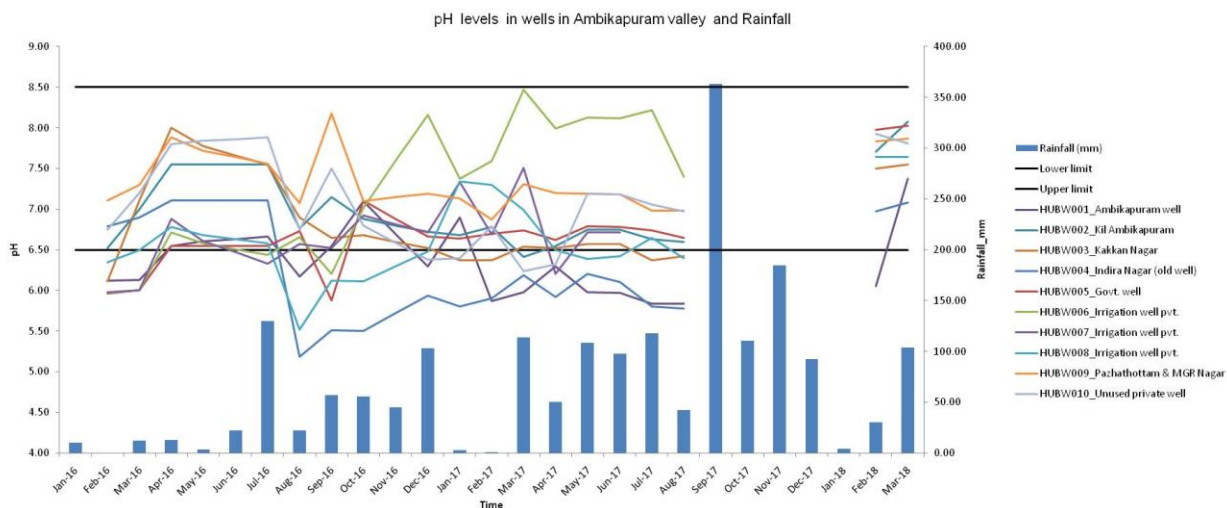


Figure 12: pH in open wells in Ambikapuram valley

TDS is not a matter of concern in the region as the level is never over 200 ppm.

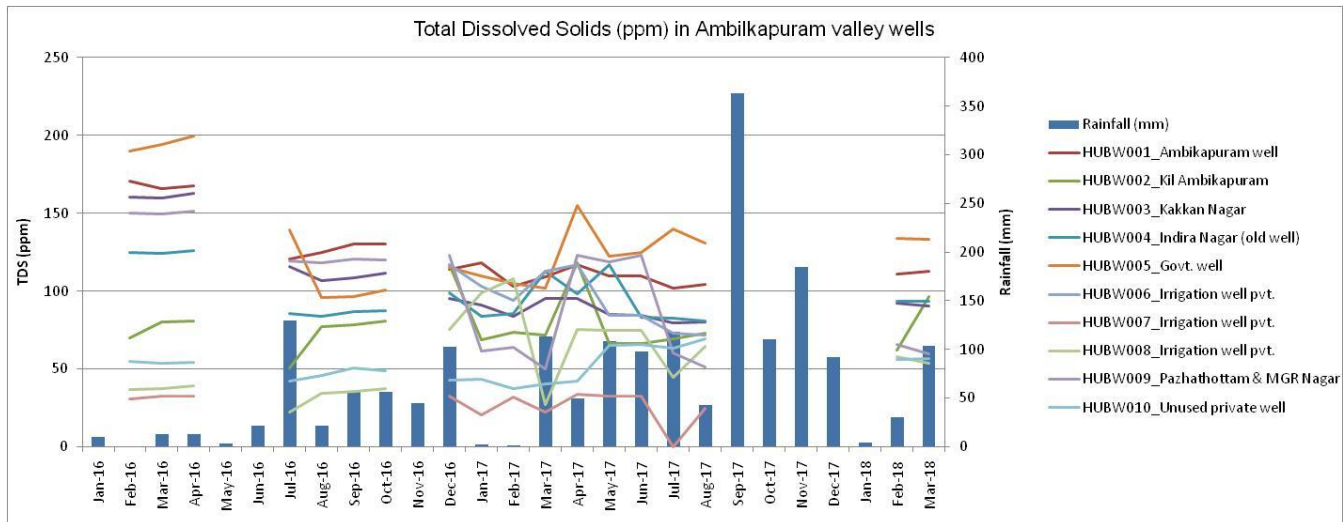


Figure 13: TDS in the wells in Ambikapuram valley and Rainfall

Faecal coliform is present across all the wells during most of the year.

Table 2: Water Quality Issues detected in Panchayat Drinking water wells

S No.	Well	Coliform	Ammonia	Phosphate	Iron
1	Chinna Hubbathalai	2015, 2016	2015, 2016	2015, 2016	-
2	Kil Ambikapuram	2015	-	2015, 2016	-
3	Kakkan Nagar	2016, 2018	2015, 2016, 2018	2015, 2016, 2018	2018
4	Indira Nagar	-	2015	2015, 2016	2015
5	Ambikapuram	-	-	2015, 2016	-
6	Pazhathottam and MGR Nagar	2018	2018	2016, 2018	2018
7	MGR Nagar	-	-	2015, 2016	-
8	Hubbathalai School	2015, 2016,	2015, 2016,	2015, 2016, 2018	-

S No.	Well	Coliform	Ammonia	Phosphate	Iron
		2018	2018		
9	Jevana Gowder Line	2015, 2018	2015, 2018	2015, 2016, 2018	2018
10	Narikulipallam	2015	2016	2015, 2016	-

Note: Samples were taken on – 2nd June 2015, 3rd August 2016 and 7th March 2018 and analysed in TWAD Laboratory, Ooty. On 29th March 2017, samples were tested using the portable water testing kit Jal Tara at Keystone.

Given that all these wells are located in one valley, there is an obvious impact of sanitation practices, waste management and chemical input based farming on the water quality. While the levels may vary from well to well due to various factors, it is clear that the above issues need to be addressed in all the upstream villages in order to safeguard the water quality. Routine maintenance of wells is also important to improve the water quality.

Waste Management

During the baseline survey in the panchayat in 2015, the only waste management set up in the panchayat consisted of waste bins in 5 habitations of which only a few were cleared by pickup service from the panchayat. Waste disposal was mostly done by the households themselves usually close to their houses with burning being the only strategy to clear the accumulated waste. Private recyclers from Coonoor visit the villages regularly to pick up salvageable solid waste that make their way to Coimbatore eventually through a multi stage complex network of waste collectors, segregators and processors (NFLC Water and Waste Study 2017). Much of the waste is also dumped close to natural drains where they are transported downstream to the Coonoor river during rains.

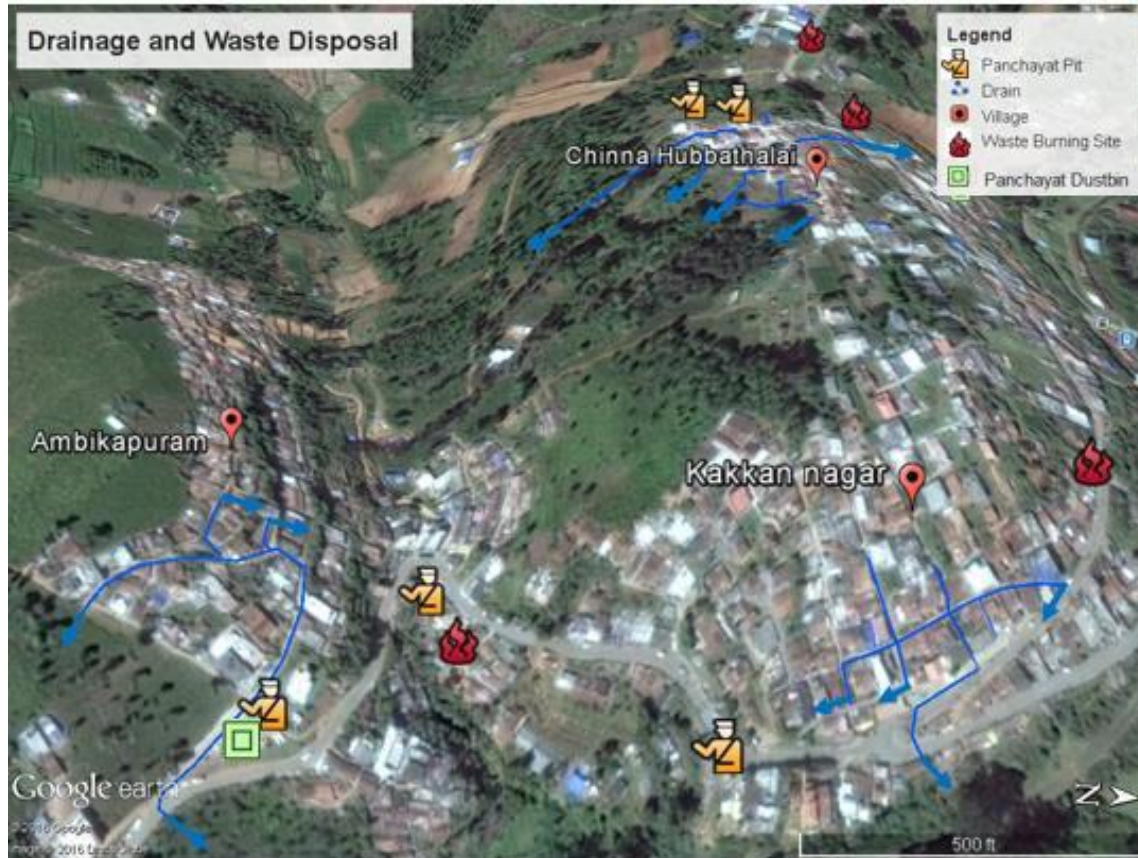


Figure 14: Waste disposal in Ambikapuram valley (NFLC 2016 Research Report)

Sewage is typically channelled into drains within the habitations, but is mostly let out into the open in tea fields close to the habitations. This system of disposal drains the sewage towards the valleys where the wells are located. The presence of ammonia above the prescribed limits in samples from seven out of the ten wells sampled indicates that the sewage is finding its way into the aquifer and from there to the wells.

A sample survey of people from Chinna Hubbathalai, Ambikapuram and Kakkan Nagar in 2016 indicated that 90% of respondents didn't think that their waste disposal in any way affected their water quality. This might explain the common practice of dumping waste near drainages where rain water run-off would easily carry it away downstream.

Since 2016-17, the MGNREGA has been leveraged to support waste collection efforts in the villages. In the 32 areas of the Panchayat, there are 27 workers and several supervisors. The job requires that Thoymai Kaavalars collect and segregate the waste from at least 10 houses each day. One Thoymai Kaavalar covers one

habitation, but in dense areas, there is usually some type of work sharing to avoid overloading any single Thoymai Kaavalar. For example, in 4 close-by habitations, there are over 1000 households, 3 collectors and 1 supervisor. In another area, there are 3 habitations, 3 collectors, and 1 supervisor. Usually, the workers serve their own area, though sometimes they might go to the neighboring habitation to work. Both the collectors and the supervisors are always women¹. This arrangement has many issues. The workers work throughout the year, but using other people's job cards, since they can only use their own card for 100 days a year. Sometimes they have to pay a commission to the card owner to retrieve their wages. These informal arrangements seem to have the tacit approval of the administration as it seems to have been systematized. While it is important to take care of the waste, the rights of the workers should not be neglected either.

Initially, there were pits dug in the outskirts of every village, where the segregated waste was separately dumped. The biodegradable waste was to be composted on site and the plastics and other waste to be transported to a recycling unit. However in most cases only the waste that has resale value gets collected by the authorities. The rest is burnt in the pits defeating the purpose of the programme itself. Recently the scheme has been changed and only non-biodegradable waste is collected from the households. Households are expected to dump the compostable waste in the common compost pit themselves or compost it at the household level.

Sanitation

Most of the area has toilet coverage, although in the newer Tamil settlements there are often multiple reasons for lack of toilets at the household level. The government houses when built earlier did not have any provision for a toilet. Thus there is no space near the house in some cases for building a toilet under the Swachh Bharat Scheme. In some instances there is no revetment below the house without which construction of a toilet is not feasible. There are two community toilets in MGR Nagar and Narikulipallam respectively. Both of them were in disuse. However, the one in MGR Nagar, meant only for women, has been revived by the Panchayat when Keystone helped the community build a spring box and set up a pipeline and storage system for that water. There is prevalence of Open Defecation in the region, with the tea fields around the habitation being the main sites for OD. This has resulted in both the well water and spring water showing presence of faecal coliform from time to time. People do not necessarily boil the water for drinking due to various reasons. Chlorination is done only once in two weeks in the Ground Level Reservoir (GLR) and its effectiveness is questionable. People report incidences of water borne diseases especially during monsoon. Thus there is a need to raise awareness regarding Water, Sanitation and

¹ NFLC Water and Waste Research Study Report 2017.

Hygiene.

Where toilets are being built and used, the design is faulty. Soak pits are preferred to septic tanks that can contain the waste as families do not want the hassle of emptying the pits once in a few years. There is also the added difficulty due to the terrain and slope and availability of roads inside the habitations unlike plains areas. Therefore the bottom of the pit is unlined and waste water is able to seep through to the groundwater. Depending on the distance and nature of soil, the sanitation waste may thus not have enough time in the soil to be purified. Thus this is another possible source of contamination.

Observations of a few families using the Baby WASH protocol in 2017 showed that the typical family is not diligent about hand washing and babies are exposed to faecal matter through a number of sources in and around the house. Thus focusing only on toilet usage is not enough, but a holistic intervention that changes WASH related behavior is needed. In this the cultural differences among different communities also needs to be factored in.

Conclusion

Considering a small area such as the Ambikapuram valley, one is able to observe the dynamics related to land-water-waste in detail. The nature of changes occurring in the landscape and the increasing demand for water are putting immense pressure on the limited resources. Solid and liquid waste and sanitation are important drivers in determining water quality. Traditional beliefs such as 'Spring water is pure' are belied by the results of coliform tests as the springsheds are used for OD or are increasingly being converted to habitations. It is therefore necessary not only to monitor and conserve water sources but also to work on the conservation of catchment/springshed areas.

References

- ACWADAM, Hydrogeological Survey of Catchments in Coonoor Basin, 2016
- NFLC Water and Waste Research Report 2015
- NFLC Water and Waste Research Report 2016
- NFLC Water Research Report 2017
- NFLC Waste Research Report 2017

Annexure 1: Water Quality issues found in drinking water wells in Ambikapuram valley, Hubbathalai Panchayat, Coonoor taluk, The Nilgiris

Samples were taken on – 2nd June 2015 and 3rd August 2016 and analysed in TWAD Laboratory, Ooty

Summary of findings and preliminary inferences

Chinna Hubbathalai

- Ammonia and phosphate levels have increased between 2015 and 2016. Indicative of runoff from sewage and farms with chemical fertilisers.
- Faecal coliform is present over time. Open Defecation/grazing pressure and/or improper septage management.

Ambikapuram

- Phosphate levels have increased in 2016 as compared to 2015. Indicative of runoff from farms with chemical fertilisers.
- Coliform was present in 2015 but absent in 2016. Since 2016 had very little rainfall, this could be due to the lack of runoff carrying the faecal matter.

Kakkan Nagar

- Ammonia level is very high compared to the permissible limit in both the years. Phosphate level is also high, increasing three fold in 2016 compared to 2015. Indicative of runoff from sewage and farms with chemical fertilisers.
- Faecal coliform was absent in 2015 but is present in 2016.

Indira Nagar

- Iron level was above the limit in 2015 but reduced considerably in 2016.
- Ammonia level was seven times the permissible limit in 2015, but reduced to 10% of that in 2016.
- Phosphate level was above limit in both the years. Indicative of runoff from farms with chemical fertilisers.

Ambikapuram

- Phosphates were well above the limit in 2015 and have increased further in 2016. Indicative of runoff from farms with chemical fertilisers.

Pazhathottam and MGR Nagar

- Phosphates were just within the limit in 2015, but have increased well above the limit in 2016. Indicative of runoff from farms with chemical fertilisers.

MGR Nagar

- Phosphates were above the limit in 2015 and increased further in 2016. Indicative of runoff from farms with chemical fertilisers.

Hubbathalai School

- Ammonia levels were more than twice the limit in 2015 and further doubled in 2016. Indicative of sewage mixing with the water source.
- Phosphates were also above the limit in 21015 and more than tripled in 2016. Indicative of runoff from farms with chemical fertilisers.
- Faecal coliform was present in 2015 and increased in concentration in 2016. Open Defecation/grazing pressure and/or improper septage management.

Jevana Gowder line

- Ammonia was well above the limit in 2015 and reduced in 2016 to be within the permissible limit.
- Phosphate also reduced in 2016 compared to the previous year, although still above the permissible limit.
- Faecal coliform which was present in 2015 disappeared in 2016.

Narikulipallam

- Ammonia level has increased drastically from very low to nearly three times the limit. Indicative of sewage mixing with the water source.
- Phosphates which were above the limit in 2015 further increased in 2016. Indicative of runoff from farms with chemical fertilisers.
- Faecal coliform which was present in 2015 disappeared in 2016.