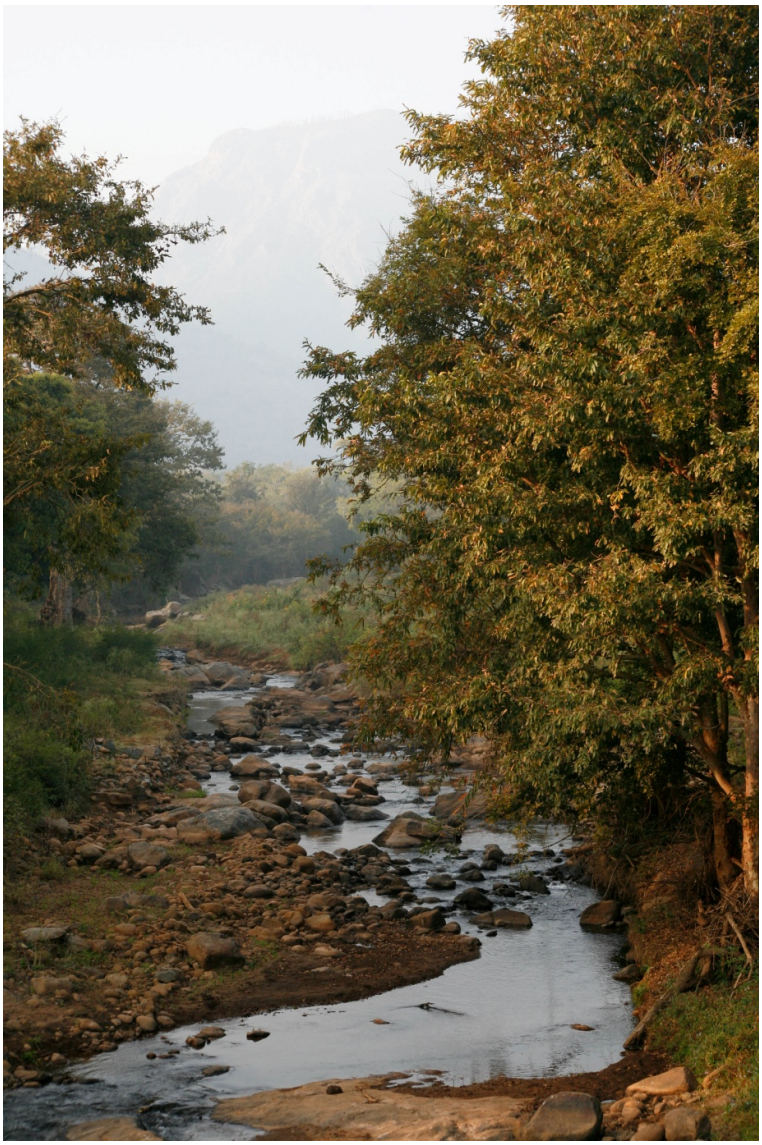
Water Resources and Communities in the Nilgiris – A Situation Analysis

Keystone Foundation, Kotagiri, 2015



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Water Resources of the Nilgiris – A Situation Analysis

This note draws on the experience of Keystone Foundation in the Nilgiris over the last two decades and also other sources of information to describe the current situation with respect to water resources and to derive directions for further work in the coming years.

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.

The Nilgiris district is approximately 130 km wide by 185 km with a geographical area of is 2465 sq. km[1]. It has undulating topography with steep slopes that are often cultivated. The elevation varies from 900m to 2636 m AMSL. The temperature varies from a minimum of 2^0 C to 25^0 C.

Nearly 60% of the district population was urban in 2001. According to the State HDR in 2003, the district ranked sixth in the State in HDI (0.685) and on both HDI and GDI (0.686) it was above the state and national averages. Out of 14 districts with higher per capita GDP rank than HDI rank, the Nilgiris is ranked sixth, implying effective conversion of income to development[2]. The GINI coefficient was 24.22 which was better than the state's performance of 28.2. The birth rate was 14.11, death rate was 5.2, Infant Mortality Rate 16.03 and literacy rate according to the 2001 census was 80%, which were all better than the state and national levels.

Prior to the British presence in the Nilgiris, the population was largely composed of tribal communities such as Todas, Kotas, Kurumbas, Irulas and others. With the opening up of the region with the arrival of the British, there was migration of other non-tribal communities from the plains. The Badagas are a local community, pre-dating the British arrival, who are progressive farmers involved in tea and vegetable cultivation as well as in jobs in service sector. Among the local communities, only the Badagas adapted to the changing circumstances and flourished.

Tribal people today form a small minority in this region. Migration of the youth to the plains areas is common for employment and studies. Overall the Nilgiris district has had a negative population growth since 2001 probably owing to this trend. The area has also seen growth of settlements of repatriated Tamil people from Sri Lanka over the last few decades. Some estimates put the number of repatriates and their descendants at close to 25% of the district

1 https://en.wikipedia.org/wiki/The_Nilgiris_District

2 HDR for the Nilgiris, 2011 – http://www.spc.tn.gov.in/reports/The%20Nilgiris.pdf.

population. The phenomenon of people from the plains owning land and houses in the district as second homes is increasing over the last few decades. This is yet another reason contributing to the marginalisation of the tribal communities in the district. The table below lists some of the demographic features of the district as per the Census of India 2011.

	Nilgiris	**Nilgiris Urban**	**Nilgiris Rural**
Population	735,394	435,655	299,739
Urbanization Rate	59.2%	-	-
Average Household Size	3.7	3.8	3.6
Sex Ratio	1042	1034	1054
Child Sex Ratio	985	982	990
Scheduled Castes (% of population)	32.1%	34.2%	28.9%
Scheduled Tribes (% of population)	4.5%	2.3%	7.6%
Literacy Rate	85.2%	88.0%	81.2%
Male Literacy	91.7%	93.4%	89.3%
Female Literacy	79.0%	82.8%	73.5%
Total workers (% of population)	52.3%	48.0%	58.6%

Source: Census 2011

Communities, Land and Water[3]

This district is home to various indigenous people including the Kurumbas – Alu, Jenu, Mullu and Betta, Kasava, Irula, Toda, Kota, Kattunaika, Paniya, Badaga, Thoraiyya Badaga and the Mountadden Chettis. Each of these communities has favoured different elevation for their habitations. The land use at these elevations has evolved to suit the livelihood requirements of these communities. Water use then, follows these land claims. The table below summarizes the natural environment, social demography and water flows.

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Keystone Foundation. Report of the Hill Waters and Livelihoods Project. http://www.indiawaterportal.org/sites/indiawaterportal.org/files/nilgiri_water_resources_project_-_final_report_0.pdf

	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 Indigenous communities have a special relationship with water sources such as springs and wetlands.

The Badagas settlements, known as hattys, mainly on hill tops, depended entirely on upper spring sources close to Shola forests and grasslands. This water is considered to be pure and the water sources are protected and worshiped once a year in a ritual called the *Halla Paruva* (Water Worship. This ritual is done prior to the North Eastern monsoon to receive abundant rainfall during the season.

In most Badaga villages, one finds that an underground source or *Huttu* (emerging) *neeru* (water) has been protected for drinking water. This is a sacred place - out of bounds for outsiders, thereby reducing the risk for external contamination. With changes in and non-availability of sufficient water from upper spring sources, Badagas have also had to depend on lower valley sources for their drinking water.

In the past, families used to maintain water channels from the source to the settlement by removing blockages and desilting. This community effort led to everyone taking responsibility for the water system. Today, this practice has been discontinued with the Government bringing in piped water and the water channels having become State-owned property. The management is different, with few salaried people doing all the work. The government water supply is often insufficient in summer; and the old *Baavi* is used then.

The buffalo is a leitmotif (guiding motif) in the secular and sacred lives of the Todas, a once pastoral community. Changes in the landscape have led to shrinking habitats for the buffalo for water and grass. According to one Toda elder, "The Nanjanad area was a zone of large swamps - almost 20-30 kms wide and so long that the crossing would take time. These areas had good clean water sources from springs and grass that our buffaloes fed on. Government policy introduced pine, wattle and blue gum and dried up the swamps. With dryness - the land developed cracks - and our buffaloes were unable to walk on these pasture lands with the risk of slipping inside the swamp mud".

The Alu Kurumba are a forest dwelling tribal group who have moved as tea estate labourers towards road fringes over the last two decades. Many of them still frequent their homes within thick forests, where they cultivate annual crops such as coffee and jackfruit. The Alu Kurumba in Pudur Kombei village recall how their drinking water used to come in bamboo poles, used as pipes to bring in water from uphill mountain springs. Today, they find it more convenient to use PVC-pipes and plastic buckets for water supply. A similar practice by the Betta Kurumba from Vaacikolli village of Devarshola town panchayat is the use of banana leaves for collecting rain water from the rooftops. Their regular water supply is from a water hole nearby.

Wild willow or *Baige* tree - is a good indicator of water according to the Alukurumbas. They believe that their roots attract water and form springs in the vicinity. In Bellathi kombei village beyond Manjoor, the Alu Kurumbas dig holes for water near these trees.

In the village of Kurumba Medu near Yellamalai, the Bettakurumbas still practice the tradition of drawing water from a spring or a swamp. They do not fetch water from the wells as they consider it "dead" water. Though there is a well close to the village, nobody uses it. They go far down the valley for fetching water in vessels from the springs.

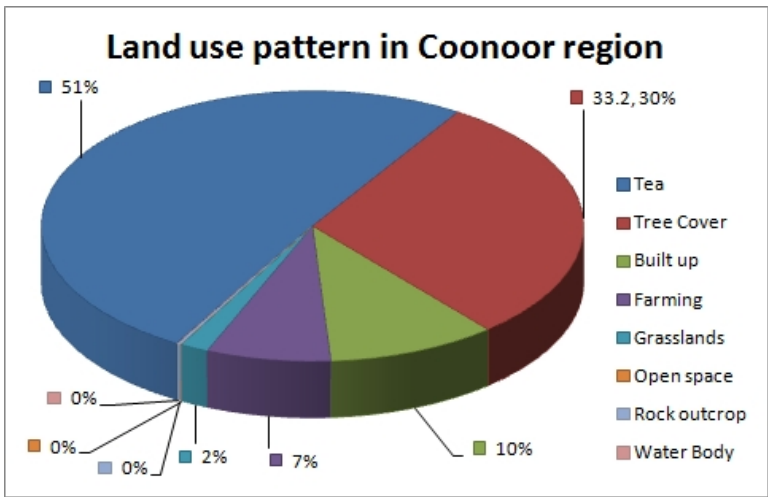
In most parts of the district, the source of springs is a sacred place out of bounds for women due to menstrual taboos. However, in a Paniya village in Melambalam, it is a *Moopathi* – a lady priestess who does the ritual pooja to raise the water table of the well.

This traditional connect with the water sources has been eroded over time with the government and Panchayats taking over the responsibility of providing water to the villages and towns. With growing settlements and increasing demand for water resources, there is a disconnect with the resource base that provides it. There is a growing market for bottled or tanker water supply to meet this demand, but mining of water resources coupled with uncertain rainfall and minimal efforts to harvest it are making it unsustainable.

In 1995, one of Keystone's earliest interventions was to set up a water supply system in Kilcoupe village from a nearby stream (See Image). This was later replicated by the forest department in many villages in the area.

Economy and Livelihoods

Tourism is the mainstay of the economy of the district, with a growth in the number of tourists visiting the district over the years. An estimated 2.5 Million tourists visit the district every year. The increasing population with disposable incomes within the country and proximity to cities such as Coimbatore, Mysore and Kochi is contributing to increased tourist activity in the region. The tourism sector is mostly run by private entities, with the government involved in managing tourist sites as well as in organising events to popularise tourism in the Nilgiris. Recently the forest department has also started promoting ecotourism along with tribal communities in many areas. The expansion of tourism has not been planned or well regulated[4] and consequently the development of infrastructure such as accommodation, has been done in an ad hoc manner. Home stays and hotels are found not only in the towns but also in villages and in wildlife corridors. Such rapid expansion has resulted in withdrawal of water resources, contamination of water resources and proliferation of solid waste in the region.



In terms of livelihoods, the major livelihood opportunities are farming and wage labour in tea

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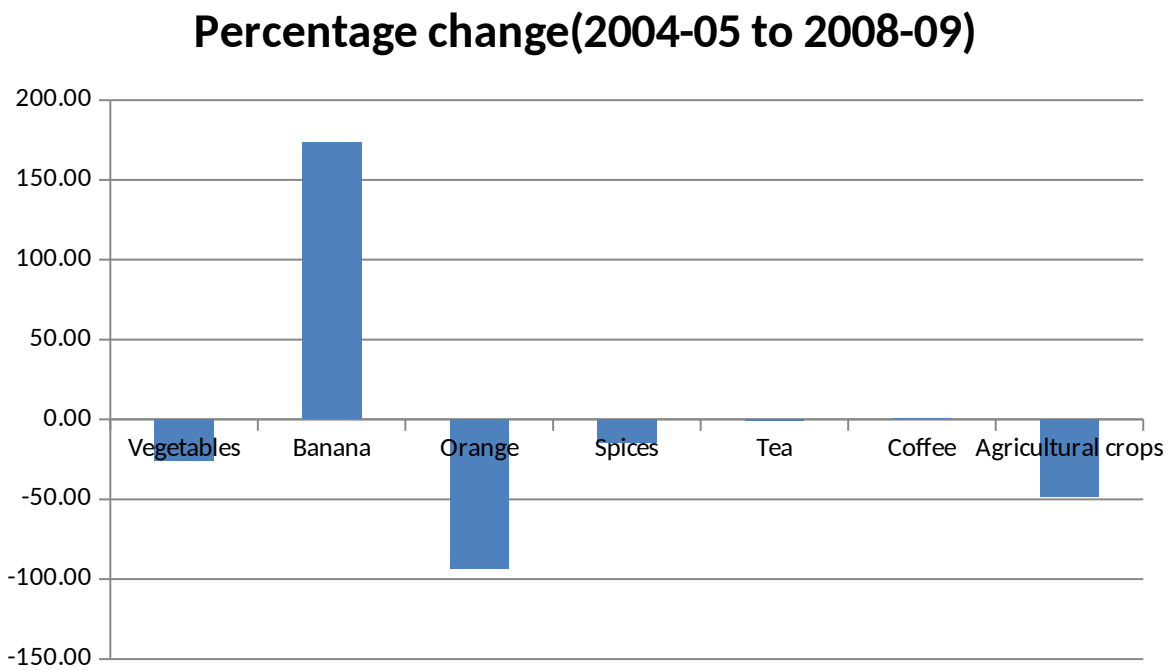
estates. Around 43,000 ha in the district is under Tea cultivation[5]. There are government owned and private tea estates in the Nilgiris that offer wage employment opportunities. Small tea growers have also increased in number due to the efforts of the United Planters Association of South India (UPASI) and the Tea Board including subsidies. These also present local employment opportunities for wage labour in and around the villages, especially for women. Over the last few years, with the increasing wage rates for labour, importing of labour from the Northern states has also started with large estates finding it more economical. There are also attempts being made to mechanize some of the activities involved in managing tea estates to reduce labour costs.

Animal Husbandry is also another occupation supported by the network of more than 100 dairy cooperative societies in the district. While the Todas were once Buffalo rearers, now this activity has reduced to ritual value and they are engaged in a variety of other livelihoods. The indigenous communities cultivated millets in large areas for their own subsistence. The availability of cheap/free rice through the Public Distribution System (PDS) has resulted in millets being gradually displaced from the daily diet of the indigenous communities. Over the decades with changes in dietary pattern, introduction of cash crops and increasing Human Wildlife Conflict, this practice has reduced to a great extent.

Given the high investment in solar powered fencing to ward off wild animals such as Elephants, Gaur, Boars etc., the tendency is to go for irrigated cash crops where feasible, rather than millets, which are more nutritious and organic. This has implications for nutritional security of indigenous communities as well as the water resources. Cultivation of 'English vegetables' is increasing in the Nilgiris with farming being done throughout the year to supply to the main market in Mettupalayam. The available data, though a bit dated, shows the changes in cropping pattern between 2004-05 and 2008-09 in the district.

5 http://www.upasitearesearch.org/coonoor



Source: District Statistical Handbook 2008-09

While on the one hand the cost of cultivation is going up owing to Human Wildlife Conflicts, the returns are also increasing due to the market oriented nature of crops being grown. One of the major impacts of such changes is in the deterioration of water resources, both in terms of availability and in terms of quality, due to the use of inorganic inputs.

Water laws and policy

Water is a state subject according to the Constitution of India. However at the time of framing the constitution, water was mainly thought of with respect to river waters and irrigation[6]. Groundwater with its own set of dynamics was not thought about then. *As per the provisions of the Easement Act 1882 and the Transfer of Property Act, 1882, the land owner is supposed to have a right to ground water beneath his land as it is considered as an easement of land. The Easement Act does not permit land owners ownership of ground water if it is passing through in a defined channel. As much of ground water is a dynamic resource which flows through defined channels, owners of land cannot claim absolute ownership over water under their land. The most important reason for ineffectiveness of legal measures lies in absence of any provisions for restricting the quantum of water extracted through existing ground water structures.*[7]

In terms of policy environment, Tamil Nadu is in a unique position. Although the Tamil Nadu Groundwater (Development and Management) Act, 2003 was enacted by the state

6 Ramaswamy Iyer, http://www.thehindu.com/opinion/lead/should-water-be-moved-to-concurrent-list/article2113384.ece.

7 Kamta Prasad Report (Institutional Framework for Regulating Use of Ground Water in India. A Report by Institute for Resource Management and Economic Development to MoWR, GoI).2008.

legislature, it was never notified. In 2011, the Madras High Court ordered the government not to allow groundwater extraction for commercial purposes till the act was notified. However the government chose to repeal the act in 2013 instead. Therefore at present there is no law regulating groundwater extraction in Tamil Nadu. The government has taken the above decision realising that many parts of the state do not have access to piped water supply and depend on groundwater extraction by local bodies and private tankers instead.

In the Nilgiris, which is classified as a safe zone based on the amount of water recharged annually as opposed to the amount of ground water being abstracted, there are issues of falling water levels and wells running dry on the back of monsoon failures. The streams and rivers, some of which are perennial, are used as sewage drains and are not used as a source of drinking water. Water quality tests reveal coliform presence across the Coonoor area. Basic chemical tests do not reveal any alarming situation although the levels of pesticides and fertiliser residues are not known as these require specific tests that are quite expensive. Scenario building exercise carried out by Keystone in 2012-13 for the Coonoor basin points to the possibility of high nitrate loads in the Coonoor river as a result of solid waste, run-off from vegetable farms and tea estates etc. The region has a high level of tourist inflow each year which exerts tremendous pressure on the water availability as well as in terms of waste disposal.

Under Nirmal Bharat Abhiyan, 60% of the 94,545 household level toilets to be built have been achieved in the Nilgiris district. All the 839 schools and all but one of the 271 anganwadis in the district have been covered as well. There is one Rural Sanitation Mart as well. Discussions with Gram Panchayat representatives and DRDA reveal that MGNREGA and other schemes are being leveraged to encourage adoption of toilets and open defecation is being practiced to some extent even now.

Water Resources and Water Supply[8]

Findings from a study in 2001-02

From the water perspective - the upper areas are the harnessing zones of water which emerge from shola and grasslands. The plateau is a network of springs. For most of the agricultural communities - though water sources have reduced - the chances of tapping a hill spring are not difficult. Most of the Government schemes work on tapping hill springs which are stored into large wells / tanks for upward pumping to the settlements and villages. From the initial survey in the plateau area from 20 villages, it is seen that the location dispersion is as follows:

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Keystone Foundation. Report of the Hill Waters and Livelihoods Project. http://www.indiawaterportal.org/sites/indiawaterportal.org/files/nilgiri_water_resources_project_-_final_report_0.pdf

Village Locations		Water Source Locations	
Valley	30%	Valley	44%
Hill Top	35%	Hill Top	4%
Slope	25%	Slope	22%
Saddle	10%	Shola	30%

It is interesting to note from the above analysis that the source of water is located maximum in the valley and it is also the location of the maximum number of villages. These are basically spring-based systems. 30% of the water sources were springs. Another finding is that the villages which have been traditionally located on hill tops (higher lineage settlements) do not have much water available any more in higher reaches. Thus, they are dependent on Government assistance through pumping systems. Most of the shola forests also occur in the fold of the mountains or the saddle zone.

The variance of water availability and water scarcity is stark in this hill district. A large population resides in water rich areas - where springs are tapped through Government schemes - for them the issue of acute water scarcity is still not an issue. The lower areas water resources are depleting at an alarming rate. Tribal villages among others such as Kolikarai, Kunjapanne, Kil Koup, Mel Koup, Thalamukh, Semmanarai, Vagapanai, Bangalapadigai, Vellerikombei (Irula & Kurumba) face an unprecedented situation. Large streams which flow through close to their settlement dry out during the summer. What happens in a small scale in the upper areas - to springs and streams - the same effect is multiplied several times leading to a complete destruction of water bodies in the lower elevations. In the survey it has been seen that large tea estates such as Burnside for the first time this year have had to bring in tankers of water to keep the labour on site.

Findings from a survey in five Panchayats in Coonoor in 2015

During the baseline survey, nearly half of the habitations stated that they were dependent on springs for their water supply (Table

overleaf). However after cross checking the sources we found that springs and wetlands were often used synonymously. We have separated these out and it turns out that one fourth of the habitations are dependent only on springs for their water supply. Another 18% have springs as one of the sources, while 41% have wells as their only water source (See Image). In all, 87% of habitations in the five village panchayats depend only on groundwater for their water supply.

Thus along with springs, the importance of wetlands is also highlighted through the baseline survey. In order to support the Panchayats and communities manage groundwater sustainably it is important to understand the wetlands and springs together. Particularly the Panchayats of Hubbathalai, Berhatty and Yedappalli are totally dependent on groundwater for meeting their water needs.

S No.	Panchayat	Total No. of habitations surveyed	Habitations dependent on springs only	Habitations dependent on springs and open wells	Habitations dependent only on open wells	Habitations dependent on springs, streams and wells	Habitations dependent on springs and streams	Habitations dependent on streams and wells	Habitations dependent on streams only	% Habitations dependent on groundwater
1	Hubbathalai*	31	7	5	18	0	0	1	0	**100**
2	Berhatty	13	2	2	9	0	0	0	0	**100**
3	Bandisholai	5	1	0	0	1	1	0	2	**60**
4	Burliyar	25	9	2	2	0	2	0	10	**60**
5	Yedappalli	17	5	4	8	0	0	0	0	**100**
	Total	**91**	**24**	**13**	**37**	**1**	**3**	**1**	**12**	**87**
	%	**100**	**26**	**14**	**41**	**1**	**3**	**1**	**13**	

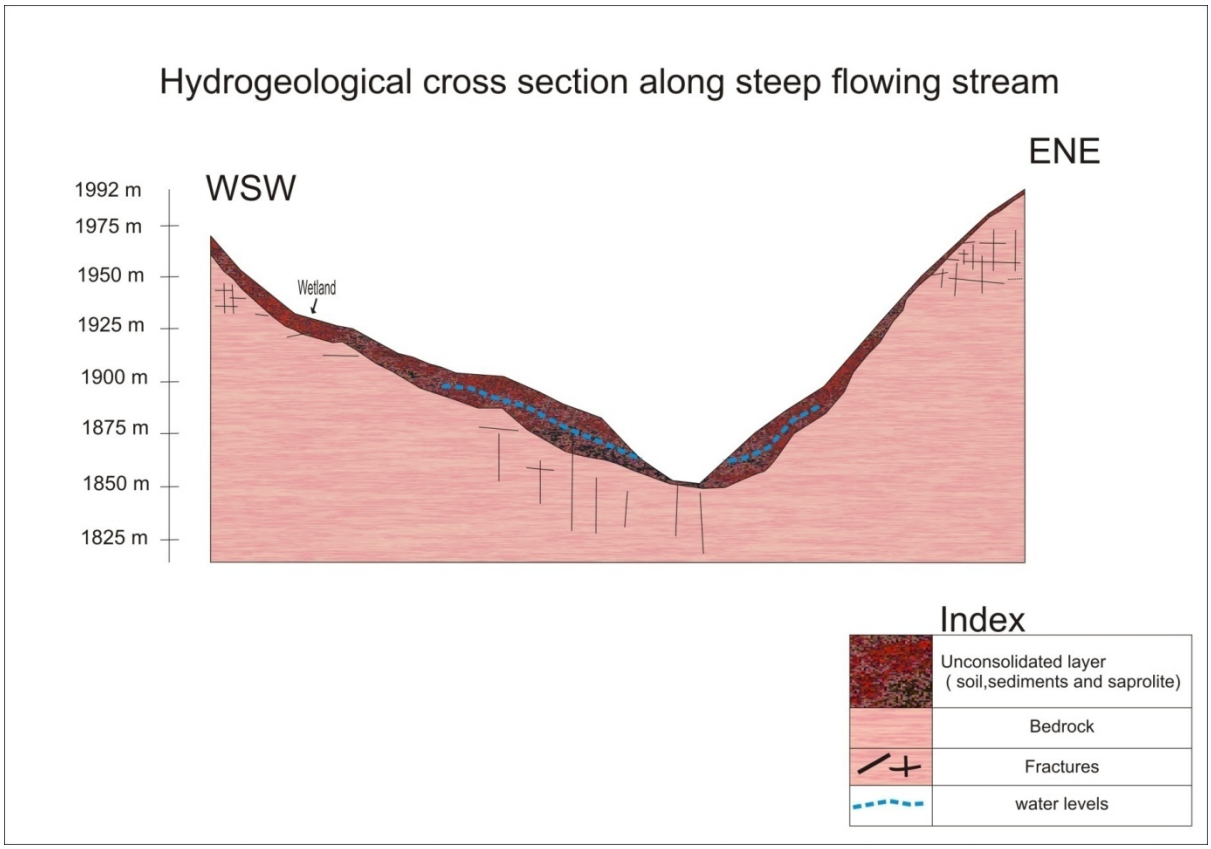
From the above data, it is evident that Hubbathalai, Berhatty and Yedappalli are dependent wholly on groundwater, whereas Bandisholai and Burliyar being further downstream are dependent on surface water from streams as well. In most of the tribal pockets where Keystone has been working, there is often dependence on both groundwater and surface water.

Springs, Wetlands and Wells - Understanding the hydrogeology

During the last two years we have been partnering with ACWADAM in understanding the hydrogeology of the Nilgiris and in particular identifying springsheds. The main rock type in the region is Charnokite. The area is characterised by high weathering but low erosion over millennia, which has resulted in weathered material going down to many meters in depth in most places.

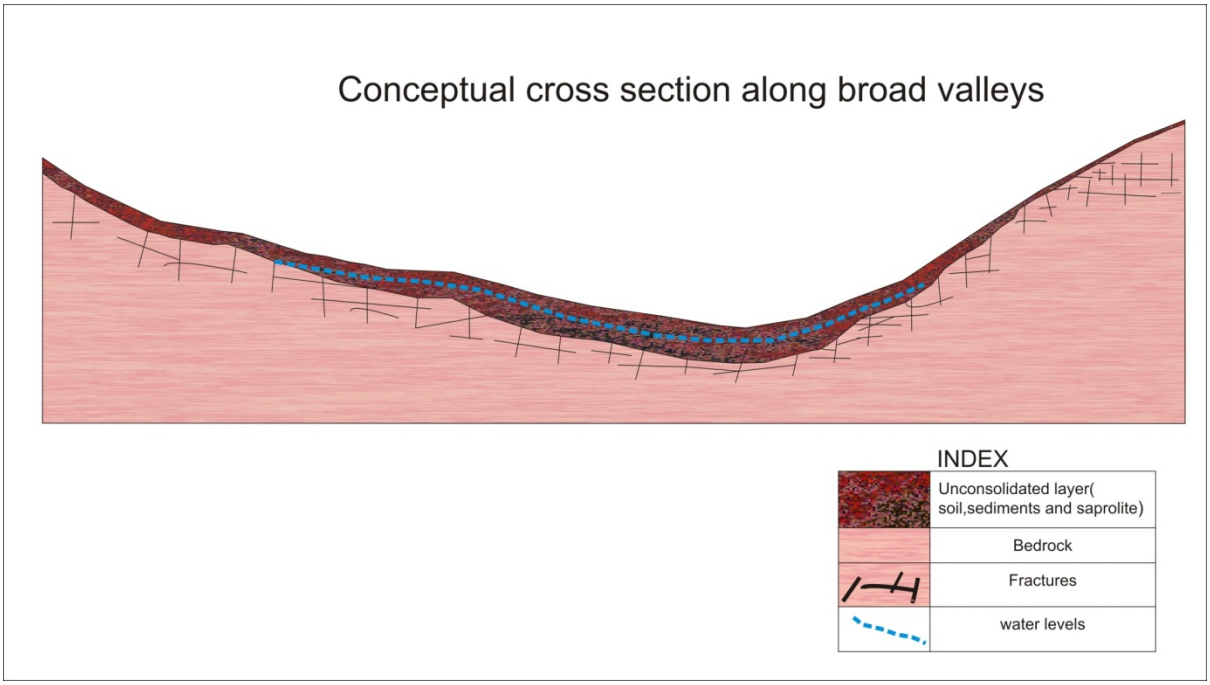
Mostly we find unconfined aquifers in the region. From the work done so far, there are a few typologies of unconfined aquifers that have emerged, which are likely to be repeated across the Nilgiris. The hydrogeological profile are given below,

Type 1



In this case, the unconfined aquifer extends till the valley part, where it is deeply eroded by high velocity stream. This stream is result of high slope gradient in the catchment. Where ever the slope gradient is high, streams erode aquifer vertically near it causing seepages and springs to occur near the valley along the stream.

Type 2



In this case, the slope gradient is low, and the sedimentation and weathering is more. This increases the thickness of aquifer and thus the storage capacity (which is useful for wells). The springs, seepages and wetlands (these mostly occur along the valley with gentle slope) form the natural discharge points along the catchment. The groundwater is brought to the surface at these points and then flow as streams in form of surface water. In valleys with gentle slope and greater aquifer thickness, groundwater appears in form of wetlands and water table in wells[9].

ACWADAM, based on their experience of assessing the hydrogeology across the country, opine that the Nilgiris is a unique case where springs occur alongside wetlands where extensive pumping of groundwater is practiced. The aquifers are highly localised with many of the springs in the upper areas being perched aquifers. To understand whether within a village whether pumping groundwater from wells in wetlands is affecting the spring flows, a localised hydrogeological assessment needs to be done.

Springs occurring in the Nilgiris are largely perennial and often occur as seepages along contacts or as a system of multiple springs emanating from the same aquifer. It is thus difficult to measure their discharge without manual intervention in terms of channelizing the flows through a chamber and/or a pipe. Contact springs, fracture springs and depression springs are commonly found in the Nilgiris. Depression springs may either flow out as springs or may form a small wetland/swamp depending on the topography. Based on the field surveys hydrogeological sections of typical springs are given below.

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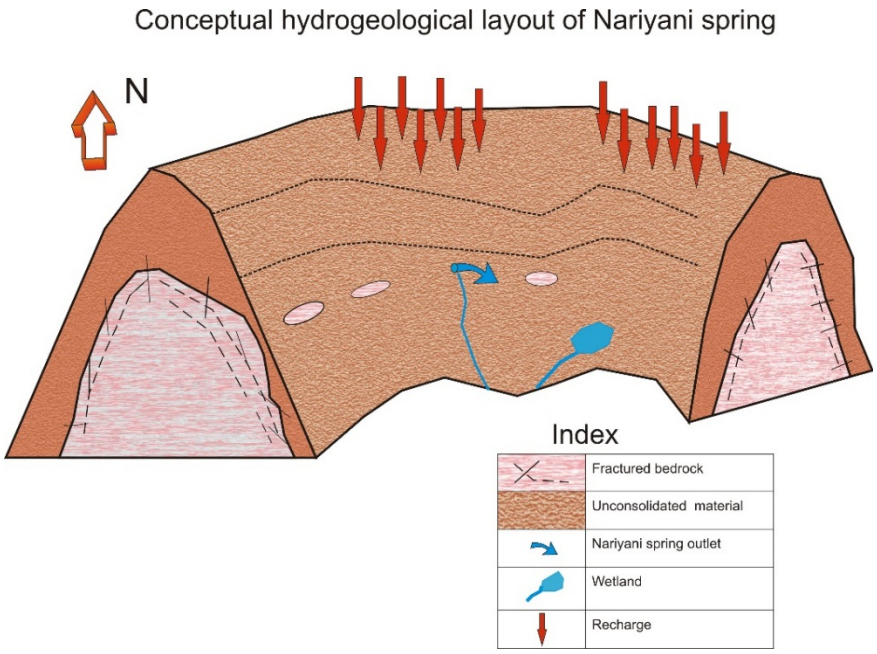
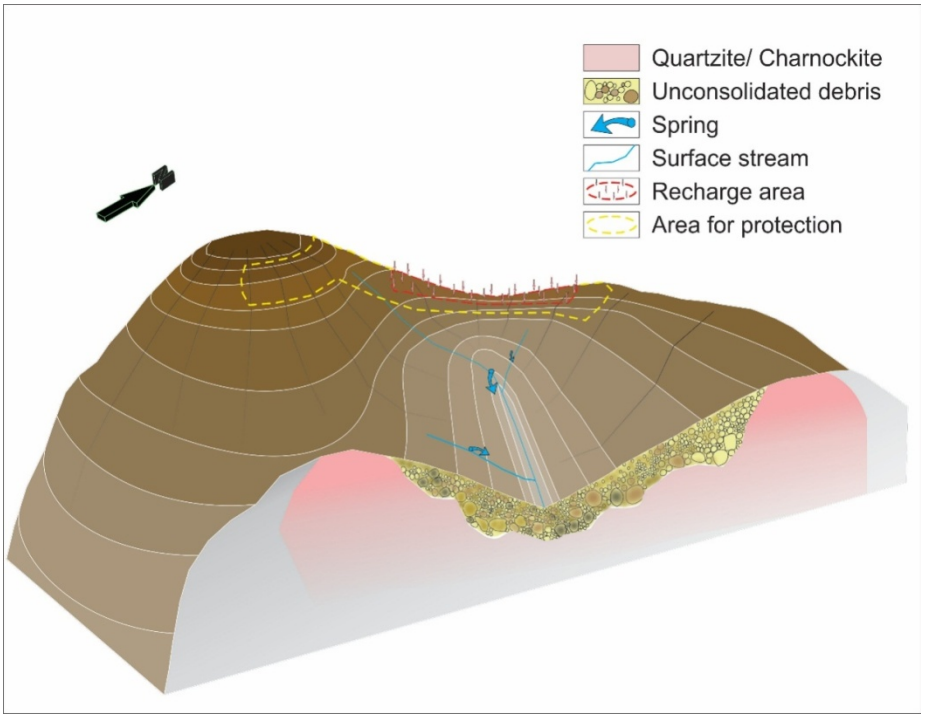
ACWADAM. Hydrogeological survey of catchments in Conoor basin. http://keystone-foundation.org/download/460/

Type 1 – Nariyani Spring system



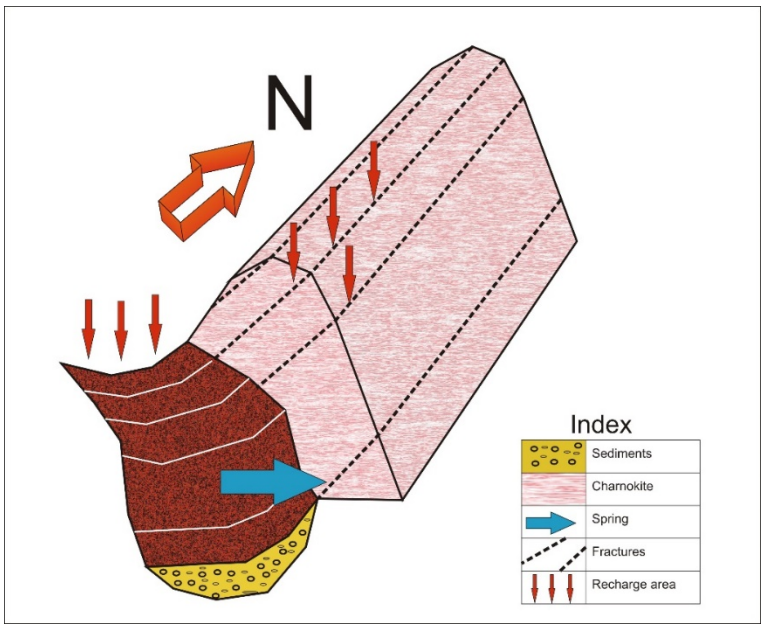
This location is actually a cluster of 2 springs on west flank of the valley and wetland on east flank. The 2 springs are originating near a tea garden and can be classified as contact spring. The contact seems to be of hard rock below and sediments, weathered material above hard rock. Big rock exposures are seen near the spring area. Both the springs have a discharge of ¬ 90 lpm (liters per minute). The aquifer tapped by the springs in this area is the unconfined one.

Type 2 – Hubbathalai Spring



The entire spring shed of the Hubbathalai spring system comprises of soil, unconsolidated debris and weathered and hard-compact quartzite/Carnockite. 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.

Type 3 – Bharathinagar Spring



This spring is found near Wellington town on western flank of the catchment. The spring area has two outlets from where the water comes to the surface. The area in the valley above the spring is a dumping ground for local people and has thickness of weathered rock and sediments of 2-3 meters. The rocks upstream of the spring show a change is jointing pattern. The rocks in this area seem to be highly fractured. The fractures show one set of trend i.e. north- South and dips towards West. Highly weathered rock is found around the cantonment dugwell near the spring. All these observations point out that unconfined aquifer provide water to the spring, and the fractures seem to contribute water to the spring too. One outlet of the spring has a discharge of nearly 45 lpm (liters per minute).

Wetlands

Small hill wetlands, also known as swamps or marshes are critical life support systems in the Nilgiris. While much of the attention of the policymakers and conservationists in on large wetlands such as those defined by the Ramsar Classification System, small hill wetlands such as those found in the Nilgiris go largely unnoticed.

Wetlands deliver a wide range of ecosystem services that contribute to human well-being, such as fish and fiber, water supply, water purification, climate regulation, flood regulation, *coastal protection, recreational opportunities, and, increasingly, tourism. Wetlands deliver a wide array of hydrological services—for instance, swamps, lakes, and marshes assist with flood mitigation, promote groundwater recharge, and regulate river flows—but the nature and value of these services differs across wetland types. When both the marketed and non-marketed economic benefits of wetlands are included, the total economic value of unconverted wetlands is often greater than that of converted wetlands*[10].

However, wetlands are also a widely neglected ecosystem. Often regarded as wastelands, wetlands continue to be among the world's most threatened regions. Most of them have been converted for agriculture, ongoing drainage, conversion, pollution, over-exploitation, fishing, real estate development and even building parks. The rich biodiversity that we often see in wetlands, though abundant, is most vulnerable to any change in wetland ecology. Much of this biodiversity stands to be lost forever if wetland resources are not used judiciously.

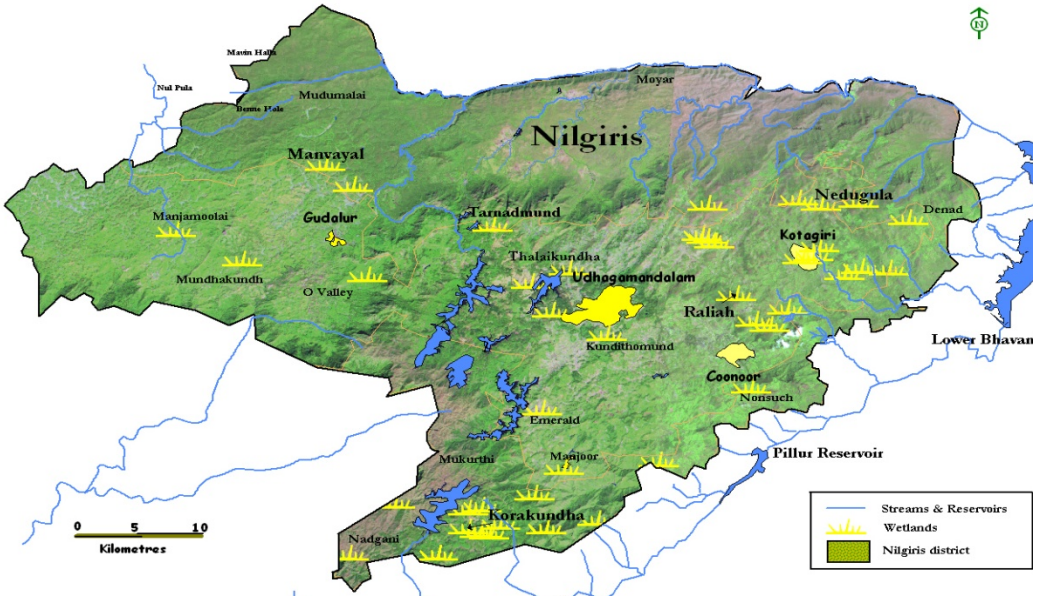
Historically, most wetland losses were due to agriculture. Today, the most common threat to Nilgiris wetlands is development because of fertile soil and location, many wetland areas are desirable for farming, business and housing developments and form localized high population zones within the Hill District. The region has suffered an immense amount of loss in the number of wetlands due to agricultural interventions in the plain, fertile, valley areas. Lately, wetland losses are also due to other developmental activities like housing, community halls, toilets, schools as well as other business activities like eucalyptus oil distillation plants. Other threats include invasive species, exotics, chemical inflows from farming and tea, grazing etc.[11]

10 MEA. Ecosystems and Human Well-Being: Wetlands and Water.Summary. http://www.millenniumassessment.org/documents/document.358.aspx.pdf

11 Keystone Foundation. Report of the project on Wetlands Conservation and Sustainable Management in the Nilgiris. 2006. http://www.indiawaterportal.org/sites/indiawaterportal.org/files/wetlands_conservation_and_sustainable_management_in_the_nilgiris.pdf

During 2006, a survey of wetlands in the Nilgiris was undertaken, in which more than 40 wetlands were surveyed and detailed data on 39 wetlands was collected. Wetlands were classified based on the type of land tenure into Common Property Resources (CPR) in urban areas, CPRs in rural areas, wetlands in protected areas and wetlands in private lands. Barring those in protected areas and reserve forests, the rest enjoyed no legal protection as wetlands. Even inside forest areas, wetlands were polluted by waste discarded by tourists. While some privately held wetlands were managed well, these are exceptional cases. Wetlands were by and large be encroached upon for farming or developmental activities. The wetlands that fell under Panchayat or Revenue control were also encroached upon and diverted for other our purposes as there is no legal recognition for these small hill wetlands under any law.

A map of the locations of the wetlands is given below.



Management plans were prepared for five of these wetlands and shared with the government for further action. In Happy Valley wetland in Kotagiri, in partnership with the Town Panchayat, a patch of common land of about 1 acre was fenced off, cleared of invasives and exotics and native shoal tree and grass species were planted there. Over the las t ten years, this has grown into a forest patch that is an important recharge zone for the Happy Valley spring which provides water to a significant portion of Kotagiri's population. Wetland plants have also been grown in nurseries and supplied to the government as well as villages and individuals for ecological restoration of degraded sites.

In 2012-13, a study of two wetlands (Tarnadmand and Nedugula) was undertaken to understand the livelihood linkages and to calculate the economic value from the wetlands. In both the wetlands more

than 80% of the families owned land in and around the wetland. Vegetables are being farmed in both the cases, although in Tarnadmand the area being cultivated is one third of that in Nedugula. While the value of agricultural output in Tarnadmand was approx five lakh rupees, it was about 93 lakhs in Nedugula. The wetland area has been a traditional grazing ground for the Toda buffaloes in Tarnadmand. While once they had as many as 500 buffaloes, less than a tenth of that remained at the time of the study.

Tenure over the wetland area has emerged as n important dimension of wetland use from the various small group discussions that were held to interpret the survey findings. In Nedugula, where the wetland is located in private land, there seems to be very little community jurisdiction over the land use. In Tarnad Mand, the wetland cuts across the Toda Patta land which is a revenue assignment to the Toad community. However, this current status of this land is unclear. The forest department claims 'ownership' over it as does the community. Under the circumstances that the community has been using the said extent of land for grazing, they are eligible to claim tenure over it under the provisions of the Scheduled Tribes and Other Traditional Forest Dwellers' (Recognition of Forest Rights) Act, 2006. Pudu *Mand, one of the habitations of Tarnad Mand has initiated the process of filing community claims over about 7 Ha. Of land. There are competing claims to this land from the neighbouring village of Sholur Kokkal as well. While there is a strong cultural motivation for the protection of the wetland amongst the Todas, due to its connection to the sacred buffalo and its pasture, we recognize that the lack of capital to invest in vegetable cultivation has also been an important factor in the fact that only a small portion of the wetland area is appropriated for vegetable cultivation currently*[12].

While in 2006, we had marked the catchment areas of these wetlands, there have been no efforts subsequently from the government or any other agency to systematically monitor the status of these wetlands. Unlike springs, there is no simple methodology to monitor the status of these wetlands. There is an urgent need to adapt existing methodologies to identify these and other wetlands and to assess them from social, economic, ecological and hydrological aspects.

Water Quality

Traditionally the communities believed that spring water was pure and consequently temples were built on springs and they were worshipped. However out water quality monitoring data from the last year shows that even spring water shows the presence of coliform indicating

12 Keystone. Report of livelihoods linkages and economic value of wetland. http://www.indiawaterportal.org/sites/indiawaterportal.org/files/report_of_livelihood_linkages_and_economic_value_of_wetland.pdf

faecal contamination of groundwater. Well water is by and large understood to be of poorer quality that spring water. It is common in villages that are supplied water from both sources, to use spring water exclusively for drinking and cooking.

The linkage between groundwater and sanitation is not very well understood. Although people do associate open defecation with water pollution, it is understood more in terms of run-off carrying the faecal matter and contaminating the wetlands. The underground route through soak pits and infiltration which could contaminate springs as well as wetlands and wells is often missed. Even in the programmes of the government such as Swachch Bharat Abhiyan and its previous avatars, the contamination of groundwater through soak pits that allow percolation of faecal matter into the groundwater is not taken into consideration. In the Ambikapuram valley where we are monitoring well levels and taking water quality measurements on a monthly basis, we found the presence of ammonia in water. Ammonia is said to be an indicator of inadequate time for faecal matter to travel underground before mixing with the groundwater. This needs to be better understood through observations across seasons and mapping faecal flow directions. However given that most villages have sewage pipelines that lead to the wetland in the valley where the water sources are also located, and the distance between the habitation and wetland is often less than a km, it is quite likely that contamination of water sources is taking place.

Given the high loads of fertilisers and pesticides used in the farms and tea plantations in the Nilgiris, we got sediment samples and fish tested from three wetlands a few years ago. The tests were done by SACON[13]. A few excerpts from their findings are given below,

- *Many organic pesticides and trace elements are hydrophobic; that is, in aquatic environments they tend to be associated with sediment particles and biological tissues rather than dissolved in water. For this reason, sampling sediment and fish is an effective way to assess the occurrence of these contaminants in the aquatic environment.*

- *β-HCH and lindane exceeded the sediment quality guidelines (SQG), threshold effect level (TEL), the probable effect level (PEL) (Buchman 2008), and the maximum permissible concentration (MPC) (Crommentuijn et al. 2000) in sediments collected from stream area of Tarnadmund and downstream, agricultural field and pond areas of Nedugula indicating possibility of adverse effects to organisms. It is known that lindane causes endocrine disorders (CEC, 2003).*

- *Residues of p,p' DDD (36.11 ng/g) and o,p' DDT (33.27 ng/g) were the maximum in the downstream sediments of Tarnadmund. Σ DDT residues in Bison Swamp*

13 Pesticide contamination in select wetlands of Nilgiris district with special reference to sediments and fish.

sediments were BDL. DDE/ DDT levels measured in sediments samples of Tarnadmund and Nedugula indicate DDT usage and slower degradation rates in these wetlands. The high incidence of DDE has ecological implications because this metabolite is more persistent and toxic than DDT. Furthermore, DDE is known to alter metabolic functions in organisms by acting as an antiandrogen, binding to androgen receptors and inhibiting transcriptional activation, which causes reproductive abnormalities (WHO 2004).

- *Concentrations of Σ HCH, Σ DDT residues in 70 % of the samples included in the present study are higher than the levels reported by Vijayan and Muralidharan (1999) from various reservoirs, namely Avalanche, Uppar Bhavani, Emerald, Kamaraj Sagar, Pykara and Maravakandy, Ooty lake and rivers such as Coonoor and Moyar in Nilgiris district.*

- *The Stockholm Convention (2010) cites 12 persistent organic substances (POPs) or dirty dozens that are considered to be extremely harmful because of their persistence in the environment, potential for bioaccumulation in tissues through the food chain and human and wildlife toxicity (Wei et al. 2007). Out of the 12 POPs, only one pesticide (Σ DDT) was detected in this study. In 2009, the Convention included 9 additional POPs, including α-HCH, β-HCH, and γ-HCH or lindane (Stockholm Convention 2009), which are detected in this study.*

- *It is necessary to mention that the quantum of pesticide residues detected may not reflect the threat because, the toxicity differs among pesticides. Apart from accumulation in animal tissues through food chains, high rainfall and laterite soil in the district facilitate speedy leaching of toxic chemicals leading to contamination of water bodies not only in the hills but also in the plains.*

- *Sediment provide habitat for many aquatic organisms but is also a major repository for many persistent chemicals that are introduced into surface waters. Concentrations of contaminants are often several orders of magnitude higher in sediment than overlying water. Thus the long-term release of low concentrations of chemicals into water can result in elevated concentrations in sediments. Contaminated sediments may be directly toxic to aquatic life or can be a source of contaminants for bioaccumulation in the food chain.*

- *Even if these pesticides are present in very trace quantities in sediments, they are hazardous because fishes are known to concentrate them to 100s of folds. Unfortunately, these chemicals are not always selective and many have adverse effects on non-target organisms.*

Land use: Change is the only constant

Forest Water Linkage

There is a crucial linkage between Shola patches (endemic montane forest-type which occur in this region) and water resources availability. Wherever Shola forests exist, existence of water source is assured. The Central Soil Water Conservation Research and Training

Institute (CSWCRTI) carried out a hydrological study between 1968 and 1992 to assess the impact of converting natural grasslands into Eucalyptus globulus (bluegum) on the water yield in downstream reservoirs.

Comparative study was done on two small identical watersheds (32 hectares) one with natural grasslands and "Shola" forest and other with Eucalyptus globulus plantation. The study area was located in the catchment of Glen Morgan storage reservoir feeding the Pykara hydroelectric project in Moyar basin (24 km away from Ooty City on Mysore road).

Calibration period was during 1968-1971. Eucalyptus plantation was raised in 59 % of a watershed in 1972 and was felled (first harvest) after first rotation of 10 years in 1982 and the second harvest (second rotation or first coppiced growth) after another 10 years in 1992. The key findings of the study are as follows:

- *Average annual reduction in total runoff (water yield) in the bluegum planted watershed over the natural grassland was 16 % during the first 10 years rotation and 25.4% (94 mm) during the second rotation of 10 years (coppiced growth)*
- *The reduction in base flow was 15 and 27 % respectively for first and second rotation*
- *Decreased Low Flow Index (LFI) by 2 and 3.75 times respectively for bluegum planted watershed over the natural grassland (+Shola) for the first and second rotation*
- *Increase of annual flow (14-17%) immediately after felling of bluegum plantation for both rotations*
- *Reduction in soil profile moisture in bluegum plantation watershed (during second rotation bluegum plantation extracted moisture from deeper soil zone than first rotation)*[14]

Land use changes

One of the most striking features of the Nilgiris is the drastic change in land use since the British period. These changes have had a profound impact on the ecology of the region.

A study of the land use changes over the two decades between 1990 and 2010, shows that the man-made activities such as agriculture; Tea plantation; built-up area had shown a

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Hydrological implications of converting natural grassland into bluegum plantation in Nilgiris, 1998, CSWCRTI, Ooty

considerable increase which shows the interruption in the natural eco system[15]. Another study compared the land use from three periods, 1973, 1991 and 2009, the findings of which are summarised in the table below.

S No.	Landuse class	Area (sq. km.)			Percentage (%)		
		1973	1991	2009	1973	1991	2009
1	Dense forest	656.91	826.59	993.34	25.75	32.4	38.93
2	Open forest	67.33	8.27	116.03	2.64	0.32	4.55
3	Forest plantation	469.20	290.36	305.41	18.39	11.38	11.97
4	Settlement	7.49	29.11	44.29	0.29	1.14	1.74
5	Waterbody/Lake/Reservoir	32.87	39.51	29.26	1.29	1.55	1.15
6	Tea plantation	483.45	471.23	437.55	18.95	18.47	17.15
7	Forest blank	82.59	9.84	24.43	3.24	0.39	0.96
8	Mixed forest	248.31	328.75	239.65	9.73	12.88	9.39
9	Land with scrub	40.19	23.83	47.65	1.58	0.93	1.87
10	Barren rock/stony waste	34.31	29.02	3.52	1.34	1.14	0.14
11	Industrial/Mining area	2.92	6.71	1.48	0.11	0.26	0.06
12	Agro-Horticulture plantation	400.69	477.51	288.63	15.7	18.71	11.31
13	Land without scrub	25.32	10.84	20.36	0.99	0.42	0.8

Source: Lakshumanan et al, 2012

The process of rapid land transformation has not only brought about an ecological crisis in the region but has also threatened the agricultural economy of the watershed through accelerated soil erosion, deforestation and reduction in ground water recharge. The land under agriculture and settlement has increased significantly at the sum of reduction of forest plantation and partially of barren land. Major changes have also been detected in forests especially open forest to dense forest and mixed forest. One possible implication to the problem facing the Nilgiris is a gradual crop diversification. The local government has initiated measures to encourage floriculture and revival of fruits cultivation such as strawberries as a substitute for the monoculture tea. [16]

There is also a high level of urbanisation in the Nilgiris which is turning recharge areas such as tea fields, vegetable farms and tree plantations into habitations, roads and other 'dead zones' which speed up run-off and do not contribute to recharge. The loss of vegetative cover to built up areas has led to incidents of landslides in the district during the monsoons. There is therefore a need to look at the water resources in the region in an integrated manner with the land use and land cover and the population pressure.

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Nalina, P., T. Meenambal and R. Sathyanarayan Sridhar. 2014. Land use land cover dynamics of Nilgiris district, India inferred from satellite imageries. American Journal of Applied Sciences 11 (3): 455-461, 2014

16

Lakshumanan C et al. 2012. Landuse / Land cover dynamics study in Nilgiris district part of Western Ghats, Tamilnadu. International Journal of Geomatics and Geosciences, Volume 2, No 3, 2012

Tea being a major plantation crop in the region, hill sides regardless of the degree of slope are covered with this crop. There is usually no soil retention measure such as bunding or terracing in place. Loss of soil along with heavy run-off is quite common during the monsoons. The other major livelihood option is vegetable farming with most of the low lying areas near the valleys converted to this. Shallow open wells are used to tap the ground water and irrigate the fields. The vegetable farms as well as tea farms often extend right up to the stream bed and over time the stream width is reduced. The chemical runoff from farms also directly flows into the streams, degrading the quality of water.

Large Government Water Schemes of the TWAD Board basically tap springs and infiltration systems. Wells are built in swamps and marshes so that percolation from springs around the well also take place. Feeder pipelines from other springs are also brought to the well. These springs are found in various altitudes. Local land use adjacent to these water bodies is critical in maintaining year round water flow. Several spring sources have dried up or the flow has drastically reduced due to land use changes or development works (revetment walls, road enlargement, check dams, etc.). Encroachments (very common) have destroyed water bodies as they have been converted for agriculture or tea thus blocking spring routes. In marshy environments, it is important to keep the passage of flow open - this is the key to wetland management, but unfortunately decision-makers perceive these areas as vacant land for further development works[17].

Way Forward

The assessment of the water resources situation from a rural community's perspective as well as an ecological perspective throws up multiple challenges. Some of these are natural, such as the nature of hydrogeology that dictates a complex system of aquifers, and some are anthropogenic such as land use changes driven by the economic pressures, tourism etc. There is clearly an immediate need to address these issues holistically as there is a crisis in terms of water quality and also the quantity of water. Consecutive years of monsoon failure as in 2012-13, can expose the vulnerabilities in water availability in most parts of the Nilgiris. The water tests though limited to a few wetlands, clearly show that chemical inputs are contaminating our water resources and with increasing dependence on groundwater for water supply, the situation is only likely to worsen.

17 Keystone Foundation. Report of the Hill Waters and Livelihoods Project. http://www.indiawaterportal.org/sites/indiawaterportal.org/files/nilgiri_water_resources_project_-_final_report_0.pdf