

SIGUR WATER RESOURCES PROJECT



Project Concluding Report by Keystone Foundation, Kotagiri

Keystone Foundation, October 2007

Acknowledgments & Executive Summary

The Sigur Water Resources Project was initiated in the plateau region of Sigur, in the Nilgiris district, in 9 villages inhabited by marginalized indigenous communities. The project aimed at

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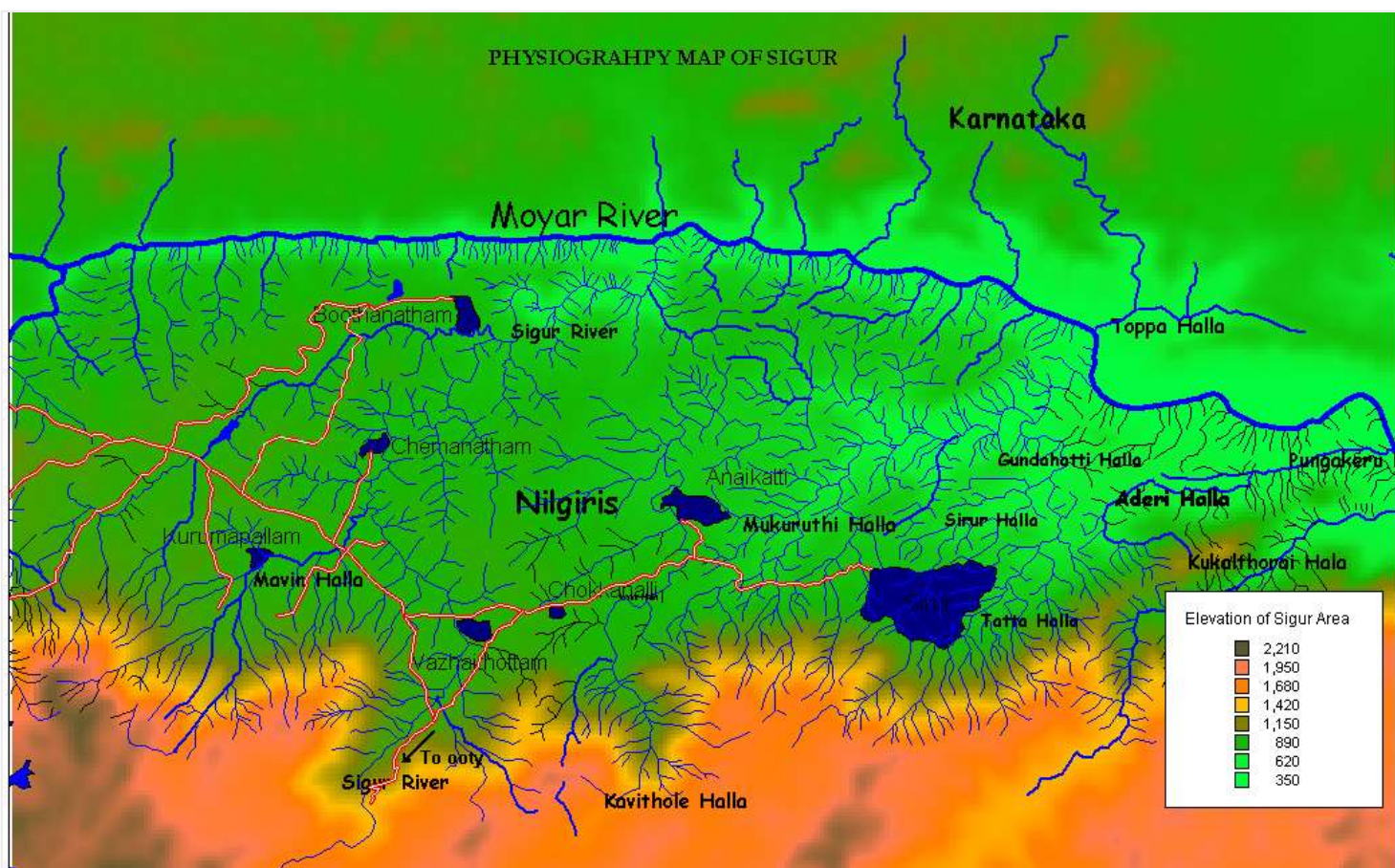
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1.1 Introduction

The Sigur Plateau is located in the northern part (Figure 1) of the Nilgiris district with the 300m deep Moyar Gorge separating the plateau from the Mysore region. The average elevation of the Sigur plateau is 900 MSL. The boundaries of the Sigur plateau are the Moyar Gorge in the north, Moyar River on the east, Wynad district and the Nilgiris massif in the south.

There are five major streams in the Sigur plateau, namely, the Moyar River, Sigur River, Avarahalla River, Kedarhalla River and Gundattihalla River. All these rivers originate in the Nilgiris plateau. The Nilgiris have several valley systems ranging in elevation between 1800 m and 2200 m drained by the Bhavani, Kundah, Hadathoraihalli, Kukalthorai halla, Sigur, Pykara, and other minor rivers some of which have been dammed up during the last five decades.

Rainfall in the Sigur plateau is quite variable with the western part of the plateau lying in a rain shadow region. West Sigur receives less than 500 mm annually, while the eastern part receives more than 1000 mm of rainfall. The difference in rainfall also contributes to the dry deciduous forests in the west part of Sigur while the eastern part has more scrub jungle. All along the river courses, dense riparian forest are seen in the western and eastern parts of the plateau. East laying scrub jungles are traditionally called '*Pankadu*'. Sigur plateau is a low rainfall marginal land with poor soils and till recent times, also had a low population density. The very fact that the area is largely of scrub vegetation makes it more suitable for pastoral activity. Before



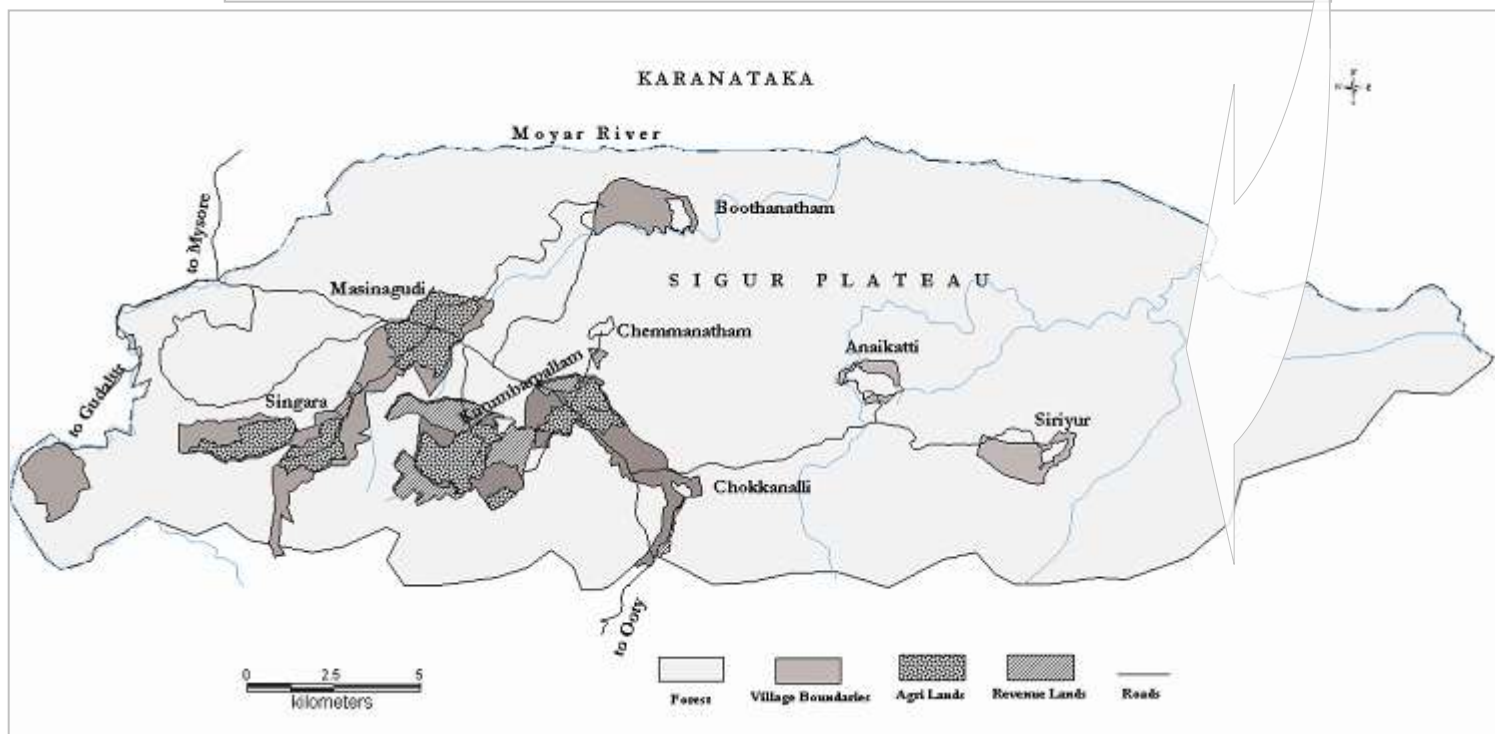
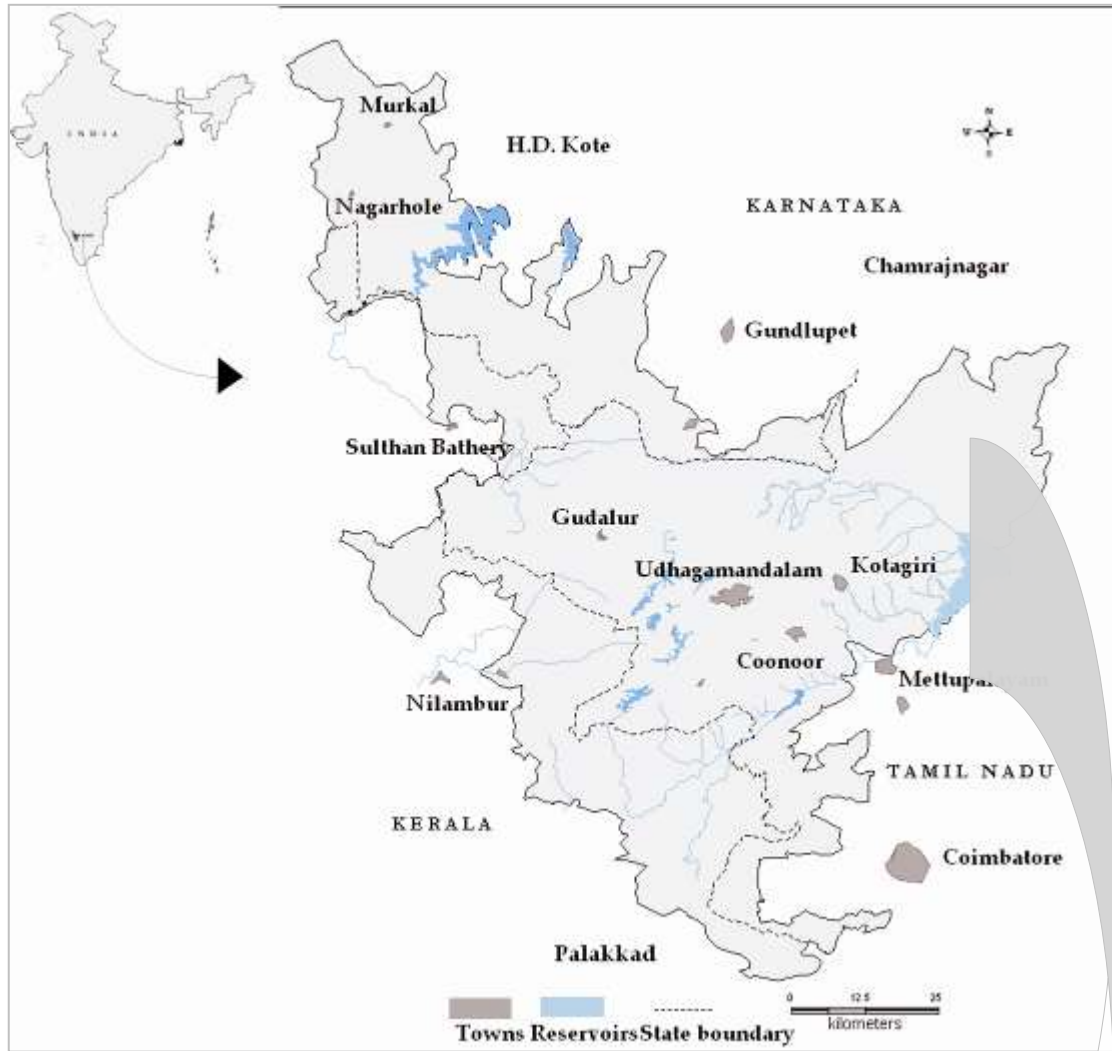
the forests became reserved, the area was open to free grazing and used by both agricultural groups from the Nilgiris and the Coimbatore plains.

Sigur has been impacted in many ways by influences from Karnataka on the north and Kerala on the west. Indigenous groups are predominantly Kasavas, Irulas, Jenukurumbas and Sholigas who have close linkages with the neighboring states. The non-tribals are also seen in large numbers. There has been a huge influx of migrants from Kerala who have set up businesses and enterprises along the Bangalore – Ooty road. Presently most of the areas have been declared as Wildlife Sanctuary and Reserved forest. Human – wildlife conflicts are common.

There is a strong school of thought that believes that tribal population ought to be displaced from this region for wildlife to progress. For several decades now, field stations had been established by Research institutions such as the Bombay Natural History Society, Indian Institute of Science (Centre for Ecological Sciences) area to study wildlife. None of these institutions have been able to provide effective solutions to the people who have co-existed with wildlife in this area for generations. The area has been identified as a crucial corridor for the Indian Elephant (the largest population in south India). There is a large extent of Revenue lands. The proposal to extend the Wildlife Sanctuary towards Thengumarahada has been opposed by the present population and a stay order has stopped the handing over the reserve forestlands to the Wildlife Warden.



Figure 1. Map showing location of Sigur in the Nilgiri Biosphere Reserve



1.2 Aims & Objectives

The main aims of the project are to document history & use of water, a water resources audit, to build up community institutions like water users groups, to ensure future needs & sustainability & finally to build a peoples' regional water management plan & setting up an e-portal for the Sigur region.

Objective

'Develop a strategy for Sustainable Community-based Interventions through: Action-Research, Innovation & Enterprise for the Conservation & Development of Freshwater Resources'.

Components

The first component in the proposed project is to trace the **history and use of water** and analyze reasons for the breakdown of community based water management systems. A proper field survey and data analysis will give us an intervention window as to how to revive the sharing mechanisms in a contemporary setting. Use of a proper mix of appropriate technologies, communications, media and culture will be tried to arrive at working solutions between communities, up-hill and downstream villages, Government water departments and villagers.

The second component is to arrive at a **Water Resources Audit**. This will consist of a resource analysis – causative factors of water crisis, typical patterns if any, and future scenarios under different management options, the conditions and variability across seasons and past trends. Data would be generated in this, which would identify freshwater budgets in hill areas, which are typically source zones. A menu of options would be available after the audit on “what to do & where by whom”.

The third aspect of the project would be to work at the grassroots level with **community institutions** and design interventions along with them. This would entail: “creation of water users group, monitoring water quality, sensitizing water department staff on local water sources, developing water managerial caliber in the villages and designing village water plans (sources, quality issues, management and distribution systems, conflicting issues)”. This component would be the implementation aspect spread through out the district.

The fourth component of the project is how to **ensure future needs and sustainability** – technically how to improve the resources, measure to counter over-exploitation. On the management, regulation and control mechanisms this will investigate possible village water funds and tariffs for financial sustainability.



The last component will be to build a **peoples' regional water management plan**. This will be in an electronic database at the block/district level. Each areas water issues and the mitigation measures will be highlighted with the budget necessary to undertake the work. This plan will facilitate the direct investment of Government funds into hill regions and make it more relevant and demand-driven. This component will be designed so as to be enterprise-oriented – results will be disseminated through a water-portal, which will be accessed by other interested parties in the Western Ghats region.

2. Methodology

2.1 Approach

A survey format – data sheet was made to collect all relevant water data available. The team surveyed all existing drinking water supply structures & situations in the Sigur plateau. Flow rate of streams were measured which are perennial as well as seasonal. Visited all the water structures made by the respective line departments like Forest Department, TWAD board, Panchayat board and check dams built by the FD or HADP. This was done to see all the amount of water which is flowing towards the Sigur plateau.

2.2 Collection of Secondary literature of the Sigur Plateau

A substantial amount of secondary information was collected for the same from various line departments like from the forest department the actual structure building in terms of check dams & the money spend on the structure & the year which has been built from starting to ending through different schemes. Through the TWAD board we have information about the supply of water in terms of LPCD to various

villages in the Sigur area. From the Union Panchayats & the respective panchayat boards we had information about their implementation work done in the region.

2.3 Collection of Socio Economic Data

All socio economic details of the working villages were surveyed to make appropriate intervention while working with drinking water components in these villages. Their occupation & their livelihoods is studied. From the analysis of this we find most of the people are dependant on other external resources to fend for them selves, they have to go far away for seeking work & wages. About 430 families live inside these seven villages & the total population here is around 1361 people, out of which the male composes of 497 & the female total is 473. The children below the age of 15 years are 391. Only few people are NTFP collectors and that too the forest department has stopped collection of these NTFP's nine years back giving importance to the wildlife aspect of this part in the district. So people have to migrate outside in search of jobs or for daily wages instead of just confining to what ever they have inside their own village. The revenue villages like Vazhaithottam, Kurumbarpallam, Mavanhalla, & Masinagudi area well placed in terms of easy accessibility to the business community who will buy their cattle or the cow dung which fetches fairly good price & then transported to the nearby state. But that is not the case with the forest settlements which have their own limitations to sell their commodities.

2.4 Collection of Physical data about drinking water

The physical parameters like constructed tanks, GLRs, water distribution systems, overhead tanks through the different Panchayats of this regions & other check dams or other structures from HMS (Hydro Metric Services) to check the flow rate & the siltation in the streams. There are three Silt Monitoring stations in this region built by the HMS. There are many check dams in the Sigur area inside the reserved forests which are built by the forest department. Small percolation tanks are built for want of water to the wild animals during the summer season. There are big two storage tanks situated in the Masinagudi town where the water from the Singara hydro power house is let out through the channel & this water is pumped from this source & is being distributed to many villages in & around the Masinagudi town. The TWAD board has built many structures like overhead tanks, GLR etc & handed over to the local panchayats for maintenance & repairs.

2.5 Data Reconciliation and Digitization for Maps

After collecting all the required data like the cadastral maps from the Masinagudi panchayat through the village administrator officer we had digitized the area for studying the area in terms of land use pattern & individual land holdings of this region. Maps have been generated for this area like the drainage map which falls under the watershed area code numbers of 41, 50,51,52,55,56,59,60 micro water sheds prioritized by the Hill Area Development Program in this region of this district. HADP has termed this area very low priority area from rest of the watersheds of this district thus neglecting the importance of water in this kind of fragile landscape. We had collected geo data using GPS. Measured all the perimeters of the forest villages & that of the revenue villages to ascertain the peoples land holdings from the settlement perspective. All the individual land holdings were also surveyed & mapped. Major

land use & land cover maps has been generated like showing specifically areas of agricultural lands, revenue lands, forest lands with village boundaries. On top of this layer the individual land holdings has been incorporated. All the streams have been digitized whether it is perennial or seasonal. All the bore wells or open wells, even structures have been recorded in GPS and an inventory has been made & mapped showing their spatial distribution in this plateau.



3 Physical Characteristics

3.1 Relief & Drainage

The majority of the area is undulating with most of the area at an altitude of 900 m. The land slopes from west towards east with a slight tilt towards the north. On the southern boundary of the Sigur plateau are seen the steep hills of the Nilgiris leading to the high plateau of 2000 meters. Towards the north is a deep gorge that has been cut by the river Moyar running west to east. All the rivers and their tributaries originate from the Nilgiri plateau and were once perennial; the modified water regimes for purposes of power generation and irrigation have rendered some of these rivers seasonal and many water courses have also been altered by new canal systems



3.2 Agro Climatic Conditions

This part of the Nilgiris has the lowest rainfall of 40 cm, which starts with the seasonal rain of April - May. The western most part of this area is just touched by the South West Monsoon. The main rain is from the North East Monsoon. This area is considered to be a rain shadow area and the vegetation of this area is very sensitive to the rains it receive. With the average day temperatures never very hot (not going above 32° Celsius and the lowest winter temperatures staying above 20° Celsius) the area is known for its pleasant and moderate climate. The rainfall in the Sigur plateau is quite variable with the western part of the plateau lying in a rain shadow region. West Sigur receives less than 500 mm annually, while the east part receives more than 1000 mm of rainfall. The difference in rainfall also contributes to the dry deciduous forests in the west part of Sigur while the eastern part has more scrub jungle. This part of the Nilgiris has the lowest rain fall 40 cm which comes from seasonal rain of April - May. The western most part of this area is just touched by the South West Monsoon. The main rain is from the North East Monsoon. The average day temperatures are never very hot not going above 32 ° C and the lowest temperatures of winter are above 20 degree centigrade, the area is known for its pleasant climate.

3.3 Soils

The soils commonly occurring are light yellow to reddish brown clay soils. Humus soils of about 0.5 m thick are confined to the areas covered by thick vegetation. The soils in the Nilgiris district are derived from the decomposition of rocks dominantly composed of Pyroxene gneisses inter banded with Pyroxene granulites and garnetiferous quartzofelspathic gneisses. The relatively low country around the massif

is made up of hornblende biotite gneiss, biotite gneisses, micaceous and ferruginous quartzites with emplacement of ultrabasics like dunite, peridotite, pyroxenite, gabrro, and anorthosite. The soils of the higher elevations areas are lateritic in origin and are derived from charnockites known as Nilgiris gneiss. Climatic conditions favour intense chemical weathering of materials. White kaolin clay formed as a result of the decomposition of feldspars can be observed in many areas. The soils are at most times stained with black, marking the presence of ferromagnesian minerals. The soil is scattered with irregular oxidation stains giving it a deep red colour in some places, and yellow where the iron has been leached due to drainage.

Regarding fertility, the soils are generally deficient in plant nutrients and are acidic with pH values of 4.6 to 6.1. These soils contain a large percentage of alumina and iron, which restrict the availability of phosphates to plants. Even the most badly eroded soils have the capacity to recuperate by proper application of organic and inorganic manures and fertilizers. Nutrient content studies show that the soils are rich in nitrogen and potash and low in phosphorus. The depth of the topsoil varies from 0 to 45 cm, on an average and that of the sub soil from 3 to 4.5 m.

3.4 Geology

Based on field study of geology by Mr. Ashok Kumar¹: During field visits in Sigur, the rock types predominantly seen were the hornblende-biotite gneisses (in all the



villages of Bokkapuram, Vazhathottam, Anakatti, Siriyur, etc). The only exception was Moyar where garnetiferous quartzo felspathic gneiss, micaceous quartzites (and charnockites, not as exposures) were seen. It seems that some of these like the charnockites and garnetiferous quartzo felspathic rocks may have been transported here.

Picture 1: Biotite hornblende gneiss - the most common rock type

Picture 2: Quartzite in Moyar



¹ Refer Annexure 1

3.4.1 Literature Study of the geology of the region

The geology of the area consists of charnockites of Nilgiri gneiss varying from acid to ultra basic ones. The geology of the area consists of charnockites of Nilgiri gneiss varying from acid to ultra basic ones. The intermediate syenodiorites are the most common geological formations. The minerals present in the rock are blue quartz, plagioclase feldspar, hornblende, hypersthene, and secondary minerals such as garnet.

The origin of the Nilgiri plateau has long been a subject of detailed studies. Based on the geological structure and geomorphological evidence, a number of geologists have put forth different hypothesis for the origin of the Nilgiris plateau. The prevalent view is that the plateau has come in to existence due to uplift by block faulting. Blandford held the view that this is a relic feature carved out by erosional processes.

The Geological Survey of India carried out pioneering geological work in the Nilgiris district in the 1850s. According to Blandford, the Nilgiris plateau has been formed by three systems of faults along its peripheries. This is based on the prominent escarpments. East North east faults with down throw to the south east of the plateau, parallel to the Bhavani River and a corresponding escarpment north west of Naduvattam with a down throw towards northwest from the first system of faults. The second system of faults trending northwest refers to the escarpment of Kundah facing Udhagamadam and another near St. Katherine Falls near Kotagiri. The third system comprises the northern boundary of the plateau and through short southern escarpment of Kundah.

According to Venkata Rao and Subramaniam (1979), a cyclic upward of the continental crust accounts for the high level deposition of the surface and elevation of co-existing erosional surfaces in the Nilgiris plateau. They consider that mega lineaments whose surface expressions are shears represent faults of Precambrian age along which the Nilgiri hills were uplifted as blocks. Auden (1971) postulates that many of the escarpments in Nilgiris are etched out by erosion processes.

The events of uplift have been timed for the Cretaceous and Miocene periods. Blandford considers the upheaval of the Nilgiris in two stages. The first was in the Cretaceous time and the second after the deposition of Cretaceous rocks. Wadia has speculated that the Nilgiris rise synchronizes with the uplift of Ceylon in the tertiary period. The alluvial deposits in Pykara and adjoining valleys are at a fairly high level above the bed stream and denote the uplift of the alluvial formation. Stanford has suggested that these may represent alluvium formed prior to the uplift of the Nilgiris.

It is interesting to note that the higher elevation on the Nilgiris plateau is made up of charnockites while the plains are composed of gneisses, viz, hornblende biotite gneiss and garnetiferous quartzo felspathic gneiss. The rock knoll of 342 Sannakkal Mokka is constituted of garnetiferous gabbro. Thus the difference in the topographic elevations has bearing on the nature of rock types present.

Landslides are a common occurrence due to the thickness of the weathered rocks and the presence of steep hill slopes. The rate of creep and erosion is pronounced at places

along steep hill slopes, road sections and stream courses. To minimize the effect of erosion, the hill slopes are cut into terraces and large-scale plantation is being done. The banks of major streams are also protected by construction of masonry structures.

3.4.2 Lithology and Structure

The main Nilgiris massif is dominantly comprised of charnockites (the reason for the Nilgiri hills being called as Blue Mountain) inter banded with pyroxene granulites and garnetiferous quartzo felspathic gneiss. The relatively low country around the massif is made up of hornblende biotite gneiss, micaceous and ferruginous quartzites with emplacements of ultra basic like dunite, peridotite, pyroxenite, gabbro, dolerites and pegmatites. On the Nilgiri plateau there are a number of lateritic cappings, which are aluminous.

Table 1. Lithological succession

Quaternary	Soil and laterite
Secondary rocks	Magnesite
Intrusive igneous rocks	Amphibolites Pink felspathic granite Dunite Peridotite Garnetiferous gabbro
Metamorphic rocks	Garnetiferous quartzo felspathic gneiss Hornblende plagioclase gneiss Charnockite

The regional foliation trend of rocks varies from ENE-WSW to east west with steep dips varying from 60° to vertical on either sides indicating synforms and antiforms.

A prominent lineament east-northeast is the one from Kundah to Moyar through Udhagamandalam over a distance of 48 kms. This lineament has flexure towards east-northeast. This has been offset by a north- northwest trending fracture in the southwest corner of the district along which the Bhavani River makes the initial flow for 10 kms.

The strikes of the joints are towards north – northeast, south southwest, north northwest and east west respectively with steep dips. The first three joints sets are more prominent. The spacing of the joints varies with the degree of shattering or disturbance, which the rock has undergone locally or regionally. The role of joints in promoting rockslides is well known but in the Nilgiris most of the slides are debris slides. It must be noted that all the prominent escarpments are developed along one or more of the three main joint directions.

3.5 Forests and Wildlife

The forest tracts of Sigur are contiguous with those of the Mudumalai Wildlife Sanctuary & the North eastern slopes towards the Sathy hills & the Kattabettu ranges on the upper slopes. Considering the interstate boundary, it is contiguous to Bandipur where the Moyar gorge separates from the Mysore plateau & Wynad areas.

This diversity in rainfall has led to the profusion of a unique floral diversity harbouring giant trees along the riverine patches, multiple canopy layers in the west and an almost desert like stunted vegetation on the east. Though presenting a desolate view, the scrub lands are host to numerous floral and faunal species and its importance cannot be undermined. The rainfall pattern has a impact on the unique



diversity of floral assemblage in the Sigur ghat. It has the riparian vegetation along the stream & river courses & mostly scrub forests except for dry deciduous towards the west of the plateau. Its faunal composition of large mammals like Elephant, Gaur, Hyena, Wild dogs, Sloth Bears, all types of deers including the blackbuck & with tigers & panthers makes this

forest very vital for conservation. It harbors good number of reptiles like, the Cobra, Branded Krait, Russell Viper & other snakes. Diverse species of birds are also seen in these forests. The forest department has a very strong mindset towards conserving this area & since the Mudumalai sanctuary now being proposed for a Tiger Reserve, more pressure has been enforced on the local communities for their dependence on the natural resources from these forests. There is also a strong opposition from the indigenous communities towards the forest department's decision to impose stringent measures on their livelihoods.

There are up to three storey levels of trees. Scrub woodland forms a major portion of the eastern part; it consists of groups of trees separated by thickets either derived from a dense forest by exploitation of the upper tree stratum, or from an open forest by the invasion of bushy species. The tree stratum can reach a height of up to 12 mtrs. These forests are subject to intense biotic pressure from both fire as well as grazing. Quite often these forests are found to be highly degraded and are then referred to as open forest.

The slopes leading from the Nilgiri Hills are covered with grassland on the top and with sholas in the valleys. The Niligiri slopes are covered with ever green to dry deciduous vegetation, while the Sigur plateau is covered with scrub jungle towards the eastern region & dry deciduous towards the western part of the plateau, and the rivers valleys & streams are covered by riparian vegetation which includes *mangifera indica*, *Syzygium Spp* and bamboo forests. From the vegetation prepared our team Sigur forests have highest diversity of vegetation species numbering more then 286 varieties.

3.6 Occupation

Since the majority of the area is covered with forests the dependence of the people is based on forests. The area used to shelter a population of more than 20,000 cattle, the caring of these scrub cattle and the collection of cattle dung used to be the major occupation. This has been on the decline due to policy of governing a protected area. Cultivation land is plenty – with the lands around Vazhaithotam having irrigation for the Sigur River. The construction of the Ooty Lake by the British is to provide perennial water along the Sigur river, but this water has been diverted to the Pykara Ultimate hydro electric project. The waters of Pykara are used for generation at Singara and then at Moyar powerhouse, hence these waters are not allowed for irrigation. The main waters of the Moyar



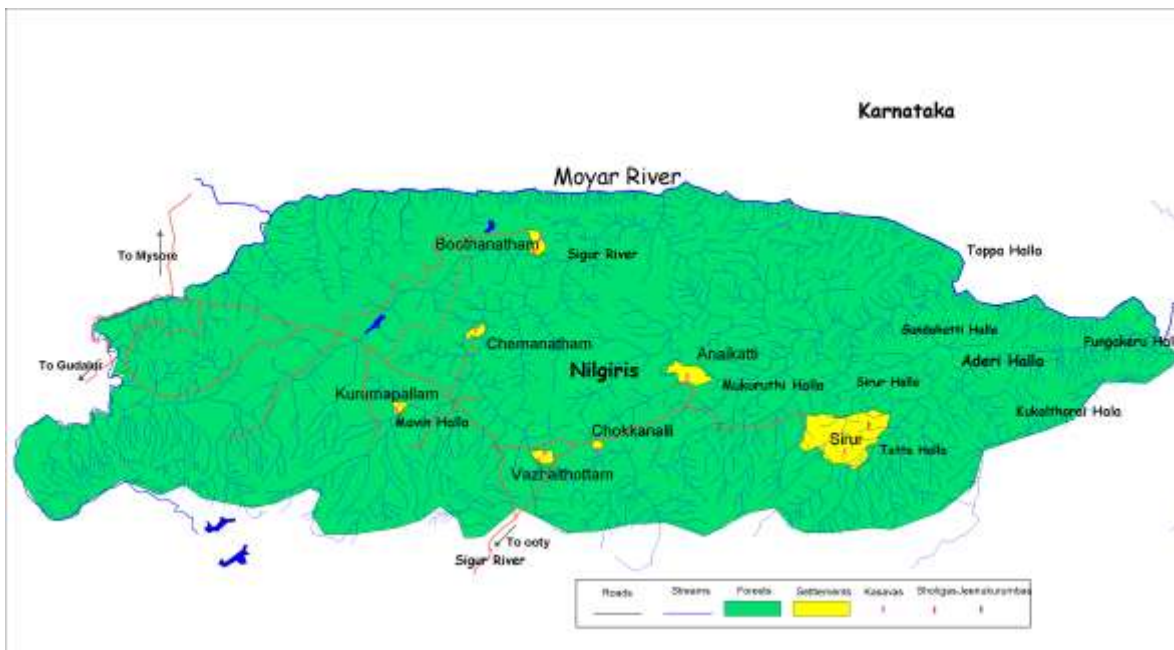
are in the deep gorge, hence beyond the reach of all the villages other than Thengumarada, which is surrounded by the waters of the Moyar on three sides.

3.7 Transport

The area is well connected by Tar Roads and has public transport service. Tourists extensively use the main Ooty road and other public transport is available at any time of the day on this road. There is a restriction on using the Masinagudi Kalhatti road after 8 pm to 6 am.

4. WATER AS A RESOURCE

Water is an important resource and to understand its importance in the lives of the people, there are several facets of water that needs to be studied and understood. Understanding watersheds helps explain the status of water in the area.



4.1 Watersheds

Table 2. The four major watersheds in the Nilgiris district are

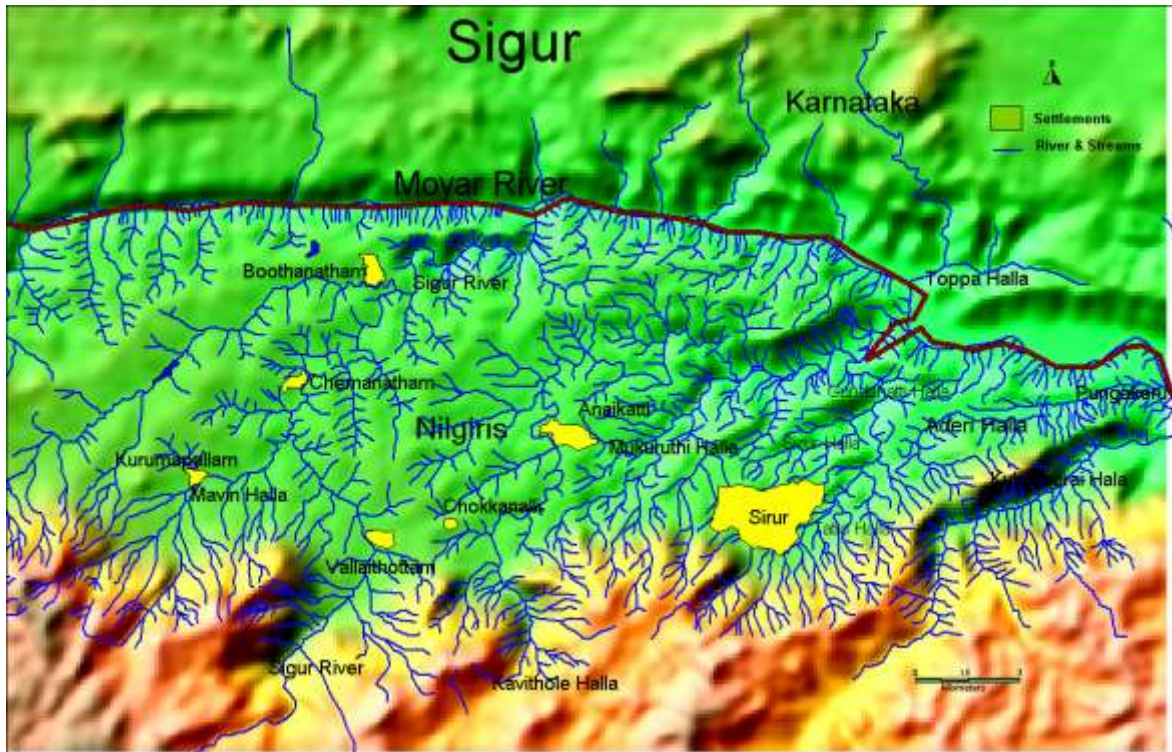
No	Watershed	Area in ha
1	Bhavani Major watershed corresponding to Bhavani River Basin	74,800
2	Moyar Major watershed corresponding to Moyar River Basin	77,500
3	Kabini Major watershed corresponding to Kabini River Basin	47,200
4	Chaliyar Major watershed corresponding to Chaliyar River Basin	52,200

4.2 Water Balance and Climatic classification

The rock base throughout the Nilgiris is fairly homogenous and impermeable and this is reflected in the uniform drainage density. However, the spatial and temporal differences of the stream flow, or run off, are considerable. The absence of aquifers, such as sandstone or calcareous formations, and the runoff mainly represents that of ‘surface’ and ‘base runoff’ of water that has infiltrated the soil and is released after a more or less extensive time lag, depending on the slope and water retention capacity of the soil. Deep percolation and groundwater runoff must be considered negligible in

the Nilgiris. Therefore, annual runoff amounts and runoff regimens are highly correlated with annual rainfall and rainfall patterns.

Hydrological data from the Mysore plateau below the Sigur plateau indicate that average runoff /rainfall ratios may even drop to 15% and individual figures suggest that in some years these areas do not contribute to the stream flow of the Moyar at all. In other words, there is evaporation loss from both local precipitation and water



consumed by the gallery forests and bamboo thickets along the banks of several perennial streams descending from the upper Nilgiris.

Table 3. Hydrological data for Administrative Blocks in the Nilgiris

Block	Groundwater gross recharge HEC	Utilizable recharge HEC	Net draft HEC	Balance Groundwater
Coonoor	2395	2036	12	2024
Gudalur	2775	2359	3	2356
Kotagiri	-	-	-	-
Udhagamandalam	4596	3908	27	3831
Total	9768	8303	42	8261

Boothanatham Poly line tanks

After installing the solar pump with panels to pump up water for the villagers for drinking purpose as well as for irrigating their barren lands. Two poly line tanks were made for irrigation purpose. There was water user's group formed in the village to look after the pump & maintenance of the same. Initially there was good response from the villagers but after problems started during the peak summer for sharing the water they all split. They did not come forward for maintaining the tanks which in turn got torn and leakage could not be arrested. The interest for farming also receded from the group in spite of giving support for seeds, field ploughing & buying hose pipes for irrigation. Only Basuvan from this village took special interest to irrigate and maintain the system up to date. There was a change in the social dimension - people (the Irulas) who got the support was happy & the people who live little upwards (the Sholigas) were not happy, but they had a Panchayat build tank already in place before putting up the solar pumps with poly line tanks. The problem was the water sharing did not happen in between the communities. Our intervention here impacted the people for equality in water sharing & their right to water.

4.3 Study of Water Sources and Conservation Structures - Impressions from the Field

During the field visits, wells, bore wells, springs and check dams were studied to understand the hydrological and hydro-geological situation and to look at opportunities for designing strategies and activities for a sustainable water management programme. The four water sourcing and / or conservation systems are:

- Springs
- Dug Wells
- Bore Wells
- Check dams

4.3.1. Springs

The availability of springs within the Sigur Plateau, in comparison, with the other hilly tracts of the Nilgiris is relatively low. During the field visit in the month of February, 2006 (after an unusually high 2005 rainy season), only two surface springs were seen. Technically,



Picture: Spring emerging from soil at Anakatti

many more are present, as a spring is defined as “water emanating at the soil / rock surface. Where the expression of the water table is above the rock or soil surface, a spring can form and these could be perennial or temporal. The evidence indicates that the springs at Anaikatti are perennial and dependable low flow springs



Picture: Spring emerging from rock at Anakatti

4.3.2 Wells

Three wells in the villages of Vazhathottam, Chemmanatham, and Moyar were studied to understand well characteristics like dimensions, yield, water table data, and geology from exposures. The wells sections indicate that the soil thickness (depth to rock) and intensity of fracturing show considerable variation in the Sigur Plateau. This also means that the opportunities for source development as well as water conservation work, which essentially depend on the former, also differ even within small distances.

4.3.2.1 Kishore's well at Vazhathottam

The property has on its western boundary, a canal 1 metre deep and 0.75m wide, which functions as 'run of the river' providing irrigation water at the upper western part of the Kishore property till December or January every year. The well is on the eastern boundary and further to the east is the Sigur River, which is perennial. The well is 7.5 m by 7.5 m and around 5 m deep. The water level in the well is around 3 m above the stream level. The water level is, now 2.2 m below the top edge of the well.

A cabbage crop with high pesticide use was observed. The rampant use of Endosulfan, Rogar, and DDT- pesticides, which are prohibited in agriculture, is observed. DDT is sold on the sly in Ooty. Large farmers also practice high fertilizer dosage use.

The person in charge told us there is 4 ft of mud at the bottom which make the water only 3 ft or so. The pumping is done for 4 hrs only now at around 5000 LPH with a 5Hp electric motor and centrifugal pump. The lift is around 40 ft. to irrigate for cabbage. 20klpd. Earlier, cabbage was grown on all 10 acres and the pump worked for 24 hrs a day. Electricity is given free by the TNEB.

Present Water Use

Daily pumping - The well is pumped for 4 hours at 5 klph to a total daily use of 20klpd. The well dimensions of 7 m x 6 m x 1 m = 42 klpd available. Half the water in the well is being pumped daily. In earlier days they used to pump 24 hrs x 5 klph = 120 klpd. This volume of water is not available now. The well needs maintenance including cleaning, desilting, and side protection. This well offers scope for development as a recharge well. Among the risks to this well are new bore wells coming up in the vicinity.

Open well dries up

An open well at Vazhathottam of one Chokka gowder dries up at the peak season only in the earlier days, but now the open well around 15 feet deep has dried up throughout the year. This shows the utilization of water through bore wells the ground water has depleted to certain extent.

4.3.2.2 Dug Well at Chemmanatham

The well is around 15 m long, 6 m wide and 12 m deep. Currently the well is totally dry and there is evidence of partial collapse into the well. The well has a volume of around 1000 m³, which is a million liters of storage. From the viewpoint of recharge, this well could prove to be invaluable and will contribute significantly to the rejuvenation of springs in Chemmanatham.

The well needs repair, and can function as an effective recharge well by adding a collection, filtration and filling system, which will allow water to flow into the well without damaging the sides. The well also will need the sides to be raised to prevent runoff from entering the well directly. Desilting side protection and a regular maintenance schedule will ensure that this well could be of great value to the Chemmanatham community. The risks that the well could face are new bore wells coming up in the locality (since it was reported that influential people are still able to drill bore wells due to corruption at the local level). It is recommended that after the completion of works and recharging of the water table, a study be undertaken of the pumping rates, recovery rate of the water table, time and depth, etc.

4.3.2.3 Dug Well at Moyar (OB Lingan)

OB Linga a farmer at Hundi Moyar whose well is 6m by 6m and 10m deep. This well has a bore well placed adjacent (belonging to the same person) at a distance of around 12 m. The well water has been impacted by the bore well. The bore well is also low yielding. The well has not been maintained and the debris of the earlier walls has partially fallen inside the well. The inside of the well exhibits good joints patterns and joint spacing. This can be used as a good recharge well during the rainy season. The well has joints patterns in both horizontal and vertical. The bore well is a low yielding using a 5 HP Air compressor and the yield is around 2 klph. The BW is near the well and water level in the well goes down on pumping, indicating the seepage connection. Water is also pumped to this property from a near by bore well which is yielding more water and probably has a direct recharge from the small Moyar reservoir.

4.3.3. Bore Wells

Though bore wells are officially banned, there are reports of bore wells being dug on the sly. The bore wells seen are the ones in Vazhaithottam on King's Range (a bore well with low output – 2 HP pump 1000 lph), O.B.Linga Farms (which has three and only one yielding with low yield) There are other bore wells in the different Wildlife Tourist Resorts but all are reportedly low yielding, reflecting the nature of the secondary low porosity.

Pesticide case study

One farmer at Moyar Mr. O.B. Linga Gowder has around 20 acres and plants vegetables like garlic, potato & so on. These are very high pesticide consuming crops which he sprays every year crop after crop. This high intensity of use of pesticides in this region is not good for the farm lands as well as the consumers. He has a huge open tank & an open well from where his fields are irrigated through sprinklers, but just the adjacent lands belong to the Boothanatham adivasis who do not have access to such kind of infrastructure & water. The FD governs them a lot on such matters.

4.3.4. Check dams

Check dams were constructed in the early nineties to assist local communities and wildlife avail of water during the difficult summer season. The alteration of river courses and changes of vegetation on the slopes starting in the British days and continuing today from endogenous to exotics have had significant impacts on water availability in the lower reaches, the most prominent of which is the Sigur.

Check dams proved to be of help probably for a few years until the sides were breached or the check dams themselves were broken by the force of water, which speaks volumes for both design and execution of such projects at the hands of various agencies. Only one check dam was seen which was still 'whole' at Bokkapuram and the ones at Siriyur, Manavala and probably others constructed along river courses at the foothills where the Sigur shares a boundary with the massifs were all seen to be in stage of damage and disrepair. Even the Bokkapuram check dam has gaping holes, which will eventually lead to the collapse of the check dam.

4.4 Interpretation from yields of dug wells and bore wells

It can be concluded that the four areas of Siriyur, Bokkapuram, Chemminatham and Moyar relatively offer the maximum scope for groundwater development. The open wells where linked to recharge systems like stream flows, and well-developed fractures or joints as seen in Siriyur and Moyar are quite dependable sources of good quality water as long as the water bearing horizons are not subjected to excessive exploitation, especially for irrigation, etc. Where bore wells have come up in the vicinity of these wells, the likelihood of the well drying up is very high, and examples can be seen in places like Chemmanatham.

The muscovite quartzites in Moyar probably offer good scope for groundwater development but further local studies using geophysical studies like 'Resistivity' interpretation can provide conclusive directions. The flat area in Bokkapuram, which is the wildlife 'drinking water' area with no rock exposures, is another area offering promise; however, this falls in the Reserved Forest area and probably will not qualify for further investigation or development without the concurrence of the Forest Department.. The foothills of Siriyur also offer ample scope for development of water resources.

4.5 Groundwater table

The ground water table is ranging from 350 feet at Masinagudi to less than 15 feet at Singara estate. This shows from the survey the water table variability is very fine. But the estate at Singara which has a open well and is only 10 feet depth with water is a low lying area. But have to check during the peak season for the availability of water in these open wells.

The ground water situation is alarming since there is no proper recharge process since the whole Sigur area falls under rain shadow belt. The rainfall is scanty with an average of 400 – 700 mm annual rainfall. The percolation of water is also less due to the porosity of the soil & the amount of rainfall. Since there is ban on bore wells

Livelihoods case study

People from Chemmanatham village find difficult to come to the main town, though they have a road there is no transport facility for them to travel in & out of their settlements. Though many schemes have been implemented by various government departments & panchayat board they have not looked for long term sustainability in the schemes. Since the agriculture scheme has become a flop due to one such scheme, they had no option but to do other alternative work, such as fishing and some small game activities. Most of them travel far of to Singara estates in search of work. They go early & come late in the evening for their day's earnings. Though some have cattle & graze and even some are hired for grazing others cattle, the cow dung from this place is sold outside to far of Kerala & Karnataka. Due to no job opportunities lots of people migrate out to other places like to Tiripur & Coimbatore for search of work. Many who could not afford to go elsewhere had joined the resorts in the Bokkapuram area for their earnings.

This is not the case with this only village, but there are many cases in other villages also. For example, Suresh & Mathan from Siriyur, Indranagar have to get up by 4 am to cook food for their bus by 6 am to go to work which is far more than 30kms to Singara and get back home only by 8 pm. This is the routine time table for both of them to make a living. Many have migrated outside this village because there is only one bus which goes out in the morning & comes back in the night. Many live on the ebb of life like hand to mouth existence. Since agriculture is only rain fed they have to depend on others & collection of non timber forest produce is also banned in this region for more than 10 years.

across the plateau, still private people do exploit lots of water for resorts & other uses. But the indigenous communities are denied this facility stating this as a wildlife zone.

Taking the scenario from the conservation angel, lots of ground water is being pumped for many purposes thus depleting the ground water without any monitoring how & when it is being recharged. Many bore wells gets dried up during the summer spell. Many bore wells have dried up permanently due to over exploitation.

4.6 Water Conservation Structures

There are lots of water conservation structures made across the plateau. The Forest Department has built numerous structures like check dams, earthen bunds, and percolation tanks. But most of them prove to be futile in their own usage. Most of them are silted up, many broken structures, no maintenance & constant monitoring of what has happened to these structures. Many of them are not in use & lots of them have surpassed its purpose of serving. Now lately percolation tanks have been made for wildlife, in which most of them are serving its own purpose to save wild animals.

4.7 Surface Water Resources

There are hardly surface water resources except for the monsoon season – for a period of less than six months all the streams in the plateau becomes active. But not all of them are tapped properly for the use, due to lots of regulation by the FD for the want of use by the wildlife. People get benefited during only the monsoon season & people who have bore wells to irrigate their crops. So the whole land is utilized fully during the monsoon only & left fallow during the summer & dry spell. All streams dry up fast due to upstream cultivation practices. Many small check dams also prevent water flowing down the stream. So only the Masinagudi stream which is the life for the people, because it supplies drinking water to most of the places on the plateau, and also for the wildlife of that particular area. This water comes from the Ultimate Pykara Hydro Project outlet from Singhara power station goes down the Moyar canal to join the Moyar river near the Boothanatham settlement.

There are hardly any springs in this plateau, except for two, one in Anaikatti & the other in Siriyur which is active only after the rains and it gets easily dried up fast during the summer.

Towards safe drinking water

The people at Chokkanalli had to walk 200mtrs to draw water from an open well which is not safe to fetch. They used to stand on the parapet wall draw water using a bucket & rope. It is not safe for children also. We change the situation by buying a hand pump with a foot valve & hose for pumping water while on the ground itself, need not climb the parapet wall and in course covered the open well with chain link & wire mesh for preventing fall of dead leaves or other materials into the well. The people use the hand pump when there is no power to operate the motor.

4.8 Local Body Institutions

4.8.1. Panchayat boards

There are five Panchayat Boards for the seven villages which we work with in the plateau. All coming under different administrative blocks, see details in the below table. It is very imperative for the people of this region to operate from their villages to access these Panchayat boards since the distance & the logistics needed to fulfill any obligations or requirements takes its own time in completion. Any such small repair works or any maintenance work to be done or any breakages, leakages to be complained or get it restored it takes days or weeks, sometimes even months for the concerned officials to come take stock of the situation & do some remedial measures for the people. Sometimes even people hesitate to travel so far & spend money to complain & take risk. There is no proper transport facility to most of the settlements, especially to the forest settlements.

Table 4. Panchayat Boards in Nilgiris District

Administrative Block	Panchayat Boards	Villages
Gudalur	Masinagudi Panchayat	Boothanatham, Chemanatham, Vazhaithottam
Ooty	Sholur Panchayat	Kurumbarpallam
Ooty	Kadanad panchayat	Chokkanalli
Ooty	Ebbanad panchayat	Anaikatti
Ooty	Kukalthorai Panchayat	Siriyur

4.8.2. Tamil Nadu Forest Department

The forest department has its own stake in the whole of the Sigur Plateau. This region comes under the Nilgiris north division & is adjoining the border of Karnataka with Bandipur Tiger Reserve in the north side & the Sathyamangalam forests towards the east side. Towards the west is the Mudumalai Wildlife Sanctuary & National Park. Towards the south lies the escarpment of the Nilgiris Upper massifs. The Sigur plateau is divided into two ranges like the Sigur range & the Singhara range & other area comes close to the sanctuary area. One main river is the Moyar which is the life line for wildlife existing in the region. The FD has done many beneficial schemes for the development of the indigenous communities of the region, but lately due to lots of restrictions & other developments in conservation like the proposed tiger project is making people miserable thus depriving them of their social dwellings & other needs. The FD has banned collection of NTFPs nine years ago, taking the stand for wildlife conservation, etc. By doing so the people have no other livelihood options but to migrate to labour force outside the forest settlements for earning their bread, but still the transport availability is very much limited. Bore wells have been done by the FD for drinking water & other uses which is not sufficient enough to meet the requirements of all the needs of the people in the villages.

From the water perspective they are not allowing communities living inside the forest settlements to exploit the ground water through bore wells, they have fixed restrictions, but the resort people somehow get enough for their needs. There are numerous work implemented by the FD like the watershed wok, the HADP work for

soil & moisture work, but no one knows the effectiveness of all the structures made & who are the beneficiaries. Some of the work done by the FD is given below in a tabular form.

4.8.3. TWAD Board

The Tamil Nadu Water & Drainage Board is instrumental in implementing water related works in the Plateau. They have built huge tanks in Masinagudi to pump in water & then distribute drinking water to most of the town & settlements in that region. Mainly water is taken to Chemmanatham, Mavinhalla, Vazhathottam beside the Masinagudi town itself. It has implemented many schemes & has handed over to the Mansinagudi Panchayat board once it is operational. The information collected from the TWAD board office at Ooty will throw some light into the work done by the TWAD at Sigur.

Table 5. Work progress By TWAD Board

<u>Village Name</u>	<u>Census Village</u>	<u>Population 1991 - 2001</u>	<u>Total Pop</u>	<u>No. of Houses</u>	<u>Permanent Construction</u>	<u>Thatched Roof</u>	<u>W S status in LPCD</u>	<u>River Basin</u>
<u>Valaithottam</u>	Masinagudi	SC-100, ST-300	1000	240	200	40	OA-40Mi-40Ma PP-30Mi-40Ma	Moyar River
<u>Boothanatham</u>	Masinagudi	90	90	14	14		HP-30 PP- 20Mi-30Ma	Moyar River
<u>Siriyur</u>	Kokalthorai	ST-250, 150	250 - 150	50	50		OA-40Mi-40Ma PP-40Mi-40Ma	Moyar River
<u>Anaikatti</u>	Ebbanad	ST-610-250	610 - 250	60	50	10	OA - 20 - 25 PP - 20 - 25	Moyar River
<u>Chokkanali</u>	Kadanaid	ST-210-150	200 - 150	40	40		OA - 40 - 55 PP - 40 - 55	Moyar River
<u>Semanatham</u>	Masinagudi	ST-110-125	110 - 125	40	20	20	OA-20Mi-30Ma PP-20Mi-30Ma	Moyar River
<u>Kurumbapalam</u>	Sholur Nagaratham	ST-285-270	285 - 270	50	40	10	OA-30Mi-40Ma PP-30Mi-40Ma	Moyar River

4.8.4. Tamil Nadu Electricity Board (TNEB)

Though the British regime in the district has changed the whole water regime of the region given lots of redesigning of the streams etc, the Tamil Nadu Electricity board

has followed suit trying to promote Hydel power stations thus altering the water availability and tapping even springs from upper slopes which has been diverted to the power generation plant through channels or tunnels. The Moyar camp is a famous camp, the last one before the main Moyar Gorge. The construction of the Ooty Lake by the British is to provide perennial water along the Sigur River, but this water has been diverted to the Pykara Ultimate hydro electric project. The waters of Pykara are used for generation at Singara and then at Moyar powerhouse, hence these waters are not allowed for irrigation. The main waters of the Moyar are in the deep gorge, hence beyond the reach of all the villages other than Thengumarada which is further down below the North Eastern Slopes, which is surrounded by the waters of the Moyar on three sides. The whole town Masinagudi has developed due to the EB Moyar camp; even now the Singhara power station has added lots of development to this region. Though there is large scale production of Power is there, the power is taken to other districts and linked to the state & national grids denying power to the indigenous people who live here for ages. But lately due to the TV scheme by the present CM has enabled most of the settlements to get power.

4.8.5. Hydro Metric Services – River Valley Project

Hydro Metric Services (HMS) which is part of the River Valley Project implemented by the District Administration, HADP – watershed component has got its own structures made along the stream & has put up monitoring stations to record flow of water, silt etc. to check water flow rate, erosion possibilities etc. It has an automated machine which records all parameters in a graphical mode. The stations are inside the wildlife sanctuary & one near Kurumbarpallam which is easily accessible.

Table 6. Water Sources for Villages in Sigur

Village Names	Power Pump/Scheme Year	Hand Pump/Scheme Year	Mode of Finance	Executing Agency	Cost	Status/Condition	Top Soil	Sub Strata
<u>Valaithottam</u>	1994	1989	Local Body Drought Relief	Local Body			Clayey	Sediment
<u>Boothanaham</u>	1995	2001-Extension Pipeline	Local Body Municipality	Local Body	0.8 Lacs 5.5 lacs	Not Working	Others	Hard Rocks
<u>Siriyur</u>	1997		Local Body	Local Body		Not Working	Gravelly	Hard Rocks
<u>Anaikatti</u>	1998		Local Body	Local Body	2.5 lacs	Working Satisfactorily	Clayey	Hard Rocks
<u>Chokkanali</u>	1982		Local Body	Local Body		Working Satisfactorily	Clayey	Hard Rocks
<u>Kurumbapallam</u>	1999-Extension Pipeline		Local Body	Local Body	1.2 Lacs	Working Satisfactorily	Gravelly	Combination

5. PROJECT ACTIVITIES

5.1 The Land & Water Use Study

To understand the land use pattern, land holdings from different villages & stake holders regarding the water usage a complete study of the plateau was undertaken to understand the situation of the region. A complete analysis has been done & explained in a graphical output so that it is easy to understand the context. In this study the type of chemical input has been studied & the intervention of the farmers in terms of water usage their time of pumping hours, type of irrigation methods etc. The following questionnaire was made for the survey of this region.

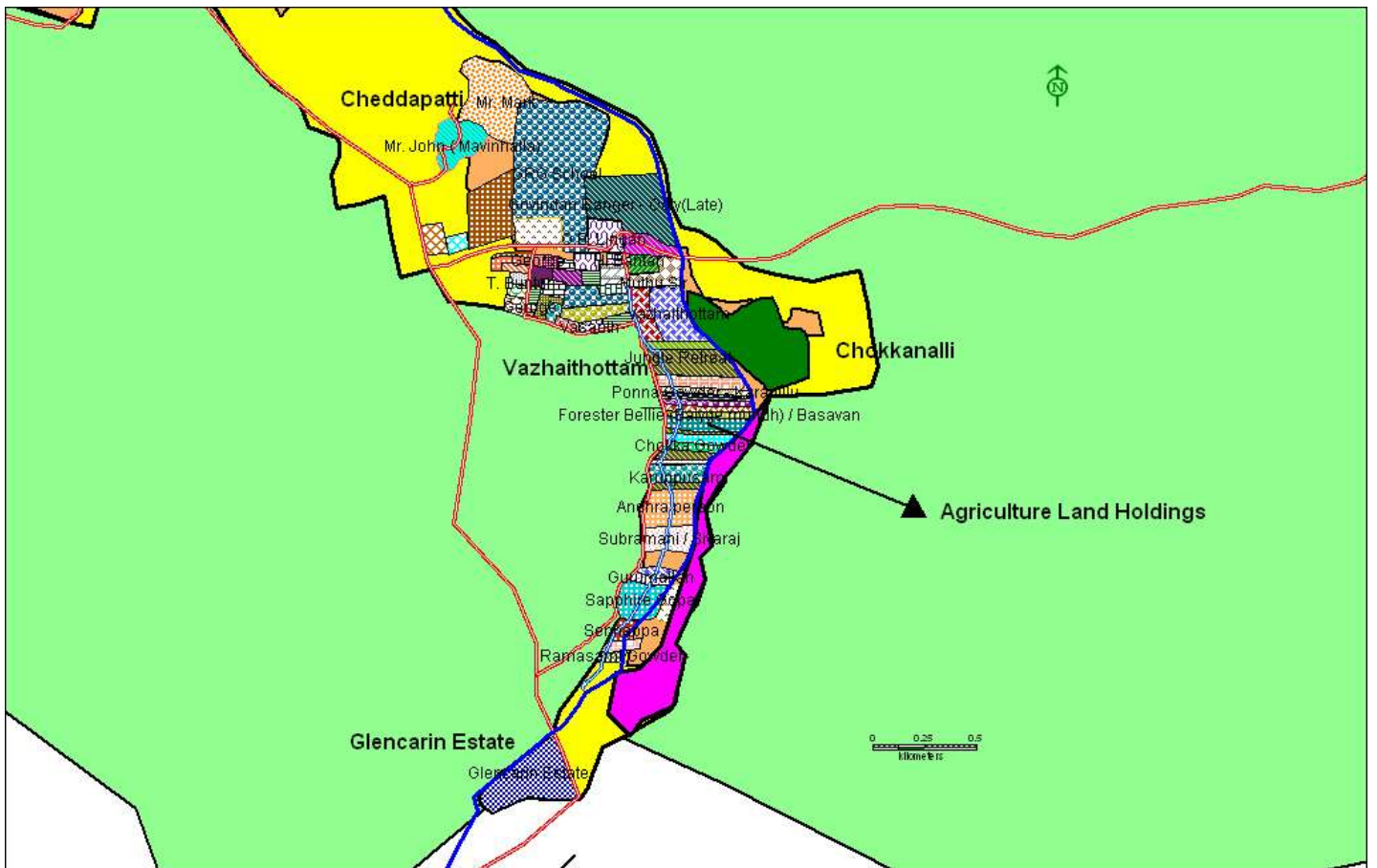


Table 6. Water Usage & Land use Questionnaire

Name of the Owner:
 Name of the Village:
 Survey number of the land:
 Land Ownership(in acres):
 Principle land use: Agriculture-

Types of Water Sources:-

Sources	Stream	River	Spring	Open well	Bore well	Panchayat connection
(Tick Mark)	√				√	
Depth/Flow (in feet/Liters) per second)						

Total number of sources for drinking water purpose: Panchayat Water

Number of sources for irrigation & time taken to irrigate & frequency:

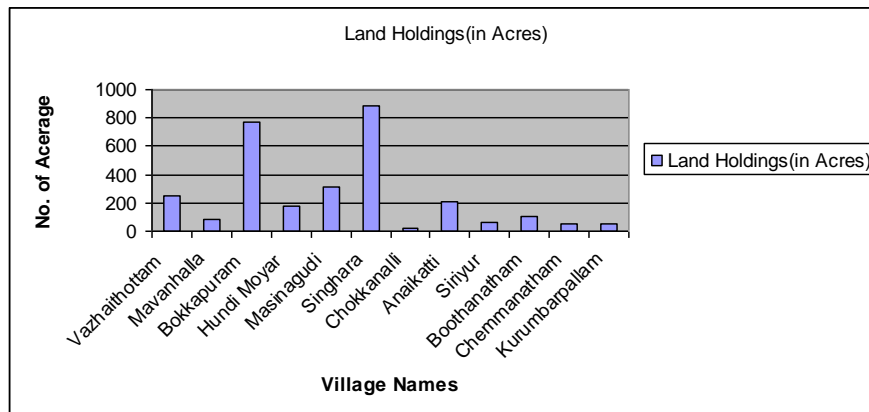
Mention if seasonal / perennial:
 Observations if any:-

Pollution
 Protection -
 Water harvesting structures if any:
 Wastage / Leakages:
 Others -

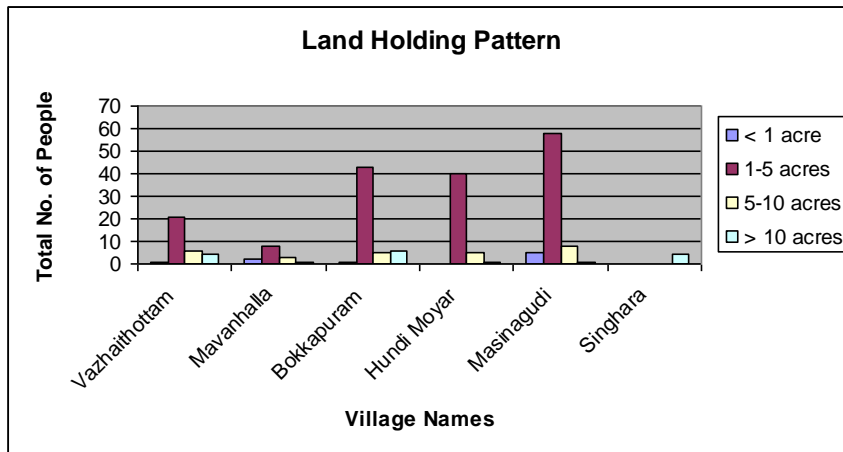
Nilgiris Water Resources - Sigur water project, Keystone 2005

The following graphical output gives an insight depth into the study carried out. The analysis of the complete survey of the plateau is as below. The bar chart shows the total land holdings in acres in all surveyed villages

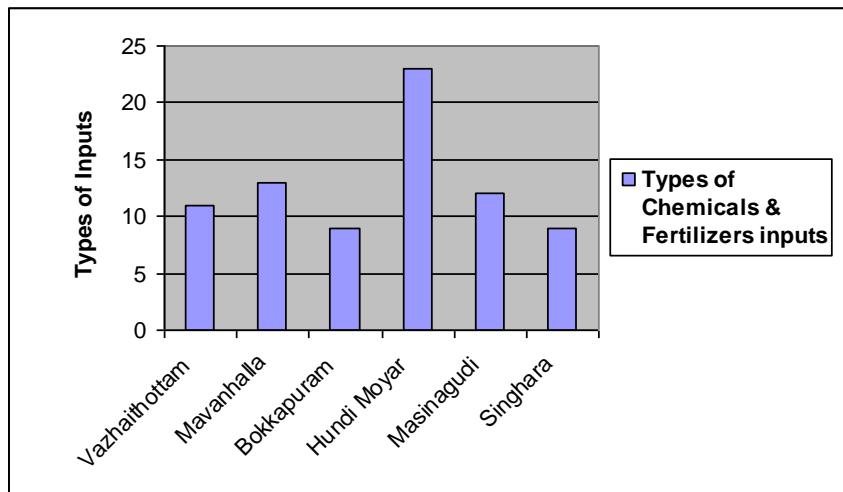
Graph 1. Total Land Holdings at Sigur – Village wise.



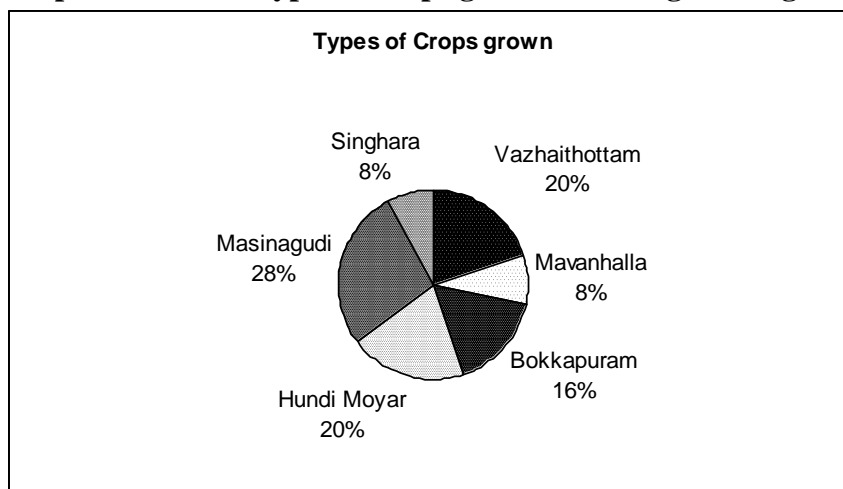
Graph 2. The size class land holding pattern of the villages



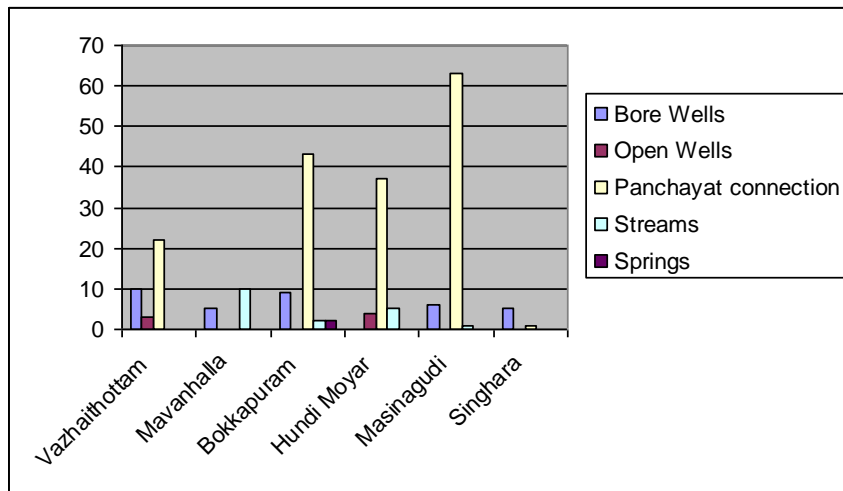
Graph 3. Different types of chemical inputs in different villages of Sigur.



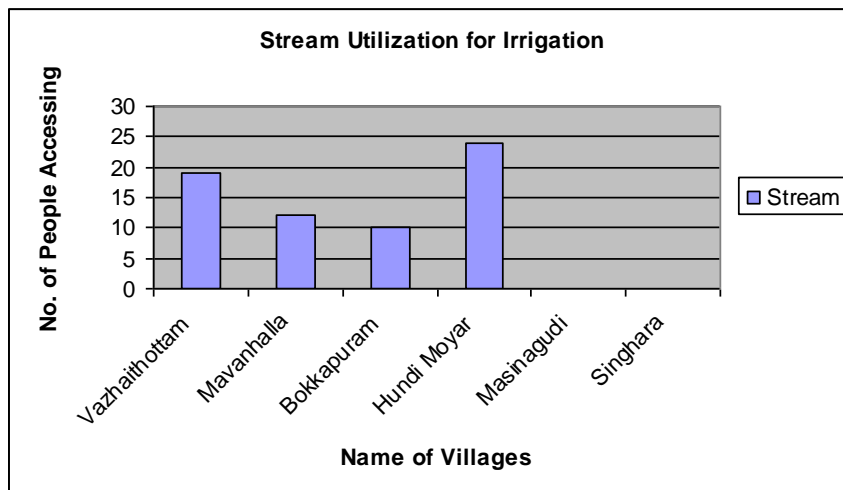
Graph 4. Different types of crops grown in the Sigur villages



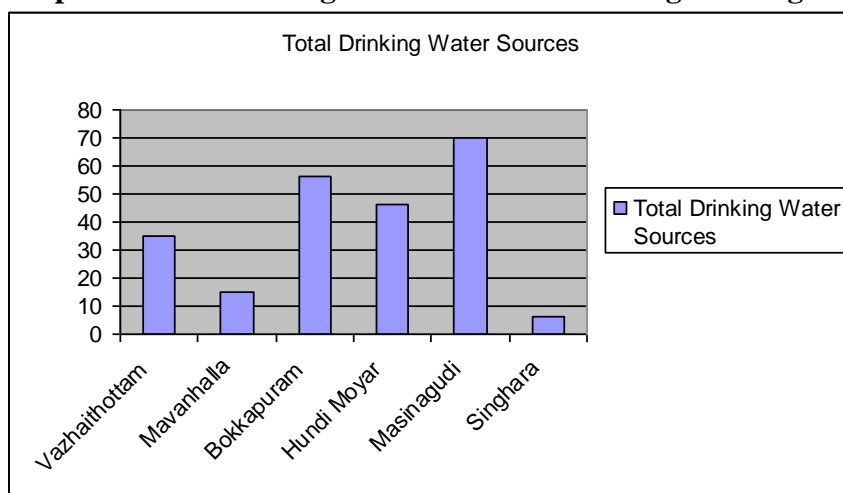
Graph 5. Different sources of drinking water in Sigur area for each village.



Graph 6. People accessing different streams of their region for Irrigation

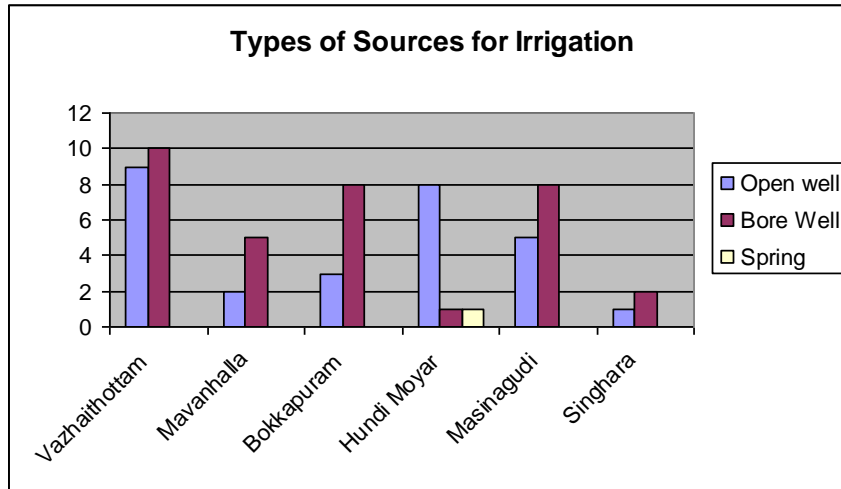


Graph 7. Total Drinking Water Sources in the Sigur Villages



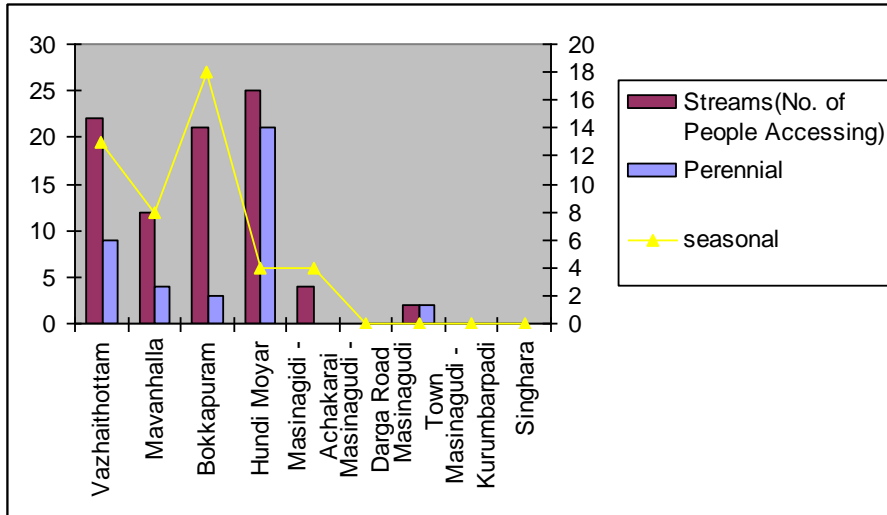
Note: These settlements are exclusive of the forest settlements inside the reserved forests of Sigur & Singhara like Chemmanatham, Siriyur, Anaikatti & Chokkanalli.

Graph 8. Different types of sources for irrigation in the Sigur region.



These sources do not apply to villages inside forest settlements where people draw water from streams during the cultivation period.

Graph 9. People depending on streams for irrigation at Sigur which are perennial as well as seasonal during the cultivated period.

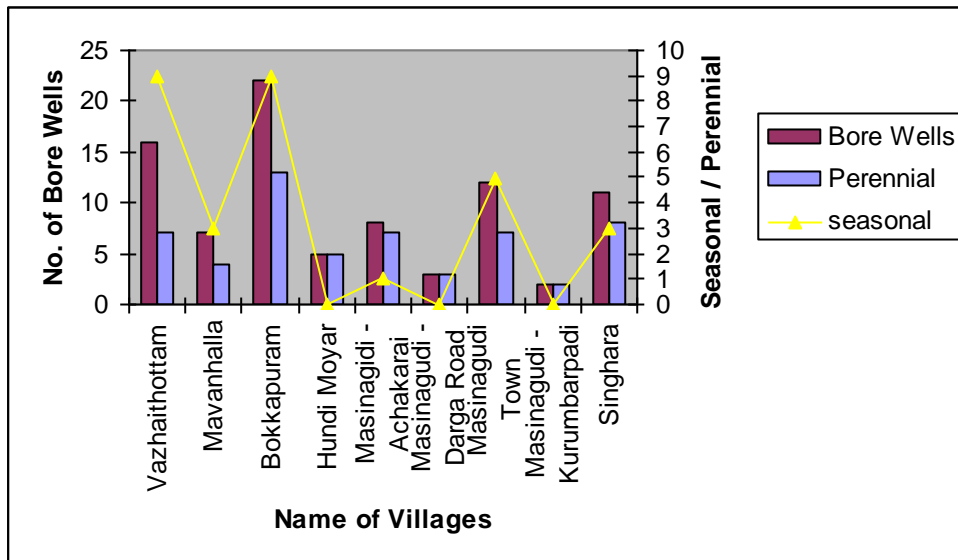


Highlights

The highest number of people accessing seasonal stream is from Bokkapuram & the minimum people accessing seasonal stream is from Hundi Moyar & Achakarai (Masinagudi).

The maximum number of people accessing perennial stream is from Hundi Moyar & the minimum people accessing perennial water is from Masinagudi.

Graph 10. Number of bore wells which are seasonal & perennial in the villages.



Highlights

The bore wells which are high and perennial are from Bokkapuram & low are from Kurumbarpadi (Masinagudi). The bore wells which are high in seasonality are from Vazhathottam & Bokkapuram, but the lowest is from Achakarai.

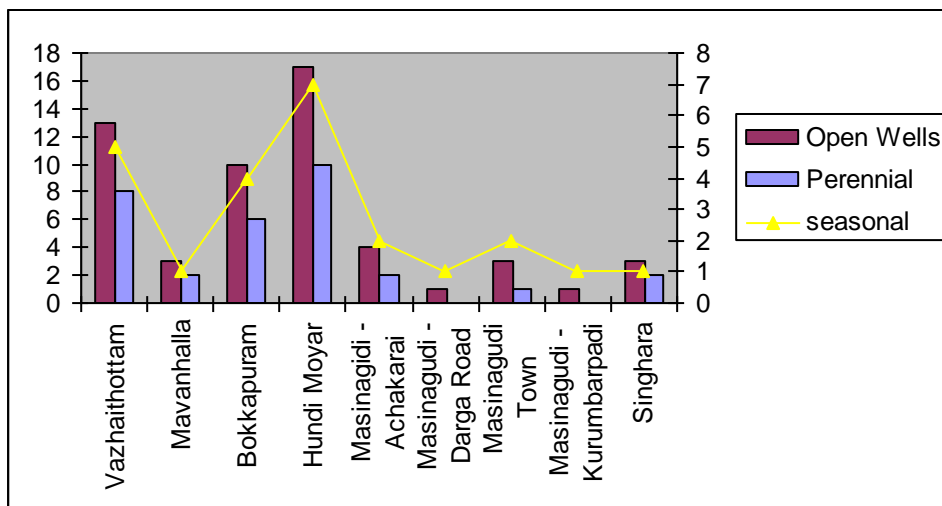
Access

At Siriur village, the main group is Irulas who have good access to water sources like the local GLR and also the right to collect water first. But Indranagar cluster, with Jenu kurumbas had no water at all at their place. They have to walk around 370 meters to catch water from the temple GLR. But after this project water was taken to their doorsteps by laying GI pipelines for about 370 meters from the main village. Taps with stand posts were provided. Inside the main village itself distribution taps were provided for all the streets to provide safe drinking water.

Similarly at Anaikatti village the Jenu Kurumbas of Kanyakumari had no water for drinking but to depend on the nearby check dam built by the FD which is not at all clean. After we intervened we had to relay all the pipes to Kanyakumari and after correcting technical errors we could give drinking water for that village. Since the people of this village are from a different community the Irulas were being hesitant to share the water with them initially, but after our intervention the problem got solved. This has changed life to safe drinking water which has a direct impact on the health of adivasis.

At Boothanatham, the farmer Basuvan had made a change in his life, the only farmer doing serious farming and initially practiced organic farming & harvested garlic & beans. But gave up after sometime to conventional farming & is the only farmer who access the facility created by us for irrigation of his land throughout the year. His occupation has increased his incomes and sustained his living. But all others due to different reasons & quarrels have abandoned farming and left their land fallow.

Graph 11. Number of open wells which are seasonal & perennial

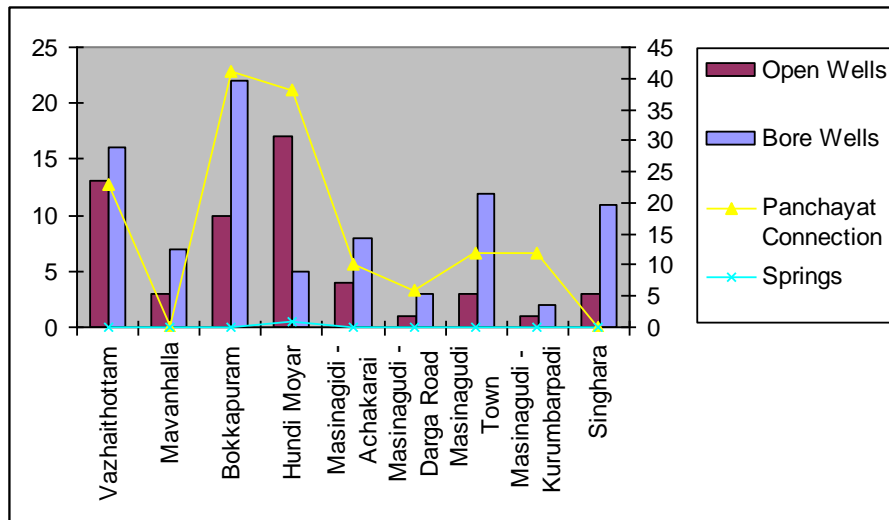


Highlights

The open wells which are perennial and more are from Hundi Moyar & Vazhathottam & which are low are from Mavanhalla followed by Singhara.

The open wells which are high in seasonality are from Hundi Moyar, but the lowest is from Mavanhalla followed by Singhara.

Graph 12. Total types of Drinking Water Sources in the Sigur Villages

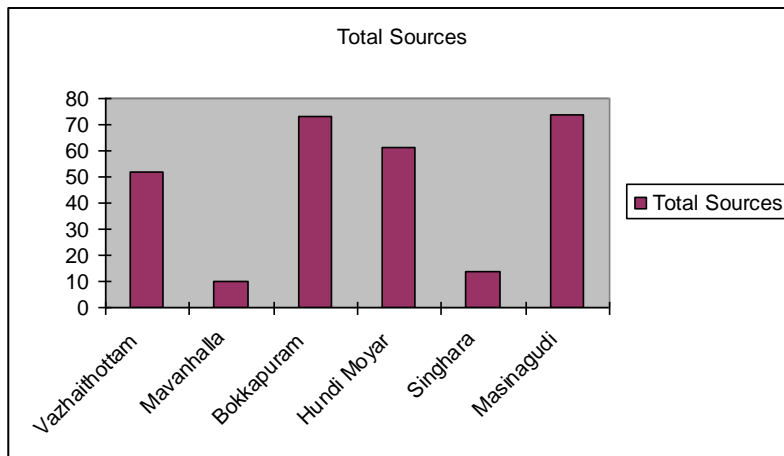


Highlights

The highest number in types of drinking water sources is from Bokkapuram area and the lowest types is from Mavanhalla & Masinagudi Durga road area followed by Singhara area.

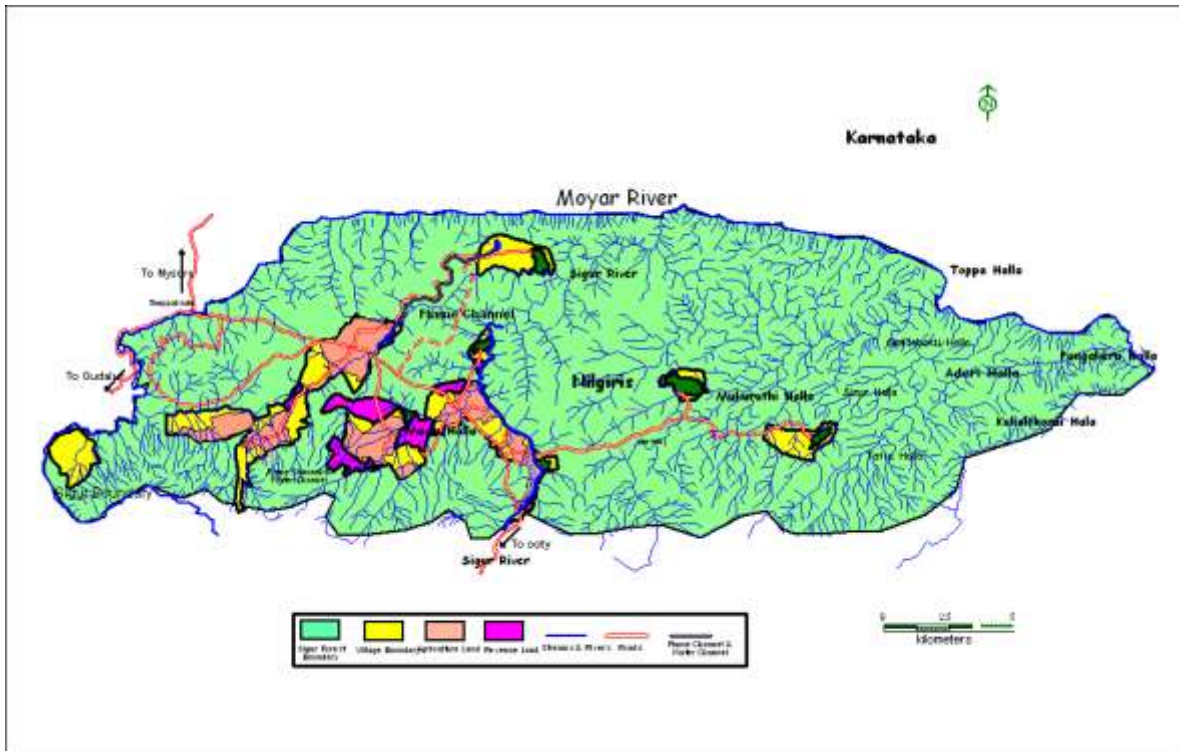
For Open Wells, the highest number is from Hundi Moyar followed by Vazhathottam & for Borewells it is from Bokkapuram. The lowest is in Mavanhalla for bore wells & for open wells the lowest is in Mavanhalla & Singhara.

Graph 13. Number of Water Sources in Sigur including drinking water & for irrigation



Highlights

The total sources at all villages exclusive of the forest settlements like Anaikatti, Chokkanalli & Siriyur.



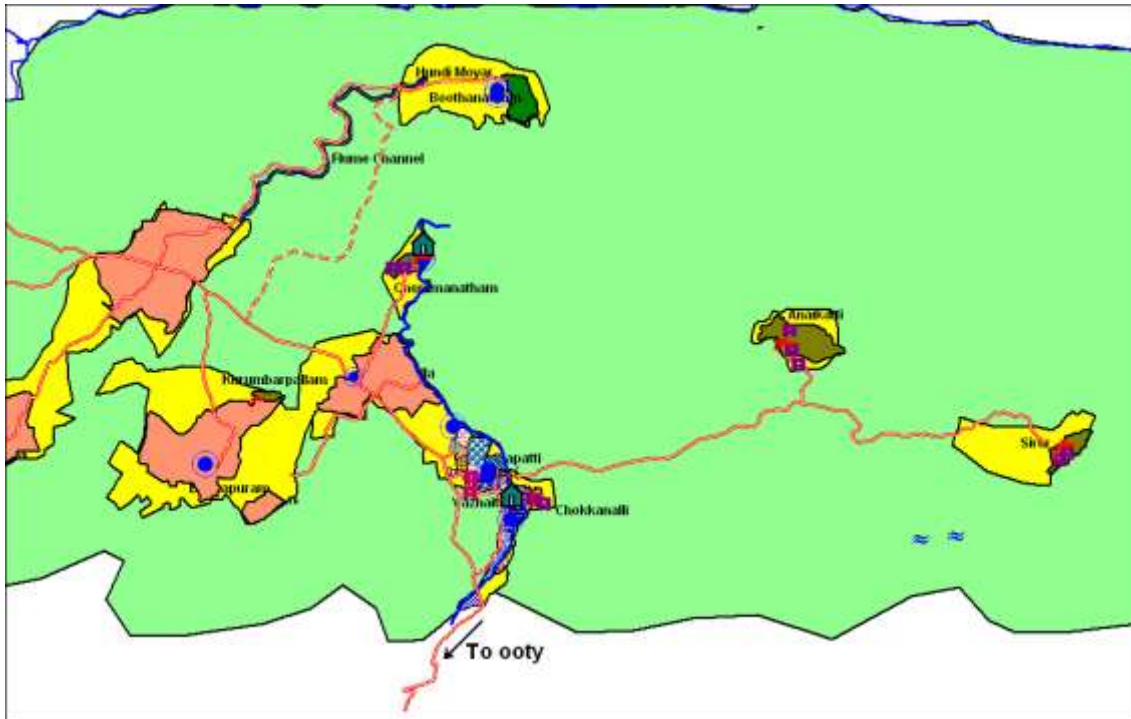
5.2 Livelihood Activities in the Sigur Region

5.2.1 Agriculture

This plateau being a unique location in terms of people, forests & wildlife – the real impetus on agriculture is not there except for few people who are doing cultivation in a regular basis. The forest settlements which has its boundaries demarcated & fenced by the FD is limiting in one way for the people who are capable of doing large scale cultivation. The land holding differs from village to village for the indigenous communities. But there are big fields of private owners who do agriculture in a big way. Some villages have lesser lands like Kurumbarpallam where the scope is limited. In areas like Boothanatham, water is a problem & the land allotted to them is not suitable enough for good crops because of its gravelly nature. In Chemmanatham water is a problem, though there is a check dam built years ago, the dam is partially defunct as the irrigation scheme is not implemented properly. Now people are blamed for not paying the electricity bill etc. There was no proper insight built into the scheme for future sustainability. The forest settlements inside the reserved forests are limited in many ways. They find difficult to acquire agriculture tools. Few people who are capable to hire tractors do. These villages have to depend on rains for a seasonal crop which is unpredictable which can be a success or a failure. It is only rain fed crops. Through Keystone lots of seeds have been distributed in these villages & helped them to hire tractors to plough fields.

This plateau has a scanty annual rainfall of 400mm which will not help the farmers for two crops in a year. All the streams will dry during the dry seasons. It is only six months where water can be used for agriculture irrigation purpose. They leave the land fallow till the next season. This way their income is limited to great extent & they have to migrate to other places in search of wages to far estates & fields. For example people from Siriya travel to Kalhatti or Singhara places in search of work.

There are irrigation channels built to facilitate cultivation at Anaikatti, Siriyur but the channels have given way & needs repair to complete the purpose. These channels dry up during the peak summer season. Crops which are grown are different beans, garlic & other millets like ragi, thennai, maize etc. There are few farmers in Moyar region who enjoy the maximum water for irrigation using sprinklers & bore wells but at the same time the indigenous communities suffer a lot without any proper attention from the administration. Lots of chemicals & pesticides are also applied to the soil which makes it more hard & dry killing most of the micro organisms. Soil & moisture conservation has to be addressed in an alarming speed to avoid loss of productivity & the health of the soil which has a direct impact on the health issues.



5.2.2. Forest Collection

Forest collection known as NTFPs which were collected for generations from the forest of Singara & Sigur has been stopped since 10 years by the forest department considering it to be a crucial area of wildlife to forage for its food and as a corridor. The department had brought up the LAMPS society earlier to facilitate collection of NTFPs and market it to the buyers for the indigenous communities to benefit from the natural resource. But, due to the ban by the department, the livelihood of the people in that area is at stake. Now there are many proposals to reconsider to open the area for collection, but time only will answer this expectation. The main NTFPs available for extractions are Amla, Kadukai, Eecham, Honey & Poochakai apart from Tamarind & other items. This was a major occupation during the harvest seasons. There is another equation altogether saying that since Mudumalai WLS is proposed for a Tiger Reserve even the Sigur and Singhara reserves should be brought under the ambient of protection as a park. So this issue is yet to be solved.

5.2.3. Grazing

The grazing factor in this region has come down of all these years, since the number of cattle has been drastically brought down some were from 28,000 to some few thousands in recent years. It is interesting to see the fact that earlier the Badagas from the upper plateau used to employ people here to graze their buffalos & cows since it was an open accessible forests for such activity. But of lately the FD has tightened its rules saying no grazing is permitted in certain areas. Only few permitted pass cattle were allowed to graze. This is of course to prevent foot & mouth disease to spread over to the wild life form the cattle. History states there was large scale outbreak of Rinderpest at certain periods, killing most of the cattle which spread across the plateau killing many wildlife mainly the Indian gaurs etc. Given this fact, the Forest Department has taken stringent measures towards the conservation of wildlife. Now hardly few farmers have cattle to plough their fields for cultivation. Earlier lots of pattis were present with buffalo herds and most of them were forcefully evacuated from the region. Now joint operations from the Forest Department along with Veterinary department with IPAN (a local NGO) & other organizations are vaccinating for prevention of such epidemic in near future is on. The sad part of all these are the manure from these places are been sold to outside parties to Kerala & neighboring states, the biomass is eaten up here but there is no recycling, the manure is taken out & the soil is not replenished. After all these the cattle is grown here & sold to beef markets at Nilambur & other places in Kerala. It is colossal loss for the farmer who sells it for meager price.

5.2.4. Resorts & Wildlife Tourism

Resorts at Bokkapuram & other places like Mavinhalla, Vazhaithottam & in private estates are engaged in wildlife tourism activities. Many new resorts have come up currently. The clientele is not only local but even from abroad. Booking is done through email and all logistics is taken care off. There are lots of activities carried out like trekking, bird watching, jeep safaris etc, with the support from the forest department. The concerns are *how safe are the animals, are their corridors disturbed by fencing the boundaries of the property & what kind of fencing has been done.* There are more than a dozen resorts at Bokkapuram & an equal number in other areas which cater to a varied clientele. A major concern is that they pump large quantity of water from their bore wells & from the streams for their own purpose. None of the customers are aware of the kind of water they are using & there is no constant water quality test done to verify the same. But denying the same for the indigenous communities of the region is an unjust motive by the administration viz, the panchayat board & the resort community. There should be a system where the valid resource is made available to all in an equitable manner. Members of indigenous communities are not treated properly by the resorts since they are the means of occupation & livelihood option for the people who are living there within the vicinity of the resorts etc. Night safaris are arranged for the tourists at high costs & in turn the FD personnel are influenced to allow people to restricted areas for the sake of money thus spoiling & breaking the rules laid for the conservation of the same. Creating inroads into the forests which can positively make exotics like lantana & euphorium to grow in the forests making the mobility of wildlife more difficult, in due course making a habitat loss. The main issue is that to see the indigenous communities are benefited out of such activity driven enterprise, access to resource & economic returns to the people of

the region. It seems like few people are gaining at the cost of the locals who are finding difficult to thrive & grow in these vulnerable conditions.

5.2.5. Status of Village Forest Councils & Self Help Groups in the region.

The status of the VFCs & SHGs in this area is very weak. They are mostly exploited and have a lesser understanding of the whole concept. People who are in charge are also not taking adequate steps in bringing in more activities which can help the groups stronger and well self sufficient in their livelihood working models. The table below shows the number of groups. Some are working but most of them are slacking behind.

5.3. Water Users Groups – Challenges, Implementations & Meetings

To see the challenges which will come out of the team as well as the people a LFA was conducted calling people from all the villages to implement some of their ideas. The minutes are as follows:-

5.3.1 By Laws & Objectives for the Sigur Seemai Water User's Groups

Table 7. Status of VFC's

Forest Division & Range	Village Name	VFC / SHG - names	No. of members	President's Name & Address
<u>Nilgiris North Sigur</u>	Anaikatti	VFC	9	Saroja, Siriyur Mavanhalla P.O.
<u>Nilgiris North Singara</u>	Chokkanalli	SHG Puthiya Poo	11	Bellu, Chokkanalli Mavanhalla P.O.
<u>Nilgiris North Singara</u>	Chokkanalli	SHG Kalasam Poo	12	Haliammal Chokkanalli Mavanhalla P.O.
<u>Nilgiris North Sigur</u>	Siriyur	SHG Vanakulu	6	Saroja, Siriyur Mavanhalla P.O.
<u>Nilgiris North Sigur</u>	Siriyur	SHG Malai Sudar	12	Janagi, Siriyur Mavanhalla
<u>Nilgiris North Sigur</u>	Siriyur	SHG Malar Sudar	11	Rukki, Siriyur Mavanhalla P.O.
<u>Nilgiris North Sigur</u>	Vazhaithottam	SHG Thiaga Sudar	15	Kamala, Vazhaithottam Mavanhalla P.O.
<u>Nilgiris North Sigur</u>	Vazhaithottam	SGH Sendhura Poo	12	Belli, Vazhaithottam Mavanhalla P.O.
<u>Mudumalai WLS</u>	Boothanatham	SHG Jalamara Poo	16	Thangamani Boothanatham Masinagudi P.O.

These groups have been formed to bring understanding of water resources available in the Sigur region for various household & domestic uses. SIGUR SEEMAI WATER USER'S GROUPS consists of seven villages in the Sigur plateau, namely Boothanatham, Chemmanatham, Kurumbarpallam, Siriyur, Anaikatti, Chokkanalli & Vazhathottam where the office cum resource centre is located.

Each settlement has its own Water User's Group (WUG) which has a president & a secretary to look after the proceedings & development at the village level. There will be monthly WUGs meetings held in their respective villages to discuss about their water situation regarding the drinking water status & any other problems related to water borne diseases. Periodic workshops are conducted in the resource center to bring together all WUGs to understand the holistic picture of the Sigur water regime for the sustainable use of water in future. Training for drinking water potability test & plumbing training for the youth of this region has already been done. A water testing lab has been set up at the Vazhathottam resource center for the whole region.

1. All the money collected from the contribution towards the WUG fund will be in a central pool named as the Sigur Seemai Water User's Group fund.
2. An account should be opened in the name of the Group in a Bank or Post Office in Masinagudi which is jointly operatable by the Office Bearers of the WUGs & a field coordinator from Keystone field office, Vazhathottam.
3. The money will be utilized for specific purpose like mending leakages in pipelines, buying spare parts or for new distribution lines & for conducting water workshops & health camps, water testing & bring awareness among the local mass in the future.
4. The benefits out of the fund will go to all the villages irrespective of their individual village contribution.
5. A joint account will be operated by Vijaya w/o B. Sivaraj, secretary of the Sigur Seemai WUGs & one village coordinator from the Keystone field station, Vazhathottam.
6. If any problem arises from the functioning of the Groups, the Sigur Seemai Water User's Groups have to sit & sort the disputes with the support of the Keystone field staffs.
7. Money power upto Rs 1000/- can be sanctioned & approved by the President & Secretary of the Sigur Seemai Water User's Groups to carry out immediate or emergency implementation work related to water.
8. To operate the account at any given time or period the acceptance of all the WUGs is a must & the president & the secretary has to be present for the minutes approval.
9. All office bearers are liable to work as honorary office bearers for the Sigur Seemai Water User's Groups.

All the WUGs were invited for a water workshop at Vazhathottam field center on September 23rd, 2005, & Madhavi, w/o of Siddan of Chemmanatham was elected as the president & Vijaya w/o B. Sivaraj son of Bantan of Boothanatham was elected as the secretary of the Sigur Seemai Water User's Group. In this meeting it is agreed in principle that all WUGs will contribute from Rs 5/- to Rs 10/- per household/member per month towards the WUGs fund & the following conditions were unanimously accepted.

The WUGs at every village meet once every month represented by Keystone volunteers or by the village coordinators who discusses the issues & ways of implementing to solve the problems time to time. In the same time a contribution fund has been collected towards the groups fund for the future sustainability of the group to

implement work in the villages. All WUGs contribution fund is pooled into a common fund at the office. The list of members of each group & the status of the fund collection village wise is given below to give an idea of the developments. The contribution amount has been decided by themselves in the WUG meetings. From the inception of the project the following table gives an insight into the formation of the WUGs with its number members & their savings ending up to August 2007.

Table 8 . No. of WUG members & savings fund in Sigur Villages

S.No.	Village Name	WUG members	President Name	Savings
1	Boothanatham	29	Vijaya	1795
2	Kurumbarpallam	40	Bellu	2455
3	Chemmanatham	32	Madhavi	1920
4	Vazhathottam	14		540
5	Chokkanalli	27	Kavitha	1265
6	Anaikatti	31	Masi	1655
7	Kanyakumari	17	Basuvi	390
8	Siriyur	31	Laxshmiammal	1735
		221		+ 11755

0

Some Members of the Water Users group

Anaikatti Water User's Group.	Boothanatham Water User's Group	Siriyur Water User,s Group
<ol style="list-style-type: none"> 1. Jeyamani 2. B. Mari 3. Vanitha 4. Gowri 5. Parvathi 6. Nagi 7. Laskhmi 8. Sarsa 9. Banty 10. Vijaya 11. Menaka 12. Hallammal 13. Ganagai 14. Bellammal 	<ol style="list-style-type: none"> 1. Vijaya – President 2. Rajamani 3. Sumathi 4. Kala 5. Rani 6. Devi 7. Ponni 8. Madhavi 9. Halamani 10. Kalli 11. Mare(poojari) 12. Gowri 13. Mare 14. Sangeetha 15. Lakshmi 16. Siddhi 17. Thangamani 18. Sudha 19. Rajamma 20. Chikki 21. Ratna 	<ol style="list-style-type: none"> 1. Selvi 2. Vijaya 3. Sundri 4. Masiniamma 5. papathi 6. Rukku 7. Rangaswamy 8. Suresh 9. Mani 10. Moorthy 11. Chandramohan

The table below gives an idea how the WUGs are contributing towards the corpus fund for the future sustainability of the Groups.

Table 9. Contribution fund of Water user Groups towards the sustainability of the project

Village Names	YEAR 2005				YEAR 2006												Year 2007								Totals
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug	
Boothanatham	60	60	30	40	0	65	40	0	0	50	40	0	65	15	40	40	50	85	40	60	35	60	840	80	1795
Chemmanahatm	0	0	0	0	60	0	0	0	0	0	0	0	0	55	200	70	90	55	30	50		25	1280	5	1920
Chokkanalli	0	95	50	45	75	100	0	0	5	75	40	0	40	5	0	90	95	65	80	85	65	70	115	70	1265
Vazhaithotttam	0	0	0	0	0	0	0	0	0	0	15	40	0	65	50	55	55	90	5	70	40	55			540
Kurumbarpallam	0	0	0	55	85	65	65	65	65	65	0	120	60	0	240	185	205	150	260	350	0	190	120	110	2455
Siriyur	0	0	60	65	60	110	50	50	60	80	75	70	65	70	50	95	20	105	75	135	140	100	105	95	1735
Anaikatti	20	35	0	0	10	25	10	10	25	70	15	70	180	145	130	120	130	90	120	105	100	55	95	95	1655
Kanyakumari													35	60	30	65	25	10	0	75	5	0	75	10	390
																									11755

5.4 Implementation

As part of the project component lots of implementation work has been done in the Sigur plateau regarding water and related work with farmers, the following table sums up all the implementation work so far in all the working villages with participatory approaches with the WUGs, youth & the farmer groups in the villages.

Table 10. Implementation in various villages

S.No	Village Names	Work Implemented	No. of Beneficiaries	Other details
1	Boothanatham	1. 2 polyline tanks for irrigation & drinking.	WUG - 29	Total Pop - 87
		2. Sprinklers 3 Nos. for farming	Farmers Group-25	
		3. Distribution pipeline(hose)- drinking.		
		4. 500 meters hose pipes for irrigation(farmers).	Direct Beneficiaries = 54	
		5. Supported field ploughing for WUG members	Indirect Beneficiaries =	Rest
		6. Distributed saplings to farmers		
		7. Seed support was given		

		8. Compost training was given & initiated organic farming.		
		9. Maintenance of Solar pump & panels.		
		10. Plumbing & fitting trainings		
2	Kurumbarpallam	1. Distribution pipeline work has been done.	WUG - 40	Total Pop - 214
		2. Tractor support for ploughing field - 13 farmers from WUG	Farmers Group-13	
		3. Seeds support given to the group		
		4. Bore well re maintenance initiated	Direct Beneficiaries = 53	
		5. Plumbing & fitting trainings	Indirect Beneficiaries = Rest	
3	Chemmanatham	1. Field ploughing support to farmers(WUG)`	WUG - 32	Total Pop - 158
		2. Seed support for group members - 20 persons	Farmers Group-28	
		3. Pipeline burried under ground from Mavanhall to the village.	Direct Beneficiaries = 60	
		4.Plumbing & fitting trainings	Indirect Beneficiaries = Rest	
4	Vazhathottam	1. Supported field plouging for farmers	WUG - 14	Total Pop - 205
		2. Seed support for WUG members	Farmers Group-2	
		3. School fees support for WUG childrens	Direct Beneficiaries = 16	
		4.Plumbing & fitting trainings	Indirect Beneficiaries = Rest	
5	Chokkanalli	1. Hand pump installed for drawing safe drinking water in absence of power.	WUG -27	Total Pop - 123
		2. Open well covered for safety with chain link & chicken mess.	Farmers Group-12	
		3. Distribution lines installed with five taps. 1/2 Hp motor repair work undertaken	Direct Beneficiaries = 39	
		4. 3" foot valve with hose pipe provided for irrigation pump set.	Indirect Beneficiaries = Rest	
		5.Plumbing & fitting trainings		
		6. Field ploughing support		
		7. Seed support for WUG farmers		

		8. School fees support (WUG) & DIET		
6	Anaikatti	1. Distribution pipelines for streets with 15 taps	WUG - 31	Total Pop - 431
		2.Plumbing & fitting trainings	Farmers Group-6	
		3. Spare parts for leakages		
		4. Bore well maintenance work & repairing of bore well pump	Direct Beneficiaries = 37	
		5. Field ploughing support	Indirect Beneficiaries = Rest	
		6. Seed support for WUG farmers		
		7. School fees support (WUG)		
7	Kanyakumari	1. Field ploughing support	WUG - 17	Total Pop - 34
		2. Seed support for WUG farmers	Farmers Group-11	
		3. Distribution pipelines for streets with 3 taps		
		4. The main pipeline from Anaikatti to Kanyakumari relaid.	Direct Beneficiaries = 28	
		5. Leakages repaired with spare parts	Indirect Beneficiaries = Rest	
8	Siriyur	1. Dhanakadavu check dam – de silting & cleaning	WUG - 14	Total Pop - 81
		2. Re laid the whole pipeline - 3 kms mending leakages	Farmers Group-5	
		3. Distribution lines to steets with 9 taps		
		4.Plumbing & fitting trainings	Direct Beneficiaries = 19	
		5. Field ploughing support	Indirect Beneficiaries = Rest	
		6. Seed support for WUG farmers		
		7. Seedlings of horticulture & fruit trees distributed		
9	Indranagar	1Hose pipe laid to village from the temple tank, now replaced with GI pipes-340m	WUG - 17	Total Pop - 28
		2. Field ploughing support	Farmers Group - 6	
		3. Seed support for WUG farmers	Direct Beneficiaries = 24	
			Indirect Beneficiaries = Rest	
		Note : Out of the total population in the villages 24.24% are direct beneficairees.	Direct Beneficiaries = 330	Total Pop = 1361

6. Environmental parameters of drinking water

6.1. Methodology of water testing

The methodology of water quality testing is followed by the guidelines set in by the Jal Tara of Development Alternatives of New Delhi whose following the norms set by the Bureau of Indian Standards for water quality. We have done & testing water for 13 physical parameters for the potability tests of drinking water (Annexure II). The table below shows the test carried for the parameter and which chemicals are being used for and how it is tested. These criteria has been translated into regional language, here into Tamil and is been shared by the villages.

From the above testing criteria & procedures the testing characteristics and its permissible limits and effects are given in detail in the following table,

Table 11. Test Characteristics For Drinking Water source: ESB- Development Alternatives

S. No.	Substance or Characteristics	Requirement (Desireable Limit)	Effects outside the Desirable Limits	Permissible limit in the absence of alternate Source	Remarks
1.	pH value	6.5mg/l - 8.5 mg/l	Beyond this range the water will affect the mucous membrane &/ or water supply system	No Relaxation	
2.	Temp * C	>25 *C	Too hot to drink		
3.	Dissolved Oxygen	500 mg/l	Beyond this pal ability decreases & may cause gastro intestinal irritation	2000 mg/l	
4.	Residual, free Chlorine	0.2mg/l			To be applicable only when water is contaminated. Min 0.5mg/l
5.	Turbidity NTU, Max	5	Above 5, consumer acceptance decreases	10	
6.	Chlorides(Cl mg/l)	250	Beyond this limit, taste, corrosion & palatability are affected	1000	
7.	Nitrate(NO ₃)mg/l	45	Beyond this metha-emoglobinemia	100	

			takes place		
8.	Fluoride(F) mg/l	1.0	Fluoride may be kept as low as possible. High fluoride may cause fluorosis	1.5	
9.	Iron (Fe) mg/l	0.3	Beyond this limit taste, appearance are affected, has adverse effect on domestic users & water supply structures, & promote iron bacteria	1.0	
10.	Total Hardness(CaCO ₃)	300	Encrustation in water supply structure & adverse effects on domestic use	600	
11.	Phosphorous				
12.	Coli forms	No		No Relaxation	

These have been translated into Tamil language and is been displayed in the resource centre to be explained to the villagers and the groups for proper understanding of the water usage and its health factors. The translation in Tamil is given in Annexure 2.

6.2 Field lab – Water Quality Test

At the resource centre at Vazhathottam a field lab for testing water quality for drinking water parameter has been set up. The water samples are collected once in every two months to carry out the tests. It has been a continuous activity since the lab has been set up at the centre. Water from all the villages has been tested and the results are shared to the villages during the WUGs meetings every month and are been advised to boil the water if there is any adverse affect on the health due to rains or dryness or could be due to hygienic factors.

6.3 Training of Field Staff

Two village women coordinators have been trained to carry out the water quality testing in the resource centre lab. They have been trained to take precautionary measures while collecting the water samples. Then they interact with the WUGs in the villages during the meetings about the findings. There are two water testing kits one if the main office & one in the resource centre. People from private wells & estates come to the field for testing water & even students come to learn and perform tests themselves for their reports and so on.

6.4 Data on Potability tests & Analysis

As stated earlier there are lots of test results which has been analyzed periodically and been shared to the community people regarding the findings. Here are some of the test results which can be looked upon for the kind of water the people in the Sigur plateau are consuming.

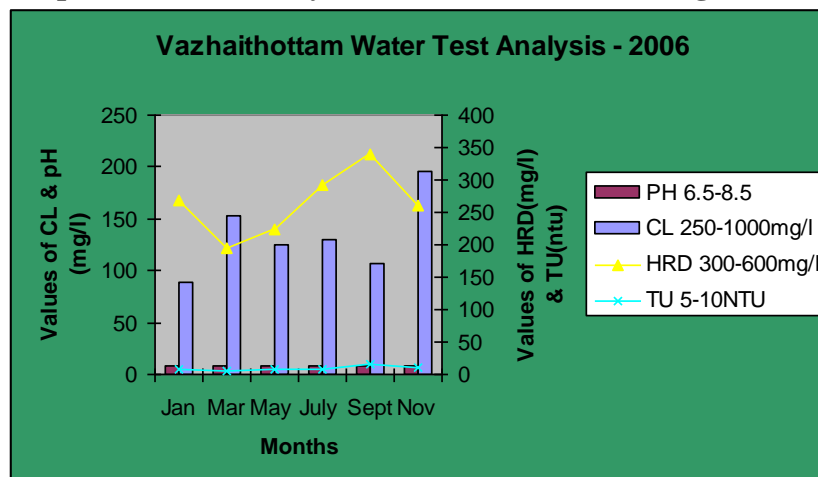
Figure 2. Sample of Test Results for the month of January, 2007

Test Results for the month of January 2007													
Name of Village	pH/6.5-8	Temp C*	DO-500	RC - 0	TU - 5	Cl-250-10	Nitrate-45	Flouride	P-10-30	Fe - 0	HRD- 30	NH3 >	Coli - Y/N
Vazhaithottam	8	not taken	11mg/l	0.2	15	106.5	10mg/l	0.6mg/l	0.2	0.3	160mg/l	1	not done
Chokkanalli	8	not taken	12mg/l	0.2	16	88.625	10mg/l	0.6mg/l	0.2	0.3	304mg/l	1	not done
Anaikatti	8	not taken	18mg/l	0.2	20	709	10mg/l	0.6mg/l	0.2	0.3	200mg/l	1	not done
Siriyur	8	not taken	11mg/l	0.2	15	77.99	10mg/l	0.6mg/l	0.2	0.3	220mg/l	1	not done
Chemmanatham	8	not taken	11.2mg/l	0.2	15	77.99	10mg/l	0.6mg/l	0.2	0.3	120mg/l	1	not done
Kurumbarpallam	8	not taken	15mg/l	0.2	15	302	10mg/l	0.6mg/l	0.2	0.3	280mg/l	1	not done
Boothanatham	6	not taken	12mg/l	0.2	10	85.08	10mg/l	0.6mg/l	0.2	0.3	160mg/l	1	not done

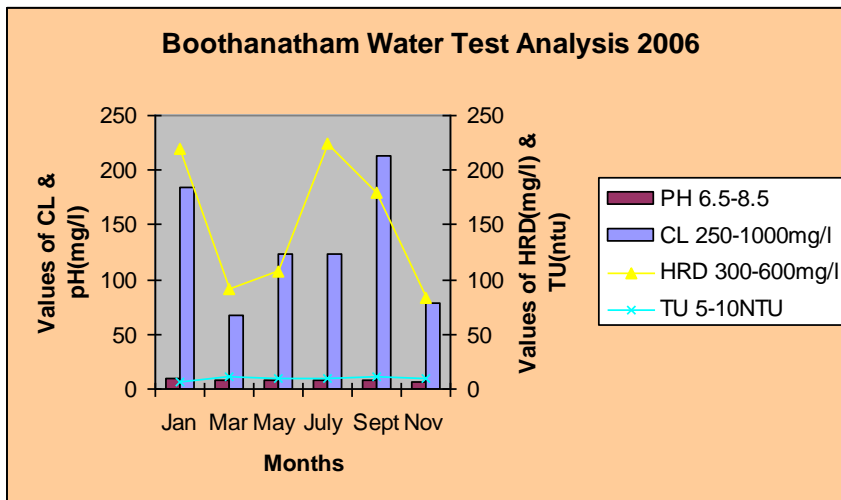
Note:- The p H values are above & below at Chokkanalli & Boothanatham respectively.
 Dissolved Oxygen is very much low in all the villages - reason not known.
 Chloride & Nitrate is also low in all the villages
 Hardness is also low except for Chokkanalli
 Temperature was not taken due to non availability of thermometer & Coliform test not conducted.

6.5 Analysis on the Water Quality Data of Sigur

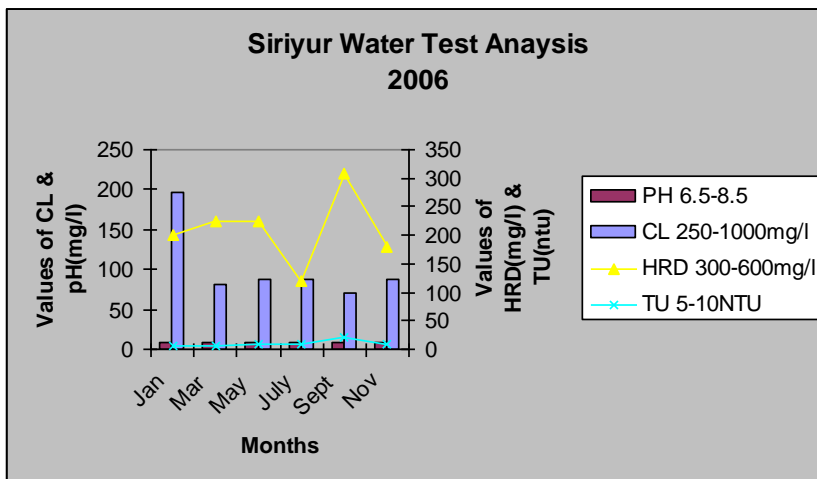
Graph 14. Water Analysis for Vazhaithottam Village in Year 2006



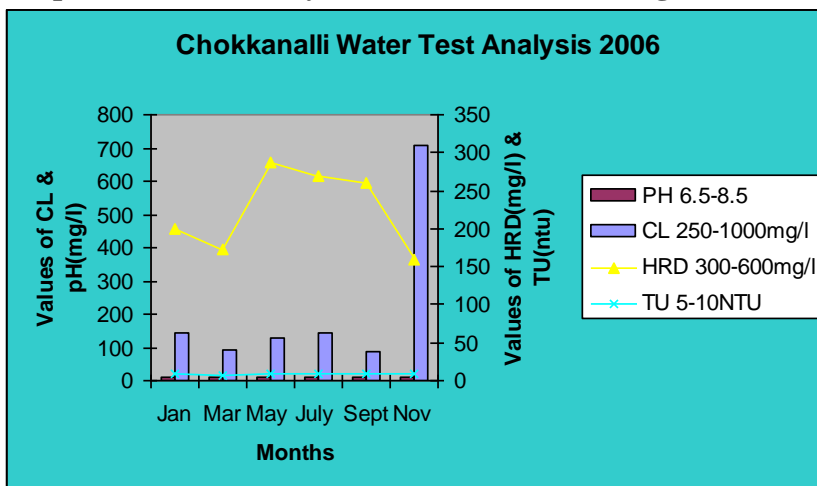
Graph 15. Water Analysis for Boothanatham Village in Year 2006



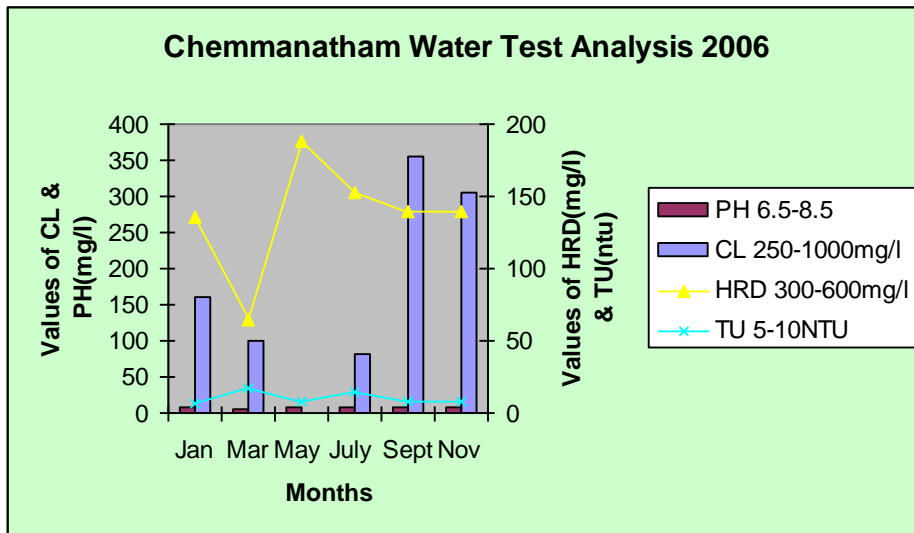
Graph 16. Water Analysis for Siriyur Village in Year 2006



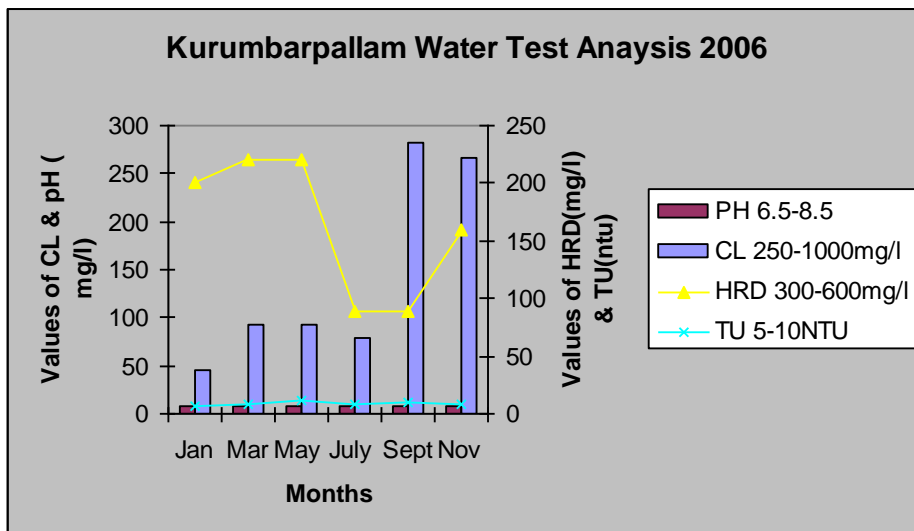
Graph 17. Water Analysis for Chokkanalli Village in Year 2006



Graph 18. Water Analysis for Chemmanatham Village in Year 2006



Graph 19. Water Analysis for Kurumbarpallam Village in Year 2006²



² The rest of the Analysis are on Annexure 4

Table 12. Water Testing Findings for Project Villages -2006

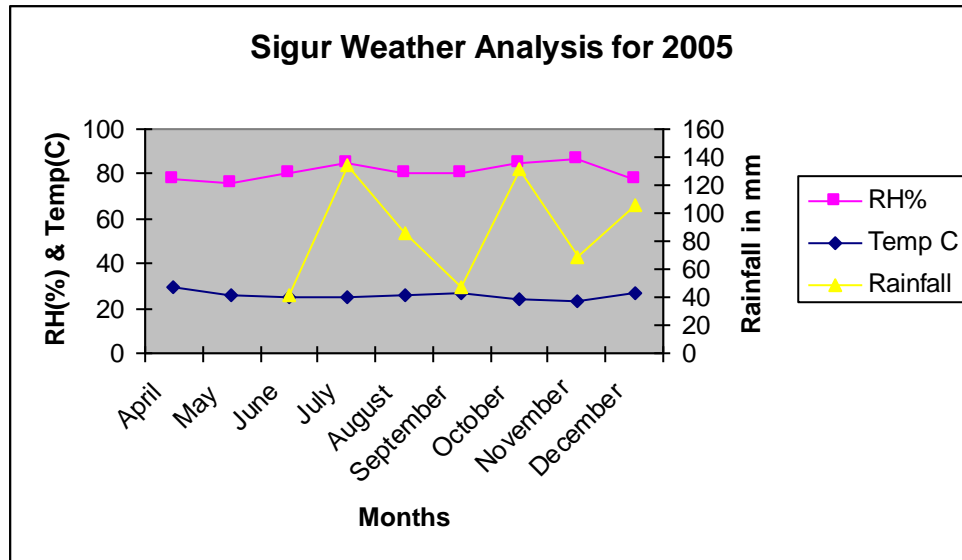
Parameter(mg/l) Standard Permissible	PH 6.5- 8.5	T(°C) >25*	DO 5mg/l	RC 0.2mg/l	TU 5- 10NTU	CL 250- 1000mg/l	No3 45mg/l	F 1mg/l	P 10- 30ug/l	Iron 0.3	HRD 300- 600mg/l	NH3 1.5mg/l	Coli Y/N
Vazhathottam													
6-Jan	9	21	9.2	0.2	9	88.625	10	0.6	0.2	0.3	268	1	Y
5-Mar	8	22	6.8	0.2	6	152.435	10	0.6	0.2	0.3	196	1	
(May 2006)	9		7.2		8	124.72	10	0.6	0.2	0.3	224	1	
(July 2006)	9		9.6	0.2	9	130.255	10	0.6	0.2	0.3	292	1	
(Sept 2006)	8		11	0.2	15	106.35	10	0.6	0.2	0.3	340	1	
(Nov 2006)	9		16	0.2	10	196.3	10	0.6	0.2	1	260		
Boothanatham													
1-Jan	9	22	7	0.2	6	184.34	10	0.6	0.2	0.3	220	1	Y
6-Mar	8	22	6.4	0.2	12	67.355	10	0.6	0.2	0.3	92	1	
(May 2006)	8	22	4.6	0.2	9	124.175	10	0.6	0.2	0.3	108	1	
(July 2006)	8		9.6	0.2	9	124.175	10	0.6	0.2	0.3	224	1	
(Sept 2006)	8		8	0.2	11	212.7	10	0.6	0.2	0.3	180	1	
(Nov 2006)	6			0.2	9	77.99	10	0.6	0.2	0.3	84	1	
Chokkanalli													
6-Jan	9	21	4.8	0.2	8	141.8	10	0.6	0.2	0.3	200	1	Y
5-Mar	8	25	6.8	0.2	7	92.17	10	0.6	0.2	0.3	172	1	
(May 2006)	8		8.8	0.6	9	127	10	0.6	0.2	0.3	288	1	
(junly 2006)	9		9.4	0.2	9	141.8	10	0.6	0.2	0.3	270	1	
(Sept 2006)	8		16	0.2	10	88.625	10	0.6	0.2	0.3	260	1	
(Nov 2006)	8		8	0.2	8	709	10	0.6	0.2	0.3	160	1	
Anaikatti													
6-Jan	9	22	6	0.2	6	141.8	10	0.6	0.2	0.3	340	1	Y
5-Mar	8	24	6.8	0.2	25	81.535	10	0.6	0.2	0.3	220	1	
(May 2006)	8		6.4	0.2	25	1028.05	10	0.6	0.2	0.3	100	1	

(July 2006)	8		7.4	0.2	25	92.17	10	0.6	0.2	0.3	120	1	
(Sept 2006)	8		18	0.2	10	106	10	0.6	0.2	0.3	200	1	
(Nov 2006)	9		7	0.2	10	106.35	10	0.6	0.2	0.3	140	1	
Siriyur													
6-Jan	9	22	8	0.2	7	195.975	10	0.6	0.2	0.3	200	1	Y
5-Mar	9	24	6	0.2	7	81.535	10	0.6	0.2	0.3	224	1	
(May 2006)	9		7.4	0.2	8	88.625	10	0.6	0.2	0.3	224	1	
(July 2006)	8		10	0.2	8	88.625	10	0.6	0.2	0.3	120	1	
(Sept 2006)	9		16	0.2	20	70.9	10	0.6	0.2	0.3	308	1	
(Nov 2006)	9		10	0.2	10	88.625	10	0.6	0.2	0.3	180	1	
Chemmanatham													
6-Jan	8	21	10	0.2	7	159.525	10	0.6	0.2	0.3	136	1	Y
5-Mar	6	22	8.4	0.2	17	99.26	10	0.6	0.2	0.3	64	1	
(May 2006)	7		10	0.2	8	524.35mg/l	10	0.6	0.2	0.3	188	1	
(July 2006)	8		10	0.2	15	81.535	10	0.6	0.2	0.3	152	1	
(Sept 2006)	7		16	0.2	8	354.5	10	0.6	0.2	0.3	140	1	
(Nov 2006)	8		18	0.2	8	305.5	10	0.6	0.2	0.3	140	1	
Kurumbapallam													
6-Jan	8	21	10	0.2	7	46.085	10	0.6	0.2	0.3	200	1	Y
5-Mar	8	21	9.6	0.2	8	92.17	10	0.6	0.2	0.3	220	1	
(May 2006)	8	22	6.4	0.2	12	92.17	10	0.6	0.2	0.3	220	1	
(July 2006)	8		6.8	0.2	8	77.99	10	0.6	0.2	0.3	88	1	
(Sept 2006)	7		12.6	0.2	10	283	10	0.6	0.2	0.3	88	1	
(Nov 2006)	8		8.6	0.2	9	265.6	10	0.6	0.2	0.3	160	1	

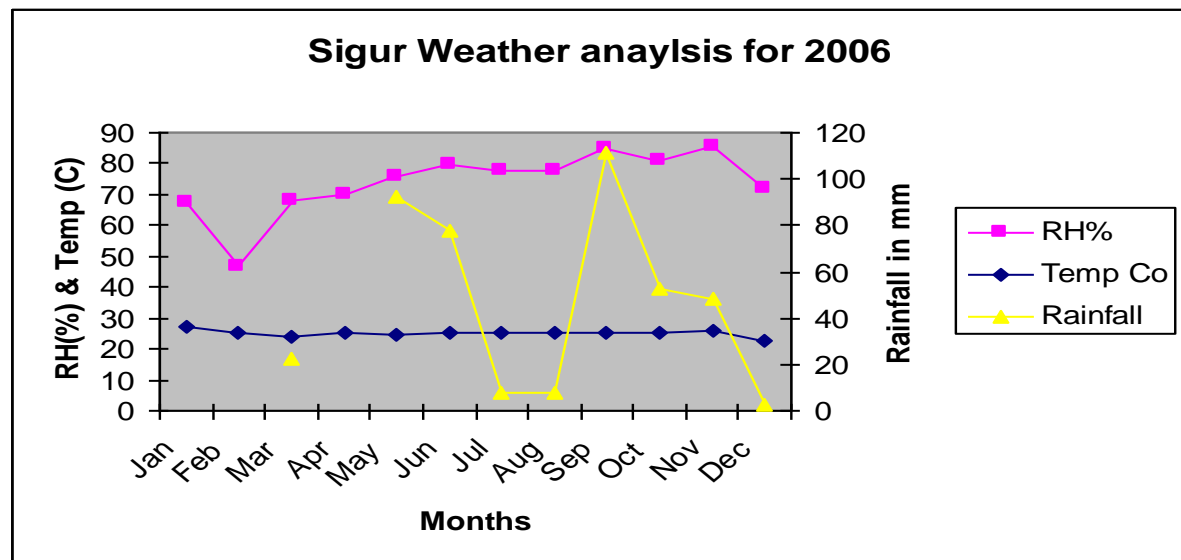
6.6 Initiatives at Setting up of a Weather Station

Weather station has been established and data has been collected regularly to see the changes in the weather pattern in terms of rainfall, relative humidity & variation in temperature of the region. The graph below shows the weather analysis for the three years period from 2005 – 2007.

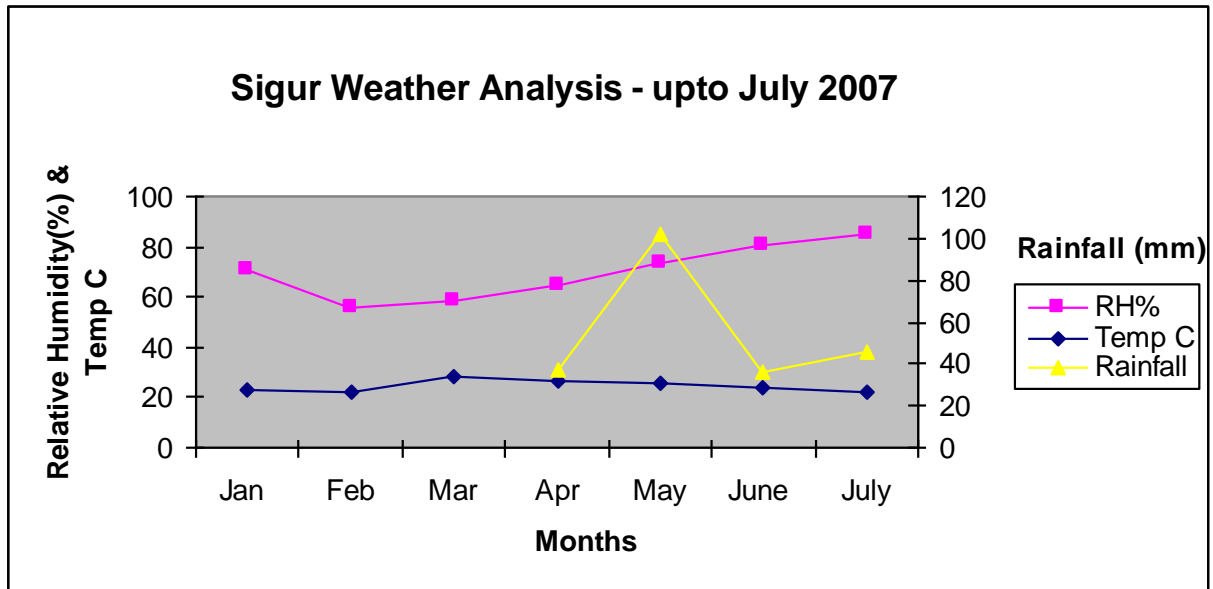
Graph 20. Weather Analysis for 2005



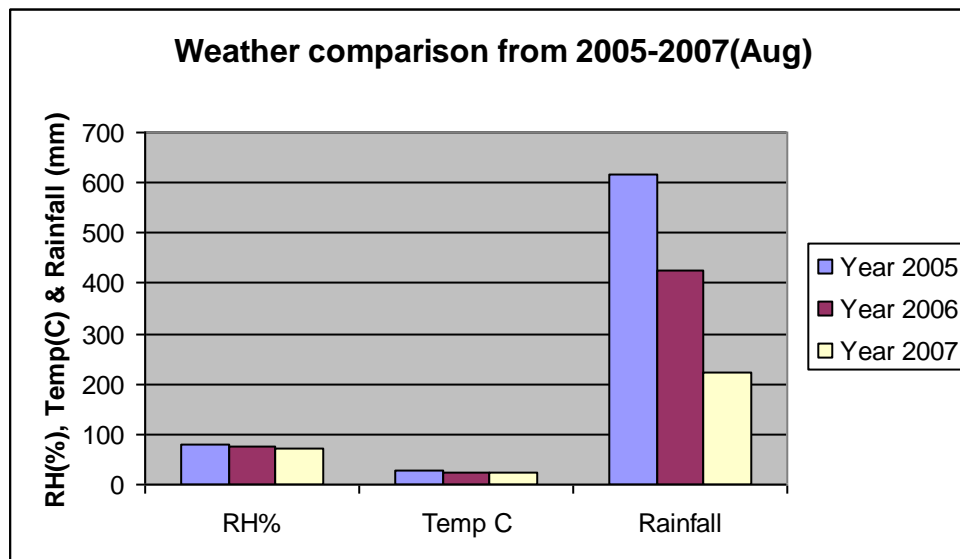
Graph 21. Weather Analysis for Year 2006



Graph 22. Weather Analysis for Year 2007



Graph 23. Difference in rainfall at Sigur from 2005-2007(Aug).



MORE TO BE WRITTEN

7 The Sigur Water Resources Audit

Since Sigur is said to be very special area comparing the drainage pattern, climate as rain shadow area, the type of vegetation as shrub jungle towards the east and most of the area comes under the crucial wildlife zone. Where again the plateau is banned of drilling bore wells & consumption of water for various purpose has been restricted for one or more reasons. The indigenous people need water for their interests for growing crops of their likes & the wildlife in the reserved & the sanctuary need water also to survive. Where in the government on the other hand the TNEB has its own stake in hydro power generating & bringing in revenue to the state exchange & are least bothered of the developments taken in this plateau. There are the other departments like the Forest Department who has its own stake in building its own infrastructure like numerous check dams & percolation tanks from its own angle. The Hydro Metric Services measuring the flow rate with silt accumulation & so on. The TWAD board & the local governing body are implementing their own water schemes. There are private estates & fields who irrigate their lands for their various crops. Thus it makes us interesting to make a good water resources audit of this area to ascertain future sustainability of water usage & to draw an ecological balance in this whole fragile ecosystem.

The names of the streams in the Sigur plateau.

1. The Pykara River which is one of the major source and flows into the Moyar river runs along the boundary of the Sigur boundary towards the west and continues towards the Moyar valley down the river up to the Thengumarada valley. All along the course, it is on periphery of the sigur plateau.
2. Karimora Hole is a tributary to the Pykara river and the drainage is from the Glenmorgan slopes coming down towards Singara to join the main stream.
3. Kurumamat Halla is another stream which flows from the Bokkapuram reserved forests. These streams are basically seasonal only during the monsoon periods. This one ends up at the Marvakandy dam from there the water is carried along a flume channel to the Moyar power station & ultimately let into the Moyar river. This stream becomes Avara Halla & is used for irrigation purpose at Hundi Moyar and adjoining areas & after joins with Sigur river before falling into Moyar gorge.
4. Mavin halla is another seasonal stream, dry during peak summer. This originates in between the Bokkapuram reserved & the Kalhatti reserved forests. This stream joins the Sigur river after Mavinahalla town before Chemmanatham settlement.
5. Sigur stream starts from the upper areas from the Sandynallah reserved forests from Sholur area & from outlet of the Kamarajsagar dam & flows down the Kalhatti falls where it reaches the foothills Vazhathottam and further continues along the plateau north wards and plunge into the Moyar falls.
6. Kedar Halla is a big stream originating from Ebbanad from one side & the other side from almost Thavanai basically called Toddanad side. This drains from the Ebbanad reserved forests partially & mostly from Sigur reserved forests. This stream flows along the Anaikatti settlement and joins the main Moyar river at the Mangalapatti junction. This stream plays a vital role in both conserving the people as well wildlife. Another tributary called Mukkuruti Halla joins this stream before Masipatti.

7. Sirur Halla drains basically from the Bikkapathi Mund reserved forests. This stream flows along the Siriyur settlement and joins the main stream after Masipatti, but before joining another stream called Tatta halla which becomes the Gundhatti halla after flowing for some time also joins this stream.
8. Another stream called the Aderi Halla originates from the plateau when there is enough rainfall & becomes the Pungakeru Halla and reaches the Thengumarahada settlement.
9. The Kukalthorai Halla is the other boundary at the eastern part for the Sigur and this originates from Kukalthorai area and flows towards the Thengumarahada plain lands.

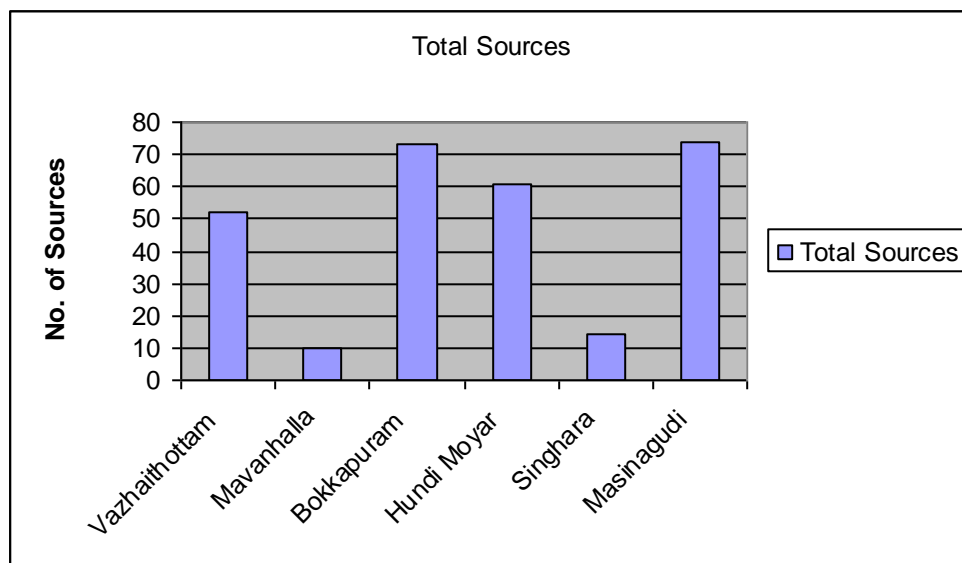
Most of these rivers are seasonal except for the main streams namely the Pykara stream, the Sigur stream, the Kedar halla & the Kukalthorai halla. But when severe drought persists & during the peak summer season some of the perennial source also dries up like this year the Kedar Halla & the Sigur River dried up causing lots of panic with the local communities and the wildlife.

The flow rates of each stream differs from seasons like it is more during the peak monsoon & less or almost no during the peak summer. It depends on the usage of water by the upstream communities who are dependent on the streams for various agricultural purposes.

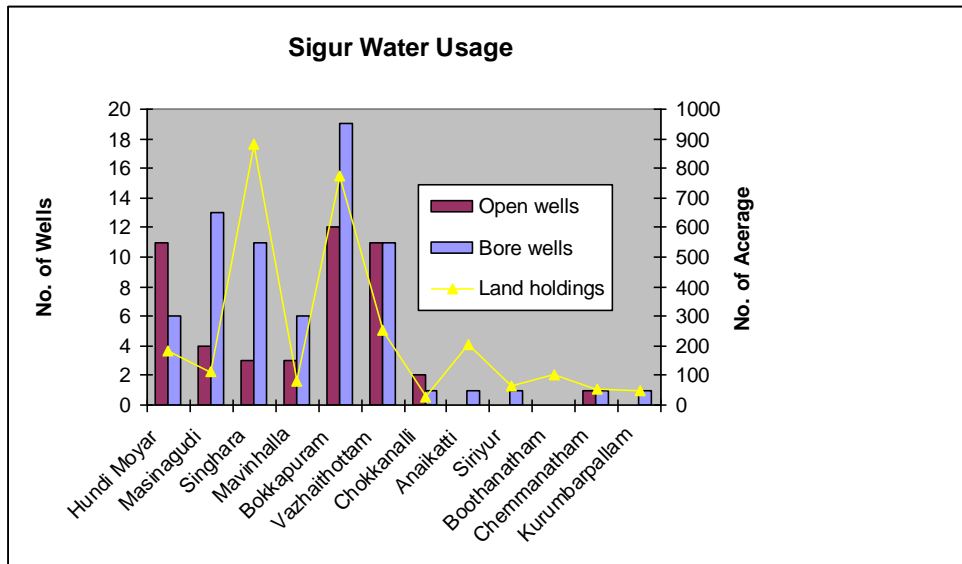
The Water usage & source in the Plateau by various sectors like farmers, resorts, and establishments like schools, hospitals etc. and other end users like EB are given in the table in the annexure.

The following graph shows the number of open wells & bore wells against the land holdings in all different villages where water is made use of. This does not include water consumption from the streams of the plateau.

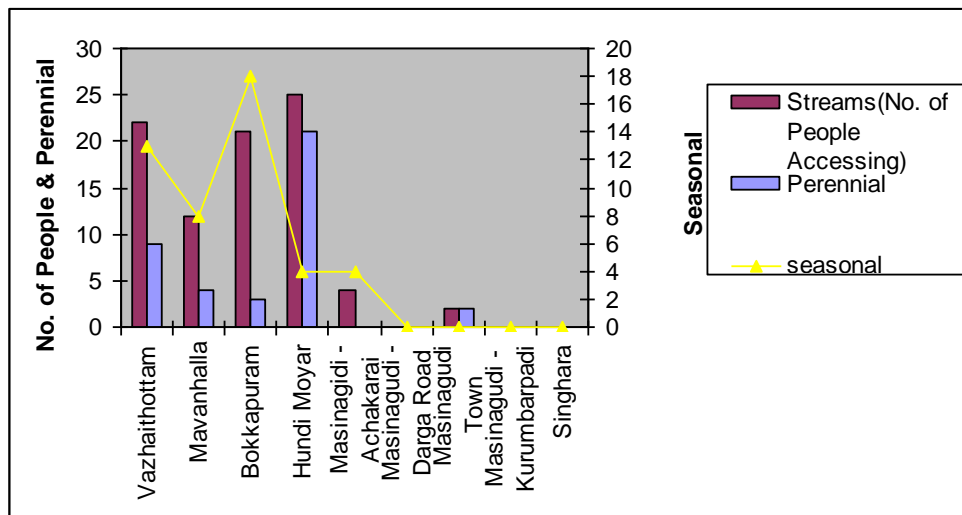
Graph 24. Total number of sources in the Sigur plateau



Graph 25. Usage of water in terms of number of wells against land holdings



Graph 26. Number of people accessing perennial & seasonal streams for various purposes.



Major findings of the survey for water related aspects.

1. Water used for irrigation – minimum time used for pumping 2 hours and maximum time pumped is 6 hours.
2. The HP Motors used for pumping water – the maximum is 20 HP & the lowest is 2HP
3. The maximum depth of Bore well is about 400ft & 450ft at Masinagudi & Boothanatham respectively & the minimum depth of bore well is 50ft at masinagudi.
4. The maximum depth of Open well is about 300ft & 10ft at Achakarai & Singara respectively & the minimum depth of bore well is 50ft at masinagudi.

5. Total land holding surveyed in the plateau is 2483.39 acres
6. The total number of people covered in the project is 1361

8. The Nilgiris Water portal

To disseminate the information of the project & expose to the outside world about the Sigur water resources project. How people from different parts of the country can follow this model elsewhere for proper & sustainable water management – an e portal has been designed known as the www.nilgirihillswater.in.

Nilgiris Water Portal



The Nilgiris, Blue Mountains of South India, is located at the junction of the Eastern Ghats and the Western Ghats, the two prominent mountain ranges that run almost parallel to the coastlines of Peninsular India.

The district is located over an elevation range of 1,000-2,636 m above sea level, comprising hilly peaks, plateau and lower plateau regions - most of the settlements are located in the latter two elevation ranges.

The district is home to a number of indigenous communities and they include the Todas, Badagas, Kotas, Kasavas, Irulas, Kurumbas, Jenukurumbas, Mulu Kurumbas, Bettu Kurumbas, Kattunaickens, Paniyas, Mandadan Chettis and Wynaadan Chettis.

Water resources in the hill district of the Nilgiris, play a crucial role not for drinking and other uses to the rural and urban communities in the district, but also serve as the upstream source to four river basins serving the state

s of Tamil Nadu, Karnataka and Kerala. The water resources of the district are used for power generation and account for more than a third of total hydro-power generated in Tamil Nadu. Water as a natural resource plays a vital role in the ecology and economy of the district - be it in the large scale hydro power, the tea estates or in the forest dweller's livelihood system. The Nilgiris is the source of two main river systems - the Bhavani and the Moyar, which comprise several streams emerging from high altitudes and flowing down to the Cauvery basin in Tamil Nadu.

Publications

- Publication 1
- Publication 2
- Publication 3



News and Events

October 2007						
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28	29	30	31			

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Annexure

Annexure 1 - Terms of reference for Hydro-geology Consultancy

Background

From June 2001 – June 2002, Keystone Foundation executed a project on “Hill Water & Livelihoods- the Nilgiris Water Resources” with support from The Ford Foundation – Winrock International India, Small Grants Program. This project was primarily to take stock of the situation of water resources in this hill district. The project culminated with a Stakeholders Workshop that brought out a range of issues that needed further investigation. From September 2002 to January 2003, a series of Citizens meetings were held in different talukas of the district to share with people the findings of the study and get their perspectives on how to manage water locally.

Based on the feedback of diverse stakeholders a new proposal has been developed. One of the principal concerns is that water being a common resource – the management of water is non-participatory. This has led to the fragmentation of old water-sharing mechanisms that existed in these hills among the indigenous communities.

Objective

Develop a strategy for Sustainable Community-based Interventions through: Action-Research, Innovation & Enterprise for the Conservation & Development of Freshwater Resources.

Terms of Reference of a Hydro-Geologist

1. To prepare a Water Resources Audit report for the hydro-geological features of the Sigur Plateau with specific reference to water resources – ability for conservation, geological features available which would support retention, percolation and recharge.
2. Detailed maps would be drawn of the Sigur Plateau highlighting the geological conditions prevalent.
3. Field visits to villages will be undertaken to specifically investigate the water situation vis a vis hydro-geological conditions and opportunities.
4. The report will consist of a resource analysis – causative factors of water crisis, typical patterns if any, and future scenarios under different management options, the conditions and variability across seasons and past trends. Data would be generated in this, which would identify freshwater budgets in hill areas (Sigur plateau), which are typically source zones. A menu of options would be available after the audit on “what to do & where by whom”.
5. All available data will be given to the Consultant. Keystone Field Team from Sigur will assist the Consultant during field work.
6. Consultant shall complete all work and give the final report to Keystone Foundation in 7 days time. He shall be paid a professional fee after receiving the final report of Rs. 2000 per day X 7 days = Rs. 14,000/-. All other expenses of travel, boarding and lodging will be paid by the Organization. All tax liabilities will be borne by the Consultant.

The assignment will be completed before end of February 2006. The Consultant has to be based in the Field Station at Vazhithottam in the Sigur plateau where the office cum residence is situated.

Annexure 2. Water Testing Procedure

TEST	REQUIREMENTS	PROCEDURE
pH	water sample,pH paper.	Dip the pH paper into the water sample. Dry and compare with the test colour chart.
Temperature Temp	water sample,thermometer.	Dip thermometer in water for 1 min. and read the level.
Dissolved oxygen	DO bottles,Manganous sulphate,Alkaline Potassium	Fill DO bottles without air bubbles and place the lid.Add 3-4 drops
(DO)	Iodide, Phosphoric acid,Starch,Sodium Thiosulphate,	of Manganous sulphate.
	t.tube,1ml syringe	Transfer 10ml to T.tube.Add 1-2 drops of starch.Take Sodium
		thiosulphate in 1ml syringe without air bubble and titrate
		till blue colour disappears. Read DO value.
Residual Chlorine	water sample,Ortho toludine,T.tube,pH paper	Take 10ml of sample in t. tube.Check pH. If pH is less than 9 add
(RC)		4 drops of Orthotoludine.If more than 9 add 8-10 drops.
		Compare with colour chart. Note the value.
Turbidity (TU)	water sample,turbidity tubes.	Slide the end of upper tube into the open end of the lower tube
		and fix the interchangeable joints.Place a white paper on floor.
		Hold the tube perpendicularly 3` above the paper.
		Look through the open end of upper tube,at a distance 10cm and
		see if black cross is visible.Shake water sample and pour slowly
		into the tube.Keep observing the black cross.
		Stop pouring the water when the cross disappears.
		Compare level to the closest level.Note the value.
Chloride (Cl)	water sample,Potassium chromate,	Take 5ml of sample in t. tube.Check pH between 7-10, if not add
	Silver nitrate,T.tube,1ml syringe,pH paper.	sulphuric acid/ammonia to adjust pH.Add 1 drop
		Potassium chromate.Take Silver nitrate in 1ml syringe,add
		in drops and titrate till permanent brick red colour appears.Note
		the amount of Silver nitrate consumed.

		Calculate the value (volume consumed*354.5 mg/l).
Nitrates (NO₃)	water sample,Dis. water,PDA,Ammonia solution,	Take 5ml of sample in t. tube.Heat on spirit lamp for 4-5 min.till
	T.tube,spirit lamp,t.holder,2ml syringe,match box	liquid evaporates.Cool to room temp.Add 8-9 drops of PDA
		Shake t.tube to dissolve residue.Dilute the solution with 2ml
		of Dis.water.Add 23 drops of Ammonia solution.Shake t.tube
		Add dis.water till 5ml mark in tube with 2ml syringe.Compare
		with chart.Note value.
Fluoride (F)	water sample,Zirconyl alizarine,2 t.tube	Take 50ml water sample in t.tube.Add 2.5ml of Zirconyl alizarine.
		Mix solution by pouring in another t.tube.Allow solution
		to develop colour for 1 hrs.Compare with chart.Note value.
Phosphorous (P)	water sample,Ammonia molydbate,Stannous chloride	Clean t.tube thoroughly with Dil HCl and take 12ml of water sample.
	Dil HCl,2ml syringe,T.tube	Add 0.4ml of Ammonia molybdate from 2ml syringe.Shake the tube.
		Add 2 drops of Stannous chloride.Shake the tube.Wait for 10 min.
		Compare with colour chart.Note value.
Iron (Fe)	water sample,Hydrochloric acid, Hydroxyl amine	Take 5ml of water sample.Add 0.4ml of HCl with 2ml syringe.
	Hydrochloride,Ammonia acetate buffer,Phenanthroline	Add 4 drops of Hydroxyl amine Hydrochloride.Heat the solution till it
	dis water,spirit lamp,holder,t.tube,2ml syringe 2nos..	reduces to 1/3 of its volume.Cool to room temp.Add 1ml of
		Ammonia acetate buffer from 2ml syringe.Add 0.4ml of
		Pheanthroline from 2ml syringe.Add dis water till 5ml mark on t.tube.
		Wait 10-15 min.Compare with chart.Note value.

Hardness (HRD)	water sample,Eriochrome black T powder,EDTA,	Take 5ml of sample and add 1-2 drops of Ammonia buffer to raise
	Ammonia buffer,T.tube,1ml syringe	pH Add a pinch of Eriochrome black T powder.Take EDTA in 1ml
		syringe and titrate till colour changes from wine red to blue.
		Note the amount of EDTA consumed.
		Calculate the value (volume consumed*400 mg/l).
Ammonia (NH₃)	water sample,Nessler`s reagent,T.tube	Take 5ml of sample in tube and add 2-3 drops of Nessler`s reagent.
		Compare with chart.Note value.
Coliform (Coli)	Coliform bottles	Wash hands.Fill bottle with 20ml of water sample (leave 2cm space
		from source)Place lid immediatelyand tightly.
		Keep bottle at 30oC(wrap in cloth or keep in closed
		cupboard).for 24-48 hrs.If water turns blackwithin 24-48 hrs ,it is unfit for
		drinking. Record - presence/absence of coliform.

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Annexure 4. Water Project LFA Workshop Minutes

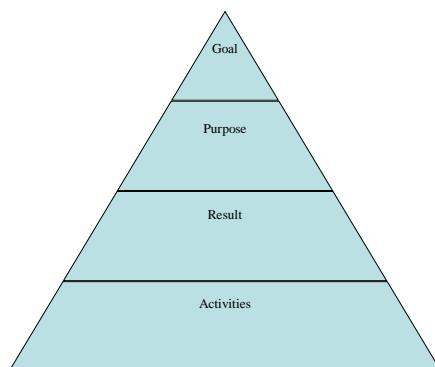
Program:

- Presentation
- LFA what is that?
- Mapping exercise
- Current year - What was expected?
- What are we achieving?
- What is planned for next year?
- What do you want to achieve next year
- LFA problems/opportunities
- Possible solutions

The LFA was conducted by Joakim of Swallows. The first day was introduction of the participants present for the LFA. The number of participant were twelve members from the villages of Annaikatty, Boothanatham, Sirur, Semmanatham, Valaithotham, of with three were women and Nine of them men. Keystone staff members Pratim Roy, Senthil, Justin raj, Robert Leo and Shiny were present. In the introduction the members expressed their water problems in the village.

What is LFA?

LFA stands for Logical Framework Analysis. It is a tool to find out the problem and to find solution in a realistic way. The way of finding problems and its solution involves people from the villages, members of the panchayat and the FD. The people will not be directly involved in the implementation part but their ideal, suggestion will be taken into consideration. An exercise was done to know the activities year round keeping the following in the mind.



Exercise No.1 The Mapping Exercise

In this exercise the participants were grouped into three groups and asked to describe their activities throughout the year through mapping. . It can be agriculture activities, NTFP collection, cattle grazing, firewood collection, water collection, going for labor wages, festival time, Agriculture etc; All groups presented their occupation activity through charts. This showed their occupation through out the year and showed the availability of water in which season of the year. Farming takes place after the rains

and the harvest is directly linked to the water availability for agriculture. The following are the outcome of the mapping exercise.

Activity planner

Exercise No. 2

Finding out the problem

In this exercise each of the participant were told to list out or draw diagrams regarding water problems in their village. After which six stones were given to each of the participant to rate the problems and find out which was the major problem regarding water. The rating was done by placing stones on the drawing, 3 stones for the major problem, 2 stones for medium problem and 1 stone for the least problem and the ones being repeated.

The gist of the problems regarding water and its uses are listed below which was expressed during the exercise.

- Destruction of pipe line by elephants, causing no flow of water in the village.
- Construction of check dams in upstream causing slow or less flow of water to downstream villages.

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Activity Group 1	NTFP	Festival	Festival	Rain, Fields, Seed	Rain, Honey seeds	Rain, Hon	Harvest Till Field	Rest	2 nd season Honey Agri	Honey Agri	Agri	NTFP
Group 2	NTFP	Festival No water for agri	NTFP Nelli Kad Pooch Puli	Honey Fields Tillin g Graz NTFP	Honey Sowing NTFP Kalp	Rain Planti Chilli Veg	Harvest Rain	Small Work Fields	Harvest	Honey Sow seeds	App Fert NTFP Kad	Going For Wages, If failure
Group 3	FD Work NTFP	FD Work Wage NTFP Festival	Festival Grazing NTFP Broom	Tillin g NTFP Broom Festival	Honey NTFP Broom	Honey NTFP Planting Ragi Chilli Veg	FD Wage Agri	Harvest	Harvest	Harvest Agri NTFP Maha	Agri NTFP Nelli Kad Siva Mah	Winter Crop NTFP FD Wage

- Blockage of pipe line by silt
- Pumping of water in upstream
- Chemical input, pollution
- Leakage of water from the pipeline
- Payment of electric bills not done
- Poor Maintenance of motor pump
- Quality of water is not good
- Social problems

From the exercise done, two major problem regarding water was –

- Water not available for the people in Kanyakumarai from Annaikatty.
- Discontinuity in the water flow from Dhanakadavu check dam to Sirur and Indra Nagar.

During the second day a brief idea of the water project was given by Pratim Roy.

- History of water use
- Water resource audit
- Community institution
- Ensure future needs and sustainability
- People regional water management plan

Activities done

1. Meetings- Siriur, Annaikatty, Chokannalli, Boothanatham, Semmanatham.
2. Water testing- Valaithotam, Siriur, Annaikatty, Chokannalli, Boothanatham, Semmanatham, Kurumbapallam

An exercise was done to work out the problems regarding water and presentation was given. Also an exercise on how to find out ways or solution to the problems was done and presented. The participants were divided into three groups.

TEAM A - Anaikatti _ Kanyakumari & Siriyur Indranagar

The main source to the Siriyur village is from the check dam from Dhanakadavu 3 kms from the village. The main source to the Kanyakumari village is from the Anaikatti GLR, which is pumped from a bore well.

Problem Tree

1. Water not coming regularly
2. Pipeline blocked due to mud & other waste.
3. There is no proper filtering net or covering for the check dam
4. Since the pipeline is not buried underground and breakage due to wild animals, elephants, bisons.
5. Pollution in the stream – washing clothes & washing vessels
6. No one is bothered about others using the water, no co-operation, and many factions in the village.
7. There is a small outlet from the Anaikatti GLR to the Kanyakumari pipeline.
8. Due to the force and improper pipeline laying through upland surface, water is not reaching the Kanyakumari people. One of the land owner objected to the

pipeline to be laid in a proper manner resulting in more lengths of pipeline also.

Solution Tree

1. To clean the block & check the pipeline every month and inspect them.
2. To test the quality of the water and create awareness not to pollute the water
3. If a big foot valve is fixed from the GLR, Kanyakumari people will get more water from the Anaikatti GLR
4. To contact DFO to lay pipeline to Kanyakumari properly for the people to get rid of water scarcity.

SEMANATHAM

The main source of water to the village is from a big check dam.

Problem Tree

1. Water is available – only management problem
2. No coordination between people – line departments (Electricity department & Panchayat board)
3. The EB bill not paid, due to non availability of funds.
4. Bill amount is Rs, 80,000/- , no cooperation among the villagers to take initiative for payment.
5. The check dam storage is small – water fully utilized during the summer.
6. Need hose pipeline for agriculture purpose.
7. Have to dig well for drinking water during summer if the water supply stops.

Solution Tree

1. Proposal is sent to HADP to solve the problem.
2. Have to approach the EB department, but no attempt from the Villagers.

TEAM B – BOOTHANATHAM

The main source for the village is from the Open well from a nearby farm land which is pumped to the village GLR.

Problem Tree

1. Villagers quarrel about the dwindling water resources.
2. Not enough water for agriculture.
3. Solar pump helping only 8 families for agriculture
4. Pipeline distribution not sufficient.
5. No drinking water distribution for 15 households
6. Panchayat not responding for the complaint given...
7. Avarhalla stream contaminated – pesticides packets thrown inside by the farmers.
8. Drinking water quality not good – canal water – lots of diseases
9. Drinking well water – quality not good – now the well is in others hands.
10. Outsiders taking the land – transfer of ownership- forefathers betrayed by outsiders- changed lease deed into ownership registration.
11. Water quality unchecked.

Solution Tree

1. For more pumping of water – can go for windmill operated motors due to availability of wind.
2. Approach Wildlife warden for help or other helping organizations to help.
3. 200 mtrs of hose pipeline (temporary to solve the problem will help)
4. To stop usage of pesticides & chemical fertilizers – go organic.
5. Test the quality of waters – know the contamination and take appropriate measures.
6. Create awareness for the local mass about water.

TEAM C- VAZHAITHOTTAM

The main source of drinking water is from the bore well near the village.

Problem tree

1. Farmers spray pesticides, herbicides, fertilizers – which drain into Sigur river
2. Farmers want to maximize production in short cycle
3. Demand on farm produce from markets (Ooty vegetables)
4. Nilgiris image – Nilgiris soil / Climate / conducive for agriculture & tourism.
5. Large number of tourists at Ooty.
6. Disease + Death in Plants + Animals from consumption of water during dry season / less flow.
7. Pollution in water
8. HPF, PPI, - industrial waste – Effluents Pollution – mix with Sigur River.
9. Human waste drains into Sigur river
10. Lack of awareness among down stream villages
11. Availability of water is an issue
12. Upstream farmers slow down water for individual purposes
13. Construction of illegal structures (Check dams, Sand bags on the river)
14. Upstream farmers pump water from Sigur River for individual purposes.

Solution Tree

1. Less usage of chemicals, less pollution, promotion of organic products
2. Highlight research stating Nilgiris as Chemical Country,
3. Introduce organic & Eco – friendly agriculture options.
4. Use Nilgiris brand image for better Sigur River Campaign
5. Highlight to authorities current situation of Drinking water and seek action.
6. Test quality of drinking water.
7. Inform TNPCB for monitoring strictly HPF, PPI discharge into the river.
8. Highlight clean sanitation systems – awareness through different methods.
9. Bring awareness to villagers for effective results
10. Ask Government & Water department to remove illegal structures.
11. Inform government about illegal water diversion / pumping / slowing down for necessary action.

The water user groups were formed very democratically through village meetings conducted in all seven villages. Each group comprises of a group head and a secretary. They will work in tandem with the members of the group for any kind of

work has to be carried out which has been recorded in the minutes books. A set of rules has been framed which are uniform for all the groups which has to be adhered if any disputes or differences of opinion arise among the members of any group. Considering all the groups in the villages a federation of the group names as the “Sigur Seemai Water User’s Group” has been formed and bye laws for the same has been formulated through the workshop & meeting held tentatively at the Vazhaithottam which has been recorded in the minutes book. Since the federation is the ultimate verdict for all the WUGs formed in the region a president and a secretary of the federation has been selected to give a collective perspective from outside. These representatives in turn approach various levels of officers like panchayat boards, TWAD board, Forest Department or the District Administration for want of various facilities to their respective villages.

Annexure 5. Socio Economic details of the Sigur Villages

Sigur Villages	Altitude	Forest Range	Route Access	Com 1	Com 2	Famil	Male	Female	Children<15	Pop	Ownership	Agri crops grown
Vazhathottam	933	Singara	Ooty to Vazhathottam	Irulars	Jen Kurumbars	56	90	70	45	205	5 *	Ragi, Chilly, Horsegram, Beans
Chemmanatham	894	MWLS	Mavanalla to Chemmanatham	Irulars		45	45	45	68	158	44	Ragi, Maize,
Boothanatham	890	MWLS	Masinagudi to Moyar	Irulars	Soligas	19	32	25	30	87	12	Ragi, Chilly, Maize, Beans
Kurumbarpallam	1015	Singara	Bokkapuram Rd	Irulars	Soligas	71	52	71	91	214	15	Ragi, Chilly, Maize, Beans
Anaikatty	824	Sigur	Vazhathottam to Anaikatty	Irulars	Jen Kurumbars	145	190	180	95	465	60	Ragi, Maize, Mochai, Beans, Veg
Sriyur	853	Sigur	Vazhathottam to Sriyur	Irulars	Jen Kurumbars	58	40	42	27	109	92	Ragi, Beans
Chokkanalli	932	Singara	Vazhathottam to Chokkanalli	Irulars		35	48	40	35	123	10 *	Ragi, Maize, Mochai, Beans, Veg
						429	497	473	391	1361	223	

Annexure 6. Sigur Water Resources- An One Day Brain Storm

20/6/2007

Introduction to the meet by Robert Leo, Presentation by Senthil on the activities done regarding water resource in Sigur plateau

Discussion:

Narashimman-President of Masinagudi Farmer's association

Issues

The Sigur River is the source of water to the people of Sigur region but due to various reasons, mentioned below has reduced the level and availability of water in the river which is causing water issues in the region.

- The destruction of the shoal forest has reduced the water in the river. The percolation of water into the soil has reduced. The dry forest and scrub jungles vegetation of Sigur region is also a reason, which receives 400-500mm of rainfall.
- The construction of Melkodu mundh dam and the diversion of the water to Glenmorgan have reduced the water flowing to the Sigur River.
- The pumping of water by the people in Sholur has reduced the water in the river.
- The let off from HPF and PPI industries is causing contamination to the river water.
- The destruction of water holding structures by wildlife, causing water shortage during dearth season.
- Lack of awareness and cooperation regarding the issue among the people is also a reason. The people do not come forward to solve the issue.

Solution

During the panchayat meeting a presentative of the village and a presentative from Keystone foundation will attend the meeting and address the issues of the region in the meeting. Rev .Mulley had suggested that a panchayat for the Sigur Plateau should be formed in the coming years. As the villages in the plateau like Siryur is governed by Kukalthurai panchayat, Annaikatty by Ebanad, Chokanalli by Kadanad, kurumbapallam and Bokkapuram under Sholur panchyat. The problems of the villages are not been solved by the panchayat. The idea was welcomed by the people, as they felt that the formation of the panchayat in the region will be solution to the issues.

The participants were grouped, representing their village to discuss the issues of the villages.

Annaikatty:

- The tank near the temple does not provide sufficient water to the village. A letter has been given to the collector regarding this matter. The collector had issued a letter stating that construction of an over head tank and two foot path had been sanctioned to the village at a cost of 6lakh rupees. But till now no action has been taken by the panchayat.

Lalita (village coordinator) has been given the responsibility for taking a photocopy of the letter. The matter will be discussed in the panchayat meeting.

- Permission to collect NTFP in the region.

A petition regarding this matter should be given by the people to the collector. On behalf of keystone foundation a petition will be given to the PCCF regarding this issue.

- Maintenance of check dam- The check dams in Erode and Kanyakumari village does not have the capacity to hold water, as there are leakages in the check dam and desiltation has to be done.

For the maintenance of the check dam money from the water user committee can be taken for the work. A resolution by the village people should be passed while taking the money from the fund. The work management will be done by keystone staff.

- Need for street light in the village

People should talk to the panchayat board.

Kurumbapallam:

- The bore well installed by the panchayat is not in working condition. Hence the people cannot get water.

The people have to talk to the ward member and discuss the issue in the panchayat meeting

- At present there are only two water distribution lines from the GLR to the village, they villagers need two more distribution lines.

It was suggested that a union (T-connection) could be fixed in the outlet pipe of the GLR and the length of the distribution pipe to be measured and purchased.

- Support for agricultural activities. The people need financial support in ploughing their field and purchase of seeds.

The activity would be supported if the people are willing to pay back the money on a monthly installment bases.

- Educational support

As health and education was not Keystone's field of work. It was suggested that they should approach NAWA for the support.

- Need for street light in the village

People should talk to the panchayat board.

Exposure trip and cell phone was also demanded by the people. For cell phone, installation of coin box was suggested.

Chockanalli:

- Free electricity for irrigation. The village was not given free electricity for irrigation purpose as there is no provision by the EB to provide electricity in forest settlements.

It was suggested that an application to be given to the EB board as well as to the collector.

- Covering net for the well. They wanted a net to cover the well to prevent leaves falling into the well

Follow up on this will be done by keystone.

- Repair of Gate at the entrance

Siriyur:

- The water from the tank was not reaching to the houses near Saroja's home. The distribution line was to be checked for any blockage.

- Constructions of houses in the village. They houses in which they are living is in a bad state. During the rains it leaks and break downs. It was suggested that the HADP has sanctioned loans for construction in the villages, so the people can give a petition to HADP. It was also recommended that the people should read `Seemai sudhi`, a newspaper published by keystone which give information on such matters for the indigenous community.
- Water not available for the villagers during festival season as the water distribution was disconnected and diverted for the festival use. This issue should be discussed with the festival organizers and the villages. Keystone can meditate the discussion.
- The distribution line to Indranagar was damaged. The distribution was to be repaired and buried underground to prevent further damage.
- Water storage for irrigation. The people wanted a tank to store water to irrigate their field during cultivation. A poly lined would be made for this purpose in the village.
- Support for agricultural activities. The people need financial support in ploughing their field and purchase of seeds. The activity would be supported if the people are willing to pay back the money on a monthly installment bases.
- Educational support - As health and education was not Keystone's field of work. It was suggested that they should approach NAWA for the support.

Vazhathotam:

- The people who are outside the village find it difficult to get drinking water as the distribution lines are within the village limit. Hence they were asking for drinking water distribution line.
- Patta for their lands.
- Re open the milk chilling plant.

Boothanatham:

- Solar pump does not work during rainy reason and not able to pump water. The water which is pumped using the solar pump is also used for irrigation purpose. No cooperation from the villagers. There is confusion about who is the village head man

Keystone will facilitate for a meeting in the village to discuss these issues.

Annexure 7. The Coonoor River Initiative

Minutes of the Coonoor River Walk meeting at YMCA Coonoor on 27th June 2007

Number of participants 19 persons.

Introduction of the meeting was given by Rev. Mulley about why the survey was conducted and to do what after this. Followed by the presentation of the survey findings of the Coonoor River, discussions started.

The Col. from DSSC was interested in our work & he had some plan for his own area for planting some water vegetation to increase water retention in his area to yield more water. He saw all our posters & praised for the good job. The main general comments from the people who participated in the meetings are as follows:-

- To bring awareness among the population.
- If fertilizers are playing a vital role we should give an alternate for that.
- The Municipal sanitary officer says all the stream bed encroachments should be evacuated for free flow of the stream. He says that is the most difficult thing. Once we are with the encroachers, the politicians are back of us not to interfere. So the whole process goes futile. He says there is a government scheme of the underground sewage & sanitation scheme which is going to be implemented soon. If this happens all the problems will be solved. There will be a treatment plant and there will be no blocks for the flow. The survey already has been conducted for the same. This should be given the top priority.
- Involving the government people will help to a great extent.
- The Market association secretary says from the 30 wards in the municipality 15 has been privatized. So the private groups can take active measures once more awareness is given. Now the whole of the market area has been privatized.
- Mr. Chandramohan emphasizes a march for one day with students & groups will not help, they will forget the next day. He says there should be constant focus and follow up for the improvement of the situation. There should be door to door campaigning for the cause.
- The consumer protection committee says there should be easy way of approach. There should be dustbins near to the households & treat the sewage outlets before entering the stream.
- Soak pit provision should be given and made a must from the municipality for approval for any construction.
- The group says they should be separate campaigns for separate groups. So that the message is conveyed in a proper manner & remedial measures are taken.
- Sanitary Inspector – says we can arrange a separate meeting for all the 146 cleaners from the municipality, give them training or awareness on waste management and so on. Should fix a date and tell him.
- Fish market campaign can be done through the markets association.
- Vannarpet , Darlington & VP Street should be given house awareness programs. Responsible person or groups from the local set up should take the initiative for this.
- The consumer forum says the presentation should be in Tamil & should reach the common man for better understanding of the situation.

- Mr. Jeyaseelan of the rotary club asks, for whom the river has to be clean, if this statement is made clear we can work on it.
- Consumer forum says first of all, our district is a tourist district so we have to take steps to keep our place clean. What is the benefit of having the river cleaned? Any awareness benefit for the people.
- We agree the ecosystem drainage should be clean. 80% of the water is wastage sewage. How do we control pollution?
- Sanitary inspector says for water wells are getting polluted at an alarming rate which was supposed to be for drinking. Due to negligence/awareness and pollution we have lost most of the clean wells. Wells are prohibited in our district as per law, but that is not the reality here. We have to clean the wells and can be used during the scarcity.
- As a citizen what are steps to be taken to stop & check encroachments. We have to at least see that there are no new encroachments on the stream banks. The municipality has to take a proactive step in curbing the issue.
- The main points – outcome of the meetings are – a forum to save the Coonoor River should be formed. Secondly a monitoring committee for the same should be selected
- There should be constant meetings & awareness programs to different groups – since this is small gathering and the larger groups or associations are outside this meeting. We should call all of them to participate in such a common cause.
- Awareness declaration should be given earlier & also decide the duties of the committee.
- Next time the meeting should be conducted in the evening – so that many official people can take part and contribute to the betterment. After 5 pm is fine and the any implementation should be proper.

The Coonoor River Initiative

Minutes of the Coonoor River Walk meeting at KVK Hall, UPASI Coonoor on 28th August 2007

A presentation by Senthil Prasad on the finding with the Coonoor walks data
 Presentation by Ann Thompson on the finding with the Coonoor River.

The members of various associations who had come for the previous meeting had not come for this meeting.

The suggestions given by the participants to clean the Coonoor River were:

- Planting of wetland species near the water source and along the water of the river can act as cleaning agents by absorbing the pollutant from the water.
- Motivate and involve the municipality to create awareness in cleaning the river. The municipality can financially support these activities.
- The local people should form a mass movement regarding this issue and also to pressurize the village headman, the local political body to take action regarding this issue.
- Involving the political party to be a part of this mass movement was also a suggestion.
- Ann suggested that during her earlier survey, the people who were using the water were ready to work on cleaning the water body. She is willing to get

project from the government for the water user groups involving in the cleaning activities.

- Creating a working group was suggested, in which people who are interested in cleaning up of the river can be members. The members are supposed to take action in controlling the waste dump into the river and in the monitoring process. The group can be supported by the Advisory committee with member of various fields (local people, politicians, scientist etc.)
- Legislation should be made to control the dumping of waste into the river.
- There should be specific methods for the house hold waste and waste from the butchery, vegetable market, to recycle these wastes.
- Formation of a core group- involving the collector, politician, local people who will work on various aspects in saving the Coonoor River.
- The next meeting should involve a larger group hence the next meeting will be at the Coonoor bus stand.

Follow up:

- The next meeting will be held at the Coonoor bus stand, the collector and the municipality taking part in the meeting.
- Information regarding water pollution should be made in simple terms so that a lay man can understand. Keystone will take responsibility in bringing out leaflets, brochures in (Eng. and Tam). This will be circulated to the participants who have attended the meeting and to people who we have met during the survey. Also to get the feed back from them.
- Organize street plays, educating the people on environmental issues.
- Core group to be formed, work to start on voluntary basis later fund will be generated.
- Training for scavengers.

Annexure 8. Results of the Coonor River Water Quality tests

Date of sample collection:13/3/07

Date of water Test:14/3/07

	Water Samples	pH (units)	Temperature	Fluoride	Dissolved oxygen	Residual chloride	Phosphorous	Nitrate	Iron	Hardness	Chloride	Ammonia	Turbidity (NTU)	Coliform	Remarks
Team I	Source	5	18.5	0.6		no result	no result	40	1	80	>1000	<1	10	Y	chloride above permissible limit
Team II	Drinking water	5	18.5	0.6		no result	no result	40	0.3	160	>1000	<1	10	Y	
	Out flow-Bandumai	5	18.5	0.6		no result	no result	10	0.3	160	>1000	<1	10	Y	
	Out flow-Gymkhana	5	18.5	0.6		no result	no result	40	0.3	80	>1000	<1	10	Y	
	Darlington	5	18.5	0.6		no result	no result	10	0.3	80	>1000	<1	25	Y	
Team III	Kattery/selas	6	18.5	0.6		no result	no result	40	1	80	>1000	<1	25	Y	

Annexure 9. Water User Group Meetings conducted at Sigur

Date	Villages - WUG Meeting	No. of Attendance
11/25/2005	Kurumbarpallam	
11/9/2005	Kurumbarpallam	
1/19/2006	Kurumbarpallam	
4/25/2006	Kurumbarpallam	
8/27/2006	Kurumbarpallam	14
9/3/2006	Kurumbarpallam	13
10/1/2006	Kurumbarpallam	13
10/14/2006	Kurumbarpallam	9
11/12/2006	Kurumbarpallam	36
12/17/2006	Kurumbarpallam	25
1/28/2007	Kurumbarpallam	17
2/18/2007	Kurumbarpallam	16
3/16/2007	Kurumbarpallam	12
26-4-07	Kurumbarpallam	26
25-5	Kurumbarpallam	20
26-6-07	Kurumbarpallam	22
18-7-07	Kurumbarpallam	22
2/9/2007	Kurumbarpallam	9
9/22/2005	Anaikatti	
12/3/2005	Anaikatti	
12/20/2005	Anaikatti	
1/5/2006	Anaikatti	
1/28/2006	Anaikatti	
3/1/2006	Anaikatti	
5/24/2006	Anaikatti	
7/11/2006	Anaikatti	14
8/16/2006	Anaikatti	7
8/24/2006	Anaikatti	22
9/27/2006	Anaikatti	16
10/17/2006	Anaikatti	21
11/22/2006	Anaikatti	24
12/15/2006	Anaikatti	13
12/27/2006	Anaikatti	11
1/22/2007	Anaikatti	15
2/13/2007	Anaikatti	17
3/27/2007	Anaikatti	12
19-4-07	Anaikatti	11
17-5-07	Anaikatti	11
30-6-07	Anaikatti	10
28-7-07	Anaikatti	8
3/8/2007	Anaikatti	10
21-4-07	Kanyakumari	7
17-5-07	Kanyakumari	15
	Kanyakumari	10
28-7-07	Kanyakumari	10
31-8-07	Kanyakumari	11
	Kanyakumari	

11/10/2005	Siriyur	
12/17/2005	Siriyur	
1/21/2006	Siriyur	
2/18/2006	Siriyur	
4/28/2006	Siriyur	
5/24/2006	Siriyur	
6/20/2006	Siriyur	
1/13/2006	Siriyur	7
3/10/2006	Siriyur	24
8/31/2006	Siriyur	15
9/28/2006	Siriyur	12
10/18/2006	Siriyur	16
11/28/2006	Siriyur	17
12/12/2006	Siriyur	14
1/24/2007	Siriyur	12
2/14/2007	Siriyur	11
3/15/2007	Siriyur	15
12/4/2007	Siriyur	10
18-5-07	Siriyur	13
23-6-07	Siriyur	11
26-7-07	Siriyur	10
14-8-07	Siriyur	15
11/9/2007	Siriyur	12
9/4/2005	Boothnatham	
11/27/2005	Boothnatham	
1/30/2006	Boothanatham	
2/17/2006	Boothanatham	
3/14/2006	Boothanatham	
3/27/2006	Boothanatham	
4/24/2006	Boothanatham	
5/22/2006	Boothanatham	
5/25/2006	Boothanatham	
7/18/2006	Boothanatham	
1/30/2006	Boothanatham	9
8-2--2006	Boothanatham	31
7/25/2006	Boothanatham	9
8/21/2006	Boothanatham	9
9/24/2006	Boothanatham	15
10/25/2006	Boothanatham	9
11/24/2006	Boothanatham	10
12/1/2006	Boothanatham	11
2/19/2007	Boothanatham	12
3/28/2007	Boothanatham	10
9/4/2007	Boothanatham	11
21-5-07	Boothanatham	18
25-6-07	Boothanatham	10
24-7-07	Boothanatham	36
24-8-07	Boothanatham	9
10/26/2005	Chokkanalli	
10/31/2005	Chokkanalli	
12/12/2005	Chokkanalli	
2/13/2006	Chokkanalli	

4/27/2006	Chokkanalli	
4/20/2006	Chokkanalli	
3/10/2005	Chokkanalli	17
7/28/2006	Chokkanalli	20
8/18/2006	Chokkanalli	28
9/25/2006	Chokkanalli	16
10/26/2006	Chokkanalli	14
11/14/2006	Chokkanalli	12
12/24/2006	Chokkanalli	14
1/1/2007	Chokkanalli	13
2/20/2007	Chokkanalli	14
3/27/2007	Chokkanalli	16
9/4/2007	Chokkanalli	14
17-5-07	Chokkanalli	12
21-6-07	Chokkanalli	8
25-7-07	Chokkanalli	11
28-8-07	Chokkanalli	11
10/9/2007	Chokkanalli	11
12/1/2005	Vazhathottam	
1/16/2006	Vazhathottam	
1/30/2006	Vazhathottam	
3/27/2006	Vazhathottam	
4/20/2006	Vazhathottam	
4/24/2006	Vazhathottam	
7/18/2006	Vazhathottam	
8/18/2006	Vazhathottam	13
9/24/2006	Vazhathottam	
10/10/2006	Vazhathottam	
9/8/2006	Chemmanatham	21
10/27/2006	Chemmanatham	17
11/14/2006	Chemmanatham	11
12/7/2006	Chemmanatham	12
1/17/2007	Chemmanatham	17
2/20/2007	Chemmanatham	13
3/25/2007	Chemmanatham	12
22-4-07	Chemmanatham	12
28-6-07	Chemmanatham	8
29-7-07	Chemmanatham	22
28-8-07	Chemmanatham	25

Annexure 10 - Trainings conducted at Sigur regarding WUGs Capacity building

S. No	Date of Training	Training Heading	No. of Trainees Participated	Trainer	No. of Days
1	7.5.2005	LFA	16	Joakim	One
2	8&9.9.2005	Plumber & Fitter	10	Sreedhar	Two
3	17.8.2005	Plumber & Fitter _II Phase	8	Sreedhar	One
4	27.9.2005	Pipe fitting	7	Sreedhar	One
5	23.9.05	Water User Group Workshop	24		One
6	September	Medical Check Up	30	Dr. Ramakrishnan	One
7					

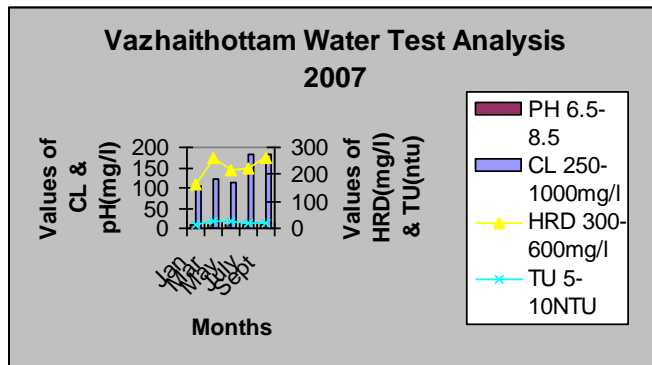
Annexure 11. Water Quality Tests for the year 2007 up to September 2007

Parameter(mg/l) Standard Permissible	PH 6.5- 8.5	T(°C) >25*	DO 5mg/l	RC 0.2mg/l	TU 5- 10NTU	CL 250- 1000mg/l	No3 45mg/l	F 1mg/l	P 10- 30ug/l	Iron 0.3mg/l	HRD 300- 600mg/l	NH3 1.5mg/l
Vazhathottam												
6-Jan	8		11	0.2	15	106.35	10	0.6	0.2	0.3	160	1
5-Mar	8	20	13.6	0.2	25	120.53	10	0.6	0.2	0.3	260	1
(May 2007)	9	20	12.6	0.2	25	113.44	10	0.6	0.2	0.3	212	1
(July 2007)	8	20	13.8	0.2	20	184.08	10	0.6	0.2	0.3	220	1
(Sept 2007)	9	25	11.08	0.2	20	184.34	10	0.6	0.2	0.3	264	1
(Nov 2007)												
Boothanatham												
6-Jan	6		12	0.2	10	85.08	10	0.6	0.2	0.3	160	1
6-Mar	8	18	12.4	0.2	20	148.89	10	0.6	0.2	0.3	180	1
(May 2007)	8	25	13.4	0.2	25	184.34	10	0.6	0.2	0.3	224	1
(July 2007)	8	26	12.6	0.2	25	152.43	10	0.6	0.2	0.2	228	1
(Sept 2007)	8	25	11.02	0.2	20	198.52	10	0.6	0.2	0.3	256	1
(Nov 2007)												
Chokkanalli												
6-Jan	9		12	0.2	16	88.625	10	0.6	0.2	0.3	304	1
6-Mar	8	18	13	0.2	15	127.62	10	0.6	0.2	0.3	252	1
(May 2007)	8	25	12.4	0.2	20	148.89	10	0.6	0.2	0.3	260	1
(july 2007)	9	23	12.4	0.2	20	170.16	10	0.6	0.2	0.3	216	1
(Sept 2007)	9	25	14.04	0.2	26	187.88	10	0.6	0.2	0.3	248	1
(Nov 2007)												
Anaikatti												
6-Jan	8		18	0.2	20	709	10	0.6	0.2	0.3	200	1

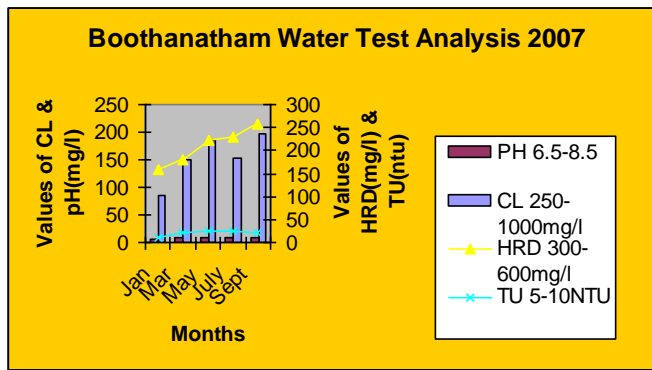
6-Mar	9	25	18	0.2	20	709	10	0.6	0.2	0.3	220	1
(May 2007)	8	25	13	0.2	25	124.35	10	0.6	0.2	0.3	216	1
(July 2007)	8	25	11.6	0.2	25	209.15	10	0.6	0.2	0.3	224	1
(Sept 2007)	8	25	12.08	0.2	25	230.42	10	0.6	0.2	0.3	260	1
(Nov 2007)												
Siriyur												
6-Jan	8		11	0.2	15	77.99	10	0.6	0.2	0.3	220	1
6-Mar	8	25	13.6	0.2	25	148.89	10	0.6	0.2	0.3	212	1
(May 2007)	8	20	14	0.2	20	124.75	10	0.6	0.2	0.3	288	1
(July 2007)	9	25	11.8	0.2	25	184.34	10	0.6	0.2	0.3	228	1
(Sept 2007)	8	20	11.04	0.2	25	194.97	10	0.6	0.2	0.3	272	1
(Nov 2007)												
Chemmanatham)												
6-Jan	8		11.2	0.2	15	77.99	10	0.6	0.2	0.3	120	1
6-Mar	8	25	14.6	0.2	20	152.43	10	0.6	0.2	0.3	208	1
(May 2007)	8	25	12.2	0.2	25	148.89	10	0.6	0.2	0.3	180	1
(July 2007)	8	20	12.8	0.2	20	187.88	10	0.6	0.2	0.3	212	1
(Sept 2007)	8	25	12.04	0.2	25	191.43	10	0.6	0.2	0.3	268	1
(Nov 2007)												
Kurumbapallam												
6-Jan	8		15	0.2	15	302	10	0.6	0.2	0.3	280	1
6-Mar	9	25	11	0.2	25	88.62	10	0.6	0.2	0.3	264	1
(May 2007)	9	25	14.8	0.2	20	152.43	10	0.6	0.2	0.3	188	1
(July 2007)	8	25	13.2	0.2	25	166.61	10	0.6	0.2	0.3	232	1
(Sept 2007)	8	20	12.04	0.2	20	170.16	10	0.6	0.2	0.3	236	1

Annexure 12. Analysis of Water Quality Tests for Year 2007

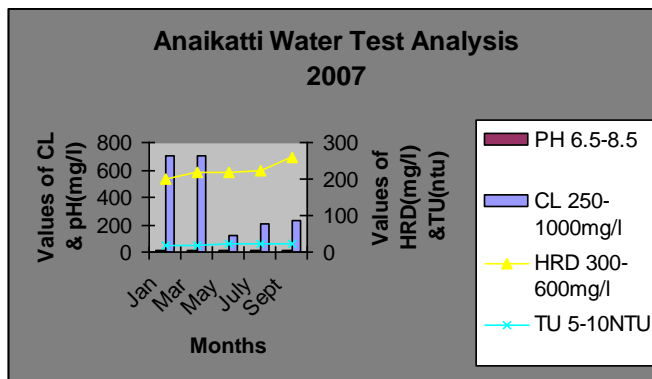
Graph 27. Water Analysis for Vazhaithottam Village in Year 2007



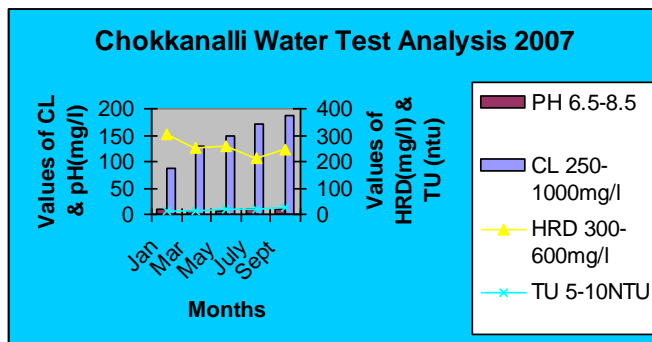
Graph 28. Water Analysis for Boothanatham Village in Year 2007



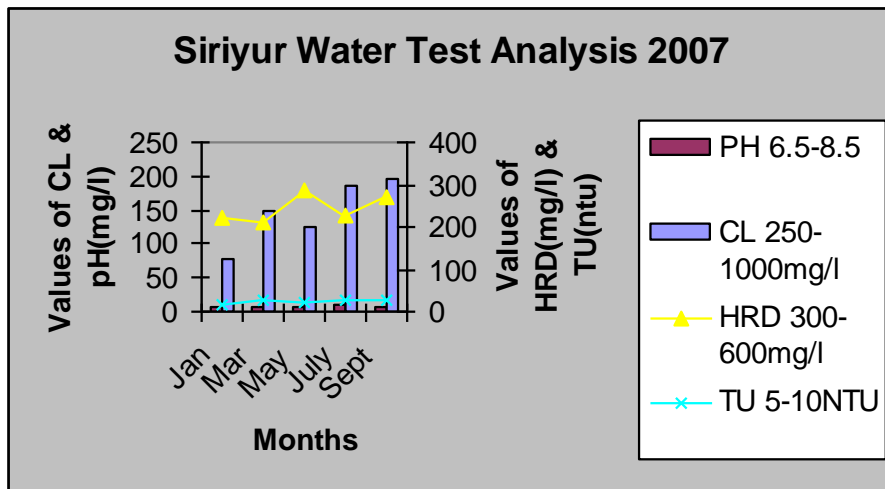
Graph 29. Water Analysis for Anaikatti Village in Year 2007



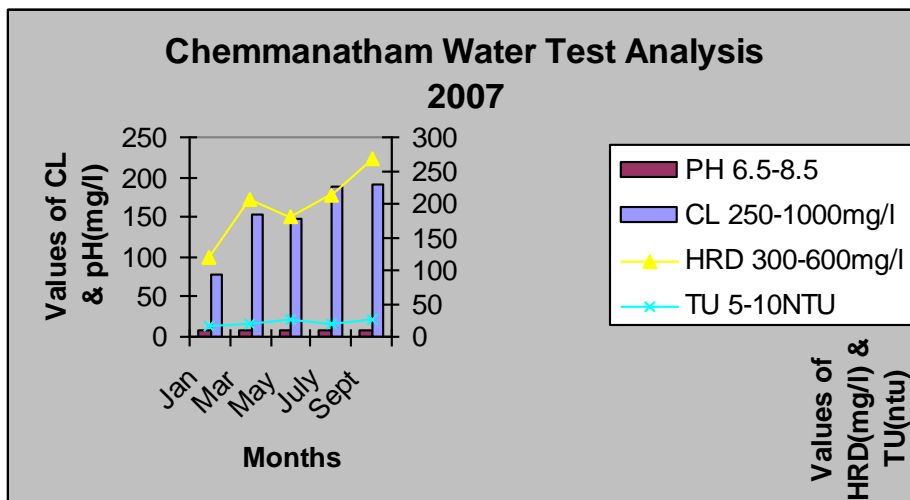
Graph 30. Water Analysis for Chokkanalli Village in Year 2007



Graph 31. Water Analysis for Siriyur Village in Year 2007



Graph 32. Water Analysis for Chemmanatham Village in Year 2007



Graph 33. Water Analysis for Kurumbarpallam Village in Year 2007

