

# Operation Rehabilitation Drive

## Rapid flood impact assessment in Kuttanad region



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**WORKING PAPER - 3**

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**This is part of a Working Paper series that came out of studies and action done by CANALPY, an initiative of the collaboration between Indian Institute of Technology, Bombay and the Kerala Institute of Local Administration.**

The major aim of CANALPY is the rejuvenation of canals through decentralised and participatory social and technological interventions. There have been two academic initiatives so far - a Winter School during November 2017 involving 36 students and a Summer School during May 2018 with 300+ students. Through a decentralised data collection process of the water and sanitation practices of Alappuzha, CANALPY was able to identify solid and liquid waste pollution in the sub-canals as the major impediment to the health of the canal system.

The floods of 2018 were an unprecedented event in recent Kerala history, affecting nearly all regions of the state. Kuttanad, a biogeographic region to the south-east of Alappuzha was one of the hardest hit owing to several socioeconomic and geographic factors. The CANALPY team quickly sprung into action after the flood, deploying a student body to carry out a rapid flood impact assessment. This report contains the findings from that assessment.

These are abridged versions of the larger reports. The academic reports may be downloaded freely from the CANALPY website, [www.canalpy.com](http://www.canalpy.com)

**Working papers in this series:**

1. Preliminary water and sanitation assessment for Alappuzha Town.
2. Comprehensive water and sanitation assessment for Alappuzha Town.
3. Rapid flood impact assessment in Kuttanad region.
4. Town level assessment of major polluters and pollutants in Alappuzha Town.

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# CONTENTS

<b>Acknowledgements</b>	3
<b>Abstract</b>	6
<b>1. Introduction</b>	6
<b>2. Objective of Canalpy in Operation Rehabilitation Drive</b>	7
<b>3. Approach &amp; Methodology</b>	8
<b>4. Execution</b>	9
4.1 Socio-economic survey of households:	9
4.1.1 Socio-Economic Survey Analysis	9
4.2 Structural damage analysis of houses:	11
4.3 Survey of public institutions:	13
4.4 Water and sanitation services in public institution	14
4.5 Damage analysis	14
<b>5. Recommendations</b>	15
<b>References/Bibliography</b>	15

## TABLE OF ACRONYMS

<b>Acronym</b>	<b>Definition</b>
APL	Above Poverty Line
BPL	Below Poverty Line
CPS	Centre for Policy Studies
CTARA	Centre for Technological Alternatives in Rural Areas
CUCEK	Cochin University College of Engineering Kuttanad
GIS	Geographical Information System
IIT	Indian Institute of Technology
IMD	Indian Meteorological Department
KILA	Kerala Institute of Local Administration
NDMA	National Disaster Management Authority
ODK	Open Data Kit
OSM	Open Street Map
QGIS	Quantum Geographical Information System
TKM	Thangal Kunju Musaliar
UNICEF	United Nations Children's Fund
WSS	Water Supply & Sanitation

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analyze the state of buildings through photographs and provide expert suggestions and remarks of close to 1000 buildings. This analysis helped in deciding the structural damages of the buildings which forms a key part of this report. Mr. Banku Bihari Sarkar of United Nations Children's Fund (UNICEF) and his team gave their valuable knowledge of working in disasters and were instrumental in making us survey the damages in Public Institutions as well during this assessment. We are also grateful to the guidance, contribution in training and support during the survey by Beena Kuttiparambil of UNICEF Thailand who became part of us as a volunteer. We thank Prof. Satish Agnihotri, Head, Centre for Policy Studies (CPS) and CTARA, IIT Bombay for his support right from the early days of our activities in Alappuzha. We also thank colleagues and staff of CTARA, IIT Bombay and KILA for their help and support. Last but the most important, we share our heartfelt gratitude to the people of Kuttanad who were kind enough to answer the survey questions despite the shock and sadness of the disaster which has struck them. We salute the grit and determination of each one of them who have been affected due to the 2018 Kerala disasters and wish that this study could be of some help in rebuilding their lives.

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**Prof NC Narayanan, IIT Bombay**

**Dr.Joy Elamon, KILA**

# **Operation Rehabilitation Drive: Rapid Flood Impact Assessment in Kuttanad Region**

## **ABSTRACT**

Kerala was hit by extremely heavy rain during the month of August 2018 which led to heavy flooding in a majority of the state. However, Kuttanad, a biogeographic region to the southeast of Alappuzha had already been affected by flooding in the month of July itself. When the floods of August struck, Kuttanad which had barely recovered from the floods of the previous month was affected again. Post flood, while volunteer action had been exemplary in rescue and rehabilitation efforts, impact assessment of the flood on the infrastructure and services was found lacking and the window to execute it was very short.

CANALPY, an initiative of the collaboration between Indian Institute of Technology, Bombay and the Kerala Institute of Local Administration, which had already been a part of water and sanitation related activities in Alappuzha, was able to take initiative in this. Relying upon the social capital already built up, the CANALPY team was able to quickly mobilise a volunteer team to be a part of the rescue and relief activities. In addition to this, a student team was also mobilised to carry out a flood impact assessment. Questionnaires were prepared to carry out surveys on socio economic parameters, structural damage analysis of households and public institutions, the impact of flood on water, sanitation services and public health in various panchayats of Kuttanad. The data collected was then shared with a team of experts for analysis and to recommend suitable paths ahead. Despite lack of expertise and minimal training, we find there was a reasonable degree of consistency between volunteer observations and expert findings of structural damages. Open source tools such as Open Data Kit (ODK), QGIS (Quantum GIS), OSM Tracker (Open Street Maps) were used for this assessment.

## **1. 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). In the year 2018, the India Meteorological Department (IMD) had issued an extremely heavy rain (over 210 mm) warning to the state ahead of the monsoon onset. The



Kerala State Disaster Management Authority (KSDMA) 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 rare. Though no one reason can be pinpointed 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), 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.

CANALPY (Read as CanAlleppey) had a great role to play in the assessment of the impact of flood in Kuttanad Region. Kuttanad being one of the lowest lying regions of the country, the impact of rains always affects the area drastically. The 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. The details of the drive and the outcomes of the move are described in detail here.

## **2. OBJECTIVE OF CANALPY IN OPERATION REHABILITATION DRIVE**

The team planned various surveys to assess the structural damage to houses and public institutions, the impact of floods on water, sanitation services and public health in the various panchayat of Kuttanad.

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.

### **3. APPROACH & METHODOLOGY**

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). 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 during rescue and relief activities as well as to do the design, training and monitoring questionnaire surveys for the impact assessment. The local team mapped the relief camps, which was helpful in assigning volunteers, managing the relief materials and planning access to these relief camps, many of them being remotely located.

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 a 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.

2200 households were surveyed across 14 panchayats in Kuttanad region out of which 58% were BPL households. The key features of the survey include:

- a) Usage of Open Data Kit (ODK), a free and open source online application, to design the questionnaire and collect data.
- b) 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.
- c) Recording photos of damages inside the houses as well as in all the four sides of the house for assessing the damage caused by floods through further analysis by experts.

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.

## **4. EXECUTION**

### **4.1 SOCIO-ECONOMIC SURVEY OF HOUSEHOLDS:**

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 during the Operation Rehabilitation Drive, when the people were returning to their flood hit homes from the relief camps. 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, 2018. The survey happened in conjunction with the Kuttanad cleanup operations carried out by the government.

The socio economic survey consisted of questions related to average flood level, a primary health survey conducted to ascertain the presence of any diseases in those surveyed, identification of common patterns of water usage and a few basic questions related to hygiene and toilet availability.

#### **4.1.1 Socio-Economic Survey Analysis**

##### **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 into their houses as opposed to gradually rising. Crop losses were reported by 580 households, with almost equal numbers of households in Above Poverty Line (APL) and Below Poverty Line (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 were multi-storeyed.

### **Health**

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 as 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 the APL category. Few households are relying on open spaces for defecation and use of bio-toilets or public toilets are very limited. Crop losses were found in about one-fourth of the households surveyed.

### **Water**

In the post flood scenario, understanding water usage patterns is important as interventions at 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% of the households were depending upon 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.

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 access to 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 for defecation constituted over 7% of those in BPL category while the corresponding percentage in APL category was 2%.



*Figure 1 Socio-economic survey of households*

#### **4.2 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.



*Figure 2 Structural Damage Analysis of Houses*

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 are important to remotely judge the structural integrity of houses if they are documented to the extent as achieved in 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. The details of magnitude of damage of houses across panchayats based on analysis by experts is available in the Operation Rehabilitation drive-2018 report, available from the CANALPY website.

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.

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 for further analysis and if complete household coverage is achieved, it can find clusters of damage.

### **4.3 SURVEY OF PUBLIC INSTITUTIONS:**

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. The details of the number and type of public institutions surveyed are available in the comprehensive report of operation rehabilitation drive.

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 more during the flooding and hence they need to be addressed as well.



*Figure 3 Structural damage analysis of public institutions*

#### **4.4 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 other local water sources need to be chlorinated. About 19% public institutions rely upon bottled water. These public institutions when rebuilt, there should be focus on rain water harvesting structures with tanks so that they attain water sustainability. More than 50% of the public institutions use the supplied tap water for washing purposes. A quarter of them use dug-well water and the rest rely upon tanker, bore-well or any nearby water body. 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 by the health authorities before they are to be used again especially for drinking or cleaning of vessels. Except for 3 public institutions, all other institutions had the toilet facilities in working condition. Also in 71% of the institutions there was a hand washing facility in working condition.

#### **4.5 DAMAGE ANALYSIS**

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.

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. Among the 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. More details of the magnitude of damage analysis and categorisation are available in report of operation rehabilitation drive .



## 5. 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 basic training.
- With climate change looming large like never before in vulnerable regions like that of Kuttanad, there is a need to focus on building the adaptation capabilities of the people. Various institutions need to pool in their strengths, come together and work along with the people to come up with solutions which can help the region survive the impacts of climate change, especially in the aftermath of 2018 Kerala floods. There is a need to focus on creation of local level quality data, which can play an important role in facilitating such collaborations.

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