Kerala Flood 2018 and the Socio-Economic Deprivation of Households in Alappuzha District

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Abstract

Kerala faced unforeseen floods in August 2018, which simultaneously affected natural and human resources. The impact of floods on households, particularly in the coastal area of the Alappuzha district, was very high. The main focus of this paper is to assess the socioeconomic deprivation of households in the Pampa River basin of the Pandanad panchayat of Alappuzha district. This study discusses the causes and effects of the flood and the unique recovery strategy of the state. The socio-economic deprivation index of flood-affected households is estimated by taking the arithmetic mean of the three indices, such as the health domain index (HDI), the economic domain index (EDI), and the standard of living index (SDI). Each dimension is calculated based on the general formula that UNDP used to calculate the Human Development Index. This empirical study found that most of the households in the study area have come in the high socio-economic deprivation category in the post-flood scenario.

Keywords: *Kerala flood 2018, PARIRAKSHA project, Disaster, Flood recovery strategy of Kerala, Socio-Economic Deprivation, Deprivation index*

1. Introduction

Globally, flooding is the most dangerous disaster for economic loss and human fatalities. During the last decade of the 20th century, floods washed out 100,00 lives and impacted more than 1.4 billion people (Jonakman, 2005). A study by Parvin et al. (2016) among the rural poor in Bangladesh, reveals that the floods increase their vulnerability leading to joblessness and depletion of their income and resources. Khayyam (2020)

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surveyed the northwest region of Pakistan and found that floods significantly impact the economic and livelihood impact of the rural poor. The flood destroyed their agriculture and livestock, which led them into poverty syndrome by washing out their savings and forcing them to borrow money.

The causes behind floods are heavy rainfall in the monsoon period, cyclones, cloud bursting, tsunamis, outbursts of glacial lakes, urbanisation, unauthorised construction, river bank erosion, sedimentation of channel beds, inefficient rivers, reservoirs, and drainage management (Tripathi, 2015; Mohanty et al., 2020; Parida, 2020). Floods have both social and economic impacts, such as the loss of people's lives, private and public property damage and agricultural land and crop destruction (Parida, 2020).

Floods constitute 84% of fatalities among India's 10 most significant disasters from 2005 to 2014. Riverine floods are the most common type of floods in India, followed by flash floods and coastal floods (Tripathi, 2015). Socio-hydro climatological variables complicate flood control in India by affecting the severity and frequency of flood occurrences. Factors like climate change, rising sea levels, and socioeconomic dynamics hamper flood management, resulting in significant socioeconomic losses and fatalities, despite substantial expenditure and ongoing flood-control initiatives throughout the nation (Mohanty et al., 2020). The central and state governments relationship is crucial for effective disaster management and economic development, as it enhances the efficiency of funding and support during disasters (Parida, 2020).

Recently the occurrence of floods is common across India (Narayanan, 2022), particularly in Kerala. After a hundred years, Kerala experienced a severe flood in 2018. In 2019 also, the state witnessed a flood that affected 1038 villages from 13 districts, 21264 houses were fully or severely damaged, and 125 people lost their lives (Kerala State Disaster Management Authority, 2019). Flood is a common phenomenon in coastal areas of the Alappuzha district of Kerala due to its topographical structure and people adapted to some extent (Santhi & Veerakumaran, 2019). However, the 2018 flood is unexpected and affects other parts of the state. The socioeconomic deprivation of people is entirely different as compared to the usual one. This paper tried to analyse the socio-economic deprivation of households in Pandanad panchayat of the Alappuzha district in the context of the Kerala flood of 2018.

According to the Global Data Lab of Radboud University (2021), the state had the highest HDI of 0.782 in 2019, comparable to developed countries. The socio-economic characteristics such as health, education, and living standards helped the state achieve this top position. The Kerala flood of 2018 severely threatened the state's socio-economic and human development. That led Kerala into a socially and economically worse situation. Human deprivation is a lack of human capabilities, opportunities, choices, values, and basic needs such as food, shelter, education, clothing, health etc. (Sivakumar & Sarvalingam, 2010). Natural disasters like floods severely impact these variables, indispensable to human development. Hence, it is necessary to assess the changes in the socio-economic variables and the level of deprivation to develop suitable policies to overcome the future impact of floods.

The paper is organised into different sections. The second section explained the data and research methods of the study. It is followed by the analysis of socio-economic effects, government actions, and the recovery strategies of the state of Kerala flood in 2018. The final section concludes the whole study with policy recommendations.

2. Data and Methods

Among the 14 districts of Kerala, Alappuzha (popularly known as Alleppey) district is the smallest in terms of geographical area. The district's geographical speciality is that it lies on the coastal plain of the Arabian Sea and is the only district without forest cover. Kuttand, renowned as the 'Rice Bowl of Kerala,' is situated in this district and is the only location globally where farming occurs up to two meters below sea level. The state has two monsoon seasons: namely, southwest monsoon from June to September and northeast monsoon from October to November. Alleppey is renowned globally for its water tourism. The word 'Alappuzha' consists of two words: 'ala' and 'puzha'. In Malayalam, 'ala' means broad and 'puzha' means river. Due to the extensive network of canals and backwaters, this district is known as 'the Venice of the East'. The existence of rivers, lakes and other aquatic bodies makes the region the most susceptible to flooding in the state (District Disaster Management Authority, Alappuzha, 2015).

The rivers flowing through Alappuzha district are Pampa, Manimala, and Achankovil. The Thottappilly Spillway in Vembanad Lake receives water from these rivers. Furthermore, of all the principal rivers, only the Pampa River is regulated

by the Kakki dam. The Pampa River, Kerala's third longest river, enters Alappuzha at Chengannur taluk and travels through Pandanad, Veeyapuram, Thakazhi, and Champakulam regions over a distance of about 177.08 km, and culminates in Vembanad Lake via multiple branches (District Disaster Management Authority, Alappuzha, 2015; Santhi & Veerakumaran, 2019).

Both primary and secondary data were used for the study. An extensive household survey was conducted in Pandanad panchayat, a rural local body, in the Chengannur taluk of Alappuzha district to gather primary data. A significant portion of the Pandanad panchayat is located on the banks of the Pampa River. Agriculture is the main economic activity in this area. Therefore, climate change significantly influences the livelihood of the people. The total area of the panchayat is 10.45 cm^2, and the density of the population is 1276.74. The total number of households is 4285, having a population of 13342. In this study, the flood-affected households were the sampling units. Among the 13 wards in Pandanad panchayat, the most flood-affected area, ward number two, was selected for the household survey. This ward is situated along the banks of the River Pampa, and all the households inside it were impacted by the floods. The strategy of selecting households at regular intervals was deemed a more effective approach in this context. Out of the 349 households in ward number two, 50 were selected through systematic sampling.

Secondary data were collected from the Post Disaster Needs Assessment conducted by UN agencies and various government reports from the Central Water Commission, Ministry of Earth Science, and Kerala State Disaster Management Authority.

Floods resulted in the loss of materials, money and lives, which directly affected socioeconomic deprivation. Deprivation of the households is assessed based on the socio-economic conditions of the households in connection with floods. The significant variables used in this study were loss of materials such as food grains, home appliances, vital documents, vehicles, jewellery, cash, agricultural products, and poultry, damage to houses and wells, sources of drinking water, occupation before and after the flood, income, health expenditure, the amount spent to clean the house after the flood, financial aid from the government and satisfaction level. A few variables are

used from the questionnaire on the Eviction Impact Assessment Tool developed by the Housing and Land Rights Network, which is based on the UN Basic Principles and Guidelines on Development-Based Evictions and Displacement (2007).

In the context of the measurement of socioeconomic deprivation, the Human Development Index (HDI) is considered the primary key indicator. The three dimensions of the deprivation index include health, economic domain, and standard of living (Pampalon & Raymond, 2000; Sivakumar & Sarvalingam, 2010; Lamnisos et al., 2019; Kiran, 2021). Here health aspects are measured through mental and physical health; economic dimensions through income and livelihood of the household; and standard of living through drinking water, housing, electricity, and assets.

The general formula used by the UNDP for calculating human development is used to calculate each deprivation index (United Nations, 2021). As such

$$\text{Deprivation Index} = \frac{\text{(actual value-minimum value)}}{\text{(maximum value-minimum value)}}$$

For getting the indices such as health domain index (HDI), economic domain index (EDI) and standard of living index (SDI), the arithmetic mean of variables under each dimension is calculated. Then for the socio-economic deprivation index (SEDI), the arithmetic mean of the three is calculated. That is,

$$\text{SEDI} = \frac{\text{(HDI+EDI+SDI)}}{3}$$

The values range from 0 to 1, where 0 means the lowest and 1 means the highest deprivation. High, low, and medium values are below 0.33, 0.34 to 0.66, and 0.67 to 1, respectively.

3. The Kerala Flood 2018

In 1907 the state of Kerala witnessed the highest rainfall. Till August 2, the rainfall has been 780 mm which was 150 per cent higher than the normal average. Kerala experienced the highest rainfall in 1924 (3368 mm), whichever happened before.

Almost all parts of Kerala were flooded due to the high rainfall and more than 1000 people died (Khelkar, 2018; Kondapally et al., 2020). After 1924, Kerala experienced the

worst flood in August 2018. This is because of the rains that have been halted for days. The rainfall in Kerala is controlled by southwest and northeast monsoons. The annual average rainfall in Kerala was 3000 mm (Central Water Commission, 2018). According to Indian Meteorological Department data (2018), from 1st June 2018 to 19th August 2018, Kerala received 2346.6 mm of rainfall instead of the expected 1649.5 mm. The rainfall over Kerala during June, July, and 1st to 19th of August was 15%, 18% and 164%, respectively, above the normal average. The state possesses 57 large dams. Major reservoirs in Kerala had above 90 per cent of their capacity in August 2018 (Shaharban & Rathnakaran, 2019). Hence, the release of water from reservoirs was essential. On August 15th, most reservoirs became near total capacity and 37 dams were opened (Government of India, 2018; Kondapally et al., 2020).

3.1 Causes of the Flood

The primary causes behind the Kerala flood of 2018 can be divided into natural causes and anthropogenic causes. The natural factors that influenced the flood were the low-pressure system which formed in the Bay of Bengal (Hunt & Menon, 2020), landslides, climate change and global warming (Kumar et al., 2020; Vanamaet al., 2021). The anthropogenic causes were inefficient dam management (Kondapally et al., 2020; Sudheer et al., 2019), extensive quarrying and mining in the Western Ghats, illegal encroachment of forest land, developmental activities on the ecologically sensitive zones as part of tourism, absence of proper drainage system and unscientific use of land (Central Water Commission, 2018; Government of Kerala, 2018; Sudheer et al., 2019). Excessive human encroachments in ecologically sensitive areas like the Western Ghats worsened the situation. The Gadgil report (Government of India, 2011) highlighted that many reservoirs, especially in the steep valleys, are silting up prematurely due to the massive encroachment and deforestation of catchments consequent to dam construction. This report warned about landslides from the ecologically sensitive areas in the Western Ghats due to the increased mining and quarrying.

The Special Centre for Disaster Research of Jawaharlal Nehru University submitted a report citing heavy rainfall, inefficient dam management, environmental degradation, infrastructural development, and a lack of preparedness as the causes of the 2018 Kerala flood. This report criticised the performance of the Kerala State Disaster

Management Authority (KSDMA) on several grounds. The KSDMA was found to have failed to ensure effective coordination and communication among various departments, failed to update disaster management plans on time, had a poorly functioning early warning system, and the fund utilisation was also not effective. This report also criticised the state government for neglecting the recommendations of the Gadgil's report. The government focused more on profit-making through electricity generation than the safety of the people in dam management (Singh et al., 2018).

3.2 Socio-economic Effects of the Kerala Flood 2018

The unexpected flood and landslides in Kerala affected 5.4 million people, 2 million people were displaced, and more than 400 people lost their lives. The non-stopped torrential rainfall leads to 341 landslides in this small state. The worst affected districts were Idukki, Wayanad, Ernakulam, Alappuzha, Kottayam, Pathanamthitta, and Thrissur. Due to the flood, close to 14 lakh people evacuated to relief camps as their homes were flooded. According to the post-disaster needs assessment, the entire economic loss from the 2018 flood was 26,720 crores of rupees (Government of Kerala, 2018).

Natural disasters have diverse economic impacts across economic sectors depending on the disaster type and intensity (Panwar & Sen., 2019). The flood and landslides caused severe damage to houses, and infrastructural facilities like bridges, railways, roads, communication networks and power supplies. About 13,362 houses were fully damaged; more than one lakh houses were severely damaged. Nearly 25 lakhs of electricity connections were disrupted. More than 300 bridges and approximately 50,000-kilometre roads collapsed. Access to drinking water was disrupted for 20% of the state's population. Around 3,17,000 shallow wells and over 95,000 latrines were substantially damaged. In the case of the agricultural sector, about 59,345.37 hectares of crops and livestock were washed away, and 3 lakh farmers were affected. The total agricultural loss exceeded 1300 crores of rupees. Many private properties, including business units, shops, showrooms, vehicles, schools and hospitals, were damaged. The primary workforce in Kerala, such as agricultural labourers, construction workers and workers in micro, small and medium enterprises, had a wage loss of 45 days or more (Government of Kerala, 2018).

Over 1.75 lakh buildings have been damaged either fully or partially. The households in the affected area lose their electronics, clothes, utensils, beds, certificates, property documents and other valuable things within hours. The children lose their study materials, bags, and uniforms. Students from classes X and XII are anxious due to the loss of books and notes, which may affect their learning. Owing to the loss of families, friends, neighbourhoods and properties, many people faced trauma and stress. The houses, vehicles, jewellery etc., are the result of many years of hard work for each one of them. Workers from the informal sector were the worst affected victims of the flood. Households are the major consumption unit and a source of savings as far as an economy is concerned. The flood slows the economy for over a month (Government of Kerala, 2018).

3.3 Immediate Action Taken by the Government

The state government of Kerala immediately responded to the situation with rescue operations. The mobilisation of forces such as the Coast Guard, National Disaster Response Force, Kerala Fire and Rescue Services, Army, Navy, Air Force, Central Reserve Police Force, Border Security Force, and fishing community of the state saved many lives. About 15 lakh people have been moved to camps and relatives' houses. More than 1700 schools, worship centres, colleges, and other institutions were used as relief camps. More than 10000 camps were opened (Government of Kerala, 2018).

The people of Kerala have overcome the unexpected natural calamity with perfect determination. The Kerala youth restlessly worked for the rescue of flood victims without any discrimination in the form of religion, caste, wealth and politics. To disseminate government instructions and speed up rescue operations, social media played an important role. The fishermen in Kerala deserve special gratitude for their timely intervention in rescuing those trapped in flooded areas (Government of Kerala, 2018). The army's rescue team could not reach all flood-affected locations, particularly in river basins, due to the overflowing of floodwater, whirlpools, large trees, and large walls. However, the fishermen overcame these challenges to rescue the lives of children, pregnant women, and the elderly. Because of these courageous actions, the Chief Minister of Kerala described the fishermen as the 'Army of Kerala'(Dhanya, 2019).

3.4 Recovery Strategy of the State

Under the guidance of the state and the local government institutions, other organisations and civil society, Kerala conducted a massive drive to clean flood-affected houses and wells and supply essential commodities and medicines. Various organisations and individuals helped the flood victims clean their houses to ensure basic needs like water, food grains, clothing, medicines, footwear etc. About 6,93,287 mud-coughed houses were cleaned, and about 14,657 dead bodies of the creatures were buried. About 25 lakhs of power supply connections were restored quickly (Government of Kerala, 2018).

The floodwaters contained sewage, dead bodies of birds and animals, and other contaminants, which increased the risk of infectious diseases. Nonetheless, no contagious diseases were reported in Kerala. However, the fact that no epidemics have been detected in Kerala due to this flood has astounded the entire world. This resulted from the door-to-door work of the efficient health workers in Kerala (Venu, 2019).

The central government, foreign countries, non-residential Indians, film stars, business people, various organisations, and many individuals, especially ordinary citizens, contributed to the chief minister's relief fund (Thummarukudy, 2019). This support helped the government to speed up post-flood relief activities.

The government of Kerala provides immediate relief in cash and kind. About 7,37,484 flood-affected families received 10,000 rupees immediately as financial support. The state also allow an additional 5000 rupees to SC/ ST families. The government provided financial aid to damaged houses in Kerala. Households from the economically backward class received food grains for three months through supply co. The authorities ensured interest-free loans up to rupees 1 lakh through Kudumbasree to the flood affected to refurbish their houses. The flood victims also got relaxation to pay the electricity bill for four months. The labourers included in the Mahatma Gandhi Rural Employment Guarantee Scheme got extra working days of 150 days. About three lakh farmers in flood-affected areas benefited from 200 crores of rupees as financial support against losing their crops. Around 21.70 crores of rupees were given to 27363 families who lost their animals in the flood (Government of Kerala, 2018). Furthermore, the government immediately provided duplicate certificates, property documents, ration cards, and identity cards to those who had misplaced them (Venu, 2019).

The psychological impact of the 2018 flood on the people of Kerala was crucial. The unexpected flood spontaneously washed out their relatives, friends, neighbours, animals, land, buildings, vital documents and other earnings of a lifetime. Hence, to recover the flood victims from the mental shock, the state government introduced a project known as "PARIRAKSHA". This project was designed to support flood-affected people, especially low-income people. The main focus of this project is to reduce the long-term psychological impact of the disaster. This project covered two million people from 93 severely flood-affected panchayats in Kerala. Accredited Social Health Activists have been used for earlier identification of individuals with psychological problems in the affected zones. This project started in March 2019, and due to the outbreak of COVID-19, the activities of PARIRAKSHA have been interrupted (Kiran et al., 2019).

4. Results and Discussion

Out of the 50 sample households, fifty per cent are Hindus, and fifty per cent are Christians. It is noteworthy that irrespective of religion and caste, the people of Kerala faced the flood together without any discrimination. More than 70 per cent of the respondents said that their interaction with neighbours improved after the flood. For almost two weeks, they cohabited and assisted one another. The presence of relatives, friends, political representatives, officials, and neighbours offered psychological assistance throughout the flood. Due to the overflow of the River Pampa and the heavy rainfall, more than 75 per cent of the households could not reach relief camps. For around 14 days, they stayed on the terrace with their neighbours. During that period, they felt insecurity and stress, among them, few respondents, especially the aged, had not recovered from the mental stress yet. The average size of the family is 4.4. The age-wise classification shows that the majority of the people were adults. They played a significant role in the rescue operations during the flood. The family's average monthly income is Rs. 27130.4, and the per capita income is Rs.73992/- which is less than half of the state per capita income of Rs. 245,323 (Planning Board, 2021). The working population in the study area included fisher folks, drivers, farmers, sales executives, MNREGA workers, and painters. The flood affected their working days. On account of the psychological and financial impact of the flood, they were unable to do work for more than a month.

Agriculture is one of the major sources of livelihood for most of the households in the study area. Fifty-four per cent of the households lost agricultural products, and 22 per cent lost poultry in flood. The total loss of this sector was Rs. 630200. The respondents had received compensation from the government, but the amount was not sufficient for them. Another effect of the 2018 flood is identified in the case of drinking water. In the pre-flood period, households in the study area depended on the Pampa River, wells and public taps for drinking water, and they did not spend money on drinking water. But, during the flood, almost all the wells were submerged in the floodwaters, and the toilet wastes contaminated drinking water sources. Due to that, 20 per cent of the families started to pay for drinking water.

Following the calamity, the state government provided flood-affected households with necessary food grain kits worth Rs 500 per month. More than fifty per cent of the respondents got this kit of food grains for three months. That was excellent support from the government, particularly to low-income families. Moreover, other organisations and individuals also distributed essential goods to the flood-affected people. To replace the damaged home appliances in flood, the State government developed a plan to provide loans of up to one lakh to each family through commercial banks. This loan amount was distributed through Kudumbashree. Among the respondents, 18 per cent of the total households took those loans, and others were not interested in raising their debt after the flood.
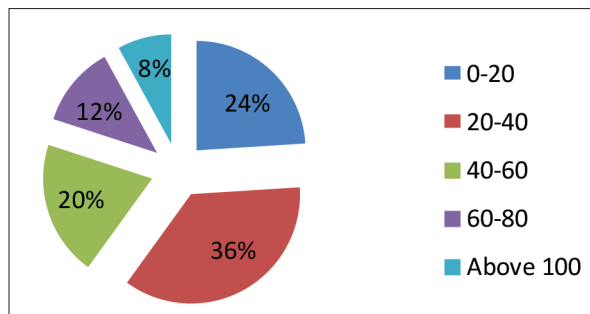
**Figure 1: Number of years living in Pandanad**

Figure 1 depicts that comparatively, more families have lived in Pandanad panchayat for 20 to 40 years. Eight per cent of the households have lived here for generations.

In their opinion, this was the first time such a flood had occurred, and they hadn't had any previous experience facing this kind of disaster. Because of the fear of future flooding, many of them started thinking about shifting to other regions.
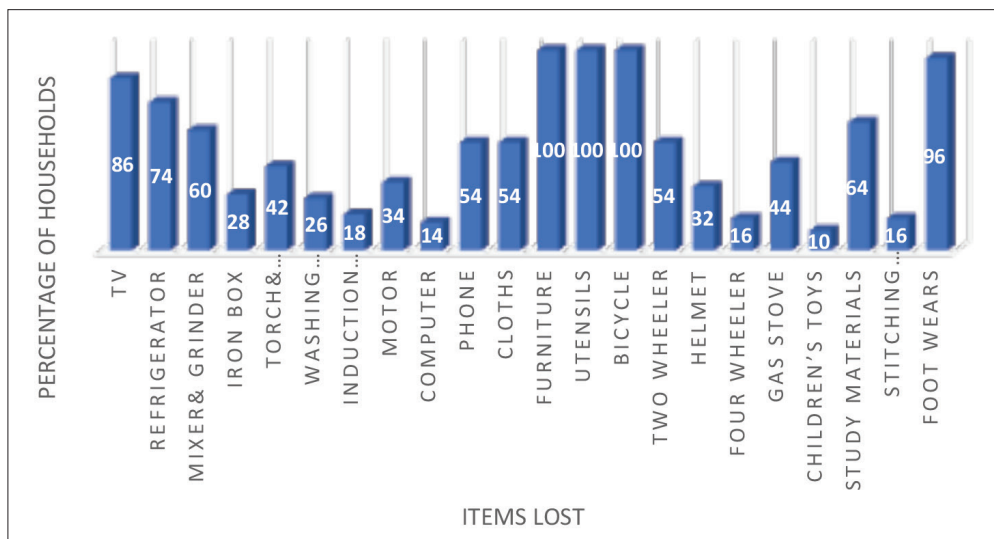
Figure 2 : Loss of household items

Figure 2 shows that the household items commonly lost were utensils, clothes, furniture, footwear, televisions, and refrigerators. The respondents required more money to replace these items. In economically backward families, the respondents lost much of their long-term earnings in the flood. That made the burden of the flood too severe.
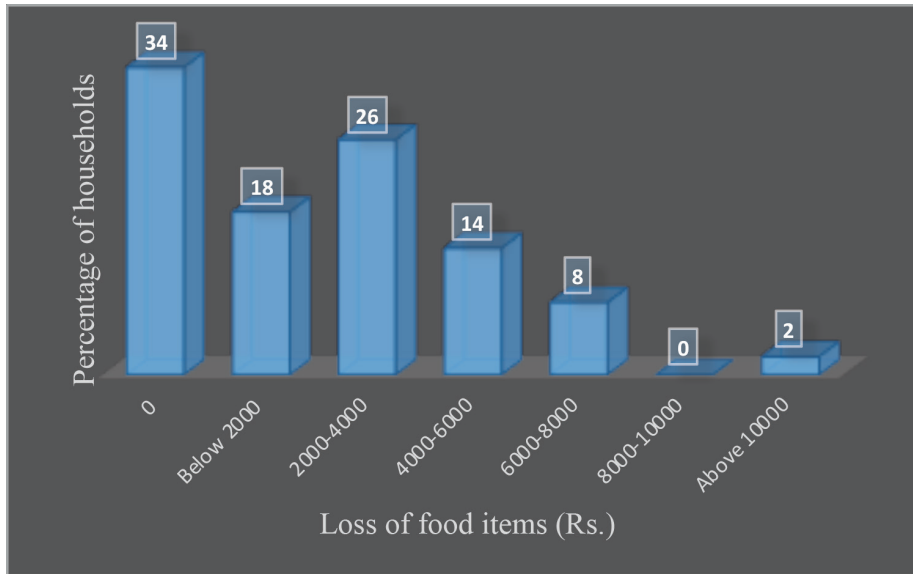
Figure 3 : Loss of food Items

Figure 3 reveals that around 66 per cent of the total respondents lost food stuff. Even before the flood came, households reserved more food items to celebrate the biggest festival of Kerala, 'Onam'. During the flood, most of the families in the study area stayed on the terrace, and they used these items for cooking. The extra stock of food grains helped them to avoid starving.

Table 1 : Loss of vital documents

Document	Number of Household	Total number of Documents
Voter ID	5	8
Ration Card	0	0
Aadhar Card	0	0
Passport	1	1
Birth Certificate	1	1

|		
Driving Licence	1	1
Medical Documents	3	12
Property Documents	3	4
Others	1	2
Total	**15**	**29**

From Table 1, it is clear that no respondents left their Aadhar card and Ration card. Around 70 per cent of the people moved to a safe place with all essential documents. Owing to the sudden arrival of a flood, others forgot to take their documents. To collect financial support from the government, households faced some difficulties in the post-flood period. The government of Kerala issued valid duplicates to those who lost their documents within months.
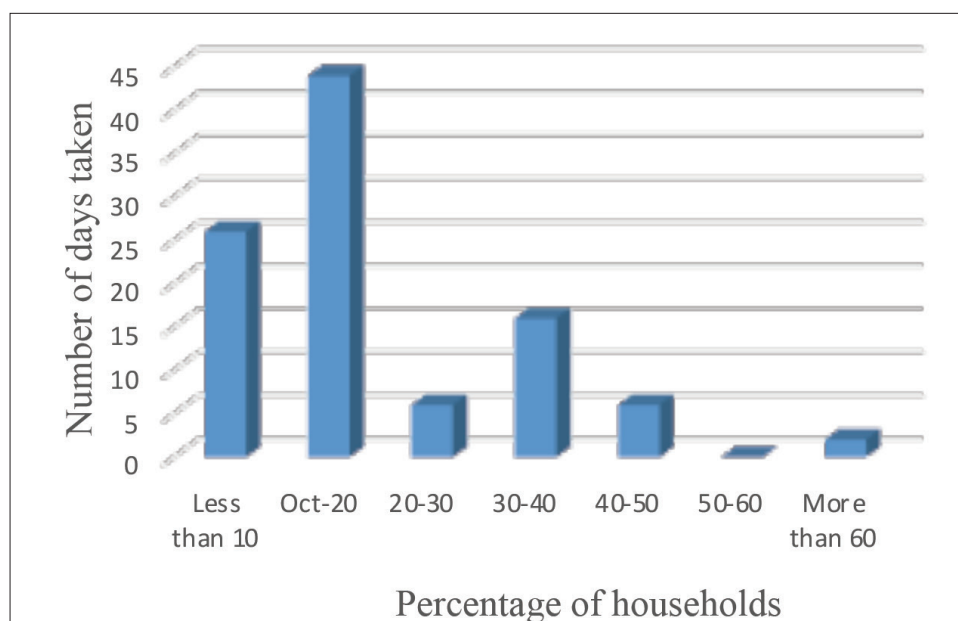
**Figure 4 : Number of days taken to clean the house**

Figure 4 shows that cleaning the houses of respondents took time. After the flood, the victims' most significant challenge was removing mud from their houses. Local

government institutions, various organisations, and individuals helped them to clean the houses. Those buildings were uninhabitable due to the stench of dirt for months. These issues affected the physical and mental health of the people too.
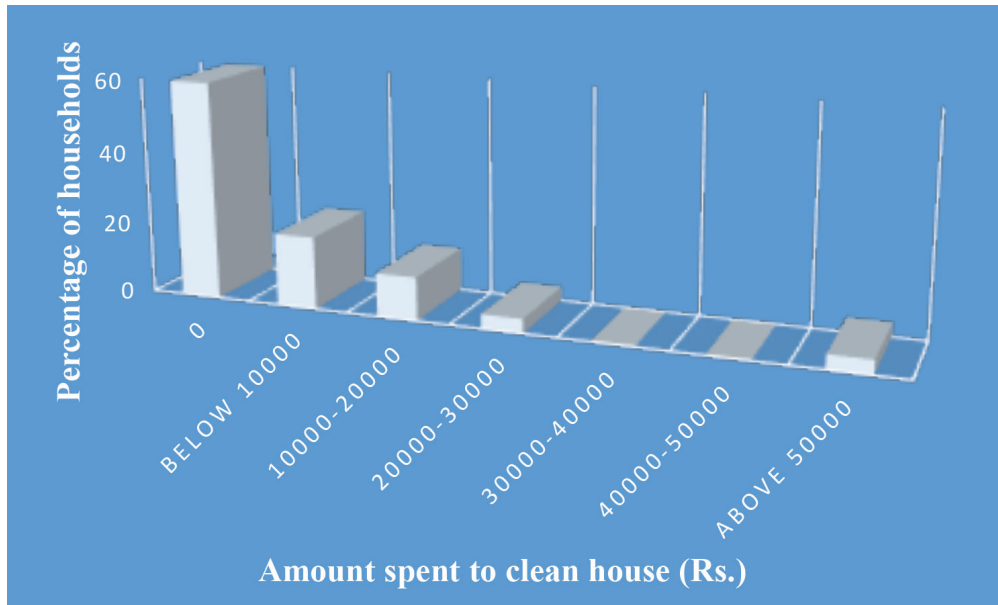
Figure 5 : Amount spent to clean the house

Figure 5 shows that more than half of the households did not spend money cleaning their homes and surroundings. Various groups and individuals helped them. Some of the victims had washed their houses themselves. Forty per cent of the respondents spent money on this. Among them, most of the households spent below 2000 rupees.
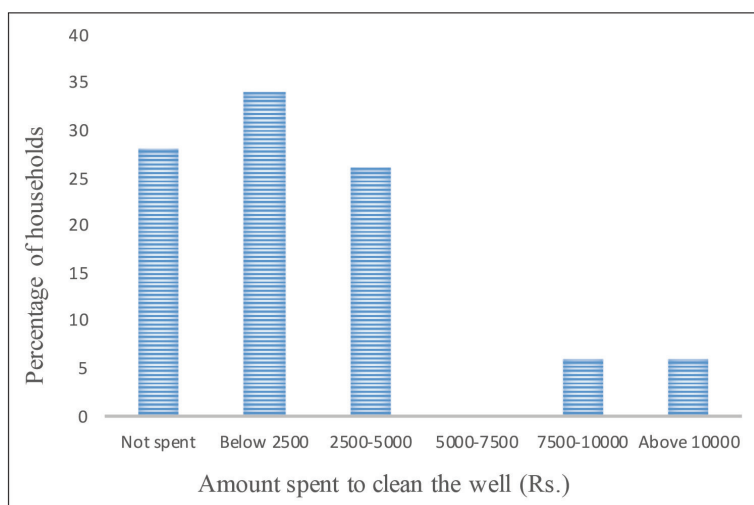
Figure 6 : Amount spent to clean the well

Figure 6 represents that 66 per cent of the families spent cash to clean wells. Those were filthy with mud and other wastes. Government institutions and other groups helped them to clean the well. For quick reuse, most people spent money to clean wells. Because of financial problems, 28 per cent of them did not clean their wells which were damaged in the flood.

Table 2 : Financial aid from the government for damaged house

Percentage of damage on house	Financial aid from Government	Number of households	Percentage
0-15	10000	15	30
16-29	60000	27	54
30-59	125000	6	12
60-74	250000	1	2
75-100	400000	1	2

Table 2 exhibits that one of the households was fully damaged in the flood and had to rebuild. The government provided financial assistance to the households based on the damage percentage. More than half of the families got worth of rupees 60,000. This financial support from the government helped the affected people to make their houses habitable.
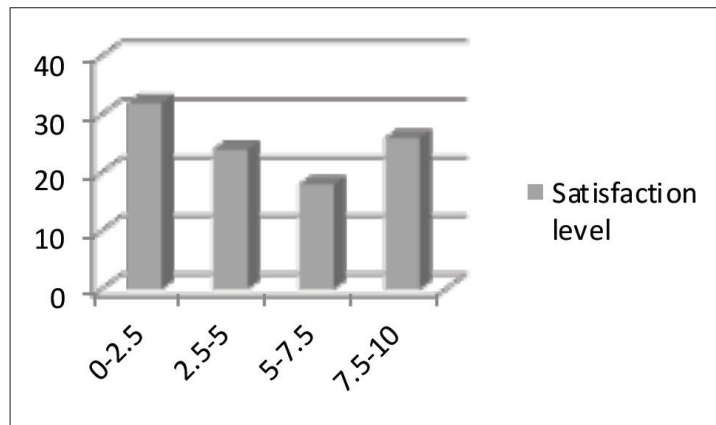
Figure 7 : Satisfaction level of victims to government's support

The Figure 7 depicts that comparatively more people were not satisfied with government support. Insufficient compensation and unfair allocation were the primary reasons for the dissatisfaction.

Table 3 : Monthly income and total economic loss of households

Monthly Income (Rs.)	Number of households	Average income	Average loss
0- 10000	7	8285.71	141850
10001-20000	11	17000	209671
20001-30000	17	25705.88	180780
30001-40000	10	35476	235531

40001-50000	1	46000	64680
50001-60000	3	59586.66	72887
More than 60001	1	95000	580550
Total	50	27,130.4	1,91,835.8

The flood affected almost all the households in the study area and had a considerable impact on the socio-economic life of the people. Table 3 shows that the average direct cost of the flood is Rs 1,91,835.8 that is seven times higher than the average income of the households.

4.1 Socio-economic Deprivation of Households

Townsend P. (1987) defined deprivation as "a state of observable and demonstrable disadvantage relative to the local community or the under society or nation to which an individual, family or group belongs". Broadly, it can be classified into two categories- material and social, indicating a lack of access to the necessities and social weakness, respectively (Pampalon et al., 2012; Sarkar, 2014). Socio-economic deprivation means the lack of social and economic advantages that are considered necessities of a community. The disadvantage of society regarding control access over material, social or economic resources and opportunities also shows socio-economic deprivation. It is a multi-dimensional concept (Lamnisos et al., 2019).

Table 4 : Deprivation index of the study area

Income groups (Rs.)	Number of households	Health Domain Index	Economic Domain Index	Standard of Living Domain Index	Socio-economic deprivation index
0- 10000	7	0.848979592	0.82857143	0.842857	0.840136054
10001-20000	11	0.737662338	0.81818182	0.741818	0.765887446
20001-30000	17	0.788571429	0.82285714	0.748	0.78647619
30001-40000	10	0.765714286	0.72857143	0.744	0.746095238

40001-50000	1	0.771428571	1	0.82	0.863809524
50001-60000	3	0.857142857	0.76190476	0.786667	0.801904762
More than 60001	1	0.771428571	0.57142857	0.68	0.674285714
Average		0.791561092	0.79021645	0.766192	
Total deprivation of the study area			0.782656418		

Table 4 exhibits that the highest socially and economically deprived families belong to between Rs. 0-10000 income groups. Most of the respondents in this group were daily wage earners, and after the flood, they lost working days for nearly two months. Compared to the high-income group, the burden of the flood was higher in this category. The standard of living deprivation is the highest in this income group due to the adverse impact of the flood on their housing, drinking water, electricity and accumulation of assets.

The flood highly deprived families in the income group of Rs. 10001 to 20000. Compared to health and standard of living domains, economic deprivation was higher. More than half of the respondents in this group worked in the unorganised sectors. Due to the flood, most of them could not go to work, and working places like shops and small-scale units collapsed. The people lost more than 45 working days during this time. Moreover, the flood affected other sources of income, especially the people's occupational equipment, livestock, and rickshaws.

Thirty-six per cent of the total respondents belong to Rs. 21,000 to 30,000 income group. The economic deprivation was higher because respondents were taken into debt and used their savings to maintain houses and vehicles and replace furniture and electronics. Besides that, the income of the respondents decreased after the flood. The total deprivation of this category is higher than the previous group.

The flood highly deprived the households with an income of Rs. 31,000 to 40,000. Among this group, health deprivation was comparatively elevated than economic and standard of living domains. The flood led to psychological damage like emotional shock, stress, and trauma among the respondents (UN et al., 2018). The impact of the flood on people's psychological health was higher than their physical health.

There was only one family that had an income range between Rs. 40,001 and 50,000. The noted thing is that this was the only family in the study with the highest economic deprivation value. The income source of this family was a shop, which entirely collapsed in the flood. This household lost its savings, and it took debt to reconstruct the building. That made the family economically more deprived. The economic impact adversely affected mental health and standard of living. Therefore the socio-economic deprivation index showed that this family was highly deprived in the 2018 flood.

Among the income group of Rs. 50,001 to 60,000, health deprivation was relatively high. From the field survey, it is identified that the people's mental health worsened than the physical health due to the deluge. They had fear about future flooding, and some of the respondents decided to migrate to other regions. The government of Kerala implemented a project, "PARIRAKSHA", in 2018 to reduce the long-term psychological impact of the flood (Kiran et al., 2020). This category was also highly deprived in flood.

In the sample, only one family had a monthly income above Rs. 60,000. In this household, the health deprivation and standard of living deprivation were high and economic deprivation was moderate. The respondent feared protecting his assets from the continuous future disasters that made them mentally weak and deprived them of health status. This is the only household in the study which had moderate economic deprivation. The socio-economic deprivation of this family was just high and close to a moderate level. The high-income level reduced the financial burden due to the flood.

The total socio-economic deprivation index of the study area (0.78) showed that the 2018 flood worsened the health, economic and standard of living status of all the households. This deprivation will lead the economy back from the path of development.

Table 5 : Low, moderate and high deprivation of the study area

	Percentage of Households		
	Low Deprivation (0 - 0.33)	Moderate Deprivation (0.33 – 0.66)	High Deprivation (0.66 – 1)
Health Domain Index	-	6	94

Economic Domain Index	-	4	96
Standard of Living Domain Index	-	28	72
Socio- Economic Deprivation	-	**12**	**88**

It is clear from Table 5 that the 2018 flood negatively affected the socio-economic aspects of all the households in the study area. The condition of no family improved in health, economic and standard of living after the flood. A few families (12%) were moderately deprived, especially those above Rs. 30,000 per month. Out of the total respondents, the standard of living deprivation of 28% families was moderate. Most of the families in the study were highly deprived in economic terms because the flood worsened their sources of income and thereby reduced income. A society characterised by high demand and a low supply of necessities exhibits poor economic and social status (Pampalon et al., 2000). The overall deprivation showed that most households were socially and economically deprived in the 2018 disaster.

5. Conclusion and Policy Suggestion

The Kerala flood in 2018 was a big challenge in the development path of the state. This deluge made a significant change in the health, economic and standard of living aspects of the people in Alappuzha. Most of the households lost their lifetime earnings, which pushed down low-income people to be more vulnerable. The study found that the majority of households in the study area come in the highly deprived category in the case of the three indices such as health (HDI), economic (EDI) and standard of living (SDI). No households come in the low level. A comparison of the three indices shows that EDI is high compared to the other two. The flood affected their possessions, such as buildings, crops, poultry, livestock, vehicles, shops, utensils, cloths, electronics. To rebuild and repurchase these items, the households used their past savings and lent money from both financial and non-financial institutions. They also lost their working days for over two months. This amplified the flood's economic impact on households. The economic burden due to the flood

in the high-income category in the study area is relatively lower than the low-income households. This demands more financial and livelihood support for the low-income category.

The study reveals that the Kerala flood of 2018 primarily resulted from abnormal rainfall. However, the impact of floods was accelerated by inefficient dam management, a lack of proper early warning system, developmental activities, an outdated disaster management plan, and the exploitation of river basins. The study area is located in a coastal district with highly flood-prone lowlands. In the context of this study, we propose the following recommendations for future policy-making:

- Ensure more accurate weather forecasting in the flood-prone areas.

- It is important to update the early warning system to guarantee timely and precise distribution of information, thereby mitigating the effects of natural disasters. Kerala's high literacy rate facilitates the efficient dissemination of disaster notifications among the people.

- The government should ensure the protection of river basins and efficient reservoir management for the safety of people should be ensured by the government.

- Regulate the extensive quarrying, mining and deforestation in the Western Ghats. These activities cause landslides and increase the destructive capacity of floods.

- Timely updating of disaster management strategies is very important in the unexpected climate-changing scenario.

- It will be better to ensure the displacement of people from flood-prone areas.

- The government should ensure proper long-term counselling sessions due to high psychological impact of disasters.

- Provide more flood relief to those with low incomes, as their economic deprivation as high.

The implementation of these recommendations is important for the existence of flood-prone areas in Kerala.

6. Acknowledgements

References

1. Central Water Commission (2018), "Study Report: Kerala Floods of August 2018", New Delhi: Ministry of Water Resources, River Development & Ganga Rejuvenation, Government of India.
2. Centre for Development Studies (2006), "Human Development Report 2005", Thiruvananthapuram, State Planning Board, Government of Kerala.
3. Dhanya, k. R. (2019), *August 2018 Keralam: Pralayam, Athijeevanam and Punarnirmanam*, Chennai: Westland Publications Private Limited.
4. District Disaster Management Authority, Alappuzha. (2015). *District disaster management plan: Alappuzha*. Kerala State Disaster Management Authority, Department of Revenue and Disaster Management, Government of Kerala.
5. Government of India (2011), "Report of the Western Ghats Ecological Expert Panel", New Delhi: The Ministry of Environment and Forests, Government of India.
6. Government of India (2018), "Report on the Exceptionally Heavy Rainfall over Kerala during 1st – 19th Aug. 2018", New Delhi: Earth System Science Organisation, Ministry of Earth Sciences.
7. Government of Kerala (2019), "Floods and Landslides 2019", Thiruvananthapuram: Kerala State Disaster Management Authority, Govt. of Kerala.
8. Government of Kerala (2021), "Economic Review 2020", Thiruvananthapuram: Kerala State Planning Board, Government of Kerala.
9. Government of Kerala. (2018), "Kerala Post Disaster Needs Assessment Floods and Landslides – August 2018", Thiruvananthapuram: Government of Kerala.
10. Hunt, K. M., and Menon, A. (2020), "The 2018 Kerala floods: a climate change perspective", *Climate Dynamics*, 54(3), 2433-2446.
11. Jonkman, S. N. (2005). Global perspectives on loss of human life caused by floods. *Natural hazards*, 34(2), 151-175.
12. Khayyam, U. (2020). Floods: Impacts on livelihood, economic status and poverty in the north-west region of Pakistan. *Natural Hazards*, 102(3), 1033-1056.
13. Kiran, P. S., Mohan, B., Abhijith, V., Abraham, A., Anoop, G., Dinesh, R. S., Krishnan, H., Mahadevan, K., Peethambaran, M., Kunheen, M., Sidharthan, M., Prathibha. S., Sukesh, S., Thomas, K. P., Jayaprakashan, K. P., and Jaisoorya, T. S. (2021), "Framework for strengthening primary health care and community networks to mitigate the long-term psychosocial impact of floods in Kerala", *International Journal of Disaster Risk Reduction*, 52, 101947.
14. Kiran, V. V., (2021). "Mapping the water Literacy of women in Palakkad district of Kerala", M Phil to thesis. Thiruvananthapuram: University of Kerala.
15. Kondapalli, S., Nagamanickam, R. K., and Ghosh, S. (2020), "Utilizing Insights from 2018 Kerala Floods Damage Survey in Catastrophe Flood Modelling", Hyderabad: Hydro 2019 International Conference.
16. Kumar, V., Pradhan, P. K., Sinha, T., Rao, S., and Chang, H. P. (2020), "Interaction of a Low-Pressure System, an Offshore Trough, and Mid-Tropospheric Dry Air Intrusion: The Kerala Flood of August 2018", *Atmosphere*, 11(7), 740.
17. Lamnisos, D., Lambrianidou, G., and Middleton, N. (2019), "Small-area socioeconomic deprivation indices in Cyprus: development and association with premature mortality". *BMC Public Health*, 19(1), 1-11.
18. Mohanty, M. P., Mudgil, S., & Karmakar, S. (2020). Flood management in India: A focussed review on the current status and future challenges. *International Journal of Disaster Risk Reduction*, 49, 101660.
19. Narayanan, A., Beye, R., & Thakur, G. M. (2022). Natural Disasters and Economic Dynamics: Evidence from the Kerala Floods.
20. Pampalon, R., and Raymond, G. (2000),"A deprivation index for health and welfare planning in Quebec", *Chronic Diseases Canada*, 21(3), 104-113.
21. Pampalon, R., Hamel, D., Gamache, P., Philibert, M. D., Raymond, G., and Simpson, A. (2012), "An area-based material and social deprivation index for public health in Québec and Canada", *Canadian Journal of Public Health/ Revue Canadiennede Santee Publique*, S17-S22.

22. Pankaj P. Khelkar (2018), India Today Newspaper: 22/08/2018, https://tinyurl.com/2ktthh6p

23. Panwar Vikrant and Sen Subir. (2019), "Economic Impact of Natural Disasters: An Empirical Re-examination", *The Journal of Applied Economic Research*, 13: 1.

24. Parida, Y. (2020). Economic impact of floods in the Indian states. *Environment and Development Economics*, 25(3), 267-290.

25. Parvin, G. A., Shimi, A. C., Shaw, R., & Biswas, C. (2016). Flood in a changing climate: The impact on livelihood and how the rural poor cope in Bangladesh. *Climate*, 4(4), 60.

26. Radboud University (2021), "Human Development Indices", Netherlands: Global Data Lab, Institute for Management Research, Radboud University.

27. Santhi, S. L. and Veerakumaran, G. (2019), "Impact assessment of Kerala flood 2018 on agriculture of farmers in EdathuaPanchayat, KuttanadTaluk of Alappuzha District", *Shanlax International Journal of Economics*, 7(4), 24-28.

28. Sarkar, B., Banerji, H., and Sen, J. (2014), "Patterns of socio-economic deprivation and its impact on quality of life: Case of a less developed region in West Bengal, India", *Athens Journal of Health*, 1(4), 271-285.

29. Shaharban, V., and Rathnakaran, A. (2019), "Disaster Prevention and Management in the Era of Climate Change with Special Reference to Kerala Flood 2018" Landslides, 50(5619.7), 2799482.

30. Singh, A., Reddy, S., Kamthan, M., & Chug, G. (2018). 2018 Kerala floods: A report on governance and legal compliance. New Delhi: UP E2, SCDR-NIDM Research Publications.

31. Sivakumar and Sarvalingam A. (2010), "Human Deprivation Index: A Measure of Multidimensional Poverty", *MRPA Paper No. 22337*, Germany: Munich University Library.

32. Sudheer, K. P., Bhallamudi, S. M., Narasimhan, B., Thomas, J., Bindhu, V. M., Vema, V., & Kurian, C. (2019). Role of dams on the floods of August 2018 in Periyar River Basin, Kerala. *Current Science*, 116(5), 780-794.Thummarukudy, M. (2019), *PerumazhaPakarnnaPadangal*, Kerala: D C Books.

33. Tripathi, P. (2015). Flood disaster in India: an analysis of trend and preparedness. *Interdisciplinary Journal of Contemporary Research*, 2(4), 91-98.

34. United Nations Development Programme. Retrieved from https://tinyurl.com/a5ja2bsr (accessed on 14/06/2021),

35. Vanama, V. S. K., Rao, Y. S., and Bhatt, C. M. (2021), "Change detection based flood mapping using multi-temporal Earth Observation satellite images: 2018 flood event of Kerala, India." *European Journal of Remote Sensing* 54, no. 1 (2021): 42-58.

36. Venu, V. (2019), *August 2018 Keralam: Pralayam, Athijeevanam* and *Punarnirmanam*, Chennai: Westland Publications Private Limited.