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Operation Rehabilitation Drive

Operation Rehabilitation Drive: Rapid Flood Impact Assessment in Kuttanad Region



Operation Rehabilitation Drive: Rapid Flood Impact Assessment in Kuttanad Region

by

Centre for Policy Studies, Centre for Technology Alternatives for
Rural Areas and Civil Engineering Department, IIT Bombay

supported

by

Kerala Institute of Local Administration (KILA), Kerala

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Dr. Joy Elamon, Director, KILA
Bombay

Professor N.C. Narayanan, IIT

Operation Rehabilitation Drive: Rapid Flood Impact Assessment in Kuttanad Region

Executive Summary

As part of the Operation Rehabilitation drive organized by the government to help the people returning from the relief camp back to their homes, the CANALPY team conducted a rapid assessment of the impact of flood. The CANALPY team was already working on the relief activities and conducting surveys in Kuttanad from July when the floods hit the region and they continued their activities as part of Operation Rehabilitation drive. The team planned various surveys to assess the structural damages of houses and public institutions, impact of floods on water, sanitation services and public health in the various panchayats of Kuttanad. About 500+ students participated in these surveys, conducted between August 28th and August 30th, 2018 across 14 panchayats in Alappuzha district of Kuttanad region.

The main objectives of the survey were:

- To assess the structural damages of households/institutions in the flood affected area.
- To assess the water/sanitation services (WSS) and the extent of prevalence of diseases, mostly related to unhygienic environment, in the flood-affected area.
- To relate the damages, interruption in water/sanitation services and outbreak of diseases with the socio-economic profile of the affected households.
- To identify pockets of most affected areas and household/institutions.

The surveys were designed after consulting disaster management experts, civil engineers, medical experts, architects and personnel working in humanitarian agencies to ensure inclusiveness and specificity. Photo documentation was used as the method to capture the damages and to ease analysis of the damages. Geo tagging of the buildings were also done along with surveys to map the households and institutions and to identify the pockets of most affected areas.

Socio-economic survey of households:

2200 households were surveyed across 14 panchayats in Kuttanad region out of which 58% were BPL households. Open Data Kit (ODK), a free and open source online application was used to design the questionnaire and collect data. Questions related to impact of floods on water and sanitation services, public health along with structural strength of buildings due to damages in walls, roofs, floor, and basement were included. Photos of the damages in the houses as well as in all the four sides of the house were captured for further analysis by experts. Common diseases found were fever (in 423 households) and diarrhoea (in 22

households) with BPL households reporting greater incidences of both fever and diarrhoea. BPL households had more people requiring special care/physical disabilities (pregnant, elderly, infants, bedridden, cancer patients, physically challenged). Boiling is the most common method of treating water for consumption. Some households did chlorination in addition to boiling. APL households were twice likely to use chlorine tablets as those of BPL households. All the wells had flooded, with less than half of the number chlorinated at the time of survey. Well ownership was significantly higher among those in APL category. Few households are relying on open spaces for defecation and use of bio-toilets and the use of public toilets are very limited. Crop losses were found in about one-fourth of the households surveyed.

Structural Damage Analysis of Houses:

Flood levels have risen on an average of 5 feet in most of the places and all the households surveyed were affected at least to some extent. Lack of tall structures has increased the impact of floods, as only 5% of the buildings surveyed had more than one storey. Based on the photos of one third of the house buildings taken using the app during the surveys, judgements were made by civil/structural engineering experts in IIT Bombay.

- 5.27% of houses are affected by the flood and require complete reconstruction or need major intervention.
- 65.67% of the houses analysed seem to require some intervention.
- 19.45% of the houses do not require any major renovation.

Despite lack of expertise and minimal training, there was a reasonable degree of consistency between volunteer observations and expert findings of structural damages. This exercise also meant that photographs is important to remotely judge the structural integrity of houses if the documentation is proper as found from this exercise. The experts also were satisfied with the photo analysis method of the houses as it helped them to make judgements easier than only looking into each of the data entries.

Major Observations and Recommendations

- Flood is a regular phenomenon in Kuttanad. More than 2/3rd of the flooded houses are flooded at least once a year
- Based on photographs of 740 houses, the experts identified 5.27% of the buildings required complete reconstruction. Similarly 65.67% of the samples require some intervention and 19.45% do not require any major renovation.
- Incidents of fever and diarrhoea higher among BPL households.
- More than half the house holds containing people with special needs fall in BPL category. People needing special care included pregnant women, elderly, Elderly, bedridden, pregnant women, infants, physically challenged, cancer. 42% of BPL households surveyed has members requiring special needs.
- Drinking water scarcity should be addressed in the panchayats.
- Chlorine tablets should be made available to those moving back to their houses.
- During rehabilitation, measures should be made to ensure that proper septic tanks are constructed to avoid sewage seepage.

- **Though doxycycline tablets had been provided through the various relief camps, measures to be taken to ensure that they are consumed by people appropriately.** There is a need to make people aware of the threat of leptospirosis and how these tablets can prevent it.
- ORS should be more abundantly made available.
- Ointments for athletes' foot should be accessible to those needed.

Considering that 72% of the respondents stayed in relief camps during the floods, many of these interventions such as consuming doxycycline tablets and providing basic medicines can be carried out in camps. Ideally, a small medical kit can be provided to those returning home to address any likely medical issues such as athletes' foot and diarrhoea. Chlorine tablets can also be included. It is likely that those with chronic diseases such as high BP and diabetes and bed ridden patients will need some support during the rehabilitation period.

Socio-economic survey of public institutions:

123 public institutions were surveyed across 10 panchayats as part of this survey, with 8 groups of two persons each. This survey looked into the impact of floods on various public institutions in the villages such as anganwadis, schools, health centres, government offices, police stations, ration shops, dispensaries, cooperative banks and veterinary hospitals, which are important public institutions. These public institutions need to be in working condition as it helps in the relief/rehabilitation activities and to ensure the people can come back to normalcy as soon as possible. The key findings from this survey are as follows: There have been **considerable infrastructural losses** due to floods in many of the schools, anganwadis, primary health centres and government offices surveyed. There should be focus on infrastructural losses as well during the rebuilding of the institutions rather than focus only on the building structures. Only one third of the institutions rely on treated public water for drinking purposes. There is a need to do water quality testing of the water sources of all these institutions and a focus on water /rainwater conservation structures is desirable for the self-sufficiency in these public institutions. While less than half of the public institutions had a well in their own premises, less than half of them are chlorinated or treated. All the wells need to be chlorinated to ensure that there is no contamination due to water. Except for 3 public institutions, the toilet facilities are in working condition.

Structural damage analysis of public institutions:

Upon analysis of the photos of the buildings (of a sample of 97 buildings), structural engineering experts found 9 institutions (10% of total) needed immediate attention. Drainage issues were found in few institutions and in about half of the institutions, damages were found but not flood related. But even in these buildings, the existing damages could have weakened the structure and hence need to be addressed as well.

Recommendations:

- About 10% of the public institution buildings surveyed need immediate action.
- There has been a considerable loss of infrastructure in the schools, anganwadis, primary health centres and government offices due to the floods. Along with the reconstruction work on the buildings, focus should also be to repair and buy new infrastructure for these public institutions.

- Provision of non-contaminated drinking water, toilets and basic sanitation facilities such as hand washing are to be ensured before these institutions start working. All the wells in the premises should be chlorinated, before use.
- While reconstruction and repair work of the buildings are being done, water/rain water harvesting structures along with tanks could be opted for ensuring water conservation in these buildings.
- Photographs can be used to remotely judge the structural integrity of buildings if the documentation is proper.
- Volunteers who are not experts can aid in the assessment process if given a basic training.

Operation Rehabilitation Drive: Rapid Flood Impact Assessment in Kuttanad Region

Introduction

Blessed with 44 rivers, backwaters and inland waterways, 8.7% of the total geographical area of Kerala is considered as flood prone by the National Disaster Management Authority (NDMA 2008). This year, the India Meteorological Department (IMD) had issued an extremely heavy rain (over 210 mm) warning to the state ahead of the monsoon onset. The state disaster management authority secretary even observed that during the last eight years IMD's highest order of extremely heavy rain alert in Kerala ahead of the monsoon onset is rare¹.

Though no one reason can be pin pointed as a reason for the 2018 Kerala floods at this juncture, expert opinions suggest multiple factors. The unusually heavy rain induced by the low pressure systems in the Bay of Bengal (which by itself is linked to warming of the oceans), the landslides that occurred in multiple areas along the Western Ghats and simultaneous opening of dams across the state are believed to have led to this unprecedented disaster. The antecedent rainfall received till July has given bountiful of inflows into the major dams and at the same time saturated the soil limiting the further infiltration. In the worst affected flood the state has seen since 1924, more than 480 people lost their lives and an economic loss of more than Rs. 200,000 million is preliminarily estimated. It is in twelve of the fourteen districts in Kerala major loss has occurred and one of the worst hit regions was the Kuttanad region.

Kuttanad Region

Kuttanad is a wetland system of about 900 sq. km situated in the west coast of Kerala formed through the natural reclamation of flood deposits of four rivers - Pamba, Achenkovil, Manimala and Meenachil originating from Western Ghats. It is considered as the only place in the world where rice cultivation is done up to 2 meters below sea level and is declared as a Globally Important Agricultural Heritage System by the Food and Agriculture Organization. Nearly 57% of Kuttanad falls under the Alappuzha district, 30 % in Kottayam district and remaining 13 % in the Pathanamthitta district (MSSRF 2007).

¹<https://timesofindia.indiatimes.com/city/thiruvananthapuram/high-alert-in-kerala-with-extremely-heavy-rains-on-may-28-ahead-of-south-west-monsoon/articleshow/64322715.cms>

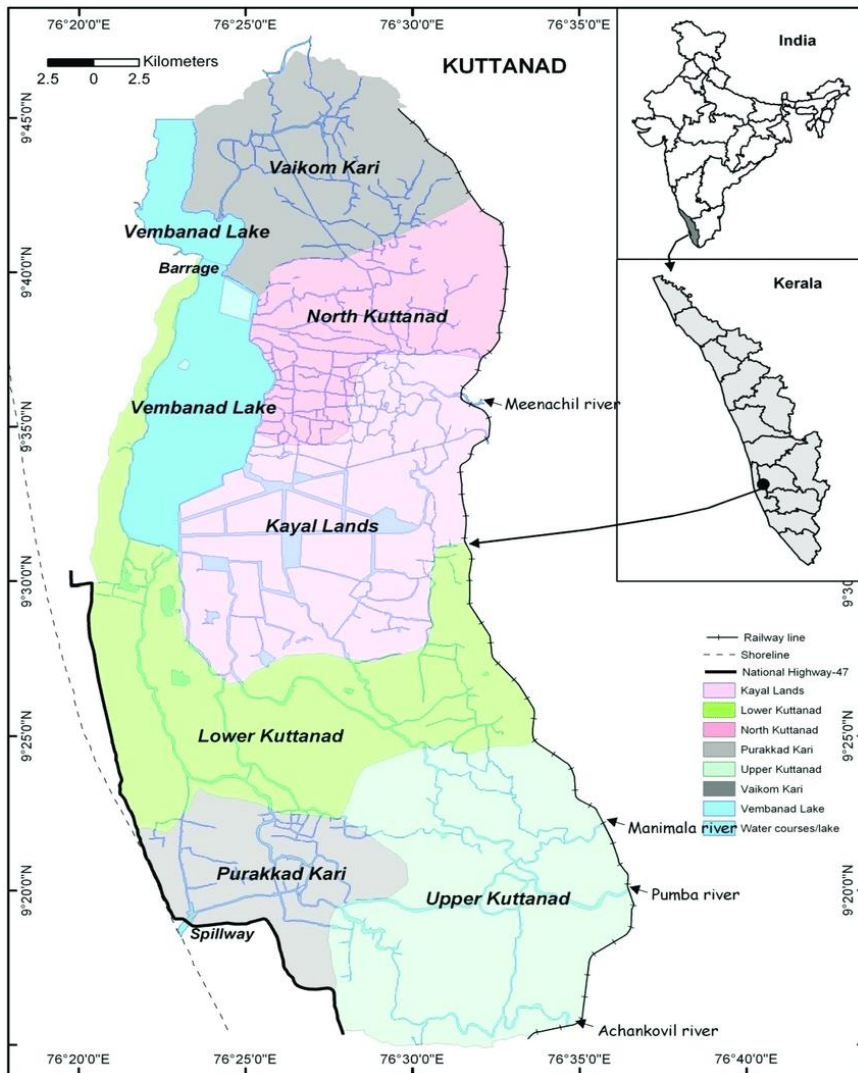


Figure 1. Kuttanad Wetlands [Source: Narayanan et.al (2011)]

A study by the National Centre for Earth Science Studies (CESS 2010 cited in KSDMA n.d) shows that more than 50% percentage of area in Alappuzha is identified as flood prone and most of these are confined to the Kuttanad region. Some or the other part of the region gets inundated almost every year and the efforts to curb the flooding had begun way back in the 1934 (pp.73 KSSP 1978 cited in Chandy 2013). The Kerala State Action Plan on Climate Change lists Alappuzha district as very highly vulnerable alongside Palakkad. The network of environmentally sensitive wetlands was one of the reasons for the district to be classified under this category (Nandakumar 2014).

2018 Floods in Kuttanad Region



Prior to the present flood, it was in 2010 that a flood, albeit in a magnitude is being reported from the state of Kerala. The flood observatory at Dartmouth College records that “In Kerala, over 23,000 people have been affected by floods, and, 48 people have died” in that episode.

Unlike the other parts of the state, Kuttanad was reeling with flood since the month of June itself. The Hindu on June 22 reports that Kuttanad have been inundated and the Revenue Department has opened 19 gruel centres in Kuttanad region following severe flooding². By July 18, the number of gruel centres opened in Kuttanad taluk stood at 375. In the week of 12th to 18th July, rainfall in Kerala was 122% above the long period average³, and in Kuttanad the situation was reported as the worst flood in the last two decades⁴.

The floods saw a mass evacuation of about 2.7 lakhs of people from the Kuttanad region within two days⁵. 673 relief camps were functioning in Alappuzha district alone. New reports emerging from the Central Water Commission also suggests that the underperformance of water management systems that spills the excess water from Vembanad Lake into the sea was adequate and the low carrying capacity of the lake due to siltation might have worsened the impact of deluge⁶. However, amidst this catastrophe, there are instances of hope like the houses built on stilts in the Kandukrishichira locality of Kuttanad. Four of these stilt houses have managed to keep the floodwater from encroaching inside. If not for its utility in a seemingly once in a hundred year flood, practices like this could be an adaptation strategy in the ongoing global environmental change. The present rapid assessment was conducted in the 14 panchayats falling in the Alappuzha part of Kuttanad. Apart from trying to understand the plight of the people and the damages occurred, it also tries to identify the coping strategies of the people of Kuttanad region.

²<https://www.thehindu.com/todays-paper/tp-national/tp-kerala/six-relief-camps-in-alappuzha/article24226099.ece>

³http://www.imd.gov.in/pages/press_release_view.php?ff=20180719_pr_293

⁴<https://www.thehindu.com/news/national/kerala/worst-floods-in-last-two-decades-ravage-kuttanad/article24454838.ece>

⁵<https://www.thenewsminute.com/article/kerala-floods-water-not-receding-kuttanad-cut-rest-state-87439>

⁶<https://indianexpress.com/article/india/how-keralas-largest-lake-worsened-flood-water-panel-5345888/>

Approach & Methodology



With the objective to reclaim the canals of Alappuzha town, a campaign by the name of CANALPY (CanAlappuzha) was conceptualized late last year by the citizens of Alappuzha. With the tagline of "canals are not drains", it strives to clean, sustain and inspire the people to take care of their surroundings and make a difference to the society. The campaign was propagated through social media and a dedicated website (<https://www.canalpy.com/>). This campaign relied upon the existing community institutions, collaborations/partnerships with government (ULBs, KSPCB, KSSP etc.), academia (CUCEK/SCMS/IITB) and people, especially the local youth of Alappuzha in last one year. This campaign also takes a participatory and decentralised approach towards waste management and aspires to tap the energy of youth and create citizen students, who can work as an interface between the people and the government and bring about transformation on ground. The students and youth volunteers were trained on concepts of water and sanitation, on conducting participatory surveys and on data collection, mapping and analysis tools such as Open Data Kit (ODK), QGIS (Quantum GIS), OSM Tracker (Open Street Maps). These data collection tools were used multiple times in last 9 months by the students. Students from the colleges and schools in and around Alappuzha were also trained with these tools and they used it to conduct these surveys. This social capital created by CANALPY team was helpful when the disaster hit Alappuzha and Kuttanad regions. The experience gained through the earlier surveys, interactions and on ground work aided the team to mobilise people quickly as well as to do the design, training and monitoring questionnaire surveys. The local team also mapped the relief camps, which was helpful in assigning volunteers, managing the relief materials and planning access to these relief camps.

kuttanad MAP

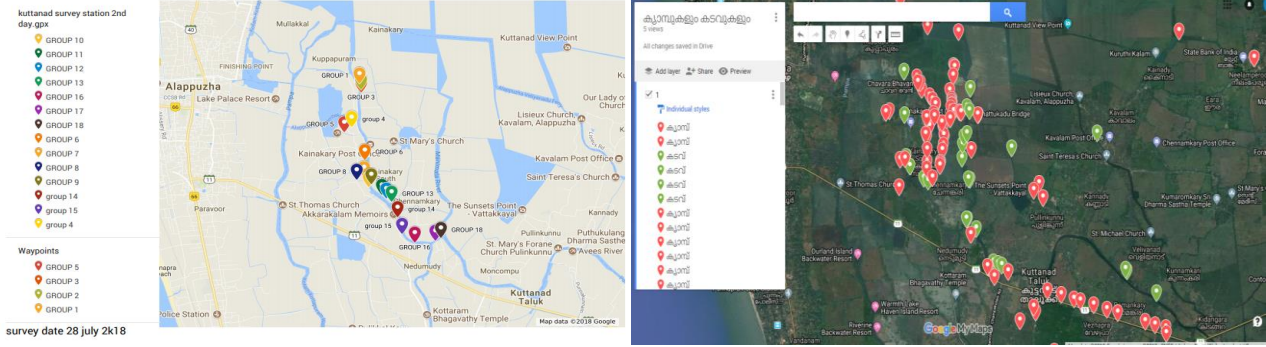


Figure 2: Various mapping activities done by the CANALPY team as part of the planning of relief activities in July.

CANALPY and Operation Rehabilitation



Operation Rehabilitation is considered to be the biggest rehabilitation mission that Kerala has ever undertaken and after a call for volunteers was mooted by the MLA and the Finance Minister of Kerala, there was an arousing response and more than 65000 volunteered to be part of this drive.

 **Thomas Isaac**
@drthomasisaac Follow

Do you want to volunteer for Operation Rehabilitation Alleppey, want to be part of 65K volunteers? We promise you a lot of hardwork, and also some moments to cherish for the rest of your life. Just click on this and register. volunteer.canalpy.com

8:13 PM - 24 Aug 2018

Figure 3: Tweet by Dr. Thomas Isaac asking people to volunteer for Operation Rehabilitation

Operation Rehabilitation, a drive to make the houses habitable and safe return of the flood-hit people from the relief camps to their respective homes was organized in Kuttanad, one of the most affected regions in Kerala on August 28th, 29th and 30th 2018. About 1.5 lakh people were evacuated when the floods hit Kuttanad. This massive drive consisted of providing sanitization of the affected houses, support with the electric, carpentry and plumbing work that might be required in the houses, ensuring safety to the people by providing preventives for leptospirosis, tetanus etc or from snake bites, electrical survey to assess the status of electrical connections at home. Various surveys were also planned including the combined socio economic & civil survey organized by CANALPY to study the impact of floods on the water and sanitation services. A volunteering team of plumbers, carpenters, electricians, cleaning volunteers, snake catchers, surveyors joined Operation Rehabilitation drive.

The CANALPY team was already working on the relief activities and conducting surveys in Kuttanad from July, when the region was first affected by floods. As part of Operation Rehabilitation, it was decided to include a rapid assessment of the impact of the flood on the building structures, water, sanitation services and public health. About 2000+ volunteers had showed interest in volunteering for this rapid assessment exercise. Out of them it was decided that about 500 volunteers will be trained and can be part of the data collection and the rest will be assigned to each grama panchayat on the basis of requirement. The volunteers were sorted and those who were interested in cleaning activities were linked with the grama panchayat authorities and arrangements for food and accommodation were done for those who came from outside Alappuzha. Out of the 1500 volunteers, 500 of them were selected to be part of the various surveys to be conducted across Kuttanad. Around 250 volunteers turned out for the training as part of the socio-economic survey. This survey was planned for households as well as public institutions by the CANALPY team and it was planned that the survey team will accompany the people returning back to their flood hit homes from the relief camps. The survey questionnaires for the household and public institutions were prepared carefully after consultation with various disaster management experts, civil engineers, medical experts, architects and people working humanitarian agencies so as to ensure inclusiveness and have specificity. In questions related to health and diseases it was made sure that except for fever and athlete's foot, reporting of any other diseases will be done only if the disease has been confirmed by a doctor.

On the day of arrival of the volunteers, they were given a short training on the questionnaire (See Appendix – 1) and introduced them to the mobile app, Open Data Kit (ODK) which was to be used for the survey. There were sessions to introduce them to the Kuttanad floods, about the CANALPY project, the survey etiquettes and also about how to conduct the civil survey. Importance of taking proper photographs was reiterated during the sessions as it formed the basis of the structural damage analysis of the survey. Later on the survey team was divided into 16 groups to be assigned to the various panchayats.

On the first day of the Operation Rehabilitation drive (on August 28th), the people from the relief camps and the volunteers gathered at SDV High School ground, Alappuzha. Buses were assigned to each of the panchayats and the survey volunteers along with other volunteers accompanied the people in each bus. Few areas to which the road network was still not in working condition from Alappuzha town, boats were used to transport people as well as surveyors and other volunteers. As the survey was to be conducted for 2-3 days, the panchayats were informed to provide food and overnight accommodation for the volunteers for these three days.



Figure 4: Kuttanad Region and the Surveyed Panchayats

As many of the public institutions were affected by the flood, a separate survey to assess the impact of floods on the civil structure along with water and sanitation facilities was also conducted along with the household survey. Public institutions such as public health centres/medical clinics, ration shops, anganwadis, primary, upper primary and high schools, banks/ATM facilities were focused on this survey. The rationale to focus on these institutions was since they are important institutions in each village and they need to be in working condition so as to ease the relief and rehabilitation process as well as to bring back the flood hit villages back to the normalcy. While the immediate goal of this study is to examine the impact of the floods in Kuttanad region post July/August floods in Kerala, the long term goal is to suggest a protocol for the assessment of doing such an impact study. With the Kerala government and other agencies planning to conduct such surveys in Kuttanad and other areas in Kerala affected by flood, this study intends to provide a template for rapid assessment of the flood impact.

Specific Objectives of this Flood Impact study

- To assess the structural damages of households/institutions in the flood affected area.
- To assess the water and sanitation services and the extent of prevalence of diseases, mostly related to unhygienic environment, in the flood affected area.
- To relate the damages, interruption in WSS services and outbreak of diseases with the socio-economic profile of the affected households.
- To identify pockets of most affected areas and household/institutions.

Socio-Economic Survey Analysis

The survey was conducted across 14 panchayats in Alappuzha districts. A total of 2200 households with an average of 4-5 members were surveyed on the 28th and 29th of September. The survey happened in conjuncture with the Kuttanad cleanup operations carried out by the government.

Panchayats	No of HHs surveyed
Thalavady	136
Thakazhy	386
Nedumudi	244
Pulinkunnu	160
Kavalam	305
Veliyanad	132
Veeyapuram	319
Edathua	122
Karuvatta	180
Champakulam	34
Kainakary	4
Neelamperoor	136
Pallippad	12
Ramankary	30

Table 1: Surveyed Panchayats and number of households in each panchayat

Of the respondents who specified their income levels, 58% fall under the below poverty line category. The religious demography consisted of 64% Hindus, 33% Christians, and less than 3% Muslims. Nearly 19% of those surveyed chose to not reveal their religion.

Flood

The average flood levels were close to 5 feet in most places, and all the households surveyed were affected to some extent. Most respondents recalled the water flowing in suddenly as opposed to gradually rising. Crop Losses were reported by 580 households, with almost equal numbers of households in APL and BPL categories. The lower percentage of BPL households reporting crop loss may be because many in this category are wage labourers who do not own agriculture land.

When the flood frequency was studied, it is noted that of the 66% of the houses surveyed were flooded at least once a year, though not as severely. The tendency to be flooded is not heavily dependent on household status. **Over 70% of households were flooded at least once in 3 years.** In general, 69% of BPL households report being flooded regularly as opposed to 64% APL households. The misery caused by flooding may have been intensified by the lack of tall structures as only 5% of buildings in the surveyed area has more than one storey.

Health

A primary health survey was conducted to ascertain the presence of any diseases in those surveyed. The common diseases reported were fever and diarrhoea. There were 423 cases of fever and 22 cases of diarrhoea in total. Of these, it is seen that those in BPL category reported a greater incidence of both diseases. Those with fever make up 22% of the BPL population and 16% of those in APL category. Diarrhoea incidence is almost entirely among those belonging to BPL category with just one person from APL category reporting symptoms.

The survey also identifies cases of chronic diseases and instances requiring special care such as pregnancy. A total of 906 such households were identified. Most of the cases identified involved the elderly and individuals with physical disabilities.

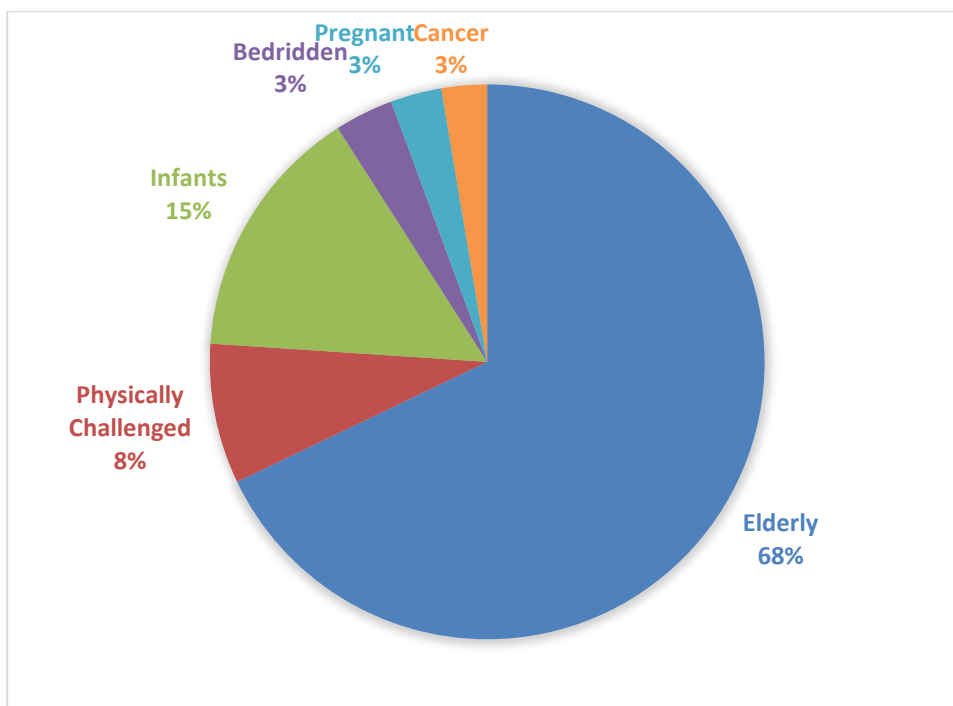


Figure 5: Distribution of individuals requiring special care

It is seen that chronic disabilities are much higher among the BPL sector. **In fact, 42% of BPL households report having someone requiring special care when compared to 31% of those in APL category.** More than half of the households containing people requiring special medical care are from BPL category.

Water

In the post flood scenario, water usage patterns are important as interventions in this level can prevent the spread of waterborne diseases. Tap water is by far the most common source of water, used by 40% of the surveyed households. Bottled water, borewells, and tankers were also popular sources. It is concerning however, that 10% depended on polluted local water bodies for supplying their requirements. Also, no discernible differences were observed in the use of water sources between APL and BPL families.

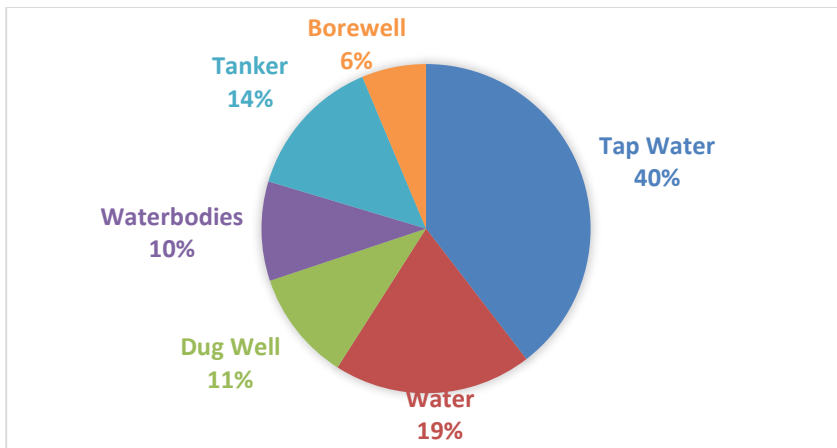


Figure 6: Water sources used post flood

Boiling seems to be the most common method for making water consumable. Some of the respondents also used chlorine tablets, but continued to boil water before use. In general, APL households were twice as likely to use chlorine tablets as those in the BPL category.

Of the households surveyed, 610 households had wells. As expected all of them were flooded during the time of survey. However, 43% of these wells had already been chlorinated. Well ownership was significantly higher among those in the APL category. Despite the higher number of BPL respondents, 50% of the total wells surveyed belonged to APL households. This is disproportionately high considering that 58% of those surveyed fell in the BPL category.

Sanitation

The sanitation questionnaire consisted of a few basic questions related to hygiene and toilet availability. With regards to toilets, 89% had access to private toilets while 3% had bio toilets. Slightly over 1% depended on public toilets while 4% of the respondents relied on open spaces. It was noted that the use of bio toilets and public toilets were largely limited to populations in the BPL category. In fact, there were no users of public toilets from the APL category. Similarly, people relying on open spaces constituted over 7% of those in BPL category while the corresponding percentage in APL category was 2%.

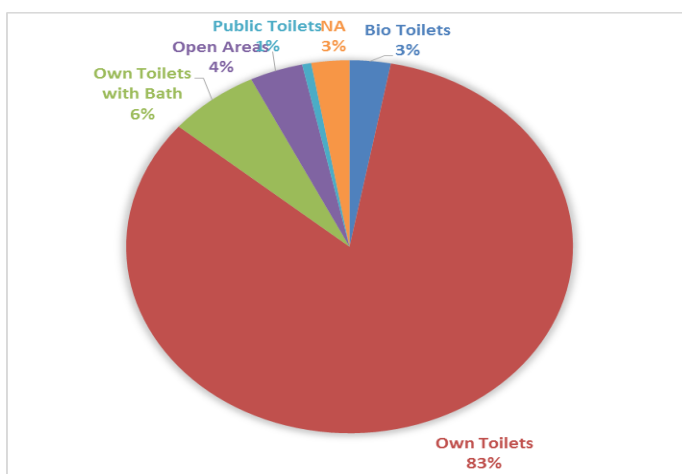


Figure 7: Types of latrines in use

Structural Damage Analysis of Households



A questionnaire was developed with the aim of assessing structural integrity of buildings post flood. Structural evaluation is a specialised field requiring expertise. However, the volunteers who were available were mostly students from various engineering disciplines. Therefore, some introductory training was provided to the volunteers regarding structural assessment. The questionnaire also required that photographs of all faults such as cracks be taken. These photographs were later analysed by experts to identify buildings that require them most assistance. However, the surveying volunteers were also asked to assess the state of the building.

As of now, 740 of these houses have been analysed by experts based on a format prepared by them (See Appendix -2). **Based on photographs, the experts identified 5.27% of the buildings as requiring complete reconstruction.** Similarly 65.67% of the samples require some intervention and 19.45% did not require any major renovation. Given that the judgement was based solely on photographs, the experts were unable to effectively assess the remaining 9.59% of the samples.

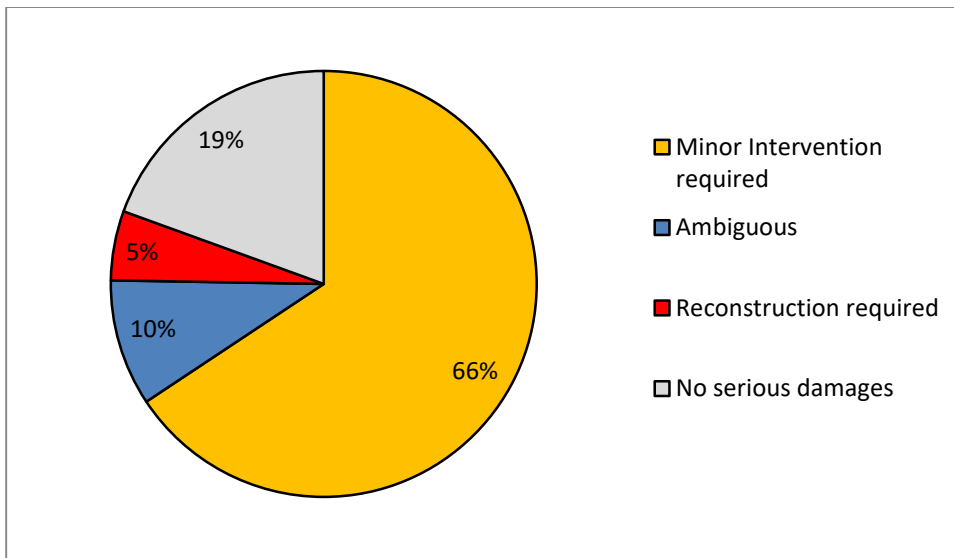


Figure 8: Distribution of Structural Damages

When the conclusions of experts were compared with those of the survey volunteers it gave interesting results. Of the 740 houses analysed, the experts classified 39 as critical, requiring reconstruction. Of these, the volunteers failed to identify 10. In essence, they managed to identify nearly 75% of the houses that required reconstruction. Similarly, the disagreement between experts and volunteers in case of houses that require some intervention was only over 13% while it was less than 5% in case of houses that were relatively undamaged.

Panchayats	No serious damages	Minor Intervention Required	Ambiguous	Reconstruction Required	Total
Ramankary	6	14	4		24
Thakazhy	28	155	6	11	200
Kavalam	2	22	2	4	30
Karuvatta	32	58	6	1	97
Veeyapuram	4	67	7	12	90
Champakulam	1	13	3	3	20
Edathua	17	44	10	1	72
Thalavady	50	39	14	5	108
Veliyanad		1			1
Neelamperoor	3	65	17	2	87
Pallippad	1	8	2		11
Total	144	486	71	39	740

Table 2: magnitude of the damages of houses across panchayats based on the analysis by experts

In all, student volunteers were more likely to classify houses as heavily damaged when compared to the experts. This is partly because experts were able to differentiate between flood related damage and existing damage while the volunteers were not. Similarly, it was seen that as volunteers are on the ground interacting with the victims, they tend to be more sympathetic, thereby overstating the extent of the damage. **However, despite lack of expertise and some biases, there was a reasonable degree of consistency between volunteer observations and expert findings.**

Therefore, at least under emergency conditions, it may be possible to use volunteers for structural assessment. Additionally, an expert can use photographs alone to judge the state of a building, making remote assessment a viable option.

Also on mapping on GIS, we can get the magnitude of damage of the houses in a map, which can be useful further analysis and if done at a complete household survey finding clusters of damage.

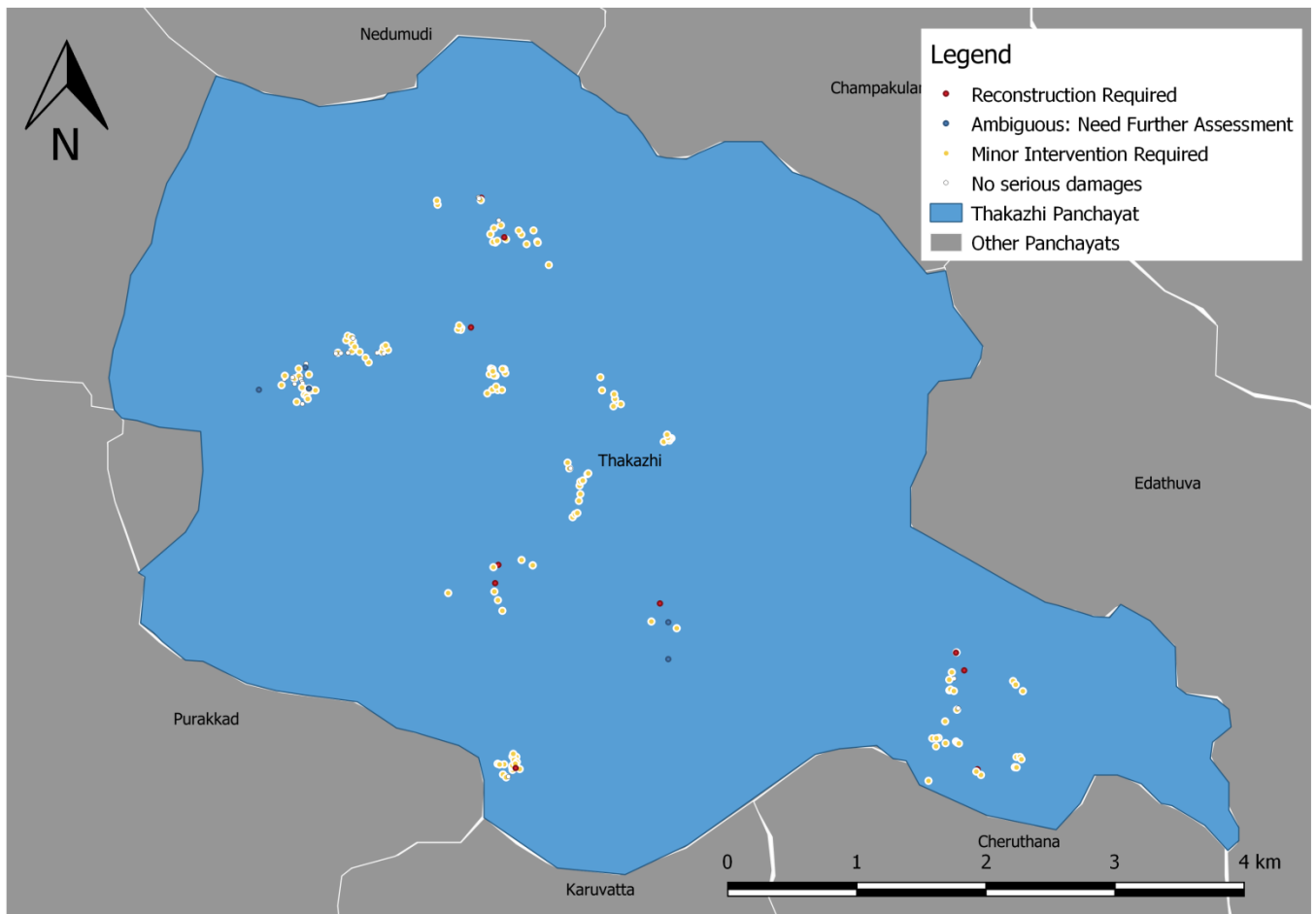


Figure 9: Magnitude of Damage in Houses, Thakazhy Panchayat

Key Observations and Recommendations

- More than 2/3rd of the flooded houses are flooded at least once a year
- Incidents of fever and diarrhoea higher among BPL households
- More than half the house holds containing people with special needs fall in BPL category. In fact, 42% of BPL household has members requiring special medical attention.
- Photographs can be used to remotely judge the structural integrity of houses if the documentation is proper
- Volunteers who are not experts can aid in the assessment process

Given that over 66% of the houses flooded are regularly subjected to the same, it may be best to develop long term rehabilitation projects to either resettle people form such areas or provide other methods for alleviating this

frequent suffering. However, this familiarity with floods may well be one of the reasons for the very low casualty count from this region.

In general, families in the BPL category are at a disadvantage in terms of access to wells and toilets. Use of chlorine tablets is also less prevalent among these households. Therefore, appropriate measures should be taken to address this gap. BPL households also have a higher than average number of people requiring special attention such as elderly and physically disabled. Health workers need to ensure that the required care and support are reaching these families.

With regards to structural assessment, it can safely be concluded that photographs can be used by experts to assess the state of a building post flood. Volunteers who were untrained in this field were able to aid this process, and even make reasonably accurate judgements regarding the structural safety of the buildings being surveyed. Therefore, this citizen science approach can be employed in the future to assess factors such as building safety after a disaster.

Case of Pulinkunnu Panchayat: Effect of flood on public health

Pulinkunnu is a village in Veliyanad block of Alappuzha district. As per the 2011 census, the village has a population of 15,210 and 3652 houses. Pulinkunnu is a predominantly agricultural area, with a vast majority of the total 2800 hectares classified as agriculture land (Census of India, 2011). This panchayat has 15 wards, of which 8 wards were surveyed immediately after the floods on 30th of September 2018. The survey covers critical areas such as water sources for drinking and cleaning and sanitation facilities. A preliminary health survey is also conducted. The sample size was 492 households with an average of 4 members each. This makes up over 13% of the overall population and gives a generic idea regarding problems faced by people post flood and can be used to formulate appropriate interventions. It should be noted that when the survey was conducted, most houses were empty as people were still accommodated in relief camps. The analysis of this data is presented below.

Drinking Water Sources

In general, people reported experiencing a shortage of drinking water. Over 75% of the surveyed population said they experience a shortage of drinking water. Irrespective of water source, 88% said that the drinking water was boiled before use. This is bound to help with limiting exposure to bacterial infections such as e-coli. Of the households surveyed, nearly 45% had wells which were in use. However, only a third of these have been chlorinated post floods and the surveyors observed that 90% of the wells seen appear to be polluted.

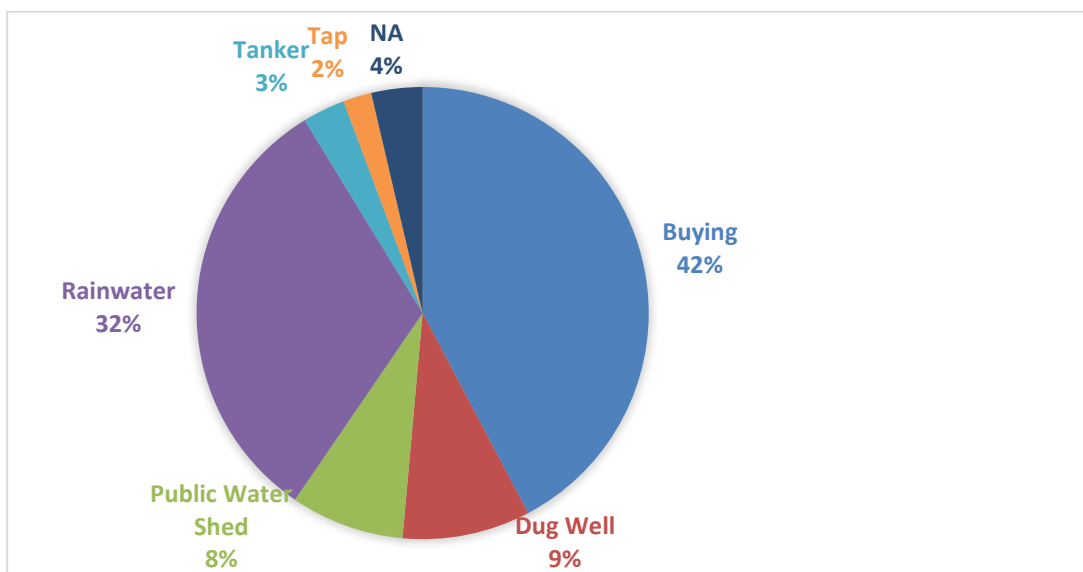


Figure 10 Drinking Water Sources

It can be seen that over 40% of the population rely on purchasing drinking water. Given that all water bodies were polluted during the floods, this is a safe approach. The municipality had also made efforts to ensure that availability of bottled drinking water, at least in camps. However, when this was not available, people relied on collecting rainwater. Again, this is a sensible approach when the ground water is rendered unusable. However, it was noted that nearly 17% of the population still relied on local water bodies and dug wells. Others relied on municipal tankers and municipal tap water supply.

Water sources for Domestic and Personal use

When it came to managing water needs for household purposes such as washing vessels and clothes, 55% relied on the local watershed (usually the waterbody in front of their house). This is the natural behaviour before flood as well. Another 25% relied on dug wells. Therefore, 80% of the population relies on naturally available water for domestic use. 13% used rain water for this purpose and the depended on tap water and municipal tankers. Over 45% of the people used water.

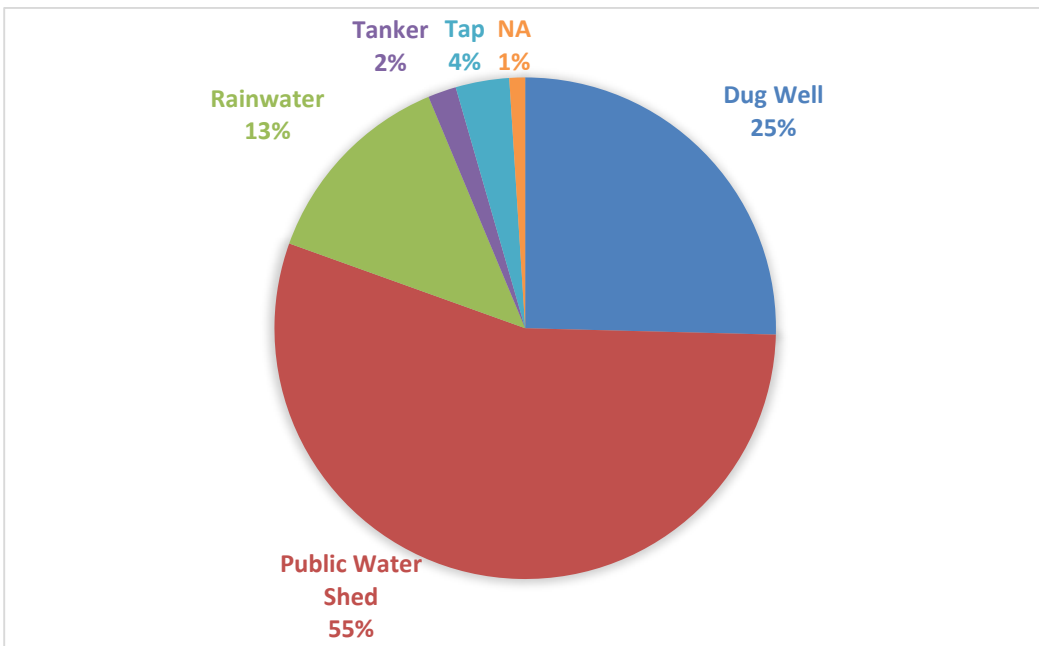


Figure 11 Water Source for Domestic Use

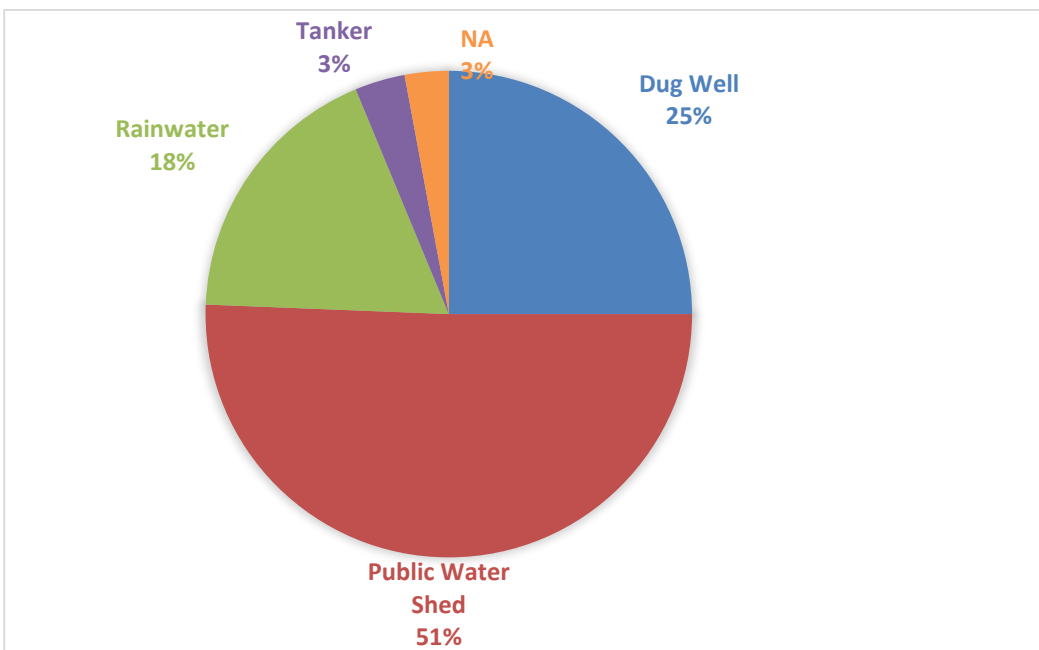


Figure 12 Water Source for Personal Hygiene

The usage patterns for personal hygiene are similar to that of domestic use. Over 50% depended on local waterbodies and 25% on dug wells and 18% on rain water. As expected, slightly larger population (26%) used chlorinated water for personal use when compared to washing vessels. **There was a shortage for chlorine tablets as over 80% of the respondents experience a shortage of chlorine tablets.**

Hygiene

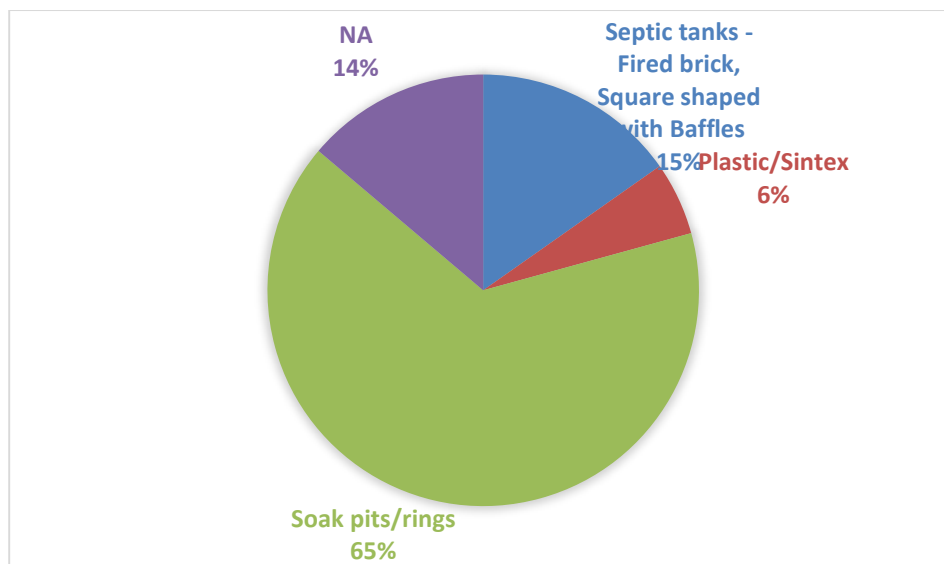


Figure 13 Septic Tank Construction

As such, no major issues were observed in personal hygiene as 95% of the population claimed to wash their hands before eating and after toilet use. However, solid waste treatment is an entirely different story. While 87% claimed to have septic tanks, over 65% have not been cleaned for the last 5 years. Given the average household strength of 4 people, this frequency is worrisome. Additionally, 56% of the households with septic tanks claimed that the tank was not cemented or that they were unaware of the type of construction. The type of material used also provides key insights. Over 65% use concrete rings. Such tanks are unlikely to be airtight, especially if the bottom is not concreted. Proper syntax tanks of tanks constructed specifically for this purpose were used only by 21% of the population. Therefore, it is safe to assume that given the level of flooding, all ground water sources are contaminated with solid waste sewage post floods.

Health

A very basic health survey was conducted in Pulinkunnu. It was seen that athletes' foot (62%) and fever (36%) were the major ailment reported. Incidents of diarrhoea were few, which is a good sign under flooded conditions. **However, it is important to note that of the people surveyed, only 37% had consumed the prescribed doxycycline tablets.** Lack of availability of tablets was cited as the reason. This lack of access to preventive measures with the relatively high incidents of fever cases should be viewed with caution as a leptospirosis outbreak is highly likely. **Similarly, ORS availability was also limited with only 14% claiming that they have access to it.**

Regarding chronic diseases, over a third of the households (34%) had someone suffering from diabetes and half the households (50%) had at least one member suffering from high blood pressure. Government hospitals and medical stores were the major source of medicine. Thirty four of the surveyed households had bedridden members, most of them elderly.

Observations and Recommendations

- Drinking water scarcity should be addressed
- Chlorine tablets should be made available to those moving back to their houses.
- During rehabilitation, measures should be made to ensure that proper septic tanks are constructed to avoid sewage seepage.
- Though doxycycline tablets had been provided through the various relief camps, measures to be taken to ensure that they are consumed by people appropriately.
- ORS should be more abundantly made available
- Ointments for athletes' foot should be accessible to those needed.

Considering that 72% of the respondents stayed in relief camps during the floods, many of these interventions such as consuming doxycycline tablets and providing basic medicines can be carried out in camps. Ideally, a small medical kit can be provided to those returning home to address any likely medical issues such as athletes' foot and diarrhoea. Chlorine tablets can also be included. It is likely that those with chronic diseases such as high BP and diabetes and bed ridden patients will need some support during the rehabilitation period.

Survey of Public Institutions



As part of the survey of public institutions a questionnaire was prepared based on the inputs from various disaster management and structural engineering experts and was conducted by a separate team of volunteers. The main focus of this survey was to look into the structural damage of public institutions. In addition to the structural damage of the buildings and water/sanitation services related questions, the survey also included questions to assess the infrastructural damages and losses in these institutions.

The methodology followed for this survey was similar to the survey of households. A smaller group of 16 student volunteers conducted this survey, divided into 8 groups of two members each. Basic introduction of the questions in the questionnaire, importance of photo documentation as well as the expectations from the survey were given to the volunteers on the previous day of the survey. Many of the volunteers in this survey were part of the Winter School and as they were familiar with ODK and doing online surveys, they helped and trained other volunteers. They conducted the survey on August 28th and 29th across 10 panchayats. These groups went to each of the panchayats along with the people returning to their homes from the relief camps.

Number of Public Insitutions surveyed in each Panchayat

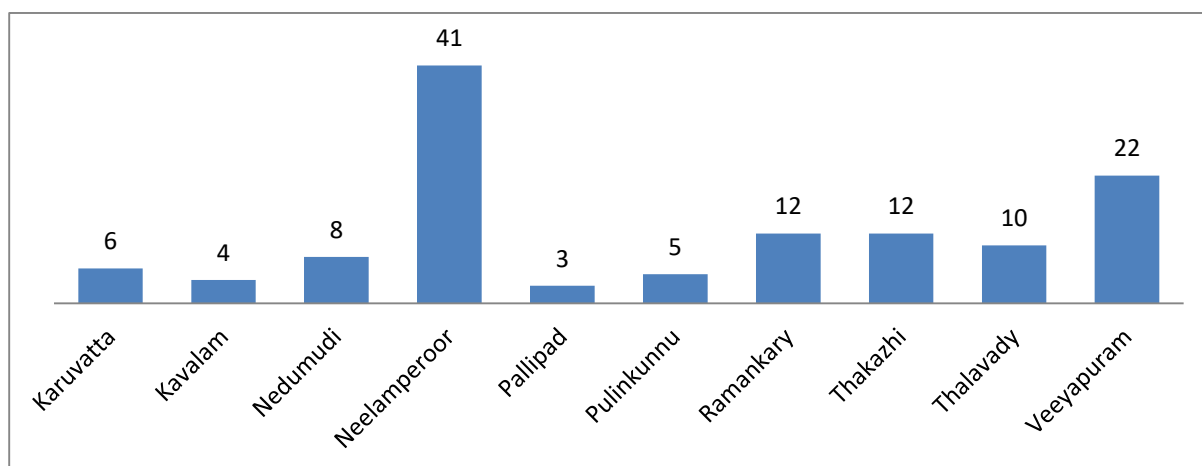


Figure 14: Number of Public Institutions surveyed in each Panchayat

Although in the questionnaire, the objective was to broadly look into the anganwadis, schools, health facilities and government offices, the survey team also surveyed police stations, ration shops, dispensaries, cooperative banks and veterinary hospitals, which are important public institutions. These are categorised as other in the chart below.

Type of Public Institutions Surveyed

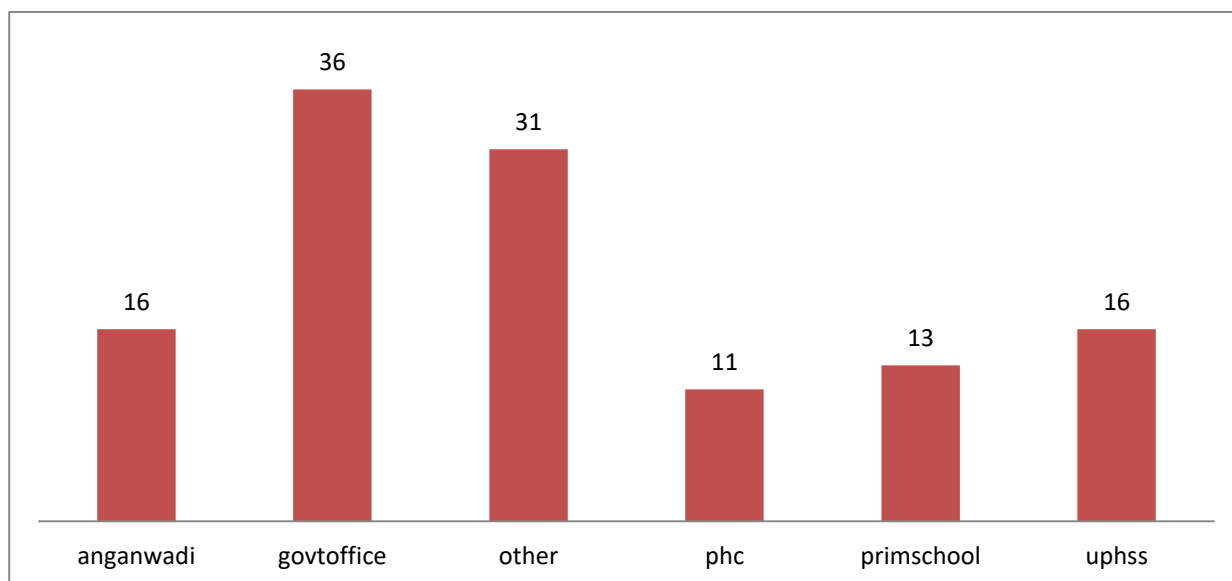


Figure 15: Type of Public Institutions Surveyed

Infrastructure related losses

The following table shows the infrastructure related losses and damages in schools and anganwadis after the floods. As is evident from the table below, there has been a considerable loss of infrastructure in the schools, anganwadis, primary health centres and government offices due to the floods.

Damages/Losses	Primary Schools				High Schools				Anganwadis			
	Yes	No	No info	Total	Yes	No	No info	Total	Yes	No	No info	Total
Loss of Infrastructure	4	5	4	13	7	6	3	16	4	5	7	16
Loss of other Infrastructre	4	3	6		6	6	4		6	3	7	
Loss of records	3	4	6		5	8	3		4	4	8	
Loss of electric projector	5	3	5		4	8	4		2	5	9	
Loss of Computer	5	3	5		4	7	5			7	9	
Chemistry Lab	No damage in the labs/No labs are there.				2	9	5		No damage in the labs/No labs are there.			
Physics Lab					2	9	5					
Biology Lab					2	9	5					
Loss of sports equipments	3	4	6		5	6	5		3	3	10	
Sports Field Affected	3	4	6		8	4	4		2	2	12	
Kitchen affected	3	4	6		7	5	4		5		11	
Food Storage affected	3	4	6		7	5	4		4	1	11	

Table 3: Loss of infrastructure in schools

Damages/Losses	Primary Health Centres				Damages/Losses	Govt Offices			
	Yes	No	No info	Total		Yes	No	No info	Total
Loss of medical infrastructure	5	3	3	11	Loss of Infrastructure	12	19	5	36
Loss of office infrastructure	6	3	2		Loss of other Infrastructre	10	17	9	
Loss of other records	5	4	2		Loss of records	16	13	7	

Table 4: Loss of infrastructure in PHCs and Govt Offices

Many of these institutions were closed and as a result, surveyors were able to capture only the photos of the building from all the sides in those cases.

Water and Sanitation Services in Public Institution

The drinking water sources in the public institutions were assessed and it was found that just above one third of the institutions rely upon tap water now. Rest of the institutions are relying upon non treated drinking water sources, which needs to be quality checked and treated before consumption. Wells and need to be chlorinated. About 19% public institutions rely upon bottled water. These public institutions while rebuilding should focus on rain water harvesting structures with tanks so that they attain water sustainability.

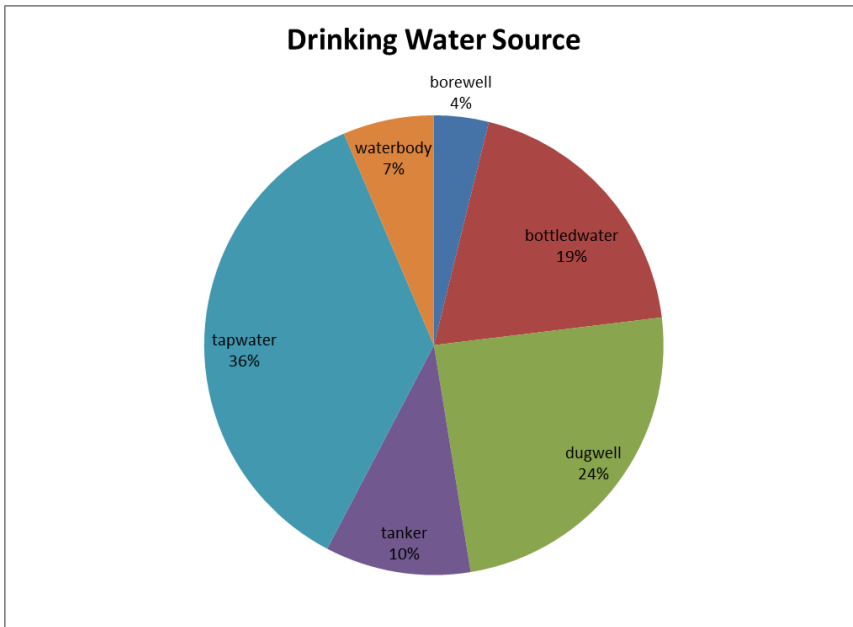


Figure 16: Drinking Water Source for Public Institutions

Source of Water for Washing

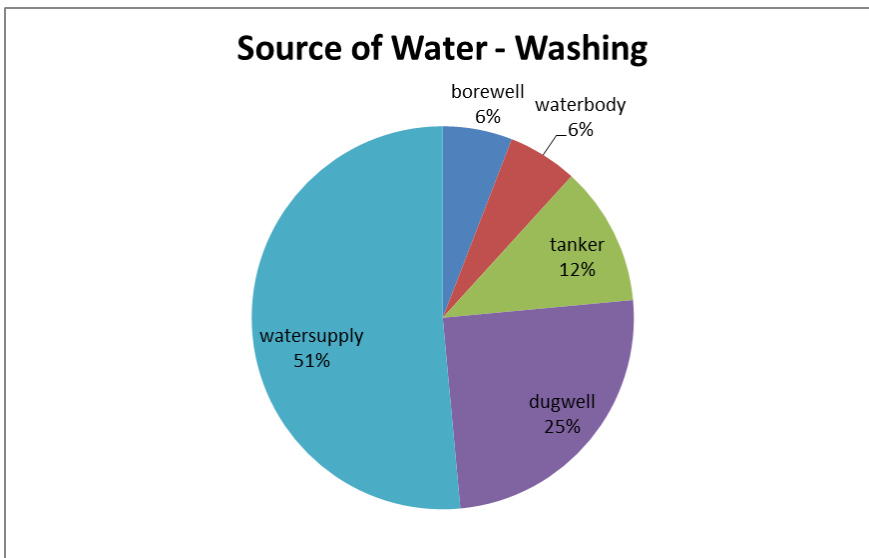


Figure 17: : Water Source for Washing in Public Institutions

More than 50% of the public institutions use the supplied tap water for washing purposes. A quarter of them use dug-well water and rest rely upon tanker, bore-well or any nearby water body.

Ground water

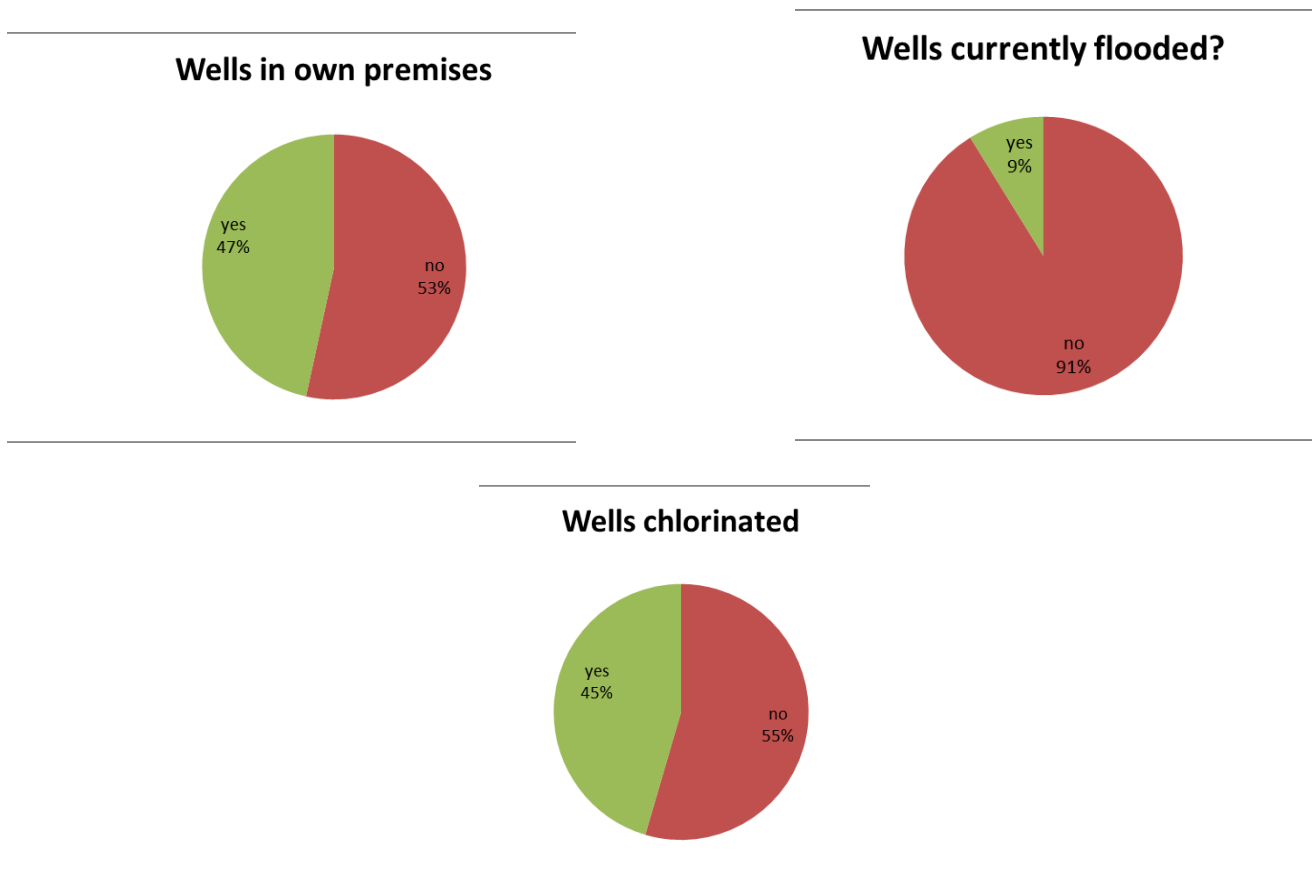


Figure 18: Wells in premises, whether flooded or chlorinated?

Less than half of the institutions had well within their premises. Out of these only about 9% of the wells were flooded currently. The chlorination has happened only in around 45% of the wells. All wells are advised to be chlorinated before they are to be used again especially for drinking or cleaning of vessels.

Sanitation

Except for 3 public institutions, institution had the toilet facilities in working condition. Also in 71% of the institutions there was a hand washing facility in working condition.

Classes of Damage

The volunteers who were available were mostly students from various engineering disciplines. Some introductory training was provided to the volunteers regarding structural assessment. The questionnaire also required that photographs of all faults such as cracks be taken. These photographs were later analysed by experts to identify buildings that require most assistance. The surveying volunteers were also asked to assess the state of the building based on their interaction and observation of the buildings.

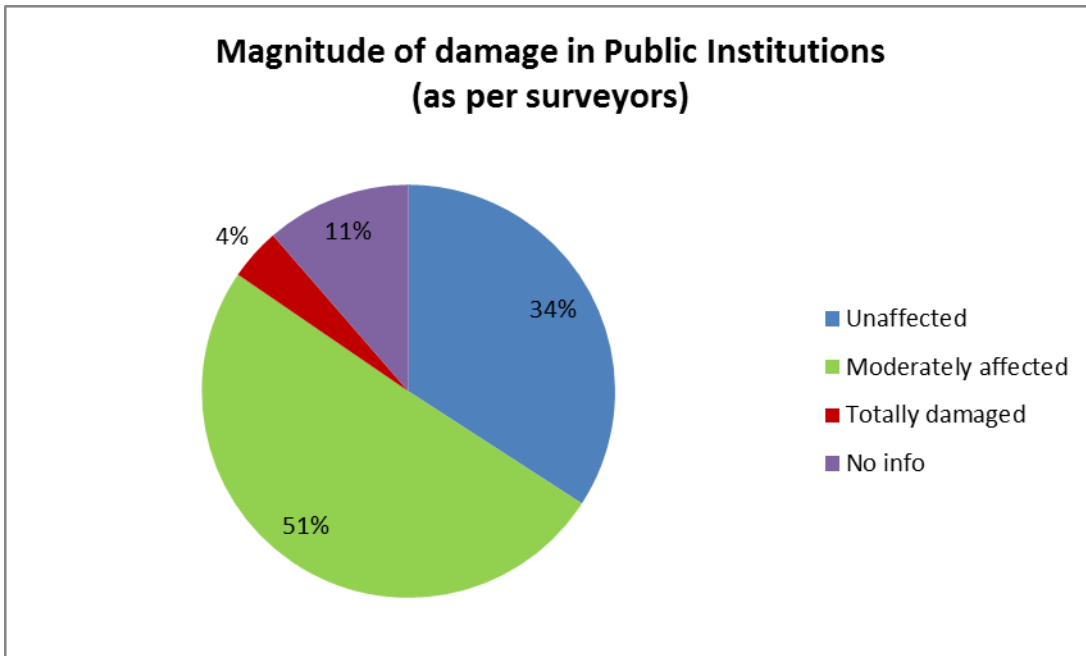


Figure 19: Magnitude of damage in public institutions

As per the surveyors, 4% of the institutional buildings were found totally damaged, while 51% were found to be moderately. Thus more than half of the institutional buildings surveyed were observed to be damaged by the surveyors. About 34% of the houses were observed to be unaffected, while no info could be gathered from the rest of the institutions as they were closed. Photos of these public institutions were shared with the experts of civil/structural engineering at IIT Bombay. 89 of these institutions in 8 panchayats were analyzed for structural damages due to floods.

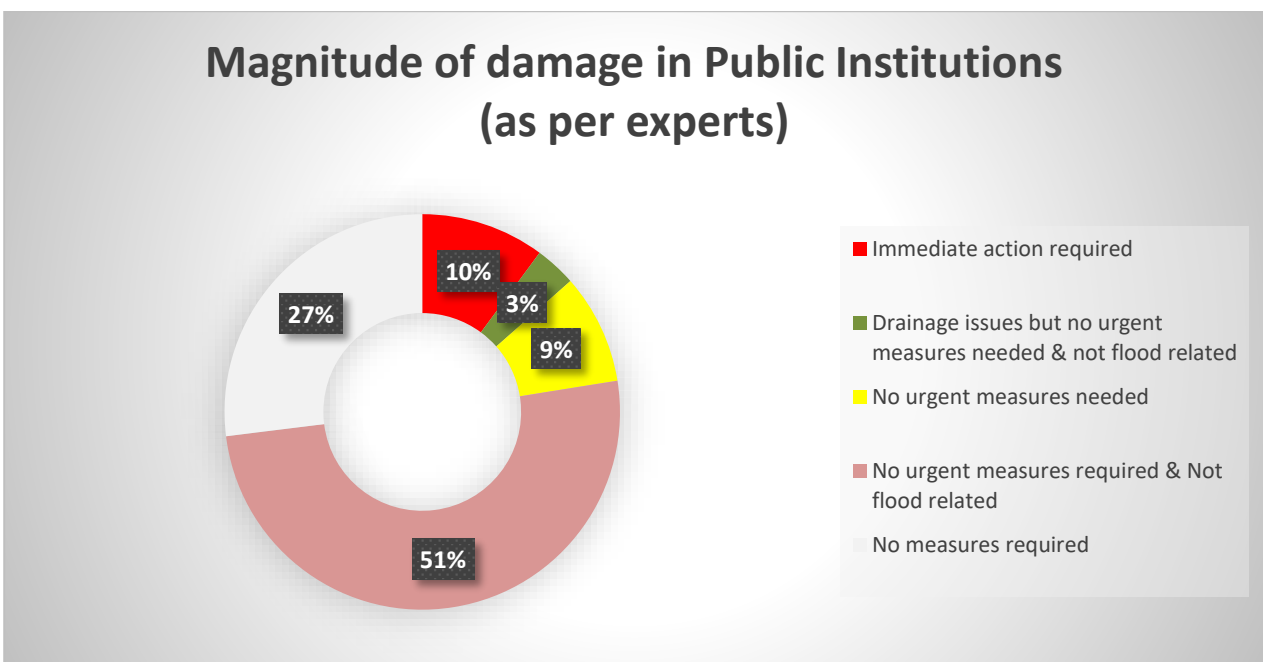


Figure 20: Magnitude of damage in public institutions by experts

The public institutions across various panchayats and the magnitude of damage:

Panchayats	Immediate action required	Drainage issues but no urgent measures needed & not flood related	No urgent measures needed	No urgent measures required & Not flood related	No measures required	Total
Karuvatta			1	3	2	6
Kavalam		1		3		4
Nedumudi		1	4		3	8
Neelamperoor	3		2	17	17	39
Pallipad	1			1	1	3
Pulinkunnu						0
Ramankary	2			9	1	12
Veeyapuram	3	1	1	12		17
Total	9	3	8	45	24	89

Table 5: Magnitude of damage by experts in various panchayats

Out of the 9 institutions which needed immediate action as found by the experts, the survey team had identified 8 of them as having moderate effect or totally damaged. In rest of the institutions, the experts could distinguish between the damages caused by the floods and the ones that were older. Based on this, the experts could categorize the magnitude into 5 different categories as in the figure above. In future such exercises, there is a need to train the surveyors how to identify the damages caused by floods as against the older ones. Although only 10% of the public institutions require immediate action, the floods could have worsened the already existing structural damages and cracks in rest 63% of buildings found to be having problems based on photos and surveys. Magnitude of Damage of Public Institutions was also plotted in QGIS for further analysis and to find if there are any clusters.

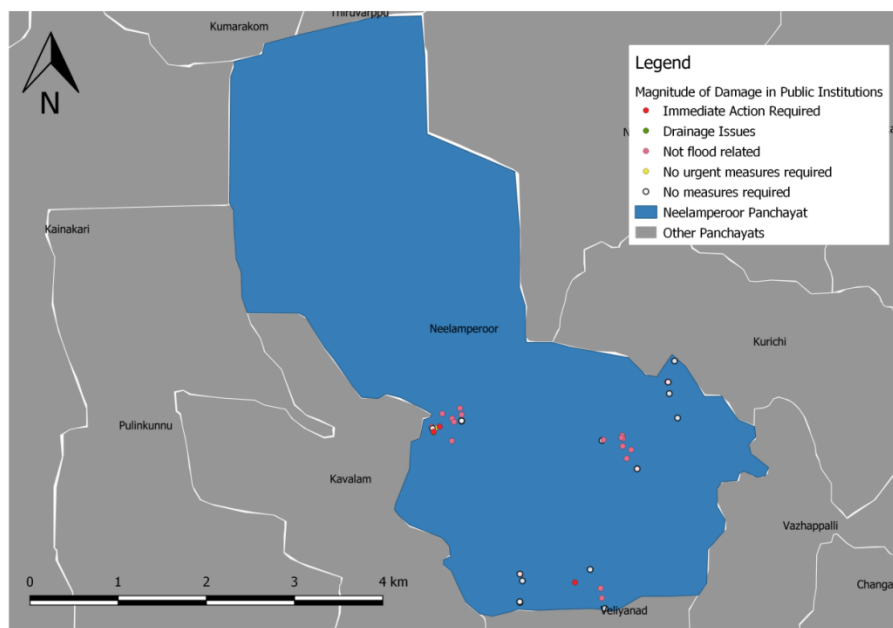


Figure 21: Magnitude of Damage in Public Institutions, Neelamperoor Panchayat

Key Observations and Recommendations

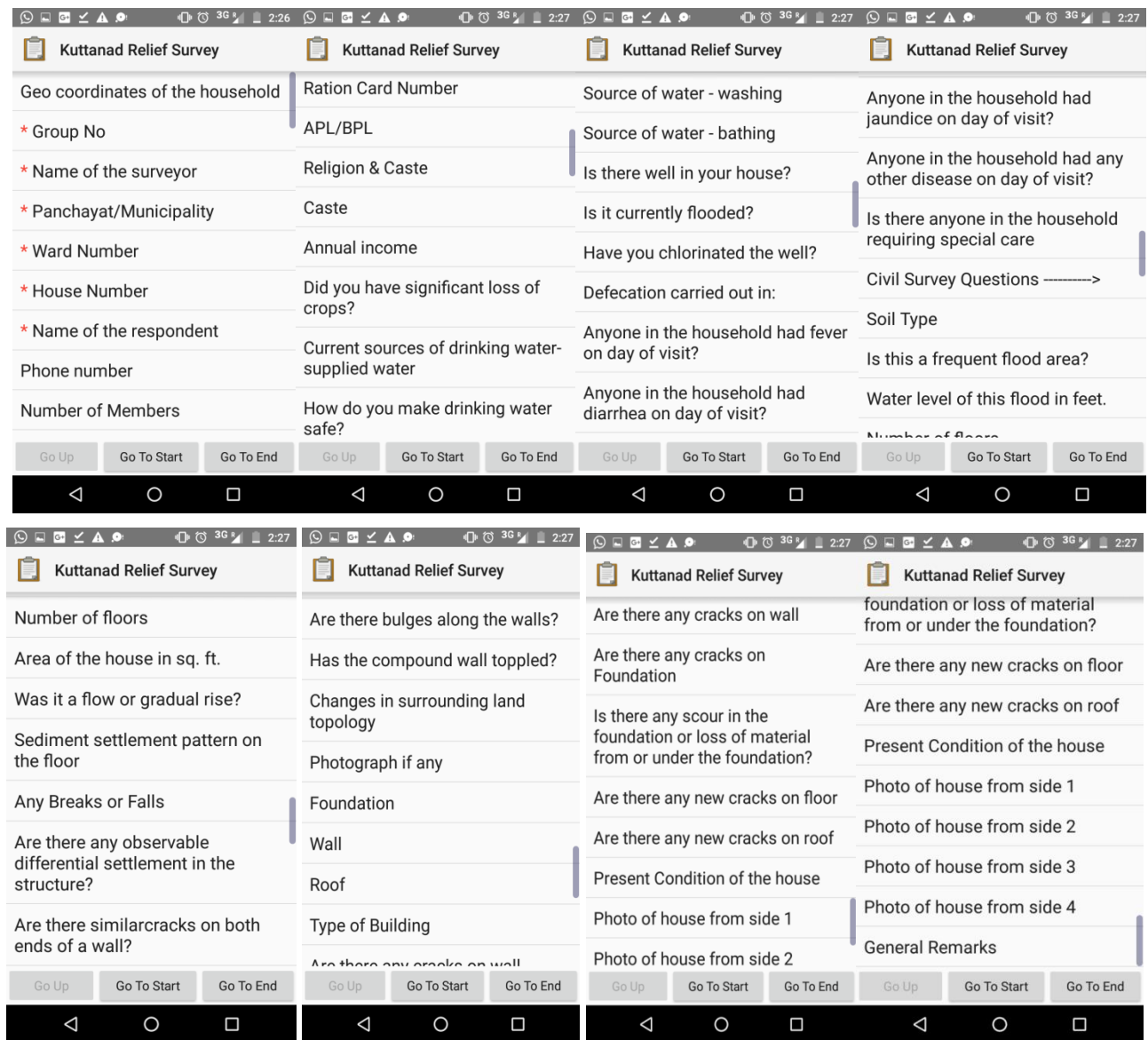
- About 10% of the public institution buildings surveyed need immediate action.
- There has been a considerable loss of infrastructure in the schools, anganwadis, primary health centres and government offices due to the floods. Along with the reconstruction work on the buildings, focus should also be to repair and buy new infrastructure for these public institutions.
- Provision of non-contaminated drinking water, toilets and basic sanitation facilities such as hand washing are to be ensured before these institutions start working. All the wells in the premises should be chlorinated, before use.
- While reconstruction and repair work of the buildings are being done, rain water harvesting structures along with tanks could be opted for ensuring water conservation in these buildings.
- Photographs can be used to remotely judge the structural integrity of buildings if the documentation is proper.
- Volunteers who are not experts can aid in the assessment process if given a basic training.

Appendices

Appendix 1: The Survey Questionnaires

The survey questionnaire was developed and data collection was done using an open source application known as Open Data Kit (ODK). Given below is the screenshot of the questionnaires from the mobile app, which were used for socio-economic surveys of households, public institutions and public health surveys:

For households:



For public institutions:

<p>Kuttanad Relief - Survey of Publ...</p> <p>Geo coordinates of the institution</p> <p>* Group No</p> <p>* Name of the surveyor</p> <p>* Panchayat/Municipality</p> <p>* Ward Number</p> <p>* Name of the institution</p> <p>Type of Institution</p> <p>Contact Phone number</p> <p>Number of People working/ studying</p> <p>Go Up Go To Start Go To End</p>	<p>Kuttanad Relief - Survey of Publ...</p> <p>Current sources of drinking water-supplied water</p> <p>Source of water - hand washing</p> <p>Is there well in the institution premises?</p> <p>Is it currently flooded?</p> <p>Have you chlorinated the well?</p> <p>Number of toilets in use</p> <p>Hand wash facilities (soap, water etc.) available?</p> <p>Go Up Go To Start Go To End</p>	<p>Kuttanad Relief - Survey of Publ...</p> <p>Any other remarks regarding water and sanitation</p> <p>Soil Type</p> <p>Is this a frequent flood area?</p> <p>Water level of this flood in feet.</p> <p>Number of floors</p> <p>Area of the institution building in sq ft.</p> <p>Was it a flow or gradual rise?</p> <p>Sediment settlement pattern on the floor</p> <p>Go Up Go To Start Go To End</p>	<p>Kuttanad Relief - Survey of Publ...</p> <p>Any Breaks or Falls</p> <p>Are there any observable differential settlement in the structure?</p> <p>Are there similarcracks on both ends of a wall?</p> <p>Are there bulges along the walls?</p> <p>Has the compound wall toppled?</p> <p>Changes in surrounding land topology</p> <p>Photograph if any</p> <p>Go Up Go To Start Go To End</p>
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<p>Kuttanad Relief - Survey of Publ...</p> <p>Foundation</p> <p>Wall</p> <p>Roof</p> <p>Type of Building</p> <p>Are there any cracks on wall</p> <p>Are there any cracks on Foundation</p> <p>Is there any scour in the foundation or loss of material from or under the foundation?</p> <p>Are there any new cracks on floor</p> <p>Go Up Go To Start Go To End</p>	<p>Kuttanad Relief - Survey of Publ...</p> <p>building</p> <p>Photo of institution building from side 1</p> <p>Photo of institution building from side 2</p> <p>Photo of institution building from side 3</p> <p>Photo of institution building from side 4</p> <p>Degree of Damage of the Institution</p> <p>General Remarks</p> <p>Go Up Go To Start Go To End</p>
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For public health survey:

<p>Disease_Mapping</p> <p>* Group Number</p> <p>Name of the Panchayath</p> <p>WARD NUMBER</p> <p>Location</p> <p>Name of the House</p> <p>House Number</p> <p>Num of house owner</p> <p>Contact Number</p> <p>Does anyone having fever at home today?</p> <p>Go Up Go To Start Go To End</p>	<p>Disease_Mapping</p> <p>Does anyone having diarrhea at home today?</p> <p>Does anyone having fever & diarrhea at home today?</p> <p>Do you have any of the following diseases?</p> <p>The following treatments have been disrupted due to flood</p> <p>Drugs for long-term illnesses have come down due to flood?</p> <p>any Bedridden Patient in your home?</p> <p>Go Up Go To Start Go To End</p>	<p>Disease_Mapping</p> <p>Have you lost the following</p> <p>Nearest primary health center of patient</p> <p>Is doxycycline available</p> <p>Did You have doxycycline tablet</p> <p>On what basis is mapping done</p> <p>Water level in meter</p> <p>Photo of the place where the water level is measured</p> <p>Other details</p> <p>Go Up Go To Start Go To End</p>
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Appendix 2:

Format used for the Structural damage Analysis

Preliminary Assessment by IIT Bombay - Exclusively Based on Photographs Provided

Mi – Minor; Mo- Moderate; Ma – Major; CW – Crack on Wall, FD – Floor Damage; S1 to S4 – Sides of building

	Buil. No & Village/ Panchayat	Foundation			Flooring			Walls			Framed structure (Beam/ Column)			Roof			Recom mendati on	Remark s
		Mi	M o	Ma	Mi	M o	Ma	Mi	Mo	Ma	Mi	Mo	Ma	Mi	Mo	Ma		
	1KV- CW; Karuvatta				X			X									Groutin g of wall cracks & floor repairs	*No urgent measure s needed ** not flood related
	1KV- FD; Karuvatta				X												Groutin g of cracks & floor repairs	*No urgent measure s needed ** not flood related
	1KV- S1, S2, S3, S4; Karuvatta							X									Groutin g of wall cracks, Provide drainag e	*No urgent measure s needed ** not flood related *** Dra inage major issue
	2KV- S1; Karuvatta																	*No issues seen

Appendix 3: List of Volunteers who had registered for the survey as part of Operation Rehabilitation.

Name	Volunteer ID
AASHIQ S	KRL180826 051942
ABDUL BARI	KRL180825 174018
ABDUL HASEEB NP	KRL180826 062143
ABDUL RAHEEM	KRL180826 073830
ABDUL RAHMAN	KRL180826 041308
ABDUL SALAM U	KRL180825 050915
ABDUL VAZI	KRL180825 101940
ABDULLAH HASIM	KRL180826 060116
ABHIJITH LAL K S	KRL180825 091715
ABIJITH T S	KRL180825 181743
ABIN JESUS	KRL180825 042733
ABIN SILVEN	KRL180825 123045
ABISHEK BABY	KRL180825 172742
ABYGANESH	KRL180825 090019
ADARSH	KRL180824 153128
ADARSH BG	KRL180825 193916
ADERSH PB	KRL180826 072547
ADHARSH CH	KRL180825 153732
ADHIL ALIF MEERAN	KRL180825 125335
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References

- Chandy, J. (2013) Economics and environmental dimensions of backwater resources in Kerala A study with special reference to Kuttanad region. *PhD Thesis*. Mahatma Gandhi University. <http://hdl.handle.net/10603/19587>
- Kerala Sastra Sahitya Parishad (KSSP), 1978. Problems of Kuttanad -A study report:. (in Malayalam).
- Kerala State Disaster Management Authority (KSDMA), n.d. Kerala State Disaster Management Plan Profile.
- Nandakumar, T. (2014). Four districts categorised as climate change hotspots. *The Hindu*. [online] Available at: <https://www.thehindu.com/news/national/kerala/four-districts-categorised-as-climate-change-hotspots/article5801125.ece> [Accessed 7 Sep. 2018].
- Narayanan, S.P., Thomas, A.P. and Sreekumar, B., 2011. Ornithofauna and its conservation in the Kuttanad wetlands, southern portion of Vembanad-Kole Ramsar site, India. *Journal of Threatened Taxa*, 3(4), pp.1663-1676.
- National Disaster Management Authority (NDMA), 2010. National Disaster Management Guidelines – Management of Floods.
- Padmakumar, K.G., 2013. Kuttanad-Global Agricultural Heritage: Promoting Uniqueness. *Proceeding of Kerala Environ. Cong.*, pp.62-72.
- Census of India, (2011). *District Census Handbook, Alappuzha*. Directorate of census Operation, Kerala. Available at <http://censusindia.gov.in/2011census/dchb/3211_PART_B_ALAPPUZHA.pdf>