

Out of the total area of the State, 14.52 *per cent* is estimated to be prone to floods. As per India Meteorological Department data, Kerala received 2346.60 mm of rainfall from 01 June 2018 to 19 August 2018 which was about 42 *per cent* above the normal. Rainfall in the State was 164 *per cent* above normal in the period 01-19 August 2018. The devastating floods in Kerala during August 2018 severely affected 13 of the 14 districts in the State resulting in huge loss of life and property.

With a view to assess the preparedness and response of Government of Kerala (GoK) to minimise the magnitude of losses due to floods, a Performance Audit of ‘Preparedness and response to floods in Kerala’ was conducted. The major findings of the Performance Audit are given below.

### **Planning and Capacity Building**

The Kerala State Water Policy 2008 was not updated in accordance with the National Water Policy and lacked provision for flood control and flood management in the State.

*(Paragraph 2.1)*

Provisions in the Kerala State Water Policy 2008 requiring the preparation of a State Level Master Plan for water resources development, formulation of Master Plans for the major rivers of the State and constitution of a State Level Authority for coordinating all water related activities at the river basin level were not complied with.

*(Paragraph 2.2)*

Flood plains of the State are yet to be demarcated and flood plain zoning legislation remains to be enacted.

*(Paragraph 2.3)*

No large-scale flood hazard map is available in the State; State’s Disaster Management Plan includes flood susceptibility map not conforming to Central Water Commission (CWC) criteria for flood prone area. According to GoK, responsibility to provide the large-scale map is that of the Ministry of Water Resources, CWC, etc.

*(Paragraph 2.4)*

The Civil Defence Training Institute building at Thrissur, which was to cater to the dedicated purpose of a full-time residential training institute for civil defence, has not served the intended purpose even after the passage of five years.

*(Paragraph 2.5.1)*

Subsequent to signing of MOU of Aapda Mitra scheme in November 2016, procedural delay at various individual stages resulted in distribution of emergency responder kits in December 2019, one year after completion (October 2018) of training of the first batch of Aapda Mitra volunteers. Disaster response skills acquired by the volunteers could not be used for the benefit of the local community despite severe flood having affected the State in August 2019.

*(Paragraph 2.5.3)*

### **Flood forecasting and reservoir operation**

Only six rain gauges against the requirement of 32 gauges (as per existing BIS norms) are available for rainfall estimation in Periyar basin by IMD.

*(Paragraph 3.1)*

Despite 275 flood forecasting stations having been set up by CWC across the country by the year 2017, no flood forecasting stations had been set up by the CWC in the State. GoK had not furnished to the CWC list of reservoirs/ cities and towns requiring setting up of inflow forecasting stations/ level forecasting stations. However, the Government had resolved to develop a full-fledged inflow forecasting and flood early warning system under National Hydrology Project

*(Paragraph 3.3)*

A project for obtaining real time data on rainfall, streamflow etc. failed to deliver reliable data on real time basis even after a lapse of five years.

*(Paragraph 3.4)*

Though the Disaster Management Plan 2016 envisaged State Emergency Operations Centre to be equipped with a full-fledged state-of-the-art IT and Communication network with an intelligent Decision Support System (DSS) capable of prediction and early warning of major hydro-meteorological hazards and support for emergency operation, even two years after the targeted date of completion of April 2019, the system cannot be relied upon to predict and give early warning of major hydro-meteorological hazards since its effective functioning is dependent on the receipt of externally sourced real time data which is yet to be made available.

*(Paragraph 3.5.1)*

Communication infrastructure was non-functional in some areas including dam sites and Government offices during or subsequent to the 2018 floods.

*(Paragraph 3.5.2)*

Contribution of the spills from Idamalayar and Idukki dams together, to the flows at Neeleswaram gauge station during the days 14 to 18 August 2018 was 46.43 per cent, 36.12 per cent, 29.54 per cent, 23.34 per cent and 16.99 per cent respectively. Contribution of spills from Mullaperiyar to the inflows at Idukki during August 15-18 ranged between 27.93 and 36.62 per cent.

There was no rule curve in place for the guidance of dam operators at Idamalayar reservoir at the time of the 2018 floods. Rule curve for Idukki reservoir framed in 1983 were not reviewed until after the floods of 2018.

Though reservoir operations at Idukki during 14 to 18 August 2018 resulted in lower spill of 467.51 MCM compared to 558.19 MCM (indicated through simulation studies) which would have resulted had the Rule Curve (of 1983) been followed strictly, outflows still exceeded inflows on one day (17 August 2018) in respect of Idukki reservoir and on two days (16 and 17 August 2018) in respect of Idamalayar reservoir.

**(Paragraph 3.6)**

Though Reservoir Operation Guidelines require capacity surveys of reservoirs to be undertaken at least once in five years, no capacity surveys or sedimentation studies were conducted in any of the KSEBL reservoirs between 2011 and August 2019 (when Audit was undertaken). However, seven sedimentation studies were carried out in 2020.

Sedimentation assessments of major reservoirs Idukki, Idamalayar, Kakki and Sholayar were last conducted in 2004, 2011, 1999 and 2003 respectively. In respect of Banasurasagar dam, commissioned during 2005, sedimentation study is yet to be conducted. KSEBL informed that in the backdrop of the 2018 floods, sedimentation study for Idukki, Idamalayar, Kakki, Banasurasagar and Sholayar reservoirs has been included in Dam Rehabilitation and Improvement Project-II.

In respect of reservoirs under the control of the Water Resources Department, though siltation studies had revealed significant levels of siltation in Aruvikkara reservoir (43 *per cent*), Mangalam reservoir (21.98 *per cent*), Peppara reservoir (21.70 *per cent*), desiltation activities were yet to take off other than in Mangalam reservoir which commenced in December 2020.

**(Paragraph 3.7)**

### **Impact of change in Land Use and Land Cover**

The Land Use Land Cover analysis for the entire Periyar basin including the test-checked districts of Idukki and Ernakulam revealed an increase in the built-up area by nearly 450 *per cent* during 1985-2015 and decrease in water bodies by nearly 17 *per cent*. During 2005-2015, the built-up area increased by nearly 139 *per cent*. Had the same rainfall and spills of 2018 occurred with 1985 land use conditions, the flood depth at Neeleswaram gauge station would have reduced from 12.32 m to 10.03 m and the flood inundated area would have reduced from 520.04 sq. km to 414.76 sq. km.

**(Paragraph 4.1)**

Continuing presence of encroachments on Cheruthoni river bed obstructed the free flow of the river resulting in damages during the 2018 floods.

**(Paragraph 4.2)**

Despite passage of 20 years since the commissioning of the airport and instances of severe flooding in the area, the Irrigation/ Revenue and Disaster Management wings/ LSGIs concerned/ CIAL have not been able to ensure a well-maintained diversion canal adequate to carry the Chengalthodu waters (in the event of heavy flooding) into the Periyar river to sustain the overall hydrology of the area and ward off the potential risks of riverine flooding to the resident population.

*(Paragraph 4.3)*

Lower than targetted dredging to deepen and widen the leading channel of Thottapally spillway coupled with the presence of over 500 trees planted inside the spillway mouth resulted in reduction of spillway capacity, contributing to the flood situation in Alappuzha in August 2018.

*(Paragraph 4.4)*

### **Financial management and survey**

Though 7124 works of immediate repair and restoration of damages in 2018 flood were approved for execution under State Disaster Response Fund, 18 *per cent* of the works were yet to be completed even after a lapse of two years and eight months (April 2021). The Government informed that the pending works were expected to be completed by May 2021.

*(Paragraph 5.2)*