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Role of WASH and Agency in Health: A study of isolated rural communities in Nilgiris and Jalpaiguri

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Role of WASH and Agency in Health:
A study of isolated rural communities in Nilgiris and Jalpaiguri

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Abstract

The objective of the Swachh Bharath Mission (SBM) or Clean India Mission of the Indian Government is to eliminate open defecation in India through installation of toilets and triggering of behavioural change by 2019. The problem is most daunting in isolated communities with poor WASH infrastructure and local agencies with scarce resources. In India, tribal communities, living near forests and along mountain ranges are among the most isolated, which means that the study of the impact of WASH (water, sanitation and hygiene behaviour) and the effectiveness of local agencies responsible for public hygiene in such communities is pertinent for our research query. Thus, this working paper presents the results of a study of 20 villages located in two districts, Nilgiris and Jalpaiguri, in two distinct Indian states – Tamil Nadu and West Bengal respectively. The central research question is: What is the role of WASH infrastructure and capabilities and local agencies in containing the incidence of excreta related diseases in isolated rural Indian communities? A novel multi-level model is developed and estimated and further validated through focus research groups. It confirms that disease incidence is jointly determined by the quantity as well as the quality of WASH. The role of agency seems to matter more at village level rather than at the household level.

Keywords: WASH, Sanitation, Health, Policy, India

JEL Codes: I15, O10, O20

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1. Introduction

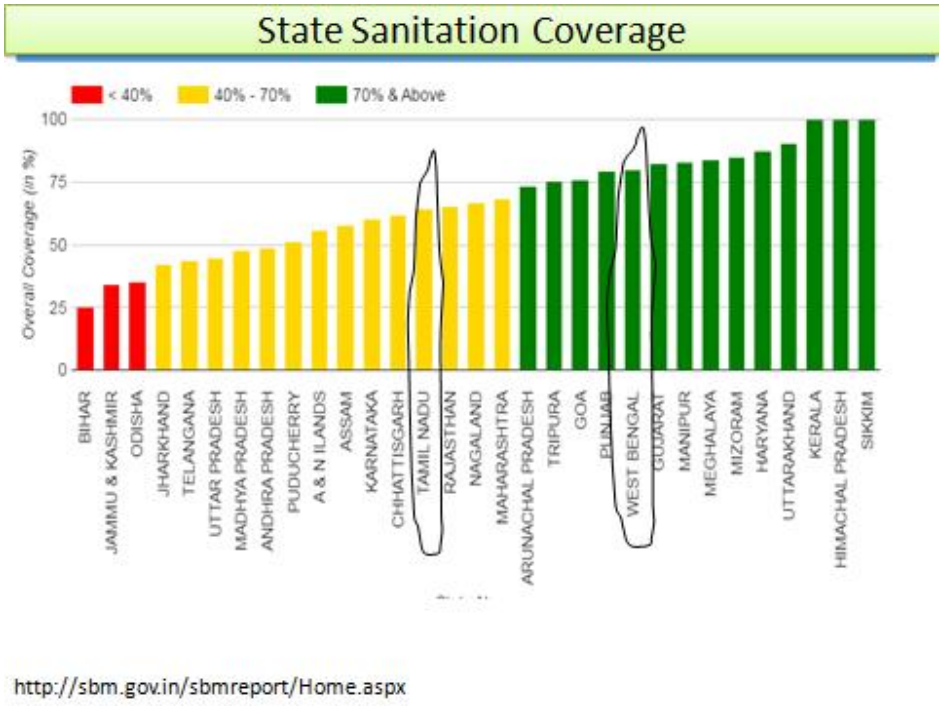
Diarrhoeal diseases refer to a symptom or sign encompassing different types of diarrhoea. They result from infections caused by a host of bacterial, viral and parasitic organisms, most of which are spread by faeces-contaminated water or lack of hygiene behaviour (WHO, 2013). Diarrhoeal diseases are the third leading highest cause of death in low income countries (445.92 thousand per year in 2012) and the fifth highest in lower middle income countries (923.35 per year in 2012) according to the latest available statistics (WHO, 2014). In sum, while the morbidity and mortality associated with diarrhoeal diseases make them a significant public health problem worldwide, the crisis is most acute in developing nations. This is because drinking water, sanitation and hygiene behaviour, referred to as the WASH variables by UNICEF, acknowledged as the three main determinants of diarrhoeal diseases, are highly lacking in developing countries such as India. Thus, one of the flagship programmes of the Government of India is the Swachh Bharath Mission (SBM) or Clean India Mission, whose central objective is to eliminate open defecation in India through installation of toilets and triggering of behavioural change by 2019. Similarly, there is also a National Water Mission whose objective is to conserve water, minimise wastage and ensure more equitable distribution both across and within states. The problem is most daunting in isolated communities with poor WASH infrastructure and local agencies with scarce resources. In an attempt to contribute to addressing this challenge the over arching research question of the present study is: **What is the role of WASH infrastructure and capabilities and local agencies in containing the incidence of excreta related diseases in isolated rural Indian communities?**

In India, tribal communities, living near forests and along mountain ranges are among the most isolated, which means that the study of the impact of WASH and agency on such communities makes for an appropriate study for our research query. Thus, this report presents the results of a study of 20 villages located in two districts Nilgiris and Jalpaiguri, in two distinct Indian states – Tamil Nadu and West Bengal respectively. Tamil Nadu is a southern state while West Bengal is in the East. The tribal communities are different with a different history. There has been a huge influx of migrants over time in both districts such that some villages now do not have any tribal population. Such diversity also lends more insight to respond to our research question.

There are two main points of note, which particularly motivate the present study. First, at present in India, efforts towards SBM (Clean India Mission) occurring from multiple sources, both public and private, seem to working in silos such that investment in sanitation and water are not coordinated with one another and investment on hygiene behaviour is dispersed among a

wide variety of programmes. However, there is increasing evidence that the interrelationships between the WASH variables are very important and hence investment must be dosed according.

Figure 1: Sanitation Coverage in Indian States



http://sbm.gov.in/sbmreport/Home.aspx

Secondly, local public agency effectiveness also matters. The SBM aims at transforming village and city populations into open defecation free (ODF) communities, wherein ODF is defined by three parameters: access to a toilet, usage of a toilet and toilet technology being safe vis-à-vis humans as well as the environment. The SBM plans investment on capacity building in the form of trained personnel, financial incentives and systems for planning and monitoring. However States are given flexibility in terms of implementation. Thus, from national to village level, experiments are ongoing to achieve the SBM. As Figure 2 shows, the challenge of the different contexts and the effectiveness of the local agencies is giving rise to diverse performance. Furthermore, as can be seen, the two districts that will be studied in this work - Nilgiris in Tamil Nadu, and Jalpaiguri in West Bengal have distinctly different sanitation coverage. West Bengal is one of the states doing well, while Tamil Nadu lies among the middle states. In the study we will examine zoom in on isolated communities in these two states to examine if this is indeed the case there also and if so, whether such differences lead necessarily to a different health status.

These two points are also illustrated by a study of the determinants of child diarrhoea finds that the higher the level of socio-economic development in a state, the higher is impact of complementarity between access to sanitation and drinking water, and hygiene behaviours of a household (Dutta, Hajra and Ramani, 2015). Further, quality as well as joint presence in terms of quantity matter for child diarrhoea. This means that when joint WASH infrastructure is least developed in a region, each WASH component, i.e. water, sanitation and hygiene behaviour, can be treated as a substitute of the other. In this case, investment in any of them will improve health status. However as joint WASH infrastructure improves in coverage and quality, the WASH components become strategic complements, and thereafter, uncoordinated or uni-focused

programmes will not have much impact. Only a three-pronged strategy targeting all WASH variables according to local gaps will maximise returns.

Given the above, the present work is based on the premise that an exploration and refinement of these results to the incidence of adult diarrhoea in India would be useful, especially for isolated communities, which might have zone specific WASH infrastructure and capabilities. It aims to contribute to this endeavour through a detailed study of the determinants of diarrhoea in two isolated mountainous districts in the Indian States of Tamil Nadu and West Bengal.

The remainder of the report is organised as follows. Section 2 summarises the nexus between the WASH variables and health. Section 3 outlines the salient features of our targeted zones for study – the Nilgiris and Jalpaiguri districts. Section 4 presents our conceptual framework. This is followed by section 5 with the questionnaire design and section 6 with the sampling design. Then come the results and their discussion in section 7 with sample characteristics, section 8 with model estimation, section 9 with village level study results and section 10 with focus group discussion results from Nilgiris. Section 11 concludes.

2. WASH and Health[1]

Water: All plants and animals including humans need to consume water to survive. Apart from drinking it to survive, we need water to cook, to clean our bodies, clothes and materials. Further, it is used in many industries required for economic sustainability ranging from agriculture to the production of transport vehicles and computers. So the importance of access to clean uncontaminated water is self-evident.

Sanitation and Hygiene behaviour: When there are no toilets, people have to defecate in the open. Fresh faeces are microbial mounds and those of infected people or animals can contain virulent viruses, bacteria and cysts of protozoa and eggs of helminths. The most common examples of excreta associated pathogens are presented in Table 1.

[1] The portions on sanitation and health in this section are from Shyama V. Ramani and Rushva Parihar, 2015, Linkages between sanitation, health and poverty reduction, for "A Framework Model on MNE's impact on global development challenges in emerging markets" EU FP7 funded project Grant agreement no: 612889

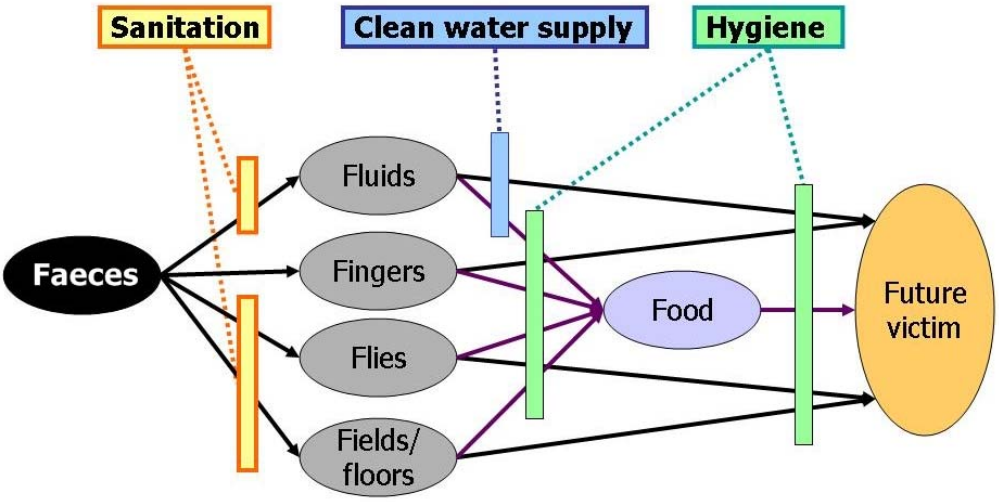
Table 1: Common pathogens found in faeces and associated diseases

Virus	Main health impact (Risk of mortality)
Norovirus	Diarrhoea – inflammation of stomach and intestine
Adenovirus	Diarrhea, Pink eye (conjunctivitis) Bladder, stomach, intestine inflammation or infection
Most Enterovirus	Rashes
Poliovirus (in the Enterovirus family)	Irreversible paralysis, usually in the legs but can be more – within hours
Bacteria	Main health impact (Risk of mortality)
Vibrio cholerae	Diarrhoea and vomiting (can be mortal)
Salmonella typhi	Diarrhoea (can be mortal)
Escherichia coli O157:H12	Diarrhoea (can be mortal through infecting organs like kidneys)
Chlamydia trachomatis	granular conjunctivitis - pain in the eyes and blindness if outer surface or cornea is affected
Worms	Main health impact (Risk of mortality)
roundworm (Ascaris lumbricoides)	Common features are of the different helminth associated diseases: diarrhoea, haemorrhages, deficient blood coagulation and undernourishment. Degeneration into cancer tumours. Infected children become physically, nutritionally and cognitively impaired. Debilitation in adults. (Risk of mortality through other co-infection due to debilitated body)
whipworm (Trichuris trichiura)	
hookworms (Necator americanus and Ancylostoma duodenale)	
parasitic worms of the Schistosoma type (snails are carriers)	Schistosomiasis with infection of the urinary tract and/or intestines.
thread-like roundworms belonging to the Filaroidea type (black flies &mosquitoes are carriers)	Filariasis (or philariasis) -enormous amount of swelling of affected areas.
Protozoa	
Giardia intestinalis (also known as Giardia lamblia)	Diarrhoea

Source: Compiled by authors from medical literature

By excreta related diseases, we refer to infections by pathogens that are present and thrive in excreta. Excreta related infections trigger illnesses that range from relatively innocuous diarrhoea to life threatening diseases or life debilitating states. The bacteria referred to in Table 1 are most virulent and infection starting with diarrhoea can cause death unless the person is treated promptly. Viruses and protozoa are usually not so lethal but they do give rise to inflammation of the stomach or intestine and/or skin rashes and can significantly lower health status with repeated incidence. Excreta-related pathogens reach human hosts via vectors that use or involve faeces as a medium (See Figure 2).

Figure 2: Vectors and Pathways of Excreta Related Infections and their Barriers



Taken from source:
http://www.wsscc.org/sites/default/files/content/Research_article_files/fluid_graphic.jpg

For instance, from faeces, the pathogens are transferred to humans either through non-hygienic behaviour or through intermediaries like flies, plants, fish, molluscs, other animals, soil and water. Hygiene behaviour such as the use of toilets, regular washing of hands, maintaining clean living spaces, workspaces and kitchens, washing meat and vegetables with non-contaminated water, using footwear, practising hygienic disposal of stools and ensuring non-contamination by sick or infected are all well known ways by pathogen transmission can be minimised. Of course hygiene behaviour is facilitated if households have access to toilets and non-contaminated water. These are all ways by which either human excreta are isolated from the living environment or the infection route is blocked through hygienic practices (JICA, 2012). ***Thus, the installation of toilets is a necessary condition for the reduction of excreta related diseases i.e. infections from pathogens that are present in excreta.***

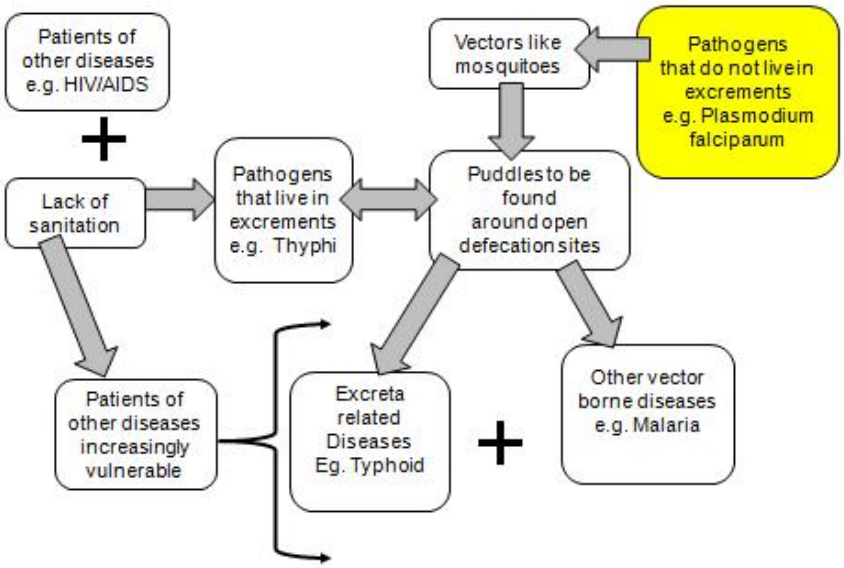
Going beyond, there are vectors like mosquitoes and other flies, snails etc. which thrive and breed on water, especially those near sites of open defecation or sewage. These are carriers of other diseases. Open defecation resulting from lack of sanitation also contributes to the incidence of other diseases like malaria, dengue and chikungunya transferred by vectors that thrive on excrements.

Finally, any patient with a debilitating health problem the lowers the immune system of the body like HIV/AIDS, TB and Hepatitis – and who does not have access to sanitation will be even more vulnerable to infectious and parasitic diseases.

Combining these facts, as Figure 3 illustrates, sanitation goes beyond excreta related diseases to impact health. .

Three types of diseases are spread by lack of sanitation: (i) those caused by pathogens living in excrements; (ii) those caused by pathogens whose vectors of transfer to human hosts thrive on excrements; (iii) those caused by pathogens that reduce the immune system of infected patients.

Figure 3: The Sanitation and Health Nexus



Lack of access to sanitation makes the area/region/community more prone to diseases which are directly or indirectly linked to sanitation, which not only include diarrhoeal diseases but also others like cholera, typhoid, dengue, trachoma, malaria, and intestinal nematode infections. For instance, the other significant killer as noted in the statistics is malaria, which reduces productive years in low income countries by 5.19% and in lower-middle countries by 2.34%. The loss of productivity percentages fall to almost zero (0.01%) in high income countries. While malaria is not directly linked to sanitation, there is a strong indirect link that can be inferred. Sites of open defecation are breeding grounds for vectors like mosquitoes, which in turn spread deadly diseases like malaria, dengue, chikungunya etc. Not only do low and lower middle countries have high incidents of open defecation that provide a medium for mosquitoes and flies, but they are also countries located in the tropical region, where the climate is ideal for mosquitoes to thrive, making them even more prone to diseases like malaria.

However, according to Figure 1, sanitation is but one determinant of health. The role of water, waste management and hygiene behaviour is also important as shown in Table 2.

Table 2: Preventive Measures for Communicable Diseases

Preventive measure	Impact on spread of
Shelter, Site planning	Diarrhoeal diseases, acute respiratory infections
Clean water	Diarrhoeal diseases, typhoid fever, guinea worm
Good sanitation	Diarrhoeal diseases, vector-borne diseases, scabies
Adequate nutrition	Tuberculosis, measles, acute respiratory infections
Vaccination	Measles, meningitis, yellow fever, Japanese encephalitis, diphtheria
Vector control	Malaria, leishmaniasis, plague, Dengue, Japanese encephalitis, yellow fever, other viral haemorrhagic fevers
Personal protection (insecticide-treated nets)	Malaria, leishmaniasis
Personal hygiene	Louse-borne diseases: typhus, relapsing fever, trench fever
Health promotion	Sexually transmitted infections, HIV/AIDS, diarrhoeal diseases, and Infections during and after deliveries
Case-management	Cholera, shigellosis, tuberculosis, acute respiratory infections, malaria, Dengue, haemorrhagic fever, meningitis, relapsing fever

Taken from Source: The Johns Hopkins and the International Federation of Red Cross Publication *Public Health Guide for Emergencies (2008)*, Chapter 8: Water, Sanitation, and Hygiene in Emergencies, pg378. URL: http://www.jhsph.edu/research/centers-and-institutes/center-for-refugee-and-disaster-response/publications_tools/publications/_CRDR_ICRC_Public_Health_Guide_Book/Chapter_8_Water_Sanitation_and_Hygiene_in_Emergencies.pdf

It is thus important to note that the installation of toilets is a necessary but not sufficient condition for the reduction of diseases directly or indirectly related to excreta. Access to sanitation, alone is not does not guarantee improvement in health. Additional supplementary measures need to be taken in order to bring about sustained and consistent improvements in health. These measures include hygiene and other personal protection measures as well as a clean environment for both disease protection and vector control.

Bartram, et al. (2005) point out that the number of people who die annually due to largely preventable diseases caused by lack of poor sanitation in combination with inadequate water supply is greater than those killed by war and terrorism combined. Diseases related to unsafe water, poor sanitation, and lack of hygiene are some of the most common causes of illness and death among the poor of developing countries. Almost half the people in the developing world have one or more of the main diseases or infections associated with inadequate water supply and sanitation: diarrhoea, intestinal helminth infections (worms), dracunculiasis (guinea worm),

schistosomiasis (snail fever), and trachoma. More than half the hospital beds in the world are occupied by people who have these diseases.

Finally, the conceptual framework designed for this study takes into account the above and also incorporates the findings of a survey of the medical literature on the drivers of diarrhoeal incidence in low and middle income countries. Summarised in Figure 3, it affirms that the WASH variables, along with a variety of other risk factors jointly trigger the incidence of diarrhoea (Ramani et al., 2012). These can be categorised into five types:

(1) physical environment (e.g. weather, water table, drainage etc.);

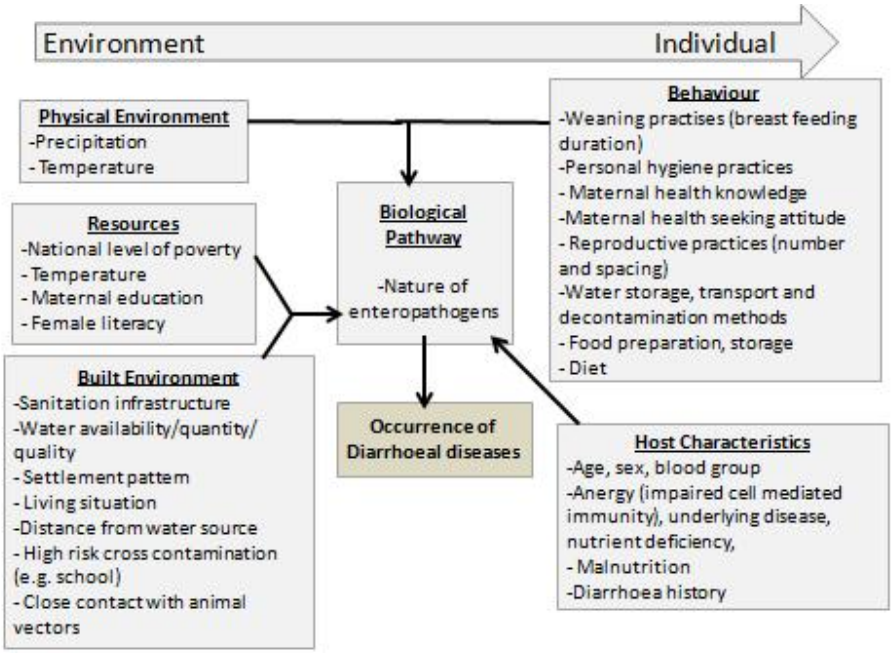
(2) socio-economic development;

(3) knowledge, resource and asset portfolio of the household (e.g. level of education of the mother, access to water and sanitation);

(4) hygiene behaviours of the household (e.g. child care practices and open defecation) and

(5) individual host characteristics (age, gender).

Figure 3: Determinants of diarrhoeal diseases as per the medical literature (Ramani et al. 2010)



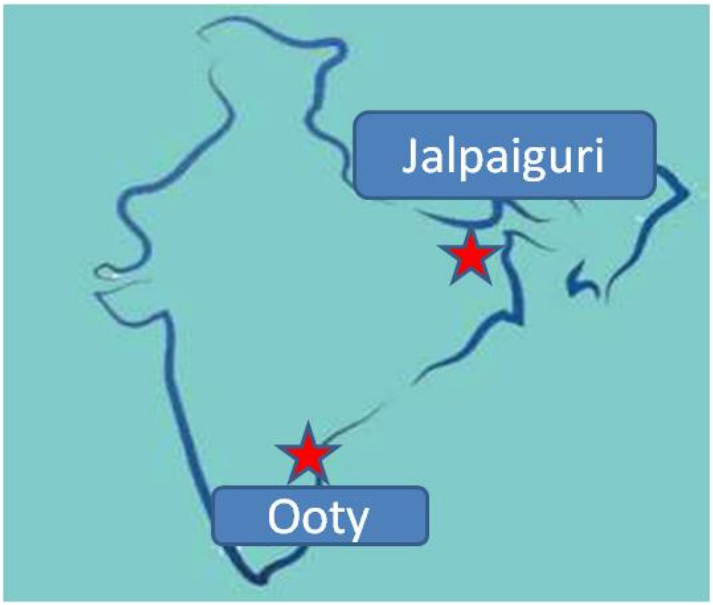
As Figure 3 shows, diarrhoea is triggered by environmental, household level and individual-level risk factors. Each of these risk factors influences the likelihood of infection by enteropathogens in a host in a distinctive way. At the same time, the different risk factors are also engaged in interactions

between themselves, which in turn may have a compounding effect on diarrhoea incidence. Thus, it is necessary to map the joint presence of the WASH variables, along with other risk factors, and understand the nature of the interactions between the various risk factors, in order to forecast their joint impact on the likelihood of diarrhoea incidence.

3. A brief outline of the salient features of the target sites of study

We now present the salient features of the Nilgiris and Jalpaiguri from the information given in the government websites. *For Nilgiri :* *http://nilgiris.nic.in/profile.html* *For Jalpaiguri:* *http://jalpaiguri.gov.in/html/census.html*

Both are hilly districts. The Nilgiris District is in the southern Indian state of Tamil Nadu. Nilgiri or Blue Mountains when translated into English is also the name given to a range of mountains spread across the states of Tamil Nadu, Karnataka and Kerala. The district is mainly contained within the mountain range. The district, basically a hilly region, sits at an elevation of 900 to 2,636 meters above mean sea level (MSL). Nearly the entire district lies in the shadow of a range of mountains called the Western Ghats.



The Jalpaiguri district is in the eastern Indian state of West Bengal. The district situated in the northern part of West Bengal has international borders with Bhutan and Bangladesh. It gets its name from the Bengali word jalpai meaning "olive" because of the olives which grew in the district. This narrow district stretch is a land lying between the Sikkim - Darjeeling Himalayas and Gangetic West Bengal basin and its entire topography is crisscrossed with rivulets, rivers and hills.

Both are home to many tribal communities. The Nilgiris district is the homeland of many native tribal communities of India including the Todas, Kotas, and Badagas. The Toda people have been the subject of much study by cultural anthropologists. Interestingly the study of the Toda people established the model for the study of indigenous peoples throughout the world.

The geographical boundaries of the Jalpaiguri district of the present day had been under the rule of various dynasties during

the different phases of history. A part of the district commonly designated as Duars had often been included in the kingdoms of Bhutan and Cooch Behar. A number of Indo-Mongoloid tribes migrated and settled in this fertile land. A majority of these the 'Raj Bangshis'; apart from them there are the Mech, the Ravas and the Totos. Additionally some Limbus and Lepchas from across the Mechi River and the Nageshias, the Uraons and the Mundas from the Chotonagpur Plateau area also live in this district.

Both contain forests around which villages with large rural populations are clustered.

According to the Census of 2011, about 40.76% of the population in the Niligiris district resides in rural areas. Besides the rich plant biodiversity in the eco-regions the Nilgiris district is also home to the largest herd of Asian elephants, tigers, some native animals such as the Nilgiri Tahr, Nilgiri Woodpigeon, and Nilgiri Blackbird.

According to the Census of 2011, about 72.62% of the population in the Jalpaiguri district live in rural areas. The Jalpaiguri district is covered with dense forest and riverine grassland and harbors interesting wildlife including the Indian rhinoceros, gaur, Asian elephant, sloth bear, chital, and sambar deer.

There are also differences between the two districts and these are captured in Table 3.

Table 3: A comparison of the salient features of Nilgiris and Jalpaiguri

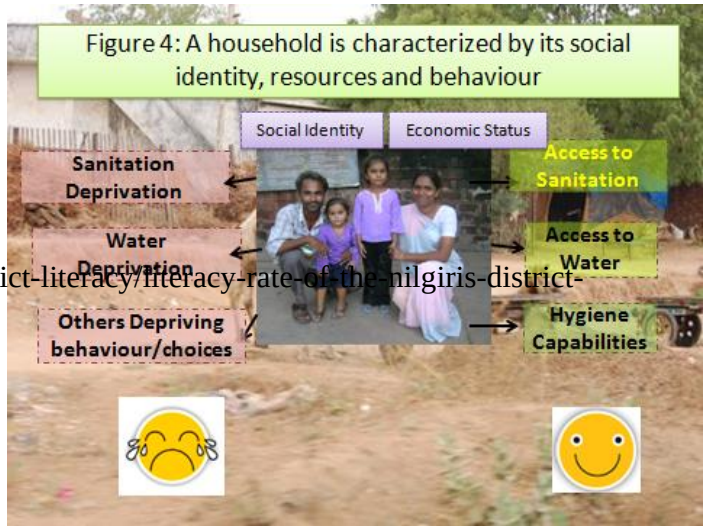
	Nilgiris	Jalpaiguri	Comment
Size	2,452.50 sq. km	3,044 sq. km	
Elevation	900 to 2,636 MSL	82m MSL[2]	Jalpaiguri is much closer to the

[2] http://niwe.res.in/assets/Docu/srra_data/WB_Jalpaiguri.pdf

			sea level than Nilgiris
Population	762,141	3,869,675	The population of Jalpaiguri is more than 5 times that of Nilgiris
Literacy	85.20%[3]	74%	Literacy is higher in Nilgirs
Climate	25^0 C to 2^0 C	37.9^0 C to 7.8^0 C	Since Jalpaiguri is closer to mean sea level, it is much warmer here than in the Nilgiri.
Rainfall	1920.80 mm	2548.8 mm	Much more rain in Jalpaiguri.
Types of crops	Tea and coffee are main crops but a lot of vegetables, fruits and spices are also grown.	tea, jute and tobacco are the main crops	Tea is a common element in both districts. Other crop types are different.
Irrigation	No irrigation	While no data is available on the status of irrigation in the district, there are a number of rivers.	Water is less of a problem in Jalpaiguri
Wildlife	Asian elephants, Tigers, Deer, Nilgiri Tahr, Nilgiri Woodpigeon and Nilgiri Blackbird	Indian rhinoceros, gaur, Asian elephant, sloth bear, Deer.	Elephants and small cats like leopards are common to both. The distinction is the indigenous animals in the Nilgiris like the Thar.
Primary Health Centers	28	26	Even though Nilgiri is smaller than Jalpaiguri in size - they have more PHC
Health Sub-Centers	194	301	On account of the larger population, there are more sub centers.

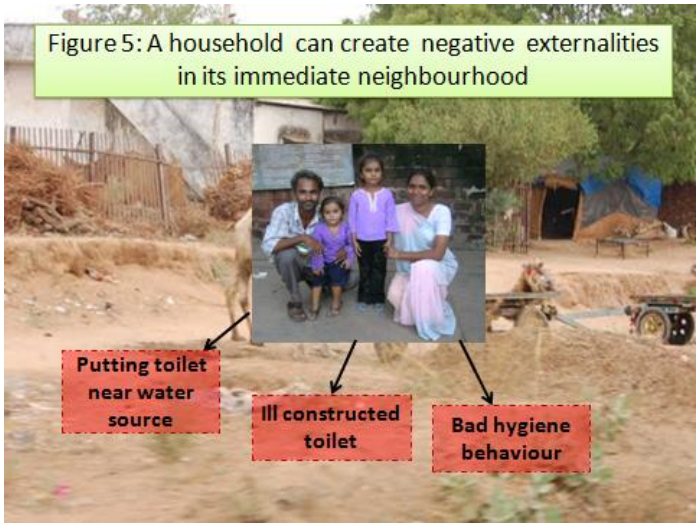
4. The Conceptual framework

Going by Figure 3, almost all people living in low- and middle-income countries are at high risk for diarrhoeal diseases. However, measurements of risk are likely to vary according to the scope of the environment considered, say entire country or region or village or neighbourhood or household etc. For the purposes of the present work, our analysis focussed at the individual household level and the village level.



[3] http://www.census2011.co.in/questions/31/district-literacy/literacy-rate-of-the-nilgiris-district-2011.html

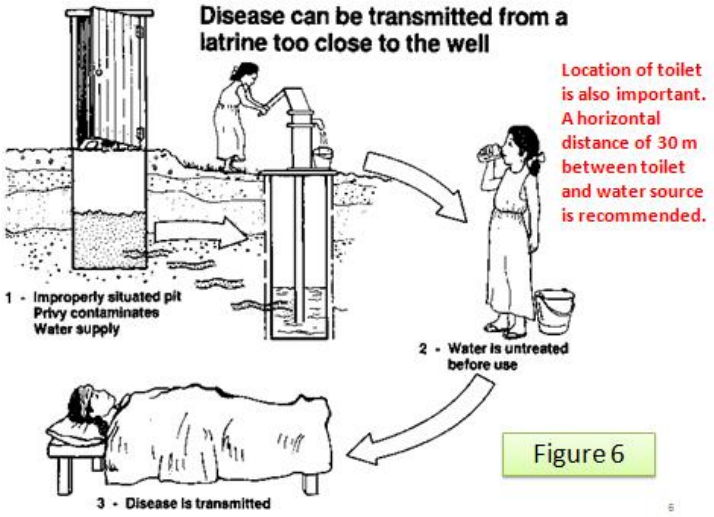
Let us consider a household to be characterised by social identity, economic status, nature of access to sanitation and water and its hygiene behaviour as shown in Figure 4. **Of course, it is most likely that the hygiene behaviour of the household is a function of its economic status, access to water and access to sanitation. But these are not the only variables to influence the hygiene behaviour of households.**



However, households can generate negative externalities through:

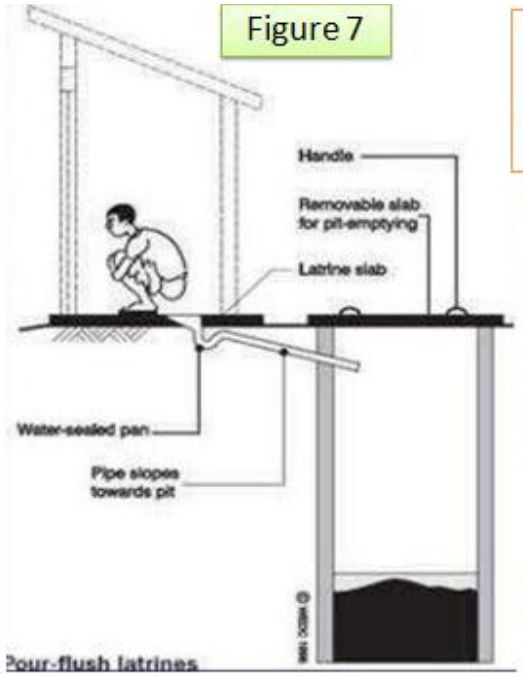
(i) Bad location of toilet;
(ii) Having a badly constructed toilet
(iii) Indulging in bad hygiene behaviour such as not using the toilet they have (common among men, young children and elderly)

Though a minimum of 30 metres is recommended, due to lack of knowledge and/or lack of space, this is often not observed. When this is not the case, the household may end up drinking contaminated water.



The most commonly diffused types of toilets are pit latrines, with either one or two pits, with the pit being either within or outside of the toilet. It is recommended that the pit latrines should be constructed only where the distance between floor of toilet and water table is at least 2 metres. But, this distance is not usually checked. This also means that pit latrines are not suitable for areas with high water tables such as coastal areas.

Figure 7



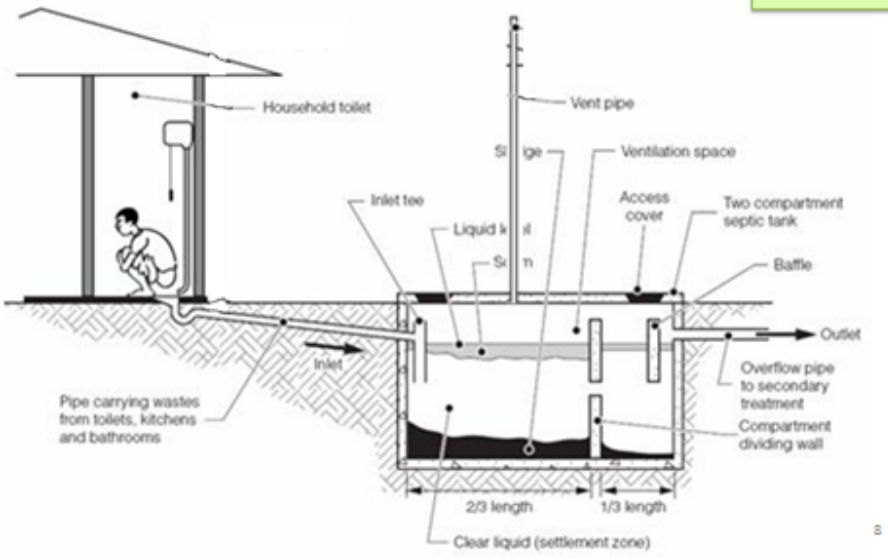
The World Bank recently acknowledged that all pit latrines may pose a danger of water contamination.

Disadvantages:
produce substantial quantities of heavily contaminated wastewater which can require substantial downstream infrastructure to avoid severe environmental and public health problems. Untreated wastewater can pose dangers to health if the outflow from leach pits may pollute the groundwater table.

http://water.worldbank.org/shw-resource-guide/infrastructure/menu-technical-options/water-flush-and-pour-flush-toilets

An alternative is the septic tank, which is a complex sanitation system and costly.

Figure 8



The alternative is the sanitation system that includes a septic tank. A major problem is that desludging agencies are notorious for doing their work badly. Sludge from septic tanks is often taken from one place and just dumped in the open a few kilometres away,

encouraging every sort of health hazard possible. Therefore, the hazard is not from the septic tank itself but from inefficient desludging agencies making it an institutional inefficiency problem.

Figure 9: Contaminating septic tanks – Photos courtesy – Subburaman Scope Agency, Trichi

Many septic tanks in rural areas are simply large pits with a few barriers that may or may not be cemented. Without an impermeable septic tank, waste water from toilets can also contaminate the surface water in high table areas with faecal matter. Also instead of the outlet going through a soak pit or a drain field often it is let out into the open or into a drain. Also if the septic tank is not desludged regularly then scum can also out of the outlet.

Spitting, blowing nose in public spaces, urinating and defecating in public spaces and littering in public spaces are major problems in India.

Even though there are agencies, Panchayats at village level and Municipalities at town and city level who are supposed to maintain cleanliness, promote public health and minimise the risk from the negative externalities – it has never been implemented systematically till recently under the Swachh Bharat or Clean India Mission. Nevertheless it will be impossible for any agency to maintain cleanliness and hygiene unless people change their hygiene behaviour in public spaces.

Typical unhygienic behaviour in India that causes contamination

This gives rise to two models to be estimated at the village and household level as follows.

Figure 11: Village level outcomes

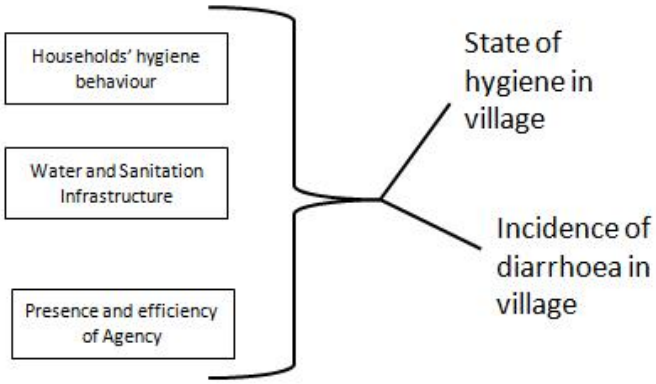
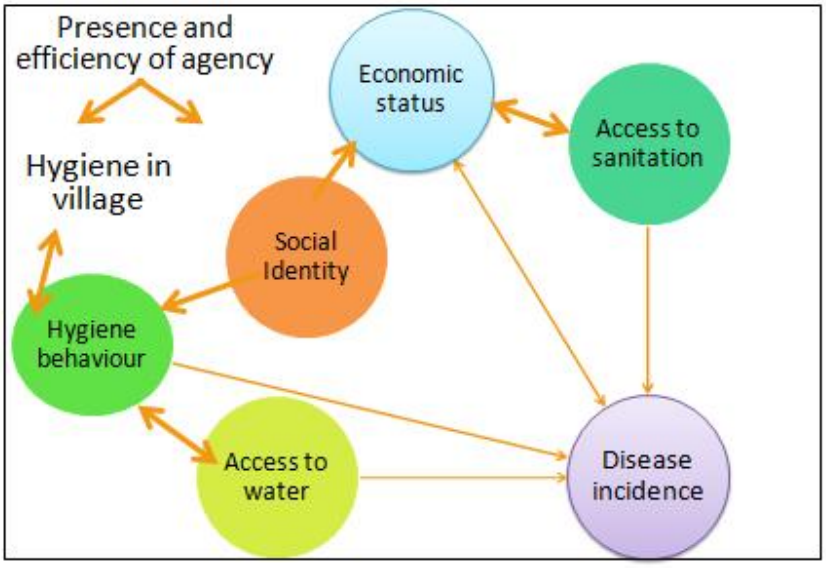


Figure 12: Household level outcomes



5. Questionnaire design: Compilation of variables of conceptual framework

5.1 Variables relating to model on households

We now describe the sets of indicators designed to capture the different dimensions of the the main nine variables whose interrelationships we want to study at household level.

Table 4: Variables and Indicators formulated for model estimation

Variable no.	Variable name	Indicators
1.	Social Identity	✓ Aid category of household, ✓ Household education ceiling ✓ Immigrant status
2.	Economic Status	✓ Monthly household expenditure ✓ Adequacy of food for household ✓ Land ownership ✓ House quality ✓ Crowding/Number of people per room ✓ Separate kitchen ✓ Livestock
3.	Access to water	✓ Water adequacy ✓ Water quality ✓ Water physical accessibility
4.	Access to sanitation	✓ Sanitation access ✓ Sanitation quality
5.	Hygiene behaviour	✓ Household hygiene ✓ Personal hygiene
6.	Contamination Potential	✓ Technology design ✓ Open defecation
7.	Health status	How many individuals in the household experienced the following in the 3 months prior to interview: ✓ Diarrhoea / Dysentery ✓ Typhoid / Jaundice ✓ Mosquito / other insect/animal vector related ✓ Skin problem/ disease ✓ Fever/Cold ✓ Other sicknesses
8.	Agency	From household distance in minutes: ✓ to health centre

		✓ to motarable road ✓ Police station ✓ System of garbage collection
9.	Village environment	✓ WASH capabilities index ✓ Lack of WASH capabilities index ✓ Contamination potential index ✓ Contamination potential index with only OD ✓ Lack of access to agency index

Variable 1: Social identity of household: This is defined by a three component vector of indicators = (Aid category, Education ceiling and Immigrant status). The social identity is important as we would expect higher social vulnerability to be also associated with higher vulnerability to disease incidence.

1.1 Aid category: The Indian government designates three groups of populations considered to be economically and financially marginalised as being entitled to get reservation in public sector employment and education system. Defined along caste religious and tribal lines, these are the scheduled castes (SC), scheduled tribes (ST) and other backward classes (OBC). The SC include Dalits and other communities of Hindus, who have been historically denied entitlements and opportunities for personal and economic growth under the caste system prevailing before India obtained independence. The ST includes indigenous tribes, some of which has become Christian, as well as Hindus. The OBC includes many Muslim communities as well as those of all other religions existing in India. However, it is recognised that this form of association of social identity with economic and financial marginalisation could include households which are not at economic and/or financial risk, and thus for any OBC member, it is necessary to further prove through certification that his or her household is not in the economic 'creamy layer' to avail of the benefits of reservation. Anyone not falling under SC, ST or OBC groups – is considered to be of the 'General' category and not eligible for reserved quota in publicly funded establishments.

1.2 Education ceiling: Within each family, the highest level of education of a member is taken as the education ceiling of the family. We have considered three categories – primary school, middle or high school and above school level.

1.2 Migrant Status: Within India, migration has greatly increased. We consider any household which is settled in the village less than 15 years as a migrant household.

Variable 2: Economic status of household: The higher, or better, the economic status of a household, the higher would be their capacity to invest in sanitation, water and education. Thus, economic status has a direct bearing on disease incidence.
First, households are often unable or unwilling to disclose their monetary household income per month. For some it may be variable over the year and hence difficult to identity. Second, they

may be so destitute that they may not know what it is. Third, they may be unwilling to state it if it is high for fear of tax officials or if it is too low, for it is embarrassing. Fourth, it is difficult to assess the income of households as in addition to monetary income, their wealth and well being may be founded on ownership of land and animals. Thus, instead of asking them about monetary income, we formulated questions on monthly household expenditure, having enough to eat, ownership of land, livestock and living conditions.

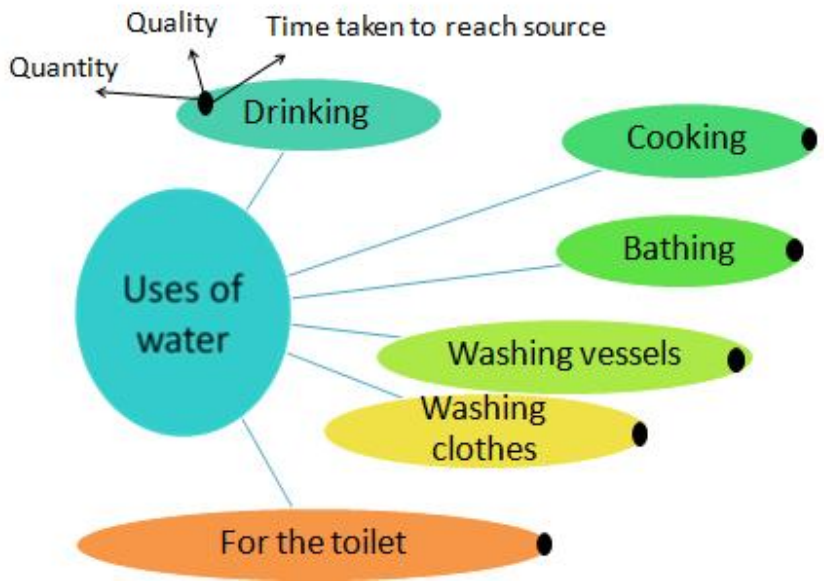
The monthly expenditure gave us a monetary scale for identifying poor households. According to planning commission and tendulkar committee - the poverty line was estimated to be Rs. 850 in Rural areas and 1000 in Urban areas; the average household size is 4.03; we therefore take the (unequivalised, fuzzy) household poverty estimate to be Rs. 4000.

Living conditions were measured by three indicators:

- House quality: According to Government of India houses made with high quality materials throughout, including the floor, roof, and exterior walls, are called pucca houses. Houses made from mud, thatch, or other low-quality materials are called katcha houses. https://data.gov.in/catalog/distribution-households-pucca-and-kutcha-house. So we noted if their houses were high (pucca) or low (katcha) quality houses.
- Separate kitchen: When a house has a separate kitchen, the conditions of the habitat are considered to be more hygienic and hence the likelihood of disease incidence would be lowered.
- Degree of crowding: Most excreta related and animal-vector transmitted diseases are communicable. Hence, the higher the degree of crowding at home the higher the likelihood of disease incidence. Thus, we defined crowding as the number of people per room.

Variable 3: Access to Water: Access to good quality water is primordial for life. First we listed the different essential functions for which water is required as drinking, cooking, bathing, washing vessels, washing clothes and use in toilet. For each of these functions, we then examined the household's access in terms of quantity, quality and time taken to access the water source. If water is inadequate, health cannot be sustained. Similarly, if water is available but contamination its consumption or use can lead to disease. Finally, greater effort to get water could make the family drink and use less water which might not be good for them. The above argument is summarised in Figure 13.

Figure 13: Access to water



Each household was asked if it had enough water for the above purposes and if the household member replied in the affirmative, then it was taken as being adequate.

With respect to quality, according to the World Health Organization/UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation "improved" and “unimproved” sources drinking water sources as follows[4]:

"Improved" sources of drinking-water:

- Piped water into dwelling, also called a household connection, is defined as a water service pipe connected with in-house plumbing to one or more taps (e.g. in the kitchen and bathroom).
- Piped water to yard/plot, also called a yard connection, is defined as a piped water connection to a tap placed in the yard or plot outside the house.
- Public tap or standpipe is a public water point from which people can collect water. A standpipe is also known as a public fountain or public tap. Public standpipes can have one or more taps and are typically made of brickwork, masonry or concrete.
- Tubewell or borehole is a deep hole that has been driven, bored or drilled, with the purpose of reaching groundwater supplies. Boreholes/tube wells are constructed with

[4] https://www.wssinfo.org/definitions-methods/watsan-categories/ downloaded on 30th April.

casing, or pipes, which prevent the small diameter hole from caving in and protect the water source from infiltration by run-off water. Water is delivered from a tube well or borehole through a pump, which may be powered by human, animal, wind, electric, diesel or solar means. Boreholes/tube wells are usually protected by a platform around the well, which leads spilled water away from the borehole and prevents infiltration of run-off water at the well head.

- Protected dug well is a dug well that is protected from runoff water by a well lining or casing that is raised above ground level and a platform that diverts spilled water away from the well. A protected dug well is also covered, so that bird droppings and animals cannot fall into the well.
- Protected spring. The spring is typically protected from runoff, bird droppings and animals by a "spring box", which is constructed of brick, masonry, or concrete and is built around the spring so that water fl ows directly out of the box into a pipe or cistern, without being exposed to outside pollution.
- Rainwater refers to rain that is collected or harvested from surfaces (by roof or ground catchment) and stored in a container, tank or cistern until used.

“Unimproved” sources of drinking water

- Unprotected spring. This is a spring that is subject to runoff, bird droppings, or the entry of animals. Unprotected springs typically do not have a "spring box".
- Unprotected dug well. This is a dug well for which one of the following conditions is true: 1) the well is not protected from runoff water; or 2) the well is not protected from bird droppings and animals. If at least one of these conditions is true, the well is unprotected.
- Cart with small tank/drum. This refers to water sold by a provider who transports water into a community. The types of transportation used include donkey carts, motorised vehicles and other means.
- Tanker-truck. The water is trucked into a community and sold from the water truck.
- Surface water is water located above ground and includes rivers, dams, lakes, ponds, streams, canals, and irrigation channels.
- Bottled water is considered to be improved only when the household uses drinking-water from an improved source for cooking and personal hygiene; where this information is not available, bottled water is classified on a case-by-case basis.

We took the above as a guideline and combined it with the classification of water used by the local authorities to come with indicators for three qualities of water sources as follows:

Table 5: Indicators of water quality

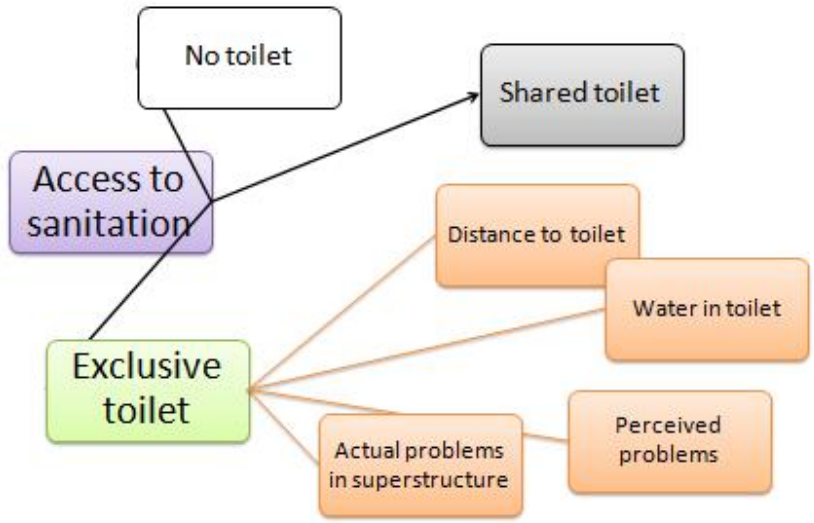
Best Quality: Piped Water to Dwelling, Bottled Water, Standpipe	Medium Quality: Protected Well/Spring, Tubewell/Borehole, Rainwater, Piped Water from tea garden, Other - Tanker Truck, Drum etc.	Worst Quality: Surface Water (River, Pond, Stream etc), Well Water (unprotected), Spring (unprotected), Other

Finally, physical access was taken to be either easy, medium hard, or tough. Easy access referred to water sources that were within dwelling, or outside dwelling, but within the premises. Medium hard meant that the water source was within 200 meters outside of the house. Tough indicated that the source was beyond 200 metres outside of the house.

Variable 4: Access to Sanitation – A sustainable sanitation system refers to a toilet, and the associated system for collection, transport, treatment, and use of excreta as well as complementary installations for the maintenance of hygiene (e.g. for hand washing and disposal of sanitary napkins). A sustainable sanitation system is one that minimises environmental contamination, makes efficient use of water available and is accessible to low-income groups in need of a toilet.

It is widely acknowledged that having access to a functioning toilet is favourable to health. Exclusive use would be even better for health as there is less crowding for use as well as more privacy and convenience. Furthermore, if the superstructure has many defects or is falling apart and/or if there is a water problem in the toilet – it might lead to disuse. Thus, the indicators for access to sanitation were formulated as in figure 13.

Figure 14: Access to Sanitation



Variable 5: Hygiene behaviour of household: We consider two forms of hygiene behaviour. First, household routines, and then personal hygiene routines of the family. In matters such as toilet usage, there is a lot of evidence, that men tend to underutilise toilets and therefore here questions were asked in terms of percentage of family members who used or did not use toilets.

Table 6: Household hygiene routines on which information was obtained

Household hygiene routine	**Options** 1 represents hygienic option; 0 represents unhygienic option.
What is used to carry water?	1= Jerry can 2=Open Container
What is used to store drinking water? 1=Closed Container 0=Open Container	1=Closed Container 0=Open Container
Do you treat water?	1=Yes 0=No
How often do you clean the toilet?	1= daily, once a week, or twice a week 0= once a month, yearly or never
How often do you clean the house?	1= daily or twice daily or once in two days 0= monthly or less;
How often do you clean the yard?	1= Twice a month, once a week, twice a week and daily 0= Once a month or less
Is Place where you throw garbage covered 1=Yes; 0=No	1=Yes 0=No
Are baby faeces disposed in a hygienic manner? Hygienic: Throw in the toilet, Rinse baby over drain, Throw in hole and cover, Bury, Use washable diapers Unhygienic: (Throw in hole without cover), (Throw in garbage), (Leave in the open)	1=Yes 2 = Never 0=No answer

Table 7: Personal hygiene routines of household members on which information was obtained

Personal hygiene routine	**Options** 1 represents hygienic option; 0 represents unhygienic option.
Do you wash your hands after using toilet?	1=Yes 0=No
With what do you wash hands with after defecation?	1=Soap 0= Ash, sand, soil or water

Do you wash your hands before eating?	1=Yes 0=No
Do you wash hands after dealing with animals?	1=Yes 0=No
How many individuals in household use toilet always?	Number
How many individuals in household always practice open defecation or OD?	Number

Variable 6: Contamination potential of negative externalities generated by households: Three sources of contamination were considered: pit latrine, any toilet with no drainage or open drainage (i.e. a pit without a cover or an uncovered gutter or open grounds next to toilet) and open defecation.

Variable 7: Health status of household: From section 2, the questionnaire enquired if any member of the family had suffered in the previous three months from the following excreta related diseases:

- Diarrhea/Dysentery
- Typhoid/Jaundice
- Mosquito related/Vector related
- Skin Disease(s)
- Fever/Cold

Variable 8: Access to Agency: When help can be obtained, health emergencies can be tackled better. Thus, we considered the distance in minutes from: (i) nearest health centre; (ii) motorable road; (iii) police station.

Waste management is becoming a problem everywhere and so even if households have a toilet, if there is open mounds of garbage outside their homes, vector borne and communicable diseases can spread easily. Hence, the fourth query in this category is whether the local village council has put in place a system of waste management.

Variable 9: Village Environment: For the village level analysis, I created 4 village level indices as percentages – i.e. a number between 0 and 1. They are: WASH index or WASH infrastructure and capabilities index, Lack of WASH index, Contamination potential index and Access to agency index.

WASH capabilities index =

The WASH infrastructure and capabilities variables for which the variance was maximal over the sample villages were:

1) % of households which have water for Washing Clothes (3.5*)
2) % of households with best quality water for washing clothes and vessels (3.7*)
3) % of households which threw their garbage in a covered place (5.7*)
4) % of households where adults wash their hands with soap after defecation? (5.10*)
5) % of households which has a toilet that it owns. (4.2*)

I define WASH infrastructure and capabilities index as a vector, say (i_1, i_2, i_3, i_4, i_5) standing for the above 5 measures for a village. Note each of these indices ia between 0 and 1. So their combined strength can be measured as the Euclidean distance from origin as $\sqrt{(i_1)^2+(i_2)^2+(i_3)^2+(i_4)^2+(i_5)^2}$.

Similarly the Lack of WASH infrastructure and capabilities can be taken as the gap between full coverage i.e. 1 and their present status. Then the Lack of WASH infrastructure and capabilities would be measured as:

$$= \sqrt{(1-i_1)^2+(1-i_2)^2+(1-i_3)^2+(1-i_4)^2+(1-i_5)^2}$$

The contamination potential index was simply the percentage of households in the village practicing open defecation. We could not consider drainage systems as in some of the villages there were absolutely no toilets.

Finally, lack of access to agency founded on two components: time taken in minutes to reach a hospital and the time taken in minutes to reach a motorable road. Longer the time taken, lower is the access to agency. To arrive at a single index, we took village level indicator for each of these and applied the same formula as for WASH capabilities.

The full questionnaire and coding of data at household level can be put in APPENDIX 2: Questionnaire, coding of data and generated variables.

5.2 Aggregated variables for village level analysis

For any characteristic, the density for a village, say village x is calculated as follows:

$$\frac{Number\ of\ households\ in\ village\ x\ with\ the\ characteristic}{Total\ Number\ of\ households\ in\ village\ x}$$

Table 7: Computation of village level densities

Variable/Question in Interview concerned	Description of density calculation
Household Size	Mean household size in village
Aid category	% of general
	% of non-general
Education ceiling	% Below secondary education
Monthly household expenditure	% with income lower than 4000 Rs. Expenditure
Separate room for cooking	% that answered YES
Do you have enough water for Drinking?	% that answered YES
Do you have enough water for cooking?	% that answered YES
Do you have enough water for bathing?	% that answered YES
Do you have enough water for Washing Vessels?	% that answered YES
Do you have enough water for Washing Clothes?	% that answered YES
Do you have enough water to clean after defecating?	% that answered YES
Quality of water for washing: 1=best quality; 2=medium quality, 3=worst quality	% with best
	% with medium
	% with worst
Quality of water for bathing: 1=best quality; 2=medium quality, 3=worst quality	% with best
	% with medium
	% with worst
Drinking water quality: 0=missing data, 1=best, 2=medium, 3=poor)	% with best
	% with medium
	% with worst
How do you transport water? Jerry can or open container?	% of households that carry Water in Jerry Can
Do you treat water?	% of households that treat water
How do you store water ? in closed or open container?	% of households which store water in closed container
Freq of toilet cleaning	% of households that clean toilet at least weekly
Freq of cleaning house	% of households that clean at least weekly

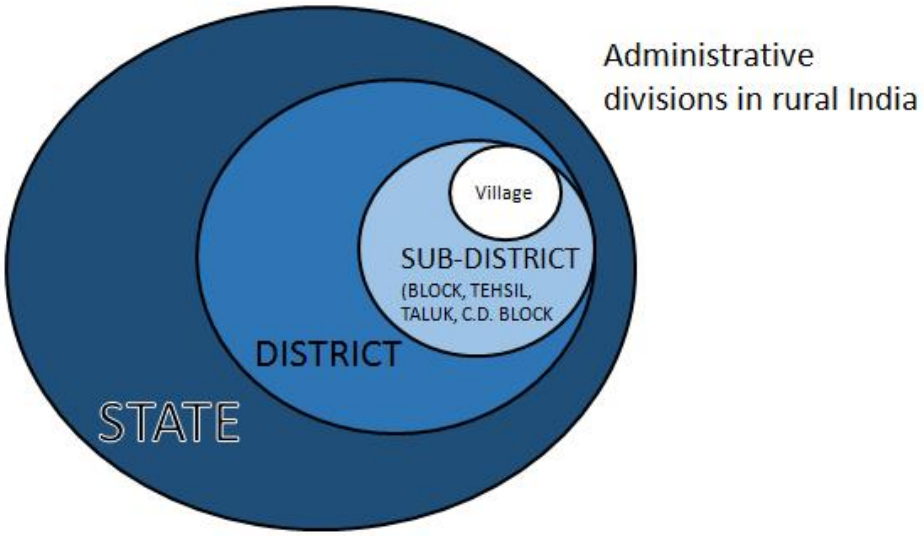
Freq of cleaning outside/yard	% of households that clean yard at least weekly
Is Place where you throw garbage covered	% of households with place of garbage disposal covered
Wash hands after using toilet	% of households where hands are washed after using toilet
With what do you wash hands with after defecation	% of households where hands are with soap after using toilet
Wash hands before eating	% of households where hands are washed before eating
Wash hands before dealing with animals	% of households where hands are washed after dealing with animals
Children below 5 years wash hands after defecating	% of households where children wash their hands after using toilet
Children wash hands before eating	% of households where children wash their hands before eating
Hygiene Promotion/Demotion - Are Faeces disposed in a hygienic manner? 1=Yes 2=Never 3=No Answer	% of households where faeces of babies are disposed in a hygienic manner
Do you have access to some toilet?	% of households which have access to some toilet?
For those with toilet access – is toilet access for exclusive use of Household or shared with households in the building	% of households which have a toilet for exclusive use
For those with toilet: problem toilet	% of households that answered 'many or some problems' to question: do you have problems with toilet
For those with toilet: 3 or more problems	% that have >3 problems in superstructure or functioning
Kind of toilet	% with pit latrine
Drainage	% with underground and/or covered drainage
Percentage of people in the household that always OD	The average % of household members that OD in a village
Percentage of individuals that always use mixed	The average % of household members that use mixed in a village
Percentage of individuals that always use OD or mixed	The average % of household members that use either OD or mixed in a village
Did anyone in you household suffer from Diarrhea/Dysentry?	% of households where at least one individual in household suffered from Diarrhea/Dysentry
How many individuals in your household suffered from Typhoid/Jaundice?	% of households where at least one individual in household suffered from Typhoid/Jaundice?

How many individuals in your household suffered from Mosquito related/Vector related disease?	% of households where at least one individual in household suffered from Mosquito related/Vector related disease?
How many individuals in your household suffered from Skin Diseas(s)	% of households where at least one individual in household suffered from skin disease?
How many individuals in your household suffered from Fever/Cold?	% of households where at least one individual in household suffered from fever/cold ?
How many individuals in your household suffered had a WASH related illness ?	% of households where at least one individual in household had a WASH related illness
How many individuals in your household suffered had a WASH related illness ?	% of households where no member in household had a WASH related illness
What is the time taken in minutes to reach the nearest Health Center ?	The median of values over village households as the village level indicator.
What is the time taken in minutes to reach the nearest motorable road ?	The median of values over village households as the village level indicator.
How is garbage collected?	% of HH who answered 'NO' to there being an arrangement by the local government

6. Sampling Design & Survey Implementation

The source of data for the choice of villages was the Census of 1991, Census of 2001 and Census of 2011. The administrative divisions of rural India are shown below.
The census of 1991 provides data at the block level; whereas the census of 2011 provides data only at the district level.

Figure 15: Indian Administrative Divisions in Rural India



We adopted a ***three stage sampling framework***:

First, taking percentage of 'female literacy' in a block to the single most important indicator of overall development, TWO blocks: one with the highest female literacy and the block with the lowest female literacy were considered.

Second, since our focus is on marginalised populations and Ooty and Jalpaiguri contain high Schedule Caste (SC) and Schedule Tribe (ST) populations, villages where the SC/ST population is highest or lowest were chosen.

Third, within each village, randomisation of households was ensured as follows. We started from South East corner of a village and chose the first HH at the edge. Then we moved to left hand corner and we chose the second/third HH, thus moving towards the center of the village. This way, we aimed to cover all types of HH: more prosperous one at the centre and more marginalised in the edge of a village.

The details of the data by which the villages were chosen is given in Appendix1. The villages are given below.

Table 8: Villages Chosen in Nilgiris District

se.no.	Village name	Village Household Population	Number of households surveyed	% of SC/ST/OBC
1	Bomalacombai	49	18	100%
2	Chengalpudhur	24	11	100%
3	Nedimandhu	11	9	100%
4	Kamarajapuram	212	40	100%

5	Shanmuga nagar	67	10	100%
6	Periya Bikkati	210	20	100%
7	Chinna Hubathalai	193	20	100%
8	Chinna Kurumbadi	12	7	100%
9	Periya Kurumbadi	16	5	100%
10	Pudhukadu	32	9	100%
11	Kunjapannai	76	51	100%
12	Sundapatty	26	15	100%
13	Bharathi Nagar	210	20	100%
14	Sundatty	294	24	96%
15	Kakkasholai	263	20	0%
16	Sulligodu	234	19	0%
	Total		298	

Table 9: Villages chosen in Jalpaiguri District

se.no.	Village name	Village Household Population	Number of households surveyed	% of SC/ST/OBC
1	Barpatina Nutanbus	2855	76	64%
2	Patkata	8496	72	33%
3	Gatia tea garden	1010	75	92%
4	Grassmore tea garden	1024	75	76%
	Total		298	

Implementation of the survey was as follows. The original questionnaire in English was first translated into the local language. 300 documents were printed for each of the two districts. The questionnaire was then administered through face to face interviews following the randomisation procedure. The questionnaire was administered via face-to-face interviews. Training on the context of the questionnaire was given through a one day workshop with a practice session for the data collectors. The questions were asked by one trained surveyor and recorded by a data collector simultaneously. Each interview lasted approximately 75 minutes.

7. Sample Characteristics and descriptive statistical analysis

The sample characteristics are summarised in Table 10.

Table 10: Salient Features of households in the Jalpaiguri and Nilgiri districts as inferred sample data

Variable no.	Variable Name - Variable Code	Total Sample Characteristics	Jalpaiguri District	Nilgiris District
0.7	Village Household Population	2686 is total population of households surveyed	1557 is total population of households surveyed	1129 is total population of households surveyed
0.8	Number of households surveyed	596 households were surveyed.	298 households were surveyed	298 households were surveyed
0.9	% of households surveyed	21.79%	4.56%	27.54%
Social Identity				
1.1	Aid Category: General Other backward caste Scheduled caste Scheduled tribe	General=23.32% ; Other Backward Caste=8.56%; Scheduled Caste=28.86% and Scheduled Tribe= 39.26%	General= 33.22%; Other backward caste: 3.36% Scheduled Caste: 27.18% Scheduled Tribe= 36.24%	General = 13.42%; Other backward caste=13.76%; Scheduled caste=30.54%; and Scheduled Tribe=42.28%
1.2	Max education level in family Low = illiterate to less than 5th class Middle = 6th class to 12th class or school completion High= greater than school education (diploma, graduation etc.)	Higher Education=83.61%; Middle=12.15%; Lower=4.23% ;	Missing=20 households; 6.71%; Higher=78.06%; Middle=16.9%; Lower=5.04%	Missing = 33 households; So denominator = 265 households; Higher Education= 89.43%; Middle education= 7.16%; Lower = 3.34%
1.3	How long have you been living in the premise (in Years)	Those who have come 10 or less years ago = 7%	Those who have come 10 or less years ago = 4.6%	Those who have come 10 or less years ago = 9.3%
1.4	Household Size (In Number)	4.5 [Range 1 to 11]	5.22 [Range 2 to 11]	3.78 [Range 1 to 8]

Economic Status				
Variable no.	**Variable Name - Variable Code**	**Total Sample Characteristics**	**Jalpaiguri District**	**Nilgiris District**
2.1	Household Expenditure below 4000 Rs per month [recall 4.5 is average household size]	57.41%	50%	64.77%
2.2	Do you have enough food to eat?	18.84% don't have enough food	17.85% don't have enough food	19.93% don't have enough food
2.3	Do you own land?	5.70% don't own land	2.35% don't own land	9.06% don't own land
2.4	Is your house 'Kacha' or made of non-permanent materials?	25.67% have Kucha	49.33% have kucha	2.01% have kucha
2.5	How crowded in your home? Or how many people per room?	on average 2.16 persons per room	on average 2.88 persons per room	on average 1.44 persons per room
2.6	Do you have a separate room for cooking?	19.87% do not	27.36% do not	12.42% do not
2.7	How many livestock do you own?	1.12	1.57	0.67
Access to Water				
3.1	Do you have enough water for drinking?	not enough drinking water = 7.55%	not enough drinking water =10.40%	not enough drinking water =4.69%
3.2	Do you have enough water for cooking?	Not enough for cooking= 9.73%	Not enough for cooking= 9.73%	Not enough for cooking= 9.73%
3.3	Do you have enough water for bathing?	Not enough for bathing = 13.28 %	Not enough for bathing = 9.76 %	Not enough for bathing = 1.67 %

Variable no. in household level data base	Variable Name Variable Code	Total Sample Characteristics	Jalpaiguri District	Nilgiris District
3.4	Do you have enough water for Washing Vessels?	Not enough for Washing Vessels = 13.93%	Not enough for Washing Vessels = 9.73%	Not enough for Washing Vessels = 1.81%
3.5	Do you have enough water for Washing Clothes?	Not enough for Washing Clothes = 15.44%	Not enough for Washing Clothes = 10.07%	Not enough for Washing Clothes = 2.08%
3.6	Do you have enough water for Defecating?	Not enough for defecating= 7.21%	Not enough for defecating= 9.73%	Not enough for defecating= 4.69%
3.7	What is the quality of your water for washing clothes or vessels?	Best=48.99%; Medium=12.92% and worst= 38.09%	Best=3.02%; Medium=21.81% and worst= 75.17%	Best=94.97%; Medium=4.03% and worst= 1.01%
3.8	What is the quality of your water for bathing?	Best=48.99%; Medium=13.59% and worst= 37.42%	Best=3.36%; Medium=23.15% and worst= 73.49%	Best=94.63%; Medium=4.03% and worst= 1.34%
3.9	What is the quality of your water for drinking?	Best=60.51%; Medium=14.41% and worst= 25.08%	Best=24.57%; Medium=24.91% and worst= 50.51%	Best=95.96%; Medium=4.04% and worst= 0%
3.10	Distance (geographical access) Easy = Within dwelling and outside dwelling but within the premises ; Medium = outside premises: less than 200 m ; Tough = Outside and greater than 200 m;	Easy=14.29%; Medium=76.70% and Tough= 9.01%	Easy=28.62%; Medium=56.90% and Tough= 14.48%	Easy=0.34%; Medium=95.97% and Tough= 3.69%

Hygiene Behaviour				
Variable no. in household level data base	**Variable Name Variable Code**	**Total Sample Characteristics**	**Jalpaiguri District**	**Nilgiris District**
4.1	Do you carry water in a jerry can or an open container?	60.51% in open container	21.84% in Open container	98.65% of households carry in open container
4.2	Do you store your drinking water in an open or closed container?	15.29% of households store in open container	0% of households store in open container	18.75% of households carry in open container
4.3	Do you treat water before drinking?	31.6% of households do not treat water	57.91% of households do not treat water	5.37% of households do not treat water
4.4	Freq of toilet cleaning Normal = daily/once or twice a week Infrequent= once a month, yearly or never	16.81% clean infrequently	29.32% clean infrequently	0.95% clean infrequently
4.5	Freq of cleaning house Infrequent= monthly or less Frequent =daily or twice weekly or once in two days	0.34% of households clean house infrequently	0.34% of households clean house infrequently	0.34% of households clean house infrequently
4.6	Freq of cleaning outside/yard Infrequent = once a month or less Frequently= daily or weekly or fortnightly	6.38% of households clean yard infrequently	10.40% of households clean yard infrequently	2.35% of households clean yard infrequently
4.7	Is Place where you throw garbage covered or uncovered?	76.31% if households throw garbage in uncovered places	99.66% if households throw garbage in uncovered places	47.93% if households throw garbage in uncovered places
4.8	Are baby Faeces disposed in a hygienic manner?	69.72% of households with babies do not dispose hygienically	69.49% of households with babies do not dispose hygienically	70.77% of households with babies do not dispose hygienically

4.9	Do you wash your hands after using toilet?	0.34% of households who don't wash hands after using toilet	0.67% of households who don't wash hands after using toilet	0% of households who don't wash hands after using toilet
Variable no. in household level data base	**Variable Name Variable Code**	**Total Sample Characteristics**	**Jalpaiguri District**	**Nilgiris District**
4.10	With what do you wash hands with after defecation - soap or something else?	21.72% of households do not wash hands with soap after defecation	9.76% of households do not wash hands with soap after defecation	33.67% of households do not wash hands with soap after defecation
4.11	Do you wash hands before eating?	1.01% of households do not wash hands before eating	0% of households do not wash hands before eating	2.01% of households do not wash hands before eating
4.12	Do you wash hands after dealing with animals?	50.00% of households do not wash hands after dealing with animals	0.76% of households do not wash hands after dealing with animals	72.01% of households do not wash hands after dealing with animals
4.14	What is the percentage of individuals in your (toilet-owning) household that always use toilet?	28.79% of individuals in toilet owning households that always use toilets	22.60% of individuals in toilet owning households that always use toilets	34.98% of individuals in toilet owning households that always use toilets
Access to Sanitation				
Variable no. in household level data base	**Variable Name Variable Code**	**Total Sample Characteristics**	**Jalpaiguri District**	**Nilgiris District**
5.1	Do you have a toilet?	59.73% don't have toilets 240 have toilets and 356 don’t have toilet	55.37% don't have toilets; 133 households with toilets	64.09% don’t have toilets 107 households with toilets

Variable no. in household level data base	Variable Name Variable Code	Total Sample Characteristics	Jalpaiguri District	Nilgiris District
5.2	For those who own a toilet: Do you have a toilet for exclusive household use or do you have to share it with others?	228 have exclusive use and 12 or 5% share with others.	2.26% share with others	8.41% share with others
5.3	For those with toilet: Distance (in meters)	Easy access: 0-4 meters = 64.71% Medium access 5-9 Meters = 26.05% Tough distance: 10 meters+ = 9.24 %	Easy access: 0-4 meters = 55.64% Medium access 5-9 Meters = 33.83% Tough distance: 10 meters+ = 10.53 %	Easy access: 0-4 meters = 76.19% Medium access 5-9 Meters = 16.19% Tough distance: 10 meters+ = 7.62 %
5.4	For those with toilet: problem toilet 1=some problems 2=many problems 0=no problems as self-reported	Out of 240 with toilets; 35 have some problems and 23 have many problems as self reported; Together they form 24.16%	40.6% of households with toilets report some or many problems;	3.74% of households with toilets report some or many problems
5.5	For those with toilet the number of problems in superstructure noted by survey team	on average 3.85	4 on average	3.67 on average
5.6	For those with toilet: deprivation in toilet quality as noted by survey team (4 or more problems=1) Otherwise 0	68.77% of households with toilets have at least 4 problems in toilet quality	70% of households with toilets have at least 4 problems in toilet quality	67. 28% of households with toilets have at least 4 problems in toilet quality
5.7	For those with toilet - what is Water source in toilet? Piped water or not?	86.19% have no water or store water in toilet	85.71% have no water or store water in toilet	86.79% have no water or store water in toilet

Contamination Potential				
Variable no. in household level data base	**Variable Name Variable Code**	**Total Sample Characteristics**	**Jalpaiguri District**	**Nilgiris District**
6.1	Kind of toilet 0=No toilet 1=toilet with septic tank 2=pit latrine ; blank = don't know	25.25% of pit latrines, 14.81% of septic tanks, 59.93% without toilets	28.62% of pit latrines, 15.82% of septic tanks, 55.56% without toilets	21.89% of pit latrines, 13.80% of septic tanks, 64.31% without toilets
6.2	Drainage 0 = No toilet; 1=Underground/Covered Pucca 2=Open Pucca or Open Kacha 3=No Drainage	No toilet = 59.73% Underground/Covered (Pucca) = 35.56% Open (Pucca Open Kacha) = 4.72% No Drainage = 1.68%	No toilet = 55.37% Underground/Covered (Pucca) = 38.31% Open (Pucca Open Kacha) = 5.42% No Drainage = 0.34%	No toilet = 64.09% Underground/Covered (Pucca) = 29.09% Open (Pucca Open Kacha) = 4.03% No Drainage = 2.68%
6.3	What % of individuals surveyed always OD	60.65%	61.59%	59.34%
6.4	What % of individuals surveyed always practise mixed	9.79%	13.87%	4.16%
6.5	Percentage of family members which only OD	62.41%	63.99%	60.84%

6.6	Percentage of family members who use both toilets and practice OD i.e. mixed practice	8.58%	13.07%	4.09%
6.7	Percentage of family members who [ONLY OD + Mixed]	70.99%	77.06%	64.93%
Health Status				
Variable no. in household level data base	**Variable Name Variable Code**	**Total Sample Characteristics**	**Jalpaiguri District**	**Nilgiris District**
7.1	which % of individuals out of surveyed population suffered from Diarrhea/Dysentry	2.61%	2.18%	3.19%
7.2	which % of individuals out of surveyed population suffered from Typhoid/Jaundice	0.93%	0.58%	1.42%
7.3	which % of individuals out of surveyed population suffered from Mosquito related/Vector related	0.26%	0.13%	0.44%
7.4	which % of individuals out of surveyed population suffered from Skin Diseas(s)	1.19%	1.93%	0.18%
7.5	which % of individuals out of surveyed population suffered from Fever/Cold	0.34%	0.58%	0.00%
7.6	which % of individuals out of surveyed population got sick with something of above	5.32%	5.39%	5.23%

7.7	which % of households did someone get sick	14.09%	23.49%	4.70%
7.8	which % of households nobody got sick	85.91%	76.51%	95.30%
Agency access				
Variable no. in household level data base	**Variable Name Variable Code**	**Total Sample Characteristics**	**Jalpaiguri District**	**Nilgiris District**
8.1	Distance from nearest Health Center (in Minutes)	Mean= 21.40 minutes Median= 15 minutes	Mean= 19.56 minutes Median= 15 minutes	Mean= 23.25 minutes Median= 20 minutes
8.2	Distance to motorable road (In Minutes)	Mean= 11.49 minutes Median= 5 minutes	Mean= 15.24 minutes Median= 10 minutes	Mean= 7.74 minutes Median= 5 minutes
8.3	2.4 Distance from nearest Police Station (in Minutes)	Mean= 105.56 minutes Median= 100 minutes	Mean= 105.56 minutes Median= 100 minutes	Mean= 107.03 minutes Median= 80 minutes
8.4	Is household garbage collected by: municipality/panchayat/corporation or residents or is it No arrangement (or other)?	No arrangement and other= 67.35	No arrangement 100%	No arrangement & other: 35.91%
Village Environment				
9.1	Lack of WASH capabilities index	1.518	2.918	1.168
9.2	Contamination potential index	0.724	0.935	0.672
9.3	Lack of access to Agency index	0.477	0.328	0.514

Simple descriptive statistical analysis leads to three insightful results.

Result 1: The two regions have both similar and dissimilar characteristics

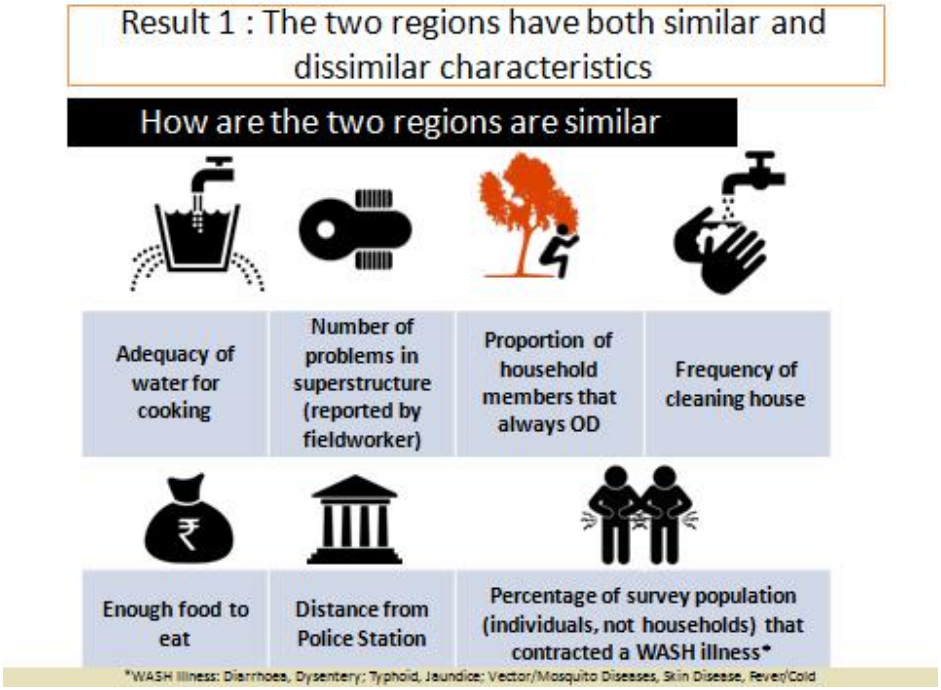


Table 11 : Similarities in WASH, Agency and Health status
N=Nilgiris, J=Jalpaiguri

Domain	Similarities	Average % of HH's with associated feature
Water	Households in both regions have identical lack of adequacy in water for cooking	N=9.73% J=9.73%
Sanitation	The number of problems in the superstructure – as reported by the fieldworker. Those with less than 4 problems is the same in both regions, despite there being nearly a 10% difference in ownership in the Nilgiris and Jalpaiguri	N=67.28% J=70%
Contaminating Behaviour	The percentage of household members that always OD	N=59.34% J=61.65%
Hygiene Behaviour	Frequency of cleaning the house; Households that clean infrequently	N=0.34% J=0.34%
Economic Status	Enough food to eat for the family	N=19.93% J=17.85%
Agency	Walking distance of the dwelling from the closest Police Station	N=107.03 J=105.56 (Mean, in minutes)
Health	Percentage of individuals (not households) that contracted a WASH disease (Diarrhoea, Dysentery; Typhoid, Jaundice; Vector/Mosquito Diseases, Skin Disease, Fever/Cold)	N=5.23% J=5.39%

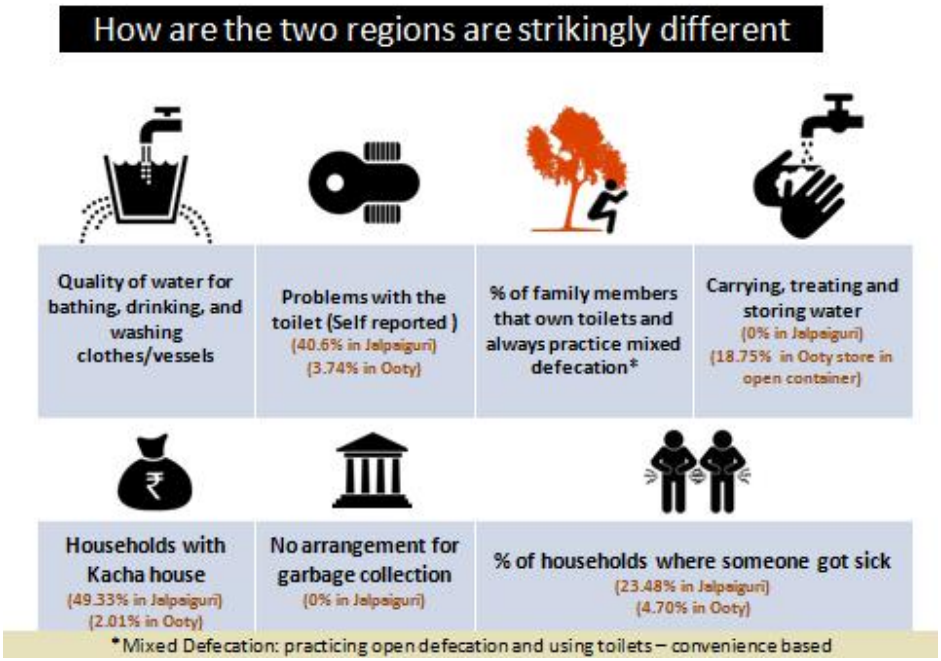


Table 12 : Disiimilarities in WASH, Agency and Health status
N=Nilgiris, J=Jalpaiguri

Domain	Dissimilarities	% of HH's with associated feature
Water	Quality of water for bathing, drinking, and washing clothes/vessels	E.g Percentage with best quality of water for bathing: N=94.63% J=3.36%
Sanitation	Problems with the toilet – self reported: Do the households feel that they have some or many problems with their toilet, as compared to no problems?	N=3.74% J=40.6%
Contaminating Behaviour	Percentage of family members that despite owning a toilet, openly defecate along with using the toilet	N=0% J=28.79%
Hygiene Behaviour	Carrying, treating and storing water in an open container	N=18.5% J=0%
Economic Status	Households with Kacha house i.e. made with poor quality of construction material	N=2.01% J=49.33%
Agency	No arrangement for garbage collection. No households in Jalpaiguri have such an arrangement	N=35.91% J=100%
Health	Percentage of households where someone got sick with a WASH disease	N=4.70% J=23.48%

First, between the two regions, we can clearly see that there is imperfect knowledge on sanitation. Though, the fieldworkers in both the regions find that the superstructure quality is relatively consistent in the two regions – more than 10 times as many toilet owning households in Jalpaiguri believed that they had problems with their toilet, compared to those in the Nilgiris.

Secondly, the capacity of toilets to curb open defecation is strikingly different. The percentage of surveyed households' members in either region that practice open defecation is 59.34% in the Nilgiris and 61.59% in Jalpaiguri. However, the percentage of household members that continue to practice open defecation along with toilet use (Mixed practice) despite owning a toilet is 28.79% in Jalpaiguri and in Nilgiris, this is 0%.

Third, ill health due to WASH is largely concentrated in households in the surveyed Nilgiris population, as at an average, a larger percentage of household members exhibited some form of a WASH related illness. Whereas in Jalpaiguri, a larger percentage of surveyed households exhibited an incidence of a WASH related illness

Result 2: Access is not always correlated to social identity – but scheduled tribes are mostly worst off

Social identity is often a determiner of social policy priority; with backward, and tribal populations receiving relatively more priority from policymakers. However, the data suggests that policy for water, sanitation and hygiene should be tailor made for social groups in different regions.

Table 13: Social Identity Descriptive Statistics

Aid Category	% of group with low education	% group with household income below Rs 4000	% of group without sanitation	% of group with low quality drinking water	% of group with low quality washing water	% of group with low quality bathing water	% of group which washes hands without soap
Scheduled Tribes	8.63%	82.48%	89.74%	26.29%	28.63%	27.78%	30.77%
Scheduled Caste	1.23%	44.77%	50%	26.19%	43.02%	43.02%	22.67%
Other Backward Classes	4.17%	64.71%	39.22%	9.80%	13.73%	11.76%	9.80%
General	1.48%	27.74%	28.78%	27.34%	56.83%	56.12%	9.49%

From an analysis of the descriptive statistics, we would expect more marginalised communities to be worse off in terms on WASH. However, the data does not confirm such a trend.

The most marginalised groups, the Scheduled Tribes or Tribal groups appear to be the worst off in case of income and education; this finding comes as no surprise but this does not translate into WASH capabilities. It is the least marginalised social group, the general category households, that appear to be the worst off in terms of water quality; Tribal households rank the lowest in toilet ownership and poor hand washing behaviours.

Result 3: Open Defecation (OD) is NOT always due to lack of access to sanitation

Within a household, individual toilet usage habits are not homogenous, which is why data on individual toilet behaviours was taken and data on the percentage of members that open within the household was analysed for the two regions, separately. In the Nilgiris and Jalpaiguri, for the households without a toilet, the average percentage of people openly defecating is 98.07% and 93.22%. This does not translate in the same way to households with toilets. In the Nilgiris, an average of 2.38% of household members continue to always openly defecate; whereas in Jalpaiguri, the average percentage of household members that always openly defecate is 19.83%. That is, in Jalpaiguri, 1 out of 5 individuals in a household that owns a toilet, choose to openly defecate every time, despite the availability of a toilet. This signals that open defecation for these individuals is by choice, rather than necessity.

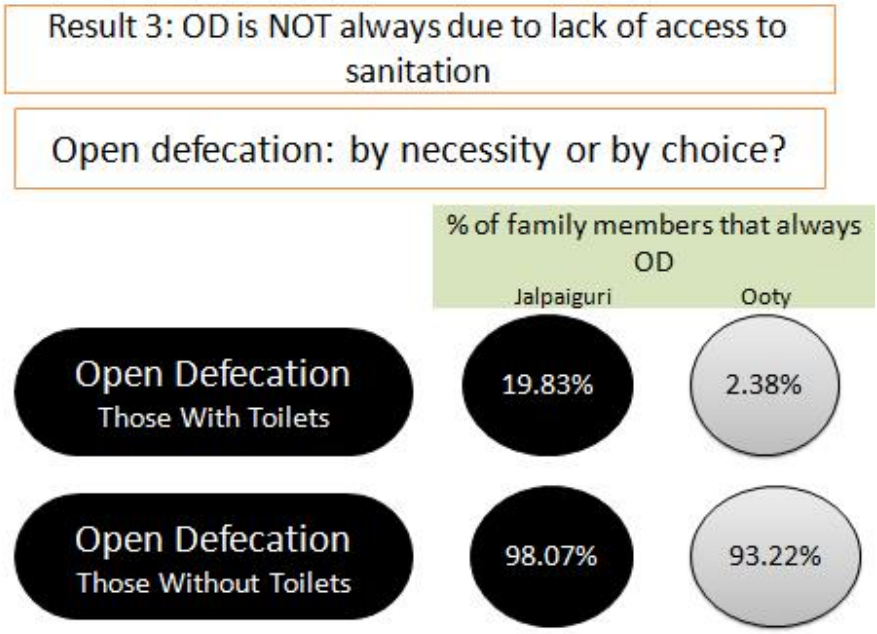


Table 14: Access to sanitation and propensity for OD

Variable no.	Variable Name Variable Code	Total Sample Characteristics	Jalpaiguri District	Nilgiri District
	FOR THOSE WITHOUT TOILETS			
6.3'	What % of individuals surveyed always OD	95.84%	98.07%	93.22%
6.4'	What % of individuals surveyed always practise mixed	3.51%	0.86%	6.64%
6.5'	Percentage of family members which only OD	95.62%	98.08%	93.49%
6.6'	Percentage of family members who use both toilets and practice OD i.e. mixed practice	3.82%	0.87%	6.38%
6.7'	Percentage of family members who [ONLY OD + Mixed]	99.44%	98.95%	99.87%
	FOR THOSE WITH TOILETS			
6.3''	What % of individuals surveyed always OD	13.42%	19.83%	2.38%
6.4''	What % of individuals surveyed always practise mixed	18.22%	28.79%	0.00%
6.5''	Percentage of family members which only OD	13.16%	21.69%	2.55%
6.6''	Percentage of family members who use both toilets and practice OD i.e. mixed practice	15.64%	28.22%	0.00%
6.7''	Percentage of family members who [ONLY OD + Mixed]	28.80%	49.91%	2.55%

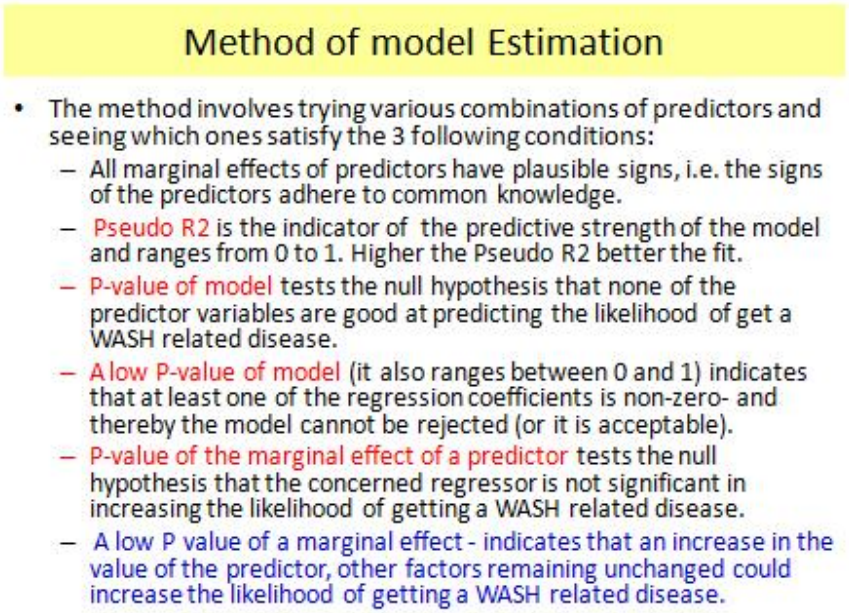
8. Model Estimation

We estimated likelihood of disease incidence at household level by using the method of probit regressions. This models the conditional probability of getting a WASH related illness given the existing values of a set of its determinants or regressors or predictors, as a function of a linear combination of the predictors. We define a WASH disease as either one of diseases considered in this study: Diarrhoea or Dysentery; Typhoid or Jaundice; Vector or Mosquito Diseases, Skin Disease, Fever or Cold.

The predictors are:

- **Resources (or Deprivations) of the household**
- **Personal habits of hygiene of the household**
- **Hygiene routines of the individual's household**
- **Potential contamination pool in village**
- **Access to agency**

We can then obtain the Marginal effect of a predictor, which is the increase in propensity or conditional probability - to get a WASH related disease for every unit increase of the concerned predictor – holding all other regressors constant at some values. Some well known features of model estimation by this method are recalled below.



8.1 Model of likelihood of WASH disease in Nilgiris

Table 15: Probit results for Nilgiris

Significant predictors of likelihood of WASH disease are in the grey coloured cells in italics

Determinant	Sign of coefficient	Average Marginal Effect	P-value of marginal effect of predictor
Contamination potential index	-	-.0061	0.893
Crowding	+	.0210	0.356
Approximate household expenditure	Insignificant for all income brackets		
Treatment of water	-	-.0929	0.217
Unhygienic disposal of child's stool (compared to those who dispose hygienically)	+	*.1652*	*0.053*
Drainage (Open drainage, compared to no toilet)	+	*.4769*	*0.004*
Distance from health centre	-	-.0001	0.918
Distance from motorable road	-	-.0260	0.189
Ownership of bad quality toilet (more than 4 problems), or no toilet (compared to toilet with good superstructure)	+	*.0514*	*0.017*
Open defecation (if 100% of the household members openly defecate)	+	.138	0.210
Pseudo R^2 = .3043 P value= 0.0050 N = 295			

According to Table 15, the significant predictors of the likelihood of WASH diseases have been highlighted. They reveal that a household:

- without a toilet,
- or with a toilet that is of bad quality,
- or with a toilet without an underground drain,
- which disposes of baby stools in an unhygienic manner;

– is more vulnerable to WASH diseases.

For a household that has open drainage, is an estimated 47.6 percentage points more likely to encounter an incidence of disease compared to ones without sanitation, ceteris paribus. Similarly, disposing children's feces in an unhygienic manner i.e. Thrown in a hole, garbage or left in the open, are an estimated 16.5 percentage points more likely to contract a WASH related illness compared to those who practice hygienic methods of disposal. Third, those without toilets

or with bad quality toilets are an estimated 5.14 percentage points more likely to experience an episode of ill health compared to those with good toilet superstructures, ceteris paribus.

8.2 Model of likelihood of WASH disease in Jalpaiguri

Table 16: Probit results for Jalpaiguri

Significant predictors of likelihood of WASH disease are in the grey coloured cells in italics

Determinant	Sign of coefficient	Average Marginal Effect	P-value
Contamination potential index	+	.2073	0.510
Crowding (Number of rooms/person)	-	-.2690	0.029
Approximate household expenditure	Insignificant for all income brackets		
Treatment of water	+	0.0005	0.991
Unhygienic disposal of child's stool (compared to those who dispose hygienically)	+	.1369	0.006
Drainage (Open drainage, compared to no toilet)	+	.0830	0.687
Distance from health centre	-	-.0038	0.014
Distance from motorable road	+	.0025	.141
Ownership of bad quality toilet, or no toilet (compared to toilet with good superstructure)	+	.1464	0.017
Open defecation (if 100% of the household members openly defecate)	-	-.1405	0.396
Lack of access to Agency index	+	.3587	0.027
Pseudo R^2 = .1121 P value= 0.0050 N = 291			

The significant predictors here are unhygienic disposal of child's stools and ownership of bad quality toilet. We also have the strange result that the further is a household from a health centre – the better is the health status wherein distance from health centre is a significant predictor.

8.3 Model of likelihood of WASH disease for toilet owners

Table 17: Probit results for toilet owners

Significant predictors of likelihood of WASH disease are in the grey coloured cells in italics

Determinant	Sign of coefficient	Average Marginal Effect	P-value
Crowding (Number of household members/number of rooms in household)	+	.0434	0.036
Bad quality of superstructure	+	.1271	0.001
No water or stored water in Toilet (compared to those with piped water)	-	-.2258	0.021
Exclusive access of the household to toilet	+	.0335	0.770
Unhygienic disposal of child's stool (compared to those who dispose hygienically)	+	.2326	0.001
Contamination potential index	+	.1780	0.183
Lack of WASH capabilities Index	+	.17808	0.550
Lack of Access to Agency Index	+	.2318	0.058
Nature of house	Insignificant for all house types		
Pseudo R^2 = .2386 P value= 0.000 N = 236			

Table 17 reveals that even if you have a toilet, if it is of bad quality, i.e. if the superstructure is deteriorating or if it is not functioning well, the predicted likelihood of contracting a WASH disease increases by 12.71 percentage points, ceteris paribus. Furthermore, the reciprocal of crowding i.e. number of persons per room, is significant, i.e. for a unit increase in this ratio, we can estimate a 4.34 percentage point increase in the likelihood of a WASH related disease, ceteris paribus. As in the case with all the models, unhygienic disposal of children's stool leads to an estimated increase in the disease incidence by 23.26 percentage points, ceteris paribus. We also have the strange result that the water in the toilet lowers the health status wherein water in the toilet is a significant predictor.

8.4 Model of likelihood of WASH disease for those who do not have toilets

Table 18: Probit results for those without toilets
Significant predictors of likelihood of WASH disease are in the grey coloured cells in italics

Determinant	Sign of coefficient	Average Marginal Effect	P-value
Contamination potential index	+	.0656	0.547
Crowding (Number of rooms/person)	+	.0276	0.612
Approximate household expenditure	Insignificant for all income brackets		
Treatment of water	-	-.0804	0.039
Unhygienic disposal of child's stool (compared to those who dispose hygienically)	+	.1141	0.042
Distance from health centre	-	-.00254	0.032
Distance from motorable road	+	.0025	0.022
Open defecation (if 100% of the household members openly defecate)	+	.0156	0.860
Lack of access to Agency index	+	.08803	0.304
Pseudo R^2 = .1893 P value= 0.0000 N = 356			

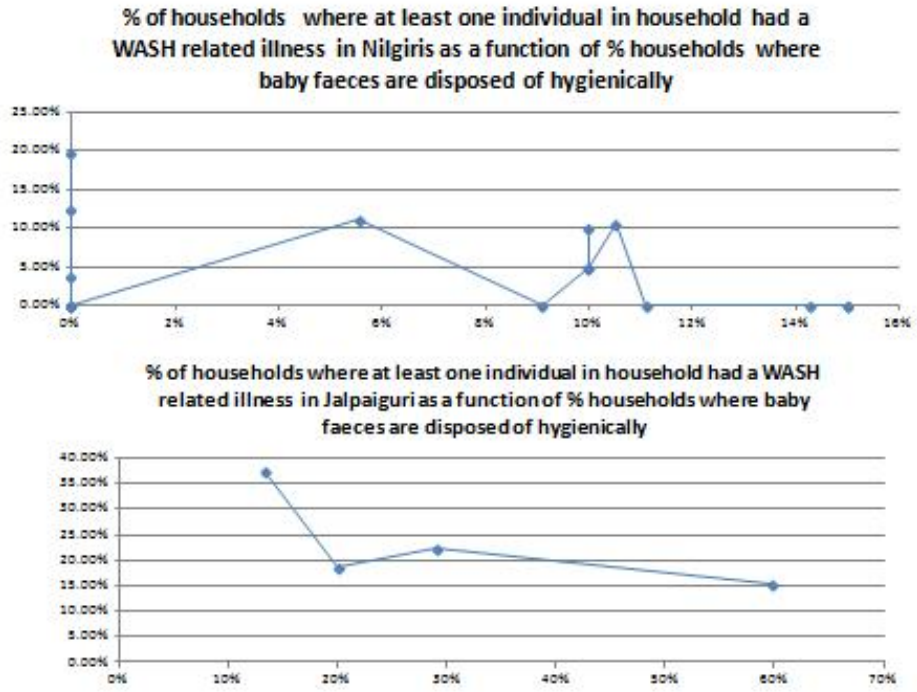
If a household does not have a toilet, then the significant predictors of health status seem to be the distance from a motorable road and treatment of water. Less isolation and treatment of water improve health status. We also have the strange result that the further is a household from a health centre – the better is the health status wherein distance from health centre is a significant predictor.

9. Results of Village Level Studies

At the village level we have only observations on 20 villages. Thus, only very simple descriptive statistics could be done. It would be interesting to extend the conceptual framework developed in this report over a larger set. Such an exercise would be useful for it will allow us to isolate influences that may not have an impact at the household level, but could generate externalities and generally reveal their influence at the village level.

At present, there were two points of note.

Figure 16



Firstly, what is important at the level of household need not be important at the level of village. For example, hygienic disposal of baby faeces was a significant predictor of incidence of WASH related disease in both districts at the household level, but at the village level Figure 16 shows it to hold true only in Jalpaiguri.

Figure 17

Secondly, turning the argument the other way around, at the village level there might be factors that are significant to predict disease that do not show up at the household level. Furthermore, village level challenges might be different even for similarly placed communities. For example, as Figure 18 shows, lack of access to agency is clearly correlated to WASH related illness at the village level, but not at the household level. And though Jalpaiguri and Nilgiris are quite similarly isolated – access to agency does not seem a good predictor of health status in the Nilgiris.

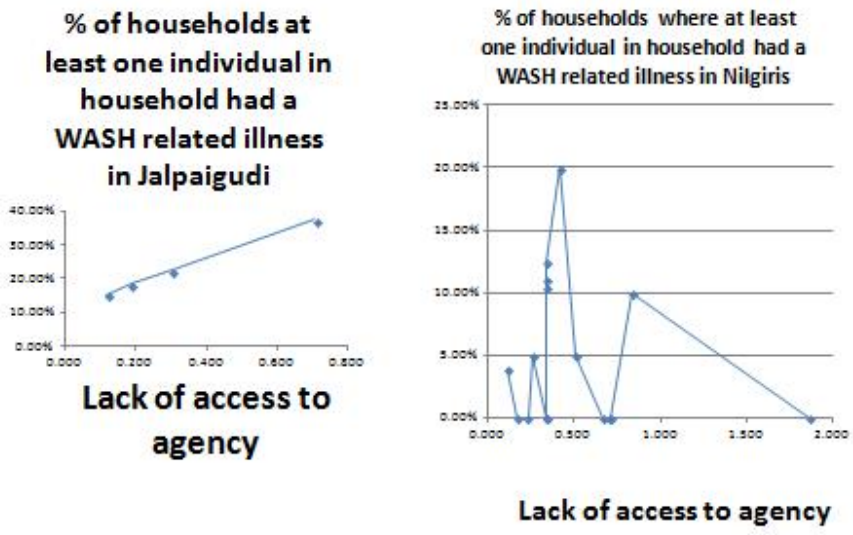
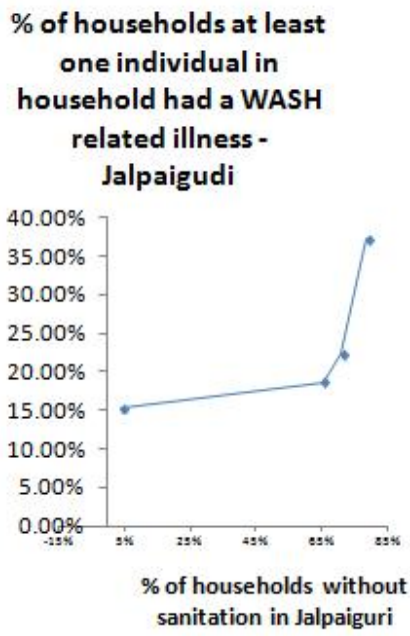
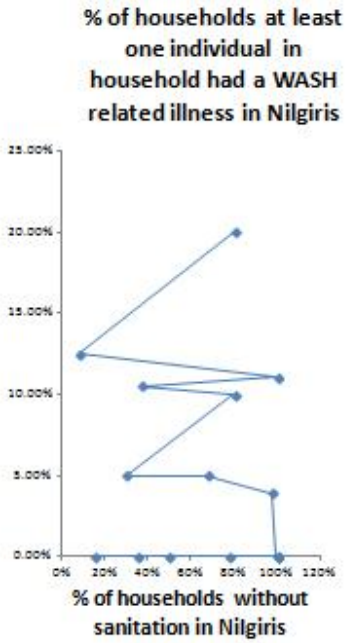


Figure 18

Thirdly, at the village level it is not just sanitation that counts for containing disease incidence always. For instance, Figure 17 indicates that lack of sanitation clearly is proportional to disease incidence in Jalpaiguri, but not in Nilgiris.





10. Focus group discussion (FGD) in Nilgiris[5]

The focus groups were structured as a series of 'open-ended' questions posed to each group. The main purpose of conducting FGDs was to gain a more articulated understanding behind the motivations of WASH behaviour. A total of 165 FGDs were conducted. Care was taken to include members of all ages and both genders and both employed and unemployed people.

Each focus group began by having everyone introduce themselves by name and where they are from to the moderator followed by the moderator thanking everyone for their time and participation in this important project, that the results will be used to help many people, and so on.

Then the FGD was initiated with a 'warm-up' question:

1. Which are the three to five major problems in the village that you would like to highlight?

It was felt that it would be very interesting to compare this with the results we had obtained from the household survey.

After the introduction, a basic laddering technique was used to infer insight on why there is reticence to invest in and/or use toilets. Three more questions were asked:

2. You know that in India – more people have mobile phones than toilets! Why do you like mobile phones? What's there in a mobile phone that's better in a toilet?
3. What are the pleasures or advantages of open defecation?
4. How do you think men can persuaded to stop open defecation?

Table 19: FGDs in Nilgiris District

Name of village	Number of FGD conducted
Periya Kurumpudi	5
Shanmuga Nagar	10
Sulligoodu	19
Bharathi Nagar	20
Kakkasolai	20
Kunjapanai	51
Sundapatty	15
Sundatty	25

Table 20: What are the problems in the villages?

[5] The translation and analysis of FGDs were carried out by M. Shanmathi.

S.NO	Nature of the problem	Frequency of the problem being cited								
		PK	SN	SG	BN	KS	KP	SP	ST	Total
1	Lack of dustbins		5	9	11	16	24	2	15	2
2	Water issues	2			10	1	33	4	5	55
3	Human-Animal conflict	7	5	4			19	10		45
4	Lack of transportation	1	9	8		4		8	12	42
5	Lack of drainages		3	1	4	1	1		12	22
6	Lack of toilets		2	4	3	3	3	1	1	17
7	Street light issues			4	1	2	2	2		15
8	Damaged roads			1		8			3	12
9	Damged drainages			4	4	2			1	11
10	Damaged platforms			3	2		1		5	11
11	Lack of revetment			1	2	1	4		3	11
12	Others	2	2	8	2	3	3		15	40

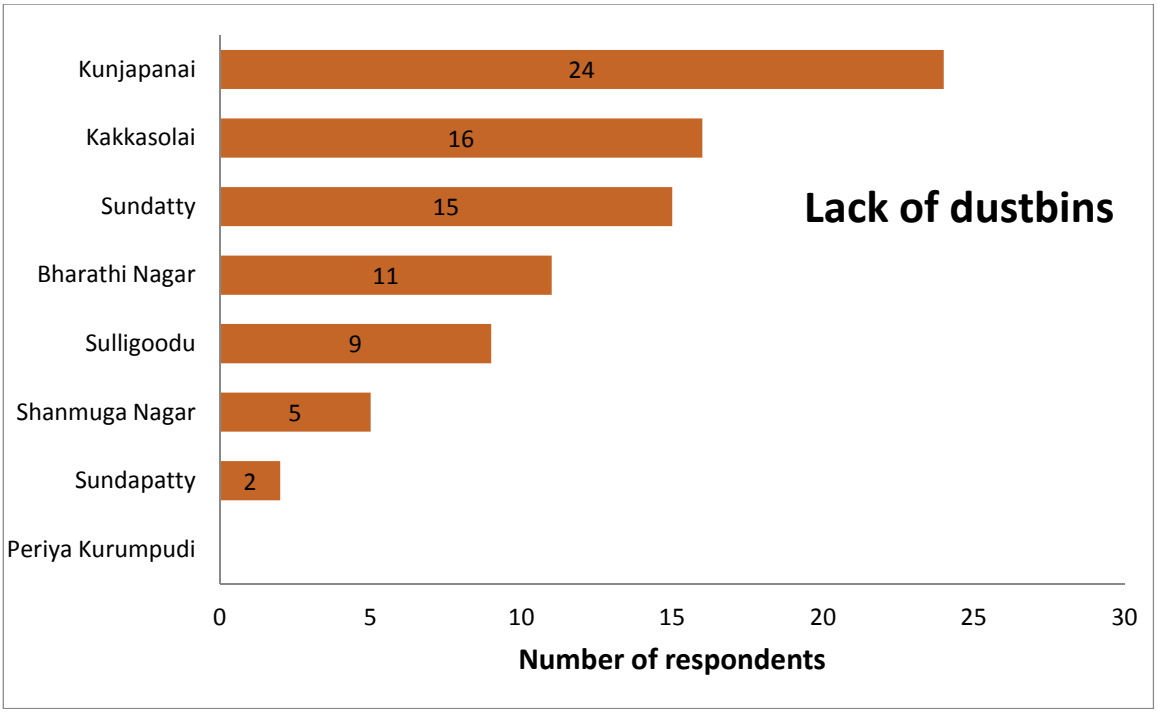
Inferences on major problems:

- Lack of transportation and bus facilities leads to people walking for miles to reach their destination. Security for women is not fully assured.
- Wild animals enter the village and create havoc. People panic and are afraid to leave their homes in the night. Elephants damage the agricultural lands which causes loss for the farmers.
- Due to lack of dustbins people dump garbage everywhere on the road and in turn the environment gets affected and causes health hazards.
- People defecate in the open due to lack of toilets leading to mosquitoes breeding on the human waste. People in the village cannot afford to construct toilets in their houses.
- The sewage water gets stagnated near the houses due to lack of drainages. The existing ones are damaged.

Lack of dustbins:

Totally 82 villagers have complained about the lack of dustbins which shows that the villages are unclean. As there are no dustbins in the village, people tend dump the

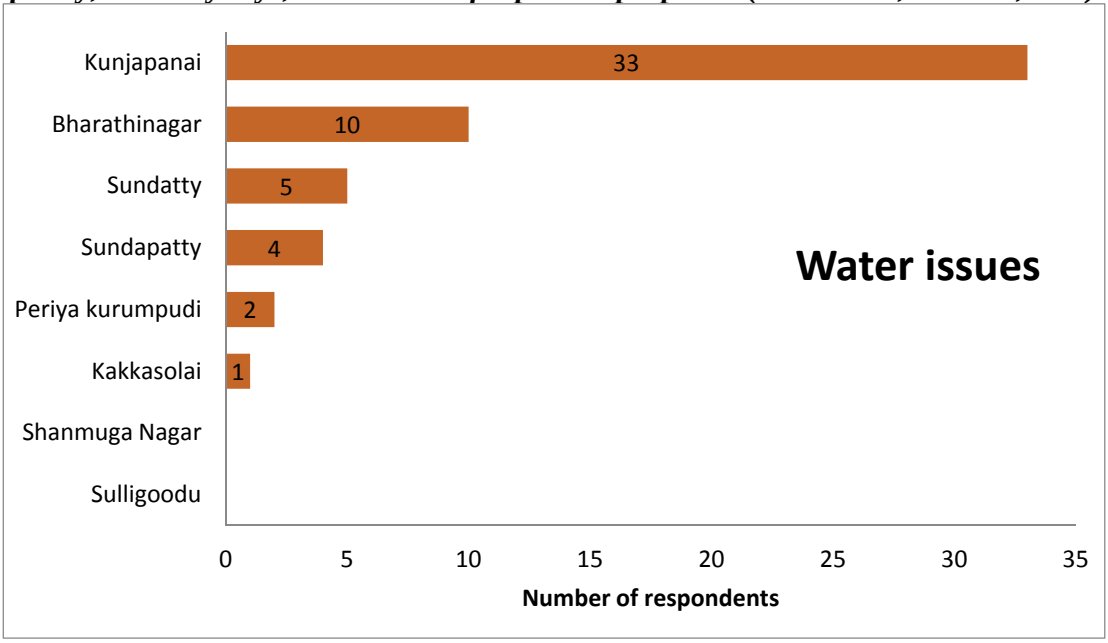
garbage on the road which spreads bad odour throughout the village. This makes it favourable for the mosquitoes and flies to breed on the garbage which in turn contaminate the food and water leading to various health problems for the villagers. People feel that necessary action should be taken by the government and dustbins should be arranged for the villages which must be cleared at least once in a week. Throwing the garbage on the road not only causes health issues but also affects the environment in the village. Due to the influence of the wind the garbage on the river side gets mixed with the water making it dirty and unclean. People wash the clothes with same water which causes various diseases. As there is no place to dump the waste, people throw them into the drainages which blocks the sewage water leading to stagnation.



Water issues:

There is shortage of water, especially during summer. Water is available only once a week. It is insufficient for domestic purposes. People should fetch water from the wells which affects their health and it is also time consuming. If the wells are dry, then they must walk one kilometre to fetch water. During night time, it becomes difficult due to strolling of animals. Necessary steps should be taken so that the water is available at least thrice a week. Some people suggest that it must be available in alternative days. Even the water that is available is dirty and contaminated.

As per a study by the Tamil Nadu Pollution Control Board (TNPCB), the lake in Udhagamandalam is one of the most polluted water bodies in the state. Its water quality, the study says, is unsuitable for potable purposes. (The Hindu, June 20,2013)[6]



Human-Animal conflict:

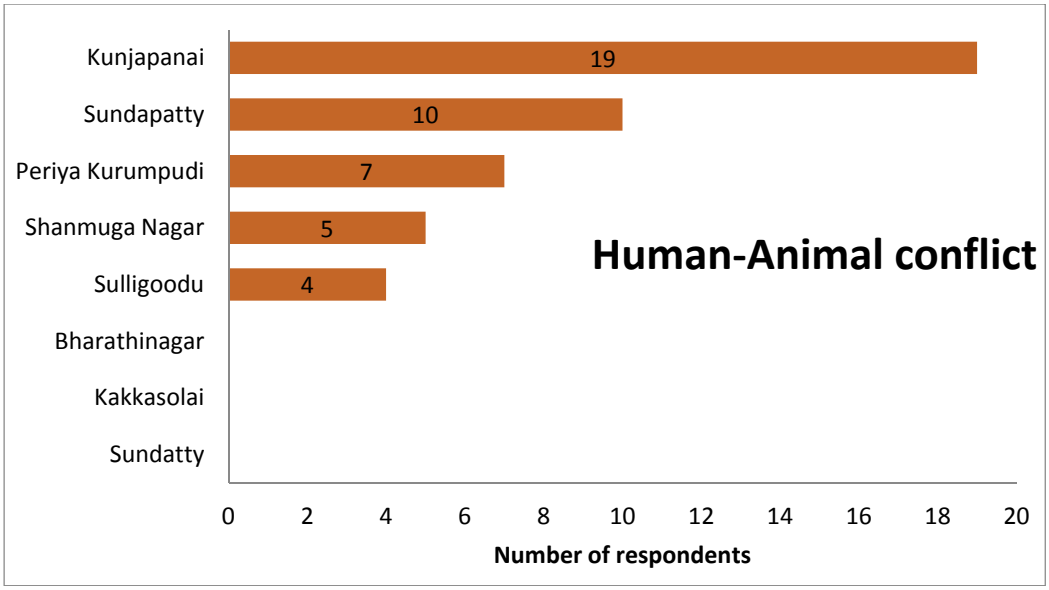
Wild animals are a major threat in all the villages. Among all the animals, villagers face most nuisance due to monkeys. They sneak into the house through the roofs and spoil the food items. They take away groceries and clothes from the houses. Hence steps should be taken to prevent them. They damage the roofs of the houses. Underground tanks are the source of water during summer. The elephants have destroyed the pipes and so the villagers are not able to fetch water. Therefore, there is increase in demand for water. They are also attracted to the odour of fruits (especially jackfruits) from the gardens adjacent to the houses and hence people are afraid to come out during night hours. People face nuisance because of the street dogs and hence they feel that the governing bodies must take steps to shift them to some other place. There is no safety in the village due to attack of wild animals like bear, cheetah and bison. As they enter the villages during night hours, people are afraid to come out of their houses. Due to lack of proper street lights they stroll freely. They attack the domestic animals like goat, causing monetary damage. While crossing the canal, they make the drinking water dirty. Due to the nuisance created by animals it is difficult to do agriculture. It is not possible to sow any seeds. Due to this, farmers are forced to take up jobs for daily wages. Hence necessary steps should be taken to fence the farms.

Two persons were trampled to death by elephants in Gudalur and Pandalur taluks in the Nilgiris on Friday, leading to public protests and downing of shutters by traders. In

[6] http://www.thehindu.com/news/cities/chennai/ooty-lake-one-of-the-dirtiest-in-tamil-nadu-reveals-study/article3679567.ece

the last five years, as many as 40 lives were lost because of the escalating human-animal conflict. (The Hindu, April 2, 2016) [2]7

Camera traps, cages, elephant patrols and audio recordings of mating calls — the Tamil Nadu forest officials are trying everything possible to capture a tiger that has killed three people in the Nilgiris district so far. (The Indian Express, January 14, 2014[8]

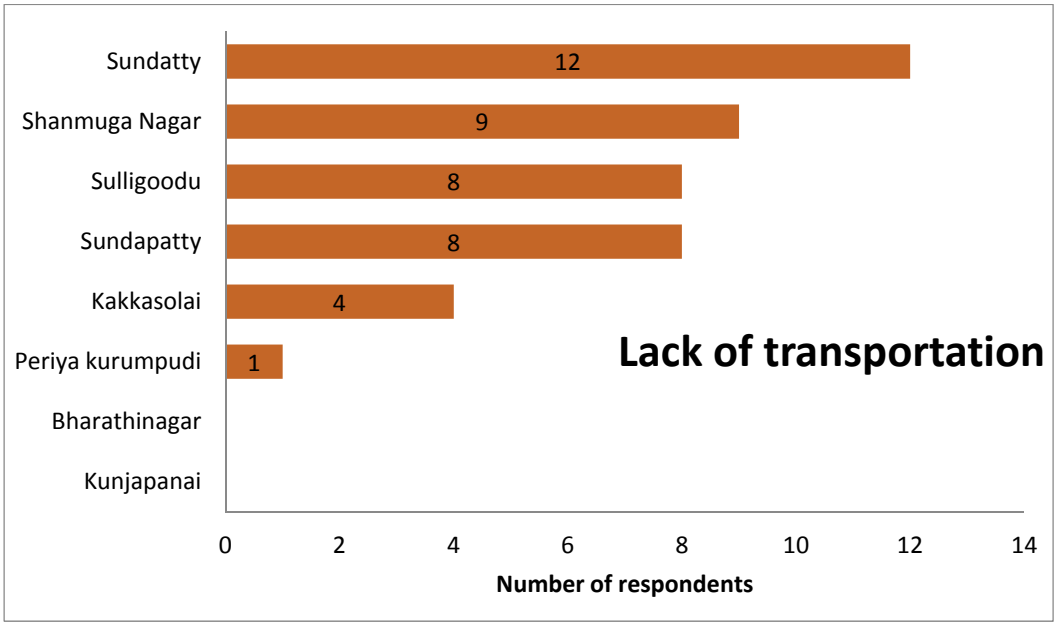


Lack of transportation:

The next major problem in the villages is lack of transportation. Villagers should walk two kilometres to reach the nearest bus stop which is inconvenient during emergencies. Due to this, children often get stringed by blanket worms on their way to schools. There is no safety for children (especially girls) when they go to schools by walk and they are not able to reach their schools on time. Transporting goods for construction becomes difficult. The buses are available only once in the morning which does not arrive on time. So, more buses should be operated so that the villagers would be highly benefited. It becomes difficult to reach the hospitals during medical emergencies. Villagers are forced to arrange their own private vehicles to reach them.

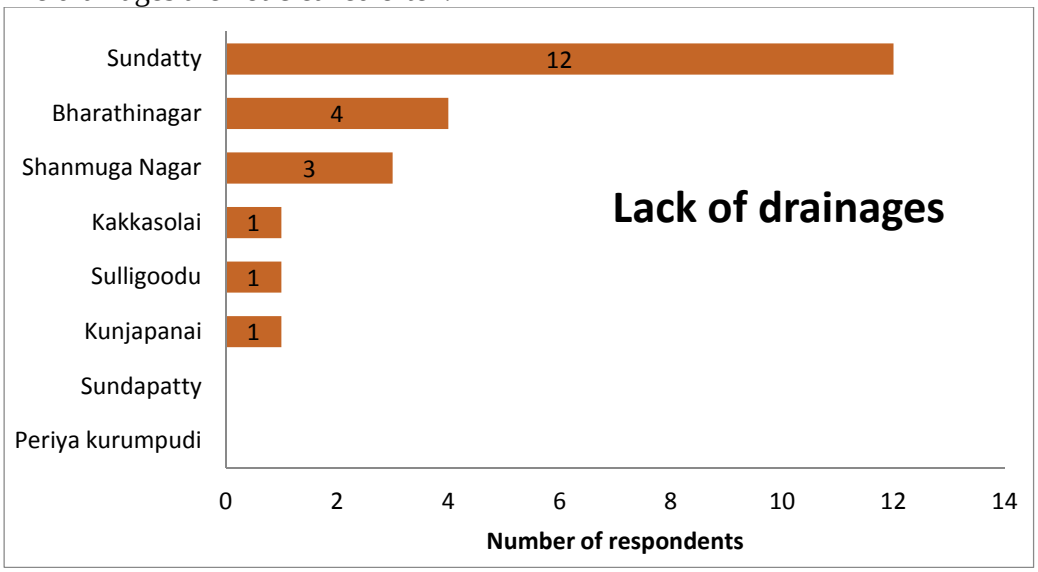
[7] http://www.thehindu.com/news/cities/Coimbatore/elephants-trample-two-persons-to-death-in-ooty/article8424827.ece

[8] http://indianexpress.com/article/india/india-others/45-ooty-schools-shut-villages-on-alert-after-tiger-kills-three/



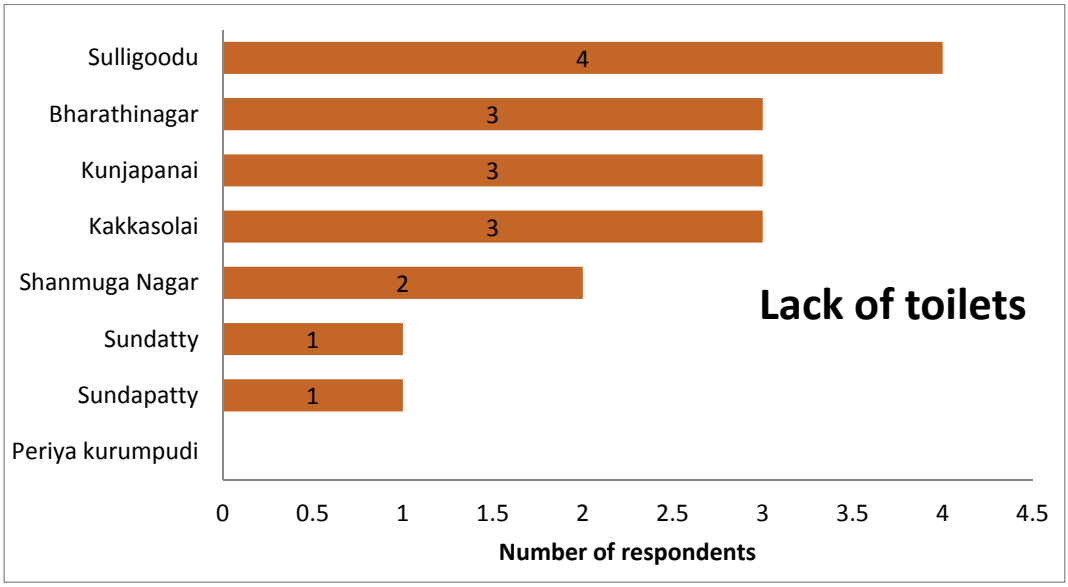
Lack of drainages:

Sewage water gets stagnated near the houses and mosquitoes breed on them causing lot of health problems to the villagers. The damaged drainages are open and hence there is risk of children tripping into them. Rats create nuisance due to these damaged drainages. The drainages are not cleaned often.



Lack of toilets:

Due to lack of toilets the villagers tend to defecate in the open. They are in a situation where they cannot afford to construct the toilets. Hence government should help the villagers in constructing them. Before the construction of toilets shortage of water problem must be resolved. After the construction of toilets if there is demand for water then it is of no use. If individual toilets are not constructed at least there must be public toilets for the people to use.



Other problems specific to the villages:
Sundatty:

For the welfare of the women, separate society hall should be built to run women self-help group meetings.

There are no schools in the village. Children should go to other villages to educate themselves.

There are no public libraries, barrier walls, playgrounds and ration shops in the village.

Kunjapanai:

The houses built by the government must be reconstructed. It is difficult to cook during rainy seasons as the roofs and walls are damaged.

Lack of barrier walls, damaged street lights, open wells and frequent power cuts are the other problems faced by the villagers.

Kakkasolai:

Even though there are bus facilities in the village it is difficult for the buses to pass-by due to poor maintenance of roads.

During rainy seasons if any barrier walls are destroyed it collapses the houses too.

Health centres are located three kilometres away from the village.

Bharathinagar:

The houses are close to each other and if one falls there is a danger of the adjacent ones falling too. Therefore, there must be barrier walls around the houses.

Sulligoodu:

The damaged drainages and sidewalks should be repaired. There is no playschools and playgrounds for children and youngsters respectively.

There are about 150 houses in the village but there are no grocery stores.

There are many literate people in the village. They find it difficult without any public libraries. They should travel five kilometres to reach the Kothagiri village to make use of public libraries.

Shanmuga nagar:

The height of the sidewalks is very high and children fall off from them.

People should walk far away from the village to buy things from the ration shops.

Periya kurumpudi:

There are no job opportunities available in the village. People should travel far away from the village to earn for their living.

There is no safety for women in the village as problems are created by the increasing number of drunkards.

Sundapatty:

- Children are strung by blanket worms on their way to school during rainy seasons.

Why do people prefer to invest in telephone over toilet?

Table 21: Why telephone over toilet?

S.NO	Nature of the problem	Frequency of the problem being cited								
		PK	SN	SG	BN	KS	KP	SP	ST	Total
1	Easier communication	1	6	5	6	9	23	8	8	**66**
2	Cheaper	1	2	6	3	4	3	1	10	**30**

3	**Receiving and Sharing of information**	1		2	2		18	4	2	**29**
4	**Useful during emergencies**		1	5	8	3	3	1	7	**28**
5	**Updating oneself with news**		1	2	2	5	1		8	**19**
6	**Others**	1	4	2	3	3	4	1	1	**19**
7	**Indecisive**	2				1	1	1		**5**

Inferences:

- The cost of telephone is relatively cheaper when compared to the cost of construction of toilets.
- People living outside the town can connect easily with their friends and family.
- Telephones are very useful during medical emergencies.
- One can keep themselves updated with the happenings of the world using cell phones.

Why telephones over toilets?

Cell phones has become a part and parcel of everyone's life as it finishes their work in a easier and simpler way. The main use of the telephone is that they can communicate information from one place to another quickly. If family members are late from work, they can easily communicate through phone about their whereabouts to others so that they do no panic about them. The cost of cell phones is much cheaper than the cost of constructing toilets. Hence even middle class families can afford to buy them. It is very much useful to be informed about the happenings around the world. Elderly people use cell phones to talk with their grandchildren. Social networking sites like Facebook and Twitter make phones a hit among the youth. It is more useful during emergencies. It can be used for entertainment and to capture the best moments of life. But sometimes calls from unnecessary people create troubles. Nobody in the village has considered the lack of toilets as an issue. So, they must be given awareness about the importance of toilets.

Table 22: What are the pleasures of open defecation?
Advantages

S.NO	Nature of the problem	Frequency of the problem being cited								
		PK	**SN**	**SG**	**BN**	**KS**	**KP**	**SP**	**ST**	**Total**
1	**None**	1		4	6	7	16	5	8	**42**
2	**Conservation of water**			4	4	5	20	1	5	**39**
3	**Inhalation of fresh air**	1		1			2		6	**10**
4	**No maintenance and repair cost**				2	2	4		1	**9**
5	**Others**	3		1		4	1			**9**

Inferences:

- Usage of water is less in open defecation and hence water is conserved.
- The maintenance and repair cost of toilets can be avoided.
- Others = provides access to fresh water and a breezy environment; lowers the wear and tear of the toilet; protects women from getting embarrassed by the sight of men; and offers a handy excuse to escape importunate wives and mothers.

Table 23: Disadvantages

S.NO	Nature of the problem	Frequency of the problem being cited								
		PK	SN	SG	BN	KS	KP	SP	ST	Total
1	Health problems	*2*	5	9	1	2			6	25
2	Contamination of water			7	5			3	4	19
3	Environment gets affected		1		6	2	4		1	14
4	Danger from wild animals	*2*	1	2	2		2	1		10
5	Breeding of mosquitoes and flies		3	3		1	1	2		10
6	Others		2	1	1	1		2		7

Inferences:

- People are affected by health problems.
- When the human waste gets mixed with drinking water, the water gets contaminated.
- The environment gets affected.

- There are chances of getting attacked by wild animals while defecating in the open.
- Mosquitoes breed on the human excretion. They contaminate the food and water.

What are the pleasures open defecation?

As per the survey some villagers feel that open defecation is an advantage whereas some consider it as a disadvantage to the environment and people.

People love to walk, admiring the nature and enjoying the breezy environment while going to defecate in the open. They wake up early in the morning which makes them feel fresh. Villagers feel that they will be restricted to defecate in the same place every day if they use toilets. But if they defecate in the open they have the liberty of changing the place every day. The usage of water while defecating in the open is less than when using the toilets. Therefore, the water is conserved. They also feel that defecating in the open is economical as the maintenance and repair cost for the toilets can be avoided.

As the human excreta lies in the open, flies and mosquitoes take advantage of this situation and breed on them. They sit on the food and water making them unhygienic causing lot of health problems. In addition, spreads a bad and unpleasant odour. There is even chance of getting attacked by wild animals while defecating in the open. The drinking water sometimes gets mixed with the human excreta and gets contaminated. People are affected by jaundice and respiratory problems.

How can men be persuaded to stop OD?

Table 24: How can men be persuaded to stop OD?

S.NO	Nature of the problem	Frequency of the problem being cited								
		PK	SN	SG	BN	KS	KJ	SP	ST	Total
1	Individual toilets	4	3	2	4	4	22	9	6	**54**
2	Awareness camps			8	7	8	7	5	11	**46**
3	Public toilets	1	5	4		3	4		8	**25**
4	Cannot be stopped			1		1	4	1		**7**
5	Penalty			1	5	1				**7**
6	Others	2	3		3	2	2	1	1	**14**

Inferences:

- Awareness should be created among people about the problems created while defecating in the open.
- Individual toilets should be constructed in each house so that people do not go outside to defecate in the open.

- Public toilets can also be constructed for those who cannot afford to construct individual toilets in their houses.

How can be men persuaded to stop open defecation?

The FGD reveals that many people are not aware of how to stop the open defecation. Some people feel that it cannot be stopped as it is a traditional way. Hence, people should be given awareness about the importance of toilets. Awareness camps can be arranged in each village so that people know about the disadvantages of defecating in the open and the need of toilets. There must be individual toilets at each house. But if the villagers cannot afford to construct them, then at least public toilets should be constructed for them. Flyers describing the need of toilets should be distributed all over the villages. Men should realise themselves that defecating in the open causes trouble to the environment as well as to other people in the village. Government should bring strict laws against defecating in the open. People should be fined if they go against the laws.

11. Conclusion

The objective of the present research project was to respond to the query: **What is the role of WASH infrastructure and capabilities and local agencies in containing the incidence of excreta related diseases in isolated rural Indian communities?**

This query is very important because there is overwhelming evidence that reduction in the incidence of diarrhoeal diseases will contribute to India's economic growth and development. However, current health policies do not sufficiently recognise that with respect to diarrhoea, it is as important to invest in preventive measures, as it is to focus on diagnostic or curative measures. The complementarities between water, sanitation, waste management and behavioural patterns are rarely recognised in State policies designed to combat the incidence of diarrhoeal diseases. Such studies can provide more insight for programmes such as the Swachh Bharat or Clean India Mission and the National Rural Health Mission.

The challenge of improving public health is particularly elevated in the case of isolated and marginalised communities. Thus, the present project focussed on two regions with a high population of Scheduled Castes and Schedules Tribes – designated as being among the neediest by the Government of India in the Nilgiris district in Tamil Nadu and Jalpaiguri in West Bengal.

The study involved four parts: (i) Formulation of a conceptual framework and questionnaire to transform into an empirical study; (ii) Conducting a survey; (iii) Analysing the data obtained; and finally (iv) further validating results through focus group discussions. Only

data on the focus group discussions from Nilgiris are presented here as they were not conducted in Jalpaiguri due to resource constraints.

The conceptual framework and research design included a number of innovative features such as consideration of: (i) quality of access as well as quantity of access to the WASH variables; (ii) their impact on a set of excreta related diseases rather than just diarrhoea; (iii) inclusion and testing of complementarity between WASH capabilities; (iv) inclusion of testing of impact of village WASH environment on household's disease incidence; (v) negative externalities by village household via open defecation and potential contamination via pit latrines; and finally (vi) village level analysis.

The five main results of the study can be summarised as follows.

Firstly, there is an enormous heterogeneity of WASH infrastructure and capabilities between regions and within regions – even though there are some common challenges. The three common challenges are: the practise of open defecation, poorly constructed toilets that start deteriorating or malfunctioning after a few years and lack of knowledge or facilities to dispose of stools of babies which cannot use toilets. Though the elderly were not considered in the study, since they also find it difficult to squat on the Indian style toilets – it may be a problem for them as well.

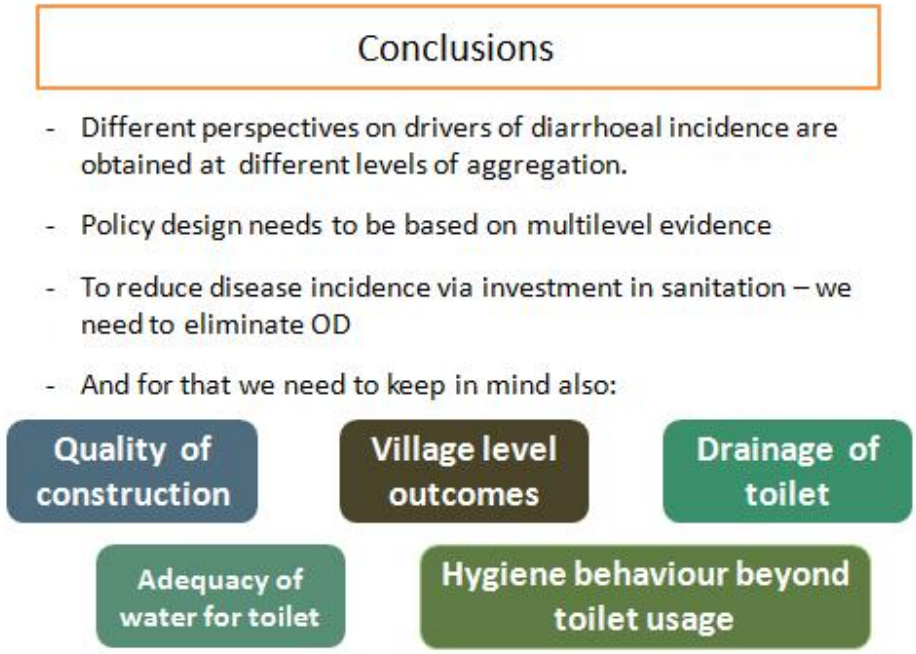
Secondly, even if similarly isolated, pathways to contain disease incidence might be different for different districts. For both Nilgiris and Jalpaiguri, poorly constructed toilets and unhygienic disposal of baby stools – referring to lack of quality construction and lack of education and motivation – were key predictors of WASH disease incidence. Furthermore, in the case of Nilgiris open drainage attracting flies and vermin was found to be a significant predictor.

Thirdly, what is required for immediate remedial measure at household level may not be the same at the village level and vice versa. For instance, in the case of Jalpaiguri while both lack of access to sanitation and lack of hygiene behaviour (given by unhygienic disposal of baby stools) were significant predictors at both the household and village level – it was not the case for the Nilgiris. Furthermore, for Jalpaiguri, while access to agency mattered at village level – it was not significant at household level.

Fourthly, ownership of toilet is not sufficient to ensure its usage. There is also open defecation by choice. Further, focus group discussions with men revealed that they prefer open defecation to a toilet because it: saves water; provides access to fresh water and a breezy environment; lowers the wear and tear of the toilet; protects women from getting embarrassed by the sight of men; and offers a handy excuse to escape importunate wives and mothers.

Fifthly, lack of WASH infrastructure and capabilities are not perceived to be the only central problems of isolated communities. In order to have a larger impact and be adopted more efficiently – they have to be embedded in a larger solution. According to the focus group discussions some of the central problems are: lack of transportation, risk of attack from wild

animals, lack of waste management, aid for the destitute who simply have the funds to invest in toilet construction, better drainage and sewerage maintenance and management.



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12. APPENDIX 1

13. Choice of villages in Jalpaiguri district

Recall that we first choose blocks by lowest and highest female literacy and then villages with maximum tribal populations.

Choice of Blocks in Jalpaiguri

In Jalpaiguri District, the Nagarkata block has the lowest rural female literacy and the Jalpaiguri block with highest rural female literacy.

Table A1.1

Percentage of Literacy by sex in rural areas in the district of Jalpaiguri, 2001			
Sub-Division / C.D.Block / M	**Male**	**Female**	**Total**
Sadar Sub-Division	**73.20**	**49.50**	**61.80**
Rajganj	70.50	46.50	59.10
Jalpaiguri	75.80	**54.00**	**65.30**
Jalpaiguri(M)	-	-	-
Maynaguri	75.30	52.30	64.20
Dhupguri	71.70	46.10	59.50
Siliguri(M.C.)Part	-	-	-
Mal Sub-Division	64.20	**40.40**	**52.50**
Mal	64.80	41.80	53.50
Mal(M)	-	-	-
Metiali	67.10	41.60	54.40
Nagrakata	60.20	**36.40**	**48.50**
Alipurduar Sub-Division	68.90	**48.00**	**58.70**
Kumargram	68.20	47.60	58.20
Falakata	71.30	50.70	61.40
Madarihat-Birpara	64.90	43.10	54.20
Kalchini	63.20	40.40	52.00
Alipurduar-I	72.60	51.10	62.20
Alipurduar(M)	-	-	-
Alipurduar-II	73.50	55.20	64.60
District Total 2001	**69.90**	**47.20**	**58.90**

1991	**51.40**	**27.00**	**40.00**
N.B.: Literacy relates to population aged 7 years and above			Source : Census of India, 2001 & 1991

Table A1.2 - Distribution of households over villages in Nagarkata Block

S.No	Total / Rural / Urban	No of Households	Persons	Males	Females
1	Total	22,791	115,907	58,790	57,117
2	Rural	22,791	115,907	58,790	57,117
3	Urban	0	0	0	0

Village Details of Nagrakata

S.No	Town / Village Name	No of Households	Persons	Males	Females
1	Angrabhasa (N)	536	2,620	1,314	1,306
2	Bamandanga Tea Garden	812	4,417	2,213	2,204
3	**Bhagatpur Tea Garden**	**2,339**	**11,843**	**6,029**	**5,814**
4	Caron Tea Garden	554	2,593	1,266	1,327
5	**Chengmari Tea Garden**	**2,601**	**12,857**	**6,438**	**6,419**
6	Chhar Tandu	433	2,265	1,184	1,081
7	Deana Forest (N)	19	50	28	22
8	Dhouda Simla (N)	552	2,680	1,409	1,271
9	Dhumpara (N)	454	2,220	1,107	1,113
10	**Gatia Tea Garden**	**1,010**	**5,391**	**2,703**	**2,688**
11	Ghasmari	282	1,489	789	700
12	**Grassmore Tea Garden**	**1,024**	**5,144**	**2,570**	**2,574**
13	Hila Tea Garden	573	2,794	1,402	1,392
14	Hope Tea Garden	808	4,129	2,086	2,043
15	Hridaypur (N)	472	2,254	1,171	1,083
16	Jaldhaka Altadanga Tea Garden (N	487	2,421	1,216	1,205
17	Jiti Tea Garden	883	5,102	2,535	2,567
18	Kalabari (N)	262	1,551	828	723
19	Kalabari Tea Garden (N)	639	3,250	1,634	1,616
20	Khairbari	577	3,089	1,620	1,469

21	Khayerkata (N)	476	2,416	1,261	1,155
22	Kurti Tea Garden	822	4,107	2,020	2,087
23	**Luksan Tea Garden**	**1,488**	**7,525**	**3,847**	**3,678**
24	Nagrakata	96	499	262	237
25	Nagrakata Tea Garden	843	4,324	2,136	2,188
26	**Naya Saili Tea Garden**	**1,038**	**5,504**	**2,773**	**2,731**
27	Sukhanibasti	668	3,312	1,751	1,561
28	Sulkapara	989	4,714	2,426	2,288
29	Tandu	51	297	155	142
30	Tandu Tea Garden	218	1,119	553	566
31	Upar Kalabari (N)	246	1,235	632	603
32	Upper Tendu Forest (M)	207	1,016	548	468
33	Uttar Nunkhawa Danga (N)	332	1,680	884	79

Source: Census of India, 2011

In Nagarkata block, as can be seen from the table, there are 6 villages with more than 1000 households.

Table A1.3 Distribution of households over villages in Jalpaiguri Block

.No	Total / Rural / Urban	No of Households	Persons	Males	Females
1	Total	57,587	280,927	145,272	135,655
2	Rural	57,587	280,927	145,272	135,655
3	Urban	0	0	0	0

Village Details of Jalpaiguri

S.No	Town / Village Name	No of Households	Persons	Males	Females
1	Amarkhana	85	435	219	216
2	Araji Amarkhana	52	241	130	111
3	Araji Garalbari	317	1,524	797	727
4	Araji Maria Kamala Pukhari	535	2,583	1,333	1,250
5	**Bahadur**	**3,547**	**17,425**	**9,008**	**8,417**
6	Banshkanthia	372	1,803	925	878
7	**Barapatina Nutanbus**	**2,855**	**14,289**	**7,276**	**7,013**
8	**Berubari**	**7,227**	**35,481**	**18,333**	**17,148**

9	Berubarinagar	173	831	417	414
10	**Bhelakoba**	**3,200**	**15,725**	**8,123**	**7,602**
11	Binnaguri	246	1,263	676	587
12	**Boalmari**	**1,251**	**6,276**	**3,279**	**2,997**
13	Chhitland Of Singimari	11	53	23	30
14	Daikhata	425	2,055	1,044	1,011
15	Dharmmadeb	65	328	174	154
16	**Garalbari**	**4,968**	**24,252**	**12,598**	**11,654**
17	Kathua	242	1,229	627	602
18	**Kharia (P)**	**11,080**	**52,399**	**26,880**	**25,519**
19	**Kharija Berubari**	**2,091**	**10,157**	**5,256**	**4,901**
20	**Mandalghat**	**2,923**	**14,126**	**7,296**	**6,830**
21	Maria Kamala Pukhari	88	422	239	183
22	**Nandanpur**	**1,096**	**5,492**	**2,850**	**2,642**
23	**Paharpur**	**3,069**	**15,153**	**7,807**	**7,346**
24	**Patkata**	**8,496**	**41,633**	**21,864**	**19,769**
25	Rarmmadeb	71	333	160	173
26	**Satkhamar**	**1,796**	**8,903**	**4,589**	**4,314**
27	Shakati	659	3,229	1,672	1,557
28	Singimari Dwitiya Khanda	163	838	437	401
29	Singimari Pratham Khanda	484	2,449	1,240	1,20

Source: Census of India, 2011

In Jalpaiguri, there are 13 villages with more than 1000 households.

Thus, it was decided that it would be possible to cover 150 households from 4 villages itself, 2 in Nagarkata block and 2 in Jalpaiguri block.

Density of SC/ST populations in the big villages of Nagarkata and Jalpaiguri

The data on ST population in the big villages of the two blocks are given below:

Table A1.4 - ST Population in Nagarkata

villages	No. of households	No. of Persons	ST population	% of ST population
BhagatpurbTea Garden	**2339**	**12555**	**7244**	**57.70**
Chengmari Tea Garden	**2601**	**14446**	**8324**	**57.62**
Gatia Tea Garden	**1010**	**5855**	**4649**	**79.40**
Grassmore Tea garden	**1024**	**5563**	**4027**	**72.39**

Luksan Tea Garden	**1488**	**8027**	**2818**	**35.11**
Naya Saili Tea Garden	**1038**	**5446**	**3510**	**64.45**

Finally, In Nagarkata we are choosing two villages: Gatia Tea Garden and Grassmore Tea Garden having highest percentage of ST Population.

Table A1.5 - ST Population in Jalpaiguri

villages	No. of households	No. of Persons	ST population	% of ST Population
Bahadur	3547	17425	145	0.83
barpatina Nutanbus	**2855**	**14289**	**3885**	**27.19**
Berubari	7227	35481	908	2.56
bhelakoba	3200	15725	122	0.78
Boalmari	1251	6276	13	0.21
Garalbari	4968	24252	518	2.14
Kharia(P)	11080	52399	_	_
Kharija Berubari	2091	10157	44	0.43
Manbalghat	2923	14126	8	0.06
Nandanpur	1096	5492	15	0.27
paharpur	3069	15153	1599	10.55
Patkata	**8496**	**41633**	**10334**	**24.82**
Satkhampur	1796	8903	169	1.90

Finally, in Jalpaiguri, we are choosing two villages: Barpatina Nutanbus and Patkata with highest percentage of population.

14. Choice of villages in Ooty district

Table A1.6: Percentage of female literacy of Ooty district blocks

1.6 SALIENT FEATURES OF 1991 & 2001 CENSUS - TALUK AND MUNICIPALITY-WISE

District : The Nilgiris

Sl. No.	Name of the Taluk/ Municipality	Density per Sq.Km	Fe males per 1000 Males	Increase in Population since 1991 in %	Urban Population in%	Literacy rate among		SC popul-ation in %	ST popul-ation in %
						Male %	Fe male %		
1	2	3	4	5	6	7	8	9	10
1	Udhagamandalam(M)	306.45	1000	13.01	100	92%	81%	28.5	0.40
2	Coonoor (M)	333.53	1022	4.37	100	95%	85%	24.80	0.20
3	Udhagamandalam (T)	233.67	1005	-- **	57	86%	68%	29.6	2.40
4	Coonoor (T)	765.02	1004	0.68	82	85%	93%	33.2	1.30
5	Kotagiri (T)	286.39	1038	-0.68	39	88%	67%	26.2	5.50
6	Gudalur (T)	193.85	1010	-- **	93	87%	73%	26.8	5.40
7	Pandalur (T)	544.71	1012	-- **	36	88%	74%	39.30	7.60
8	Kundah (T)	165.21	1049	-- **	32	89%	69%	32.40	1.10

-- ** since bifurcated after 1991 % of difference cannot be given

Source : Census of India 1991 & 2001

Note that Kotagiri Block is more rural while Coonoor is more urban in nature. However, population of Nilgiris district is much less. We could not get any further data on the Nilgiris district but upon consultation with RDO trust which has an intimate knowledge of the district, villages were chosen on two criteria: very high or very low tribal populations and very high or very low sanitation densities in village.

Table A1.7: Villages chosen in Nilgiris district

Village	Block
1. Bomalacombai	Conoor
2. Chengalcudu	Conoor
3. Nedimandhu	Conoor
4. Kamarajapuram	Conoor
5. Shanmuga nagar	Conoor
6. Periya Bikkati	Conoor
7. Chinna Hubathalai	Conoor
8. Chinna Kurumbadi	Conoor

9. Periya Kurumbadi	Conoor
10. Pudhukadu	Conoor
11. Kunjapannai	Kotagiri
12. Sundapatty	Kotagiri
13. Bharathi Nagar	Kotagiri
14. Sundatty	Kotagiri
15. Kakkasholai	Kotagiri
16. Sulli goda	Kotagiri

15. APPENDIX 2: Questionnaire, coding of data and generated variables

Variable 1 : Social Identity

1.1	Aid category 1= general ; 2=OB; 3=SC; 4=ST
1.2	Household education ceiling 1=Low = illiterate to less than 5th class 2=Middle = 6th class to 12th class or school completion 3=High= greater than school education (diploma, graduation etc.)
1.3	How long have you been living in the premise (in Years)
1.4	Household Size (to be used for crowding calculation) - How many people live in this house permanently

Variable 2: Economic Status

2.1	What is your approximately household expenditure per month? 1=<Rs.2000 2=2000-4000 3=4000-6500 4=6500-8000 5=8000-10000 6>10000
2.2	Enough food for family 1=Yes; 0=No
2.3	Do you own land 1=Yes; 0=No

2.4	Nature of House 1=Katcha 2=Semi-Pakka 3=Pakka
2.5	crowding= Number of people per room
2.6	Separate room for cooking 1=Yes; 0=No
2.7	Livestock (in Number)

Definition: According to Government of India Houses made with high quality materials throughout, including the floor, roof, and exterior walls, are called pucca houses. Houses made from mud, thatch, or other low-quality materials are called katcha houses. https://data.gov.in/catalog/distribution-households-pucca-and-kutcha-house;

Variable 3: Access to water – Adequacy

3.1	Do you have enough water for Drinking 1=Yes; 0=No
3.2	Do you have enough water for cooking 1=Yes; 0=No
3.3	Do you have enough water for bathing 1=Yes; 0=No
3.4	Do you have enough water for Washing Vessels 1=Yes; 0=No
3.5	Do you have enough water for Washing Clothes 1=Yes; 0=No
3.6	Do you have enough water for Defecating 1=Yes; 0=No

Variable 3: Access to water – Quality

3.7	Washing Quaity: 1=best quality; 2=medium quality, 3=worst quality
3.8	Bathing Quality: 1=best quality; 2=medium quality, 3=worst quality
3.9	Drinking water quality: 1=best, 2=medium, 3=poor)

Definition:

Best Quality, 1: Piped Water to Dwelling, Bottled Water, Standpipe

Medium, 2: Protected Well/Spring, Tubewell/Borehole, Rainwater, Piped Water from tea garden, Other - Tanker Truck, Drum etc.

Worst Quality, 3: Surface Water (River, Pond, Stream etc), Well Water (unprotected), Spring (unprotected), Other

Variable 3: Access to water – Physical accessibility

3.10	Distance (geographical access) 1: Easy Access = Within dwelling, Outside dwelling but within the premises 2: Medium Access = Outside premises, less than 200 m 3. Tough Access = Greater than 200 m

Variable 4: Access to Sanitation – Availability

4.1	Have toilet 1=Yes 0=No
4.2	For those with toilet: Access to toilet (shared or not) 1=Exlusive use of Household 2=Shared with other households
4.3	For those with toilet: Distance (in meters)

Variable 4: Access to Sanitation – Quality

4.4	For those with toilet: Self reported problems by household 1=some problems 2=many problems 0=no problems
4.5	For those with toilet: Total number of problems in superstructure noted by surveyor
4.6	For those with toilet: problems in superstructure 1=(4 or more problems,) else=0 as noted by surveyor
4.7	For those with toilet: water within toilet 1 = No water, stored water; 0 = 24hr piped water, piped water specific hours, piped water along with stored water.

Variable 5: Hygiene Behaviour – Household hygiene

5.1	What is used to carry water 1= Jerry can 2=Open Container
5.2	What is used to store drinking water 1=Closed Contained 0=Open Container
5.3	Do you treat water 1=Yes; 0=No
5.5	Frequency of toilet cleaning: Infrequent= once a month, yearly or never Normal =1= daily, once a week, or twice a week
5.5	Frequency of house cleaning Infrequent=2= monthly or less; Normal = 1= daily or twice daily or once in two days
5.6	Frequency of yard cleaning Infrequent=2 = Once a month or less Normal =1 = Twice a month, once a week, twice a week and daily
5.7	Is Place where you throw garbage covered 1=Yes; 0=No
5.8	Are baby Faeces disposed in a hygienic manner? 1=Yes 2=Never 3=No Answer

Definition: Disposal of baby faeces
Hygienic: Always use toilet , Throw in the toilet, Rinse baby over drain, Throw in hole and cover, Bury, Use washable diapers
Unhygienic: (Throw in hole), (Throw in garbage), (Leave in the open)

Variable 5: Hygiene Behaviour – Personal hygiene

5.9	Wash hands after using toilet 1=Yes; 0=No
5.1	With what do you wash hands with after defecation 1=Soap 0=Ash, sand, soil or water
5.11	Wash hands before eating 1=Yes; 0=No
5.12	Wash hands after dealing with animals 1=Yes; 0=No
5.13	How many individuals in household use toilet always

5.14	Generated variable:=Percentage of individuals that always use toilet
5.15/6.5	Generated variable: Percentage of individuals in the household that always OD
5.16/6.6	Generated variable: Percentage of individuals in household that always use mixed

Variable 6: Contamination Potential by technology design

6.1	Kind of toilet 0=No toilet 1=toilet with septic tank 2=pit latrine
6.2	Toilet Drainage system 1=Underground 2=Open 3= No drainage 0 = No toilet

Variable 6: Contamination Potential through open defecation

6.3	How many individuals in household always OD
6.4	How many individuals in household use mixed
6.5	Percentage of individuals in the household that ONLY OD
6.6	Percentage of individuals in the household that always use mixed
6.7	Percentage of individuals in the household that always use ONLY OD or mixed

Variable 7: Health Status of household

7.1	How many individuals in household suffered from Diarrhea/Dysentry
7.2	How many individuals in household suffered from Typhoid/Jaundice

7.3	How many individuals in household suffered from Mosquito related/Vector related
7.4	How many individuals in household suffered from Skin Diseas(s)
7.5	How many individuals in household suffered from Fever/Cold
7.6	Magnitude = how many people in the house got sick
7.7	Generated variable: Disease Incidence: Did anyone in the household contract any sickness mentioned in 7.1-7.4 Yes=1; No=0

Variable 8: Access to Agency

8.1	Distance from nearest Health Center (in Minutes)
8.2	Distance to motorable road (In Minutes)
8.3	Distance from nearest Police Station (in Minutes)
8.4	Collection of garbage from household 1=made by municipality/panchayat/corporation 2=by residents/groups of residents 3=No arrangement or other

Variable 9: Village Environment

9.1	9.1 WASH capabilities index	Square root of the sum of the squares of (3.5*, 3.7*, 5.7*,5.10* and 4.2*) - basically taken the variables whose variance is max at village level in access to water, sanitation and hygiene behaviour.
9.2	9.3 Lack of WASH capabilities index	We subtracted each component (3.5*, 3.7*, 5.7*,5.10* and 4.2*) out of 1. Then squared them. And added them. Finally, took their square root.
9.3	9.3 Contamination potential index2 with only OD indicator as it the only one there for all villages	Took only 6.5* or % of households in which at least one member practices OD.

9.4	9.4 Lack of access to Agency index	Took 8.1* and 8.2* which are the medians of the distances to hospital and motorable road respectively. Made them percentages of 1 hour. Then again took the square root of the sum of the squares of the indicators.

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