Introduction

The Nilgiris district is fully contained in the first biosphere reserve, the Nilgiri Biosphere Reserve (NBR) and is an area of significant biological and cultural diversity. It is home to six Particularly Vulnerable Tribal Groups (PVTG) and is also an important tourist destination in the state. It is a part of the Western Ghats, which is a global biodiversity hotspot. The Nilgiris is home to important tourist destinations of Ooty and Coonoor.

Shola and Grasslands – Springs and Wetlands

Sholas are local name for stunted tropical montane forests found in valleys amid rolling grasslands in the Nilgiris. These patches of shola forest are usually separated from one another by undulating montane grasslands. The indigenous communities confidently say wherever there is a shola there is a spring water source. And its true that each patch of Shola were giving birth to springs. The communities have traditionally worshipped the trees and protected them for their important role of providing water. The root systems of a few shola tree species are believed to attract water from the local underground springs and discharge it through the surface springs.

And the grasslands connected to wetlands were called the sponge beds which had stored water during the monsoon and released slowly throughout the year. These wetlands were once spread across large areas and were interconnected. Later due to the changes in the landscape, a lot of these sholas and wetlands were fragmented and the size of these gradually reduced. This has inturn affected the wildlife movement, and now there are regular Human wildlife interactions, traffics mostly around water and other natural resources.

The higher ground water tables and abundant flow of water throughout the year were found when these natural ecosystems prevailed in the Nilgiris. These sholas and grasslands were highly bio-diverse and endemic to many of the plant and animal species. Even today, environmentalists and conservationists are fighting for the removal of exotic trees like Eucalyptus and Acacia and restore the land with natural shola and grasslands to fix the water crisis thats slowly spreading across the Nilgiris. The once water surplus district is now reeling under water crisis due to the loss of these natural vegetation.

Happy Valley Case Study – Community involvement and Convergence

As part of the Wetlands study done in 2006, around 40 wetlands in and around the Nilgiris were surveyed. The wetlands that were important sources of drinking water for the communities were under huge threat. The small hill wetlands mostly fell under the waste land category in the government records. These wetlands were used by communities to dump their wastes or direct their sewage into them. Wetlands otherwise called Natural Water Treatment Plants have the characteristic of cleaning the wastes and giving back fresh water. But due to the changes in the load and type of wastes, we no longer know if the wetlands can process and sustain its character.

Under the wetlands study, one important wetland was identified for conservation and restoration. The Spring and wetland was an important water source for a part of the Kotagiri town. A patch of 1 acre land that belonged to the panchayat was just above the spring and wetland. This area was used by the local communities as a place for attending their nature

calls and dumping their solid wastes. The spring water source continued by wetland was highly contaminated with faecal matter and other solid wastes.

After continuous discussion with Panchayat and communities, Keystone decided to restore the patch of panchayats land with native shola forests. The community that used the area for open defecation (OD) were encouraged to build toilets, where Keystone helped in buying materials and man power provided by the community themselves. The area which was covered with bushes and weeds where people attended their nature calls was cleaned and fenced by the panchayat. Keystone raised a nursery and did a restoration activity in the area in 2006 with the participation of community, panchayat and a local school. This area was monitored continuously and the saplings have grown into a small patch of forests by 2016. The spring which used to go dry by the summer season earlier, has now become perennial. Even though the wetland and the valley has seen increase in the number of wells in the past few years, the small patch of shola forest has ensured, sustained and balanced the water level in the wells. The community has been positive about the changes in their practices and are grateful for the water availability in their springs and wells even during the lean seasons.

Linkages of Springs and Urban water supply

Keystone work on water has been focussed mostly on the Coonoor region due to the importance of the Coonoor river to the urban community and the water crisis that has hit the municipality due to rapid development and non availability of sustainable water resources.

As a first step, a baseline survey to understand the various water sources and their quality, and the dependence towards these sources was done. We mapped all the sources of water to the Coonoor town keeping the Coonoor river as a source point. A Coonoor river walk was organised to map the different sources of water that drained into forming the river.

A model was developed at the end of the study to understand the importance of conserving and managing the scarce resource.. The two major industries in the district, namely "The Cordite factory and Pony Needle Industry" were found falling under the watershed. The water from these industries were barely treated and the waste water effluents were directed towards agricultural lands of communities down streams which polluted their water in the agri fields. Similarly in the valleys where people practiced intense vegetable cultivation, the nitrate levels in the water were found higher than the permissible limits. And most of the communities sewage water and drains were directly let to flow into the streams and water bodies nearby which carried the waste water downstream.

When the trail continued, it was interesting to see the upstream and downstream connection. The land use and other practices in the upstream had directly polluted the drinking water source of downstream people. To develop a visual model, the catchment demarcated was used as a base layer to trace out the land uses like forests, plantations and estates, grasslands, wetlands, built up area etc.

Interestingly this helped us in finding the important sources of water for the Coonoor river. Springs and wetland in the upper catchments were the main sources of water to the

streams which converges and forms the Coonoor river. But unfortunately each of these small streams were highly polluted with wastes from households, industries and agricultural farm lands. The importance of working in the upstream catchments for water conservation was emphasized and springs and wetlands conservation were given more focus.

Hydrogeology - mapping of watersheds

Keystones work on water had mostly looked at the connection between forests, land uses and water. Hydrogeology was looked into when we felt the importance to understand the water as a whole system, than just looking at it from the surface level.

With the help of ACWADAM we were able to do a rapid hydrogeology study in 3 important catchments in Coonoor. The major water sources which supplied water to Coonoor town were focussed. As a first step the catchments of these sources were delineated. Field observations on the type of soil, rocks and their properties were recorded across these catchments. The seasonal and perennial springs and the quality of water in different parts of the watersheds were recorded. This exercise helped us identify the important recharge zones in the catchment areas which needs to be protected.

Geo – hydrological maps were produced to understand the aquifer type and characteristics. As part of this study, one catchment where the network of springs were tapped and in the following valley there were a number of wells which supplied drinking water to communities around them was monitored regularly. The water levels in the wells and their quality were monitored on a monthly basis. Apart from this, the water samples were collected twice a year ie pre monsoon and post monsoon and taken to TWAD laboratory in Ooty for testing. The samples showed us the higher levels of ammonia in water, which directly related to the closer proximity of the toilets to these wells. The faecal coliform in all tested samples came out positive. The colour of water in the wetlands turning red, yellow or having oily films on the top layer was related to the geogenic contamination where the Iron was dissolved in the water. Even though it wasn't a major contaminant, the community was resistant to using the water from the iron affected wells.

The study helped by throwing light into all the dark areas which we were finding difficult to understand for a long period of time. The cross section mapping helped us in explaining how their unsafe containments and soak pits leached out faecal water to enter into the ground water table. This also helped us in generating awareness within communities, where earlier they related to faecal contamination through open defecation affecting their water source only during rains and run off. The geology in Nilgiris was a complicated set up, where the springs had local and small aquifers and were connected to the regional wetlands aquifers when seen in a large watershed area. This set up was common among Nilgiris were springs, wetlands could be understood and groundwater can be effectively managed by a small effort on mapping the Geology.

Diverse land uses around the NBR

Keystone foundation has been working with communities around the Nilgiri biosphere reserve covering the pockets of tribal villages for more than two decades in states of Tamil Nadu, Karnataka and Kerala.

The topography of the working areas change drastically from one region to the other. The land use practices are another major factors which change across the region. The entire Nilgiris district falling under the Biosphere Reserve has gone into major land use changes over the past decades and centuries. The original vegetation of the Nilgiris was with the mix of Shola forest and Grass land ecosystem. Later Eucalyptus and Other exotic and invasive species were introduced into the landscape during the British period. Conversion of large parcels of forest and grass lands into tea plantations followed. These have altered the land uses and have highly affected the water balance in the region.

The elevations ranging from 1000 and above had the shola and grassland ecosystem and the below 1000 had dense forests of various flowering and fruiting trees.

Forest department is a major stakeholder in the region. Most of the forest lands are now owned and managed by the Forest Department. The springs in the higher elevations originate in a Shola and flow down to feed the wetlands in the valley. These small patches of Sholas are hard to see now.

	Lower than 1000m	**1000-1800m**	**Higher than 1800m**
Natural forests	Dry deciduous and scrub	Moist and dry deciduous	Shola, grasslands
Commercial forests			Cinchona, eucalyptus, pine, wattle plantations
Indigenous communities	Betta Kurumbas, Irulas, Kattunaikans, Paniyas, Kasava, Mullu Kurumbas	Alu Kurumbas, Irulas, Betta Kurumbas	Todas, Kotas
Other communities	Malayali, Tamil, Sri Lankan Tamil repatriates	Badaga, Tamils, Sri Lankan Tamil repatriates	Badaga, Tamils, Malayalis, Kannadigas, Sri Lankan Tamil repatriates

	Lower than 1000m	1000-1800m	Higher than 1800m
Water Resources	Mostly polluted water enters the Reserve Forests zone, passing through scattered tribal hamlets and large wildlife reserves. All *hallas* (streams) merge into the four basins through the few major rivers. The water carries massive top soil and wastes. In the monsoon, water sources are visible, but during the summer most of them are dry. The plantation sector suffers, and the reservoirs are half empty.	Streams become rivers and pass through urban and rural settlements. It is mostly a plantation and agriculture sector. The sources of pollution in this zone are domestic waste as well as industrial and chemical waste. There are large concentrations of populations, including immigrants, natives, tribals, service sector professionals, and the business community, all of whom use waters in diverse ways.	Water is trapped in the grasslands and sholas, releasing itself gradually through marshes and swamps. There is a network of hydroelectric projects for electrical power generation. The landscape has large reservoirs. The source of pollution in this zone is agro chemicals.
Cultivated crops	Coffee, pepper, jackfruit, silk cotton, tea, ginger, paddy (Gudalur), millets	Tea, coffee, pepper, jackfruit, silk Cotton	Tea and vegetables
Trade and business	Homestead produce, wage labour, tea (Gudalur), farm income	Timber, tea, small business, wage labour, homestead produce	Timber, tea, tourism, township

The NBR has diverse land use settings where the upper areas of the Nilgiris have a forests owned and managed by forest department, tea estates and plantations owned by private parties and individuals and village communities. The lower areas of Nilgiris are mostly mix of coffee estates owned by private estate owners and forests and agriculture lands of Indigenous communities. The Northern part of the District is drained by the Moyar river and the forests around the area falls under the Mudhumalai tiger reserve and on the North eastern part of the NBR comes the Sathyamangalam Tiger Reserve.

Conclusion

The Keystone foundations work in the NBR has been towards enabling communities in managing their natural resources in the most sustainable way possible. As exemplified by the Happy Valley Restoration, the community's consent and participation is crucial for sustained conservation action. The staff and volunteers are basically the community members who have been trained in collecting data and conducting meetings in the villages to talk about

various issues related to water resources and their quality. They will in turn be sharing and passing on the knowledge at the village level meetings and discussions. The communities are engaged in surveys and discussions to understand the situation in each of the localities. These continuous discussions with communities helps the communities in planning and managing their water resource. This has helped us in planning, converging and implementing with the Communities and other stakeholders effectively. The effort now is to look at conserving springs, wetlands, streams and rivers as part of a complex system rather than individual resources. The springs and wetlands are mostly part of the same aquifer and, looking ahead, regional level aquifer management groups are to be formed to manage these effectively.