BEFORE THE HON'BLE HIGH COURT OF KERALA
AT ERNAKULAM

WPC No. 2651 of 2019

The Foundation for Restoration of National Values
Represented by its President Dr. E Sreedharan — *Petitioner*

Vs.

State of Kerala & Others — *Respondents*

REPORT ON KERALA FLOODS, 2018 AND MANAGEMENT OF DAMS
(REPORT No: 5)

Submitted by:

Adv. Jacob P Alex
Amicus Curiae

BEFORE THE HON'BLE HIGH COURT OF KERALA AT ERNAKULAM

WPC 2651 of 2019

The Foundation for Restoration of National Values
Represented by its President Dr. E Sreedharan *Petitioner*

Vs.

State of Kerala & Others *Respondents*

REPORT ON KERALA FLOODS, 2018 AND MANAGEMENT OF DAMS (REPORT No: 5)

INDEX

Dated this the 27th day of March, 2019

Adv. Jacob P Alex
Amicus Curiae

BEFORE THE HON'BLE HIGH COURT OF KERALA AT ERNAKULAM

WPC 2651 of 2019

The Foundation for Restoration of National Values
Represented by its President Dr. E Sreedharan — *Petitioner*

Vs.

State of Kerala & Others — *Respondents*

REPORT ON KERALA FLOODS, 2018 AND MANAGEMENT OF DAMS (REPORT No: 5)

Summary of Report:

Above normal rainfall during June – August, 2018 and extremely heavy rainfall on 15-17, August, 2018 caused unprecedented Floods resulting in massive loss of life and property, across Kerala.

The impact of floods appears to have been aggravated by various factors. None of the 79 dams in Kerala were operated or used for the purpose of flood control / moderation; no effective flood control zone is maintained; high reservoir storage even in the first week of August; sudden release of water from all dams; reduced reservoir storage capacity due to siltation; no integrated operation of dams based on scientifically identified *Rule Curves*, absence of proper Flood Warning etc are some of them.

For better flood / dam management in future, it is suggested that there should be proper Flood Plain Zoning, preparation of Inundation Maps, finalization of Emergency Action Plans, updating of *Rule Curves*, evolving dam specific Operation and Maintenance Manual, proper Flood Forecasting system etc.

To identify the various causes of floods and factors that had resulted in worsening of the same, it is recommended to have a more detailed enquiry by appointing an independent expert enquiry committee headed by former judge of a superior Court and preferably consisting of a reputed Hydrologist, experts in dam management, engineers and other experts.

Introduction:

1. The captioned writ petition along with Writ Petition Nos. 28502, 29244, 29296, 29420, 28954, 29528, 29629, 29125, 29720, 29896, 29980, 30039, 31716, 32648, 33405 and 34418 of 2018 are Public Interest Litigations (PILs) pending before this Hon'ble Court in connection with Kerala Floods, 2018. On the basis of a letter from Mr. Joseph N. Rappai addressed to Hon'ble Mr. Justice V Chitambaresh, *Suo Motu* PIL was also initiated by this Hon'ble Court as WPC 28753 of 2018 on the same issue. These PILs are categorized as Batch II and pertains to various aspects relating to management of dams in Kerala and causes of Kerala Floods (2018). Common averments in these PILs are to the effect that Kerala Floods, 2018 is aggravated / caused due to the mismanagement of dams and uncontrolled release of water.

2. **Summary of allegations and relief sought in various PILs**:

Main allegations in these writ petitions are summated as follows[1]:

i. Disorganized and sudden release of water simultaneously from various dams across the State, that too without any proper and effective alerts has aggravated the Flood disaster;

ii. The calamity could have been mitigated had the weather forecast of India Metrological Department (IMD) was taken seriously and water from reservoirs were released early in a regulated manner;

iii. Dam managers in the State - Kerala State Electricity Board (KSEB) and Department of Irrigation, Government of Kerala were keen on storing maximum amount of water with profit motive. Buffer Zone / Flood Control level were not maintained in the reservoirs with a view to contain flood water;

iv. Directives / mandates etc. of various authorities such as Central Water Commission (CWC); Comptroller and Auditor General of India (CAG); National Disaster Management Authority (NDMA) etc. were not followed;

v. Guidelines / Plans such as Emergency Actions Plans (EAP), inundation maps etc. were not prepared. There are no Flood Forecasting Stations;

[1] See also Counter Affidavit filed by Re

vi. Alerts were not issued properly and people were not evacuated. No sufficient time was given to people to protect themselves from floods;

3. Based on the above allegations, petitioners in these batch of writ petitions, *inter alia* prayed:
   i. To conduct investigation by setting up appropriate Commission / Judicial body / Expert panel / Technical committee to inquire into the circumstances that resulted in floods;
   ii. To assess and compensate for damage that people suffered due to floods:
   iii. To evolve EAP, Dam Operation Manual, Safety Plans, warning alarms etc. for all dams in the State;
   iv. To prepare appropriate Floods Maps / Inundation Maps; and
   v. To take appropriate preventive / mitigation steps to avert / minimize effect of future flood events;

4. In response to various averments, allegations and prayers in the above writ petitions; separate Counter Affidavits were filed on behalf of State of Kerala, Kerala State Electricity Board Ltd. (KSEB), Dam Safety Authority (DSA) and Union of India.

5. **Summary of Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018:**

<u>Extremely heavy rains beyond all predictions</u>: (Paragraphs 7 to 15)

   i. Floods were caused by unprecedentedly "extremely heavy" rains. Extremely heavy rain was never predicted by any forecast of the IMD before 15-08-2018; (Paragraph 7)
   ii. Total live storage capacity of all 57 dams is 5.806 BCM; Annual average run off all 44 rivers in Kerala is 78 BCM; Annual life storage capacity of dams when compared to annual average run off of rivers is 7.4%. High intensity of rainfall in such short period will cause flooding even without discharge from dams; (Paragraph 10)
   iii. Rainfall during 3 days between August 15-17, 2018 and that of 3 days between July 16-18, 1924 are strikingly similar. The torrential

downpour in the State between August 15-17, 2018 was beyond all predictions; (Paragraph 12)

IMD Predictions: (Paragraphs 16 to 35)

iv. The deluge resulted from "extremely heavy rain." Such rain was never predicted by IMD before 15-08-2018; (paragraph 16)

v. Even the bulletin on IMD's website published on 09-10-2018 for the forecast between 9-22, August 2018 did not predict heavy or very heavy rainfall for Kerala... Extremely heavy rain and the consequent inundation of the State was a direct, violent, sudden and irresistible act of nature, occasioned only by the elementary forces of nature and totally unconnected in any manner, whatsoever with the agency of man; (paragraph 23)

vi. IMD never predicted "extremely heavy rain"; (paragraph 31)

Management of Dams in Kerala during August, 2018 (Paragraphs 36 to 205):

Dams of KSEB:

vii. None of the dams in Kerala are exclusive flood control dams. Dams in Kerala are designed for water conservation and power generation; (Paragraph 35)

viii. Water level in reservoirs of KSEB is controlled on the basis of historical data of rainfall during the last 30-50 years, the inflow to the reservoirs from the catchment, the long-range-weekly and daily rainfall forecast of IMD, the availability of machines for generation, its annual maintenance etc; (Paragraph 38)

ix. The opening of shutters of dams is not meant to release the water already stored in the reservoirs but is to release partially or fully the flood waters flowing into the reservoirs which would have invariably flown to downstream in the absence of these dams. The spillway discharge can only be equal to discharge through parent river. Even if the dam was not there the discharge the downstream would have been the same; (Paragraph 39)

x. CMD of KSEB convened a meeting on 25-07-2018 and fixed 3 (three) alert stages for Idukki, Idamalayar and Pampa dams; (Paragraph 43)

xi. Average inflow to Idukki between 09-08-2018 and 19-08-2018 was more than 3 times and was at the rate of 79 MCM per day, which was at an unprecedentedly higher level in the history of the dam; (Paragraph 47)

xii. Tamil Nadu suddenly opens all the 13 shutters of Mullaperiyar dam spilling about 750 cumecs... Due to this huge inflow from Mullaperiyar and the huge inflow due to the heavy rains in its own catchment, the water level of Idukki reservoir was increased by another 5.48 ft. (Paragraph 48)

xiii. Alerts (Blue / Orange / Red) were issued for Idukki, Idalmalayar, Kakki-Anathode and Pampa Reservoirs. Banasurasagar dam was opened after proper alert; (Paragraphs 51,53, 57, 63, 66, 67, 69 and 70)

xiv. Elaborate disaster preventive actions were taken before release of water from Cheruthoni dam, Idukki; (paragraphs 85-6)

xv. No early release of water was made because IMD forecast only a normal monsoon and heavy rain due to depression was predicted only 2-3 days in advance; during 2007 and 2013 water level in Idukki reservoir has gone above 2402 feet and is managed without any spill; this year all reservoirs are filled up fast; Kuttanad region was experiencing severe floods during 2nd and 4th weeks of July, 2018; (paragraph 98)

Water inflow to various dams:

xvi. Catchment area of Idukki received 408% above the expected inflow; (paragraph 80) and inflow received during 15-18 August, 2018 is 36% of the live storage capacity of Idukki reservoir and the total inflow between 01-22 August, 2018 is more than 78% of the live storage capacity of Idukki reservoir; (paragraph 82)

xvii. Catchment areas of Sabarigiri received inflow of 452% above the expected inflow; (paragraph 89)

xviii. Inflow received at Pampa and Kakki between 15-18, August, 2018 is 1624% above the expected inflow; (paragraphs 90-1)

Dams of Irrigation Department: (Paragraphs 103 to 205)

xix. Purpose of these dams (Irrigation Department dams) is not to contain floods; (paragraph 106)

xx. Because of extremely heavy rain, dams were swelled to a point beyond its carrying capacity; (paragraph 107)

xxi. Despite having heavy inflows, outflows were not even half of the designed capacity of spillways in most of the dams at any point of time during the floods of August, 2018; (paragraph 114)

xxii. Management of flood was more or less under control until 14-08-2018; (paragraph 115)

xxiii. All dams were opened after following specified protocol; (paragraphs 116-120)

xxiv. Release of water from the dams has not aggravated the floods. Floods were caused by torrential and extremely heavy rainfall; (paragraphs 203-204)

Other aspects:

xxv. Kerala State Disaster Management Authority (KSDMA) has taken all necessary steps to manage floods; (paragraphs 206 – 210)

xxvi. Report of Central Water Commission justifies the stand of State; (paragraph 216)

xxvii. Flood maps were prepared for the State; (paragraph 217)

xxviii. Deluge was caused by heavy rain and not due to discharge of water; (paragraph 218)

xxix. Early warnings were issued; (paragraph 219)

xxx. 'Though EAP is in the making, still all the 5 (five) steps in an EAP was followed'; (paragraph 220)

xxxi. Kerala Floods, 2018 is an 'Act of God'; (paragraphs 15 and 222)

6. **Summary of Counter Affidavit filed on behalf of Kerala State Electricity Board in WPC 28954 of 2018**:

i. The deluge was caused by unanticipated rain during 15th to 17th August (2018) that was beyond all predictions. The rainfall that the State witnessed during the three days upset all equations and forecasts and the situation culminated into a calamity; (paragraph 13)

ii. It is based on the predications from the IMD that the KSEB was maintaining the levels in the reservoirs so as to accommodate the rainfall; (paragraph 16)

iii. Dam levels as on 09-08-2018 were capable of accommodating the rainfall as predicted by the IMD; (paragraph 18)

iv. KSEB could not have pre-emptied the water in the dams based on the data / forecast provided by the IMD; (paragraph 20)

v. Averments in the counter affidavit between pages 6 and 30 regarding the operation of various dams are almost verbatim similar to that of the averments in paragraphs 39 to 92 of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018. The same are detailed in the preceding paragraph;

vi. Management of floods was more or less under control until 14-08-2018 when unprecedented rainfall to the tune of 1032 mm in a span of 4 days necessitated the neutralisation of inflow for the safety of dams. Following are the relevant facts:

1. Achankovilar, Manimalayar and Meenachilar without any dams had caused incomparable flooding in the history of Chenganoor, Thiruvalla and Pala;
2. Storage capacity of all dams in Kerala is just 6.6% of the total annual yield of all the 41 west flowing rivers;
3. Rains were widespread and catchment areas of dams are relatively small. Catchment and drainage areas of river basins carried more run-off and released more water than that released from the dams;
4. Discharge from the KSEB's dams and powerhouses constituted only 30% of the total flow in the rivers;
5. KSEB had taken all precautionary measures, issued proper alerts and had meticulously carried out the opening of dams shutters;

(Pages 30-33)

vii. Most of the reservoirs in Kerala was almost full during the 3rd week of July itself and water level in several major reservoirs started to rise above normal levels; (Page 33)

viii. Floods in 2018 is similar to that of the Floods in 1924; (Page 35)

ix. Flood cushion / Buffer was maintained; (Page 35)

x. CWC Guidelines were followed; (Page 37)

7. **Summary of Counter Affidavit filed on behalf of Kerala Dam Safety Authority (DSA) in WPC 28502 of 2018**:

   i. DSA is purely an advisory body; (paragraph 6)

   ii. Several dams have reduced storage capacity as a result of silting; (paragraph 7)

   iii. Opening of shutters of dams and increase in the level of water would be done by engineers in charge of the concerned owner/ custodian/ department following the orders of superior officers/ concerned district collector and not as per the instructions of DSA; (paragraph 7)

   iv. According to Report of Central Water Commission (CWC), floods occurred due to heavy rain; (paragraph 9)

   v. Spilling is done with intimation to District Collectors and revenue officials and they would give sufficient alerts to people; (paragraph 10)

   vi. During periodical inspection of dams, DSA could not notice any major defects in any dams; (paragraph 12(iii)

   vii. IMD did not predict any extremely heavy rainfall; (paragraph 12(iv & v)

   viii. Flood occurred due to natural reasons / Act of God and could not have been prevented; (paragraph 13(xiv)

8. **Summary of Counter Affidavit filed on behalf of Union of India in WPC 28502 of 2018** (with reference to Flood Forecast and Dam Management that are detailed in paragraphs 23 and 36) are as follows:

   i. IMD had issued 'all necessary severe weather warnings'; (paragraph 23.1)

   ii. IMD had issued the required weather warnings and colour coded alerts for the intense rainfall spells over Kerala during August, 2018; (paragraph 23.2)

   iii. Rather than the actual rainfall forecast, the impact based forecast and warning with colour code introduced in the recent past is applicable for disaster Management purpose since it provides guidance about the action to be taken with respect to the adverse weather scenario; (paragraph 23.6)

iv. The devastating flood situation Kerala was not due to the extremely heavy rainfall of one particular day. It was due to the persistent intense rainfall and its accumulated effect; (paragraph 23.7)

v. With the rainfall scenario prevailed over Kerala during the first half of the season, any additional rainfall of even moderate intensity could have been sufficient to add to the flood situation; (paragraph 23.8)

vi. Warning for extremely heavy rainfall issued on 15 August, 2018 was only an upgradation of the existing warning for intense rainfall activity over Kerala; (paragraph 23.9)

vii. Officials of State government machinery are briefed about the weather predictions over the State to enable them plan disaster management and mitigation measures; (paragraph 23.11)

viii. Alerts and warnings of impending weather are disseminated at more frequent intervals during adverse weather situations; (paragraph 23.12)

ix. The exact amount of rainfall that can occur on a single day over a specific location cannot be quantified accurately; (paragraph 23.13)

x. CWC had written to State governments to suggest locations were CWC could set up Flood Forecasting Stations. However, no proposal was received from the State of Kerala. There are, therefore, no Flood Forecasting Stations in Kerala maintained by CWC; (paragraph 36.3)

xi. CWC has 22 Flood Monitoring Stations set up in Kerala; (paragraph 36.4)

xii. National Committee on Dam Safety, Government of India asked dam owners / States to put in place Operation and Maintenance (O&M) Manual and also to have EMPs; (paragraph 36.6)

xiii. Preparation of O&M manuals and DMP/EAP containing rule curves for reservoir operation, inundation maps (integral part of DMP/EAP) and Hazard Zonation of dam nearby areas is responsibility of dam owners; (paragraph 36.7)

xiv. Dam Safety Organization, CWC have already provided Dam Break Analysis and Inundation Mapping in respect of 28 dams; (paragraph 36.8)

xv. Rivers in Kerala have comparatively small catchment areas and there are steep slopes. Moreover, rivers are flashy in nature and swell up quickly. Hence effective level based forecast is difficult. For developing a correlation for Flood estimation with respect to Dam releases, non availability of data pertaining to historical outflows and real time dam release is a limitation; (paragraph 36.13(i)

xvi. To prepare Flood forecasting by Rainfall-Runoff Mathematical Modelling, further data are required from the State; (paragraph 36.13(ii) & (iii)

xvii. There should be an Operation Manual in place for the purpose of schedule operations of reservoirs; (paragraph 36.13(v)

xviii. To specifically study on the aspects pertaining to Flood forecasting, a committee has been constituted by CWC and preparation of its report is underway; (paragraph 36.13(vi), (vii) and 36.14)

xix. CWC is not contesting the claims of KSDA on the basis of the report published by CWC's Hydrology (S) Directorate. However, recommendations made in the said report has to be implemented; (paragraph 36.15)

9. Constitutional and Legal framework on aspects relating to Flood / Dam management:

9.1. The subject of flood control, unlike irrigation, does not figure as such in any of the three legislative lists included in the Constitution of India. However, drainage' and 'embankments' are two of the measures specifically mentioned in entry 17[2], List II of Seventh Schedule, which is as follows:

> "Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provision of entry 56 of List I."

Entry 56, List I reads as follows:-

> "Regulation and development of inter-State rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest."

---

[2] "Water, that is to say, water supplies, irrigation and canals, drainage and embankments, water storage and water power subject to the provision of entry 56 of List I."
Entry 56 of List I read "Regulation and development of inter-state rivers and river valleys to the extent to which such regulation and development under the control of the Union is declared by Parliament by law to be expedient in the public interest."

9.2. It may be pointed out that entry 17 of List II (State List) quoted above does not cover land use involved in the administrative measures of dealing with reduction of flood losses viz. Flood Plain Zoning. For the implementation of any flood control programme, it is necessary to acquire private land for execution of engineering measures. Since there is provision for "acquisition and requisitioning of property" in the Concurrent List under entry 42, both Centre and the States can enact laws for this purpose. Land Acquisition Act, 1894 and / or the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013 are the relevant law in this regard. However, if legislation for reducing flood damages is to be resorted to by flood plain zoning, it involves restriction of land use and this power seems to be covered under entry 18 List II (State List) which provides "land that is to say, rights in and over land..."

9.3. Thus it could be seen that the primary responsibility for flood control is with the States. The schemes for flood control are to be planned, investigated and implemented by the States as per priorities within the State with their own resources and the role of Union Government is only to render assistance to States. Role of Union and its agencies relating to flood management is technical, advisory, catalytic and promotional in nature.[3] However, Article 262[4] of the Constitution deals with adjudication of inter-state water disputes.

9.4. Though flood management is an issue on the agenda of States concerned, certain national level policy measures[5] in this regard have been put forth.[6] Establishment of Central Water Commission (CWC) is

---

[3] Paragraph 2.1 'Comprehensive Flood Management in India' published by Information System Organization, Central Water Commission (September, 2018)

[4] Article 262: Adjudication of disputes relating to waters of inter- State rivers of river valleys: (1) Parliament may, by law, provide for the adjudication of any dispute or complaint with respect to the use, distribution or control of the waters of, or in, any inter-State river or river valley.
(2) Notwithstanding anything in this Constitution, Parliament may, by law, provide that neither the Supreme Court nor any other court shall exercise jurisdiction in respect of any such dispute or complaint as is referred to in clause (1).

[5] See Paragraph 1.15, 'NDMA Guidelines on Floods'

[6] See generally <http://drr-law.org/resources/India-Fed-Desk-Survey.pdf>

a major step taken by the Union Government[7] in this regard. CWC is the premier technical organization of India in the field of water resources and is presently functioning as an attached office of the Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India. The CWC is entrusted with the general responsibilities of initiating, coordinating and furthering in consultation of the State Governments concerned, schemes for control, conservation and utilization of water resources throughout the country, for purpose of Flood Control, Irrigation, Navigation, Drinking Water Supply and Water Power Development. It also undertakes the investigations, construction and execution of any such schemes as required.[8] CWC used to issue various Guidelines / Manuals etc. on various aspects of flood / dam management. As stated, since States are having primary responsibility of aspects relating to flood / dam management, they are duty bound to implement the CWC Guidelines / Manuals.

9.5. Enactment of '**National Disaster Management Act, 2005**' (DM Act) brought in a paradigm shift on all aspects of disaster management including flood management. The erstwhile relief-centric response was shifted to a proactive prevention, mitigation and preparedness-driven approach for conserving developmental gains and to minimize loss of life, livelihood and property. The National Disaster Management Authority (NDMA), as the main body under the Government of India is now endowed with the responsibility under section 6 of the DM Act to lay down policies, plans and guidelines for disaster management and coordinating its enforcement and implementation. Accordingly it formulated several Guidelines including the National Disaster Management Authority Guidelines on Management of Floods, 2008 (NDMA Guidelines on Floods). NDMA Guidelines on Floods details the role of various Central and State agencies on diverse aspects of flood management. Guidelines issued by the NDMA under section 6(2) of the DM Act are to be mandatorily followed[9] by various stakeholders. Stakeholders are duty bound to implement all such Guidelines. In other

[7] http://www.india-wris.nrsc.gov.in/wrpinfo/index.php?title=Flood_Management
[8] http://www.cwc.gov.in/
[9] Paragraph 2.2.1, NDMA Guidelines on Floods

words, non-compliance / non-implementation of various Guidelines and other stipulations under DM Act amount to failure on the part of various stakeholders.

10. Selected Policy documents, Guidelines /Manuals relating to Dam / Flood Management:

Study of Policy documents / Guidelines / Manuals etc issued by Government / various Authorities (especially CWC and NDMA) on diverse aspects pertaining to Dam Safety and Flood Management would give a general understanding about the standard procedures that are to be followed by various stakeholders.[10] Juxtaposing such documents with ground realities will provide a clear picture about the issue in hand. Some of those notable documents[11] are:

10.1. National Water Policy (2002):

10.1.1. National Water Policy (2002) provides that 'water resource developed in project should as far as possible be planned and developed as multipurpose projects[12]. It provides to put in place a master plan for flood control and management for each flood prone basin[13] and also to make available 'adequate Flood cushion in water storage projects, wherever feasible, to facilitate better management. In highly flood prone areas, flood control should be given overriding consideration in reservoir regulation policy even at the cost of sacrificing some irrigation or power benefits.'[14] [15]

10.2. National Water Policy (2012):

10.2.1. Similarly, National Water Policy (2012) also mandates that 'appropriate safety measures, including downstream flood management, for each dam should be undertaken on top priority'.[16] It also says that flood forecasting should be 'expanded extensively

---

[10] See generally <www.damsafety.in >
[11] There could be other relevant documents than those are discussed hereunder. List is not exhaustive.
[12] Paragraph 6.1, National Water Policy (2002)
[13] Paragraph 17.1, Ibid
[14] Paragraph 17.2, Ibid
[15] National Water Policy (1987) also directs to give importance of flood control.
[16] Paragraph 8.8, National Water Policy (2012)

across the country and modernized using real-time data acquisition system and linked to forecasting models.'[17]

10.2.2. Operating Procedures for reservoirs 'in such a manner to have Flood cushion and to reduce trapping of sediment during flood season'[18] are to be evolved and implemented. It reiterates necessity for preparation of Flood Inundation Maps[19] and updated Emergency Action Plans[20]. Integrated Water Resource Management practices after taking river basin / sub-basin as a unit[21] are also to be evolved.

10.3. Report on Dam Safety Procedure by Central Water Commission and Dam Safety Organization (1986) (Dam Safety Report):

10.3.1. This is one of the early reports submitted before the Government of India by CWC on uniform procedures to be adopted for the safety of various dams in the country. Aim of any reservoir operation, according to Dam Safety Report, is 'to reduce the risk of man-made floods to the areas on the downstream through carefully prepared reservoir regulation schedules, release procedure and gate operation schedules aided by an accurate and reliable flood forecasting and warning system.'[22] Any reservoir operation has to be carefully coordinated between flood disposal and building up of conservation storage.[23] In Chapter VII[24] of the Report, among other steps, periodic 'Stilt Survey' was recommended to be carried out.

10.3.2. Similarly, under Chapter VIII[25], it is mandated to carry out Flood Zoning, preparation of Inundation Maps[26], to make adequate arrangements for public safety[27] etc.

---

[17] Paragraph 10.4, Ibid
[18] Paragraph 10.5, Ibid
[19] Paragraph 10.6, Ibid
[20] Paragraph 10.7, Ibid
[21] Paragraph 12.4, Ibid
[22] Paragraph 7.3.1, Dam Safety Report
[23] Paragraph 7.3.4, Ibid
[24] Guidelines for inspection, operation and maintenance, Chapter VII, Ibid
[25] Emergency Preparedness, Chapter VIII, Ibid
[26] Paragraph 8.4.3, Ibid
[27] Paragraph 8.6, Ibid

10.3.3. It is pertinent to note that while commenting on the management of dams in Kerala, it is reported that 'in Kerala there is no practice of preparing Inundation Maps or Emergency Action Plans'.[28]

10.4. Indian Standard Operation of Reservoirs – Guidelines issued by Bureau of Indian Standards (1994) (BIS Report):

10.4.1. BIS Report, classified reservoirs into three types, viz., (i). Single Purpose reservoirs, (ii). Multi-Purpose reservoirs and (iii). System of reservoirs. Single purpose reservoirs are usually intended for Flood control or conservation (for power generation / irrigation etc). Whereas, a multipurpose reservoir is intended to cater different needs. In such reservoirs, it is necessary to maintain a 'Flood Control Zone'. In case of system of reservoirs, it is necessary to adopt a strategy for integrated operation of reservoirs to achieve optimum utilization of the water resources available and do benefit best out of the reservoirs system.

10.4.2. BIS Report highlights the necessity to maintain 'Rule Curves'[29] based on detailed sequential analysis of various critical combinations of hydrological conditions and water demands.[30] It further mandates that Rule curves, once prepared should be constantly reviewed and, if necessary, modified so as to have the best operation of the reservoirs.

10.4.3. The Report further recommends evolving method of 'operation in real time', in which water control decisions have to be taken at each instant of time[31] instead of fixed operation rules.

10.5. Real Time Integrated Operation of Reservoirs, Central Water Commission (2005) (RTIOR):

10.5.1. RTIOR says 'conventional methods of operation of reservoirs' that are based on empirical methods based on the experience and judgment of managers in taking operational decisions are inadequate

---

[28] Paragraphs 2.5.4 and 2.6.7, Ibid

[29] 'Rule Curve' means 'target level planned to be achieved in reservoirs, under different conditions of probabilities of inflows and/or demands, during various time periods in a year' (see paragraph 2.17, BIS Report)

[30] Paragraph 5, BIS Report.

[31] Paragraph 6, Ibid

and management should be on 'real-time basis'.[32] 'Real time Operation' denotes that mode of operation in which "water control decisions for a finite future time horizon are taken based on the conditions of the system at that instant and forecast of the likely inputs over this time horizon."[33]

10.5.2. While elaborating on the 'Principles of Reservoir Operation,'[34] RTIOR says that 'operation of multipurpose reservoir should be governed by the manner in which various uses of the reservoirs have been combined' and suggested to maintain five basic zones (i.e., spill zone, Flood control zone, conservation zone, buffer zone and dead storage) of reservoirs space.[35] It also says that 'Flood control zone' 'should be emptied as soon as possible to negotiate next flood event'. 'Flood moderation is one of the important functions of reservoirs' and usually it is 'combined with conservation purposes'[36]. In any case, 'Rule Curve' has to be maintained.[37]

10.5.3. In substance, RTIOR suggested to shift to 'Real Time Operation' of reservoirs[38] water control decisions regarding the reservoir operations are to be 'made quickly depending on the purpose of the reservoir operation that is Flood control, conservation, irrigation and/or power releases'.[39] It is to be done so because '*reservoirs based on fixed operation rules, which had developed taking into account the demands and historic/systemic time series data, often poses difficulties in making appropriate reservoir release decisions due to uncertainty in the probability of occurrence of the flood event exactly similar to the past event.*[40] Operation of reservoirs, therefore, becomes an operation in real-time in which water control decisions have to be taken at each instant of time. It is further pointed out that real-time operation is especially suitable during flood periods where the system response

[32] Page 4, RTIOR.
[33] Page 5, Ibid
[34] Chapter 3, Ibid
[35] Paragraph 3.2, Ibid
[36] Paragraph 2.2.7, Ibid.
[37] Chapter 4, Ibid
[38] Chapter 6, Ibid.
[39] Page 25, Ibid.
[40] Ibid.

changes very fast and the decisions have to be taken rather quickly and adapted frequently.[41]

10.6. National Disaster Management Authority Guidelines on Management of Floods (2008) (NDMA Guidelines on Floods):

10.6.1. NDMA Guidelines on Floods is a comprehensive guideline for management of floods so as to 'enable the various implementers and stakeholder agencies to address effectively the critical areas for minimizing flood damages'. It basically suggests shifting the focus to preparedness by implementing, in a time bound manner, the various suggestions made therein.

10.6.2. Various activities suggested in the NDMA Guidelines on Floods are to be implemented in three different phases, in addition to recurring activities.

10.6.3. Phase I activities include identification and marking of flood prone areas on maps and preparation of vulnerability maps. In this phase, stakeholders were mandated to modify operation manuals and rule curves. These activities were originally scheduled to be completed by January, 2010.

10.6.4. Phase II activities include implementation of the schemes for expansion and modernisation of Flood forecasting and warning network and adoption of reservoir operation manuals and enforcement of floodplains zoning regulations etc. This was supposed to be completed by March, 2012.

10.6.5. While Phase III envisages implementation of various activities including construction of dams and catchment area treatment works in India as well as in neighbouring countries. Deadline for this phase is 2025.

10.6.6. Whereas recurring activities include inspection of dams, embankment and other structural measures, execution of restoration

[41] Ibid.

and strengthening works. Expansion and modernization of Flood forecasting and warning system are also to be carried out.

10.6.7. Role of 'Flood Forecasting'[42] and 'Dams, Reservoirs and other Water Storages'[43] in Flood Management were elaborately dealt with in the guidelines. According to the same, reservoirs provide a good long-term solution to the problem of Flood. It reiterates the recommendation in National Water Policy (2002) that Flood control is to be given overriding consideration in reservoir regulation policy.[44]

10.7. Guidelines for Developing Emergency Action Plans for Dams, Central Water Commission, (2016) (EAP Guidelines):

10.7.1. An EAP for a dam is written document prepared by the dam owner, or the dam operator, describing a detailed plan to prevent or lessen the effects of a failure of the dam or appurtenant structures.[45]

10.7.2. EAP response process includes 5 steps and they are (i). Step 1 - Event Detection; (ii). Step 2 - Emergency Level Determination; (iii). Step 3 - Notification and Communication; Step 4 – Actions to be Taken and (v). Step 5 - Termination and Follow-Up.

10.7.3. It is pertinent to note that under the Step 2 (i.e. Emergency Level Determination) three levels of emergencies are usually issued. Different levels of emergencies are denoted as Blue[46], Orange[47] and Red[48]. While declaring various levels of emergencies, both the dam owner and disaster management authorities are supposed to take several steps.[49] Thereafter, further steps are to be taken in accordance with the mandates stipulated under Steps 3 and 4.[50] Similarly, while performing Notification and Communication activities, it is important that people speak in clear, non-technical terms to ensure that those

---

[42] Chapter 4, NDMA Guidelines on Floods.
[43] Chapter 5, Ibid
[44] Paragraph 5.3, Ibid.
[45] Page 1, EAP Guidelines.
[46] Paragraph 2.2.1, Ibid
[47] Paragraph 2.2.2, Ibid
[48] Paragraph 2.2.3, Ibid
[49] Chapter 2, Ibid
[50] Ibid.

being notified understand what is happening at the dam and which action to take.[51]

10.8. Guidelines for Preparing Operation and Maintenance Manual for Dams, Central Water Commission (January 2018) (O&M Manual):

10.8.1. O&M Manual is a detailed written document of procedures and protocols for ensuring that a dam is operated and maintained properly and timely. O&M Manual is *sine qua non* for safe operation of dam/reservoirs and shall inter alia provide details regarding Rule curves, inflow forecasting and Flood release procedure.[52]

11. Report of the Comptroller and Auditor General of India on 'Schemes for Flood Control and Flood Forecasting' Report No. 10 of 2017 (CAG Report No. 10, 2017):

11.1. Performance of the aforementioned and other Schemes for Flood Control and Flood Forecasting were audited by the Comptroller and Auditor General of India in CAG Report No. 10, 2017. In this Report it is found that execution of Flood Management Programmes, Flood Forecasting and other Schemes of Flood Control are not satisfactory.

11.2. CAG Report No. 10 (2017) specifically recorded that no Flood Forecasting Stations were established in Kerala.[53] Similarly it is also recorded that no EAPs were prepared for any of the 61 dams in Kerala.[54] So is the case with aspects such as Hydrology Studies, Inundation Maps,[55] and Flood Plain Zoning[56] etc.

12. Selected Study Reports / Articles on Kerala Floods, 2018:

Different expert(s) and / or academic bodies have analyzed the causes of Kerala Floods, 2018 and had prepared Reports from various angles. Notable among them are:

i. *'Study Report – Kerala Floods of August, 2018'* by Hydrology (S) Directorate, Central Water Commission, Government of India;

---

[51] Paragraph 2.3, Ibid
[52] Paragraph 2.2, O&M Manual
[53] Paragraph 4.1, CAG Report No. 10 (2017)
[54] Paragraph 5.3.1, Ibid
[55] Paragraph 5.3.2, Ibid
[56] Paragraph 6.9, Ibid

ii. *'Role of dams on the floods of August 2018 in Periyar River Basin, Kerala'* by Sudhir KP (IIT Chennai) & Others; '*Current Science*', Vol 116, No. 5 page 780; is a Research Article published in the science journal – *Current Science*

iii. '*The Kerala Flood of 2018: combined impact of extreme rainfall and reservoir storage*' by Vimal Mishra (IIT Gandhinagar) & Others – This article is understandably under review / discussion for international journal '*Hydrology and Earth System Science*';[57]

iv. '*Role of Dams in Kerala's Flood Disaster*' by Himanshu Thakkar of South Asia Network on Dams, Rivers and People, Delhi is a commentary published in Vol LIII No. 38 *Economic and Political Weekly* 20 etc.

12.1. '*Study Report – Kerala Floods of August, 2018*' by Hydrology (S) Directorate, Central Water Commission, Government of India (CWC Report): This report is already on record as Exhibit R1(ba) in the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018 and as Exhibit R5(d) in the Counter Affidavit filed on behalf of Kerala Dam Safety Authority in WPC 28502 of 2018; and is heavily relied on by those respondents to substantiate their contention that the Kerala Floods occurred mainly due to extremely heavy rainfall.

12.1.1. Major Findings of CWC study as detailed in its paragraph 6.0 are:

i. The time required for water from farthest point of the catchment area of most of the reservoirs in Kerala to reach the catchment outlet is about 2 to 3 hours;

ii. Total rainfall which occurred in Kerala between 01-08-2018 and 19-08-2018 is 164% above normal;

iii. Average cumulative rainfall of 15-17, August 2018 is about 414 mm for the entire State and this created severe flooding in the State;

iv. During August 2018, the reservoirs were either at FRL or only a few feet below FRL;

---

[57] accessible at *https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-480/hess-2018-480.pdf*

v. During 15-17, August 2018 the three-day rainfall depths realised in Periyar, Pamba, Chalakkudi and Bharathapuzha sub-basins was very high and is similar to that of 1924 rainfall;

vi. Dams in Kerala neither added to the flood nor helped in reduction of floods, as most of the dams were already at FRL or very close to FRL on 14-08-2018 due to more than normal rainfall in the month of June to July, 2018. In any case it would have been necessary to release water from the reservoirs after 1st day of extreme rainfall;

vii. It is essential to review the Rule Curves of all the reservoirs in Kerala in order to create some dynamic flood cushion;

viii. August 2018 flooding in Kerala was due to severe storm occurrences during 8-9 August 2018 and 15-17 August 2018. The storm of 15-17 August 2018 resulted in heavy flooding in Periyar, Pamba, Chalakkudi and Bharathapuzha sub-basins of Kerala. This rainfall is comparable to the historical 16-18 July 1924 rainfall of Kerala;

ix. The release of reservoirs had only minor role in Flood augmentation as released volume from reservoirs were almost similar to inflow volumes. Even, with the 75 percentage filled reservoirs conditions, the current flood could not have been mitigated as one-day rainfall in majority of the area was more than 200 mm and severe rainfall continued for 3 to 4 days.

12.1.2. The main recommendation detailed in paragraph 7.0 of the report is to review Rule Curve of all the reservoirs in Kerala to create dynamic flood cushion. It also recommended creating more storage reservoirs for Flood moderation.

12.2. *'Role of dams on the floods of August 2018 in Periyar River Basin, Kerala'* by Sudhir KP & Others [*Current Science*, Vol 116, No. 5 page 780].

12.2.1. The research question raised in this paper is - *Whether the early release of water stored in reservoirs would have attenuated the flood peaks, and if so, what would have been the extent of this attenuation?* In this paper, flood events occurred in Periyar River Basin (alone)

during August 2018 were numerically reconstructed and different scenarios of reservoir operation and antecedent conditions were analysed using the Hydrologic Modelling System of Hydrologic Engineering Centre, US Army Corps of Engineers (HEC-HMS).

12.2.2. Important findings / conclusions therein are:

i. Historical rainfall data of Kerala state indicate that maximum rainfall is experienced in June and July months, as compared to August and September;

ii. Rainfall in August 2018 was of a very highly recurrence interval (say a return period of 145 years);

iii. Dams/reservoirs in Periyar river basin were not designed for Flood control purpose, but for hydropower/irrigation, and therefore the operation policy has been to maintain the reservoir level close to FRL throughout the monsoon season to ensure maximum power generation;

iv. Probability of extreme rain event of this kind experienced in August 2018 in Periyar river basin is very small (only 0.6%), and therefore any planned operation could not have helped in mitigating floods of such magnitude as the reservoir design and/or operation might not have considered such events;

v. Role of releases from the major reservoir in Periyar River Basin to control flood havoc was less and reservoir operation could not have helped in avoiding flood situation;

vi. Improvement in the reliability of forecasting, coupled with good inflow forecasting system could help to improve the management of reservoirs;

vii. It is necessary to revisit the rule curves of the reservoirs by considering the dams as multipurpose and multi-reservoirs water resources terms, and developing integrated reservoir operation policies so as to maintain the balance between flood control and other system objectives (such as hydropower generation and irrigation).

12.3. ***'The Kerala Flood of 2018: combined impact of extreme rainfall and reservoir storage'*** by Vimal Mishra (IIT Gandhinagar) & Others accessible at <*https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-480/hess-2018-480.pdf*>

12.3.1. Conclusions drawn in this paper are:

i. Kerala received above normal rainfall in the monsoon season of 2018, which contributed to reservoir storage significantly;

ii. Most of reservoirs in Kerala had more than 90% of its capacity on 08-08-2018. Since heavy rain in the catchment's upstream of major reservoirs was unprecedented, reservoirs had to release considerable amount of water in a short span of time;

iii. Combination of factors such as above normal seasonal rainfall, statewide extreme rain, high reservoir storage, and unprecedented extreme rain in the catchment upstream to major reservoirs have played a significant role in the large-scale flooding in the state;

iv. Seasonal and extended range forecast of rainfall and improved forecast of extreme rain events at a longer lead can help in the reservoir operation.

12.4. ***'Role of Dams in Kerala's Flood Disaster'*** by Himanshu Thakkar, Vol LIII No. 38 *Economic and Political Weekly* 20.

12.4.1. According to this commentary; conclusion reached by CWC that "dams in Kerala neither added to the flood nor helped in reduction of flood, as most of the dams are already at FRL or very close to FRL on 14 August 2018, due to more than normal rainfall in the months of June to July 2018" is only an effort to absolve the dams from any blame and is only a misleading and incorrect assumption. It says that floods in the downstream area, caused due to opening of a dam is very different from the normal flood for a number of reasons such as:

i. During normal floods, water will only rise gradually and this allows people to prepare for the same and can save lives as well as valuables. Whereas floods from water released by dams come much more suddenly, leaving little time to respond;

ii. The potential damage from water suddenly released from the dam is much greater than that of a gradually rising flood in the river;

iii. The river downstream, flood plains, flood carrying capacity and riverbed which do not experience regular flood will be changed and will be usually encroached by people (eg. downstream of Idukki dam);

iv. The water released from dam is either relatively silt free or carrying too much silt if released from the bottom sluices. In either case, it is different from normal rain-induced flood water, and has a different damage potential;

v. CWC Report has not asked the real question - has the dam operators done everything possible to moderate the floods in the downstream areas?

vi. Almost all dams were almost full by the end of July;

vii. CWC Report does not mention as to whether the dam operators followed or violated the Rule Curves.

12.4.2. Conclusions of this paper are:

i. Kerala needs to update or formulate Rule Curves for all dams;

ii. There should be study of the downstream channel carrying capacity and removal of illegal encroachments;

iii. There should be mapping of inundation areas and formulation of standard operating procedures for different scenarios;

iv. There should be flood forecasting that takes into account both the upstream and downstream areas;

v. Information regarding each dam should be made available in public domain; and

vi. There should be Dam Management Committee for each dam.

13. Study of pleadings, Guidelines / Reports and selected articles leads to the following CONCLUSIONS:

13.1. Rainfall:

13.1.1. Counter affidavit filed on behalf of State of Kerala in WPC 29296 of 2018 states that actual rainfall received in Kerala between 15-17, August 2018 exceeded the expectations. Such heavy rain was never

predicted by India Metrological Department (IMD).[58] Rainfall over Kerala during June, July and August 1-9 was 15%, 18% and 164% above normal.[59] 'IMD never predicted "extremely heavy" rain before 15-08-2018 and the State was already reeling under floods with extremely heavy rains when such prediction of IMD was received by 15-08-2018'.[60] If the monsoon went according to Long Range Forecast (LRF) of IMD and its subsequent prediction, no deluge would have occurred in the State'.[61] "Though there was recurring showers since July, the torrential downpour which lashed throughout the length and breadth of the State from August 15-17, which was well beyond all human (*sic.*, available) predictions, turned fatal. The rain in these 3 days was above all forecast and the situation resulted in a major calamity."[62]

13.1.2. KSEB in its affidavit stated that "the management of floods was more or less under control until 14-08-2018 when unprecedented rainfall to the tune of 1032mm in a span of 4 days necessitated the neutralisation of inflow for the safety of the dams".[63] "This heavy spell was then followed by an extremely heavy rainfall event, which started on August 14 and continued up to August 19. The peak of this event was observed between August 15 and 17."[64] KSEB affidavit further says, "...most of the reservoir systems of Kerala swelled during first heavy spell during the third week of July itself, and the water level in several major reservoirs started to rise above normal levels. But the heavy rainfall and extremely heavy rainfall event during August 8-19 period forced the authorities to open the spillways of some reservoirs in order to release excess water, which was meant only to safeguard those structures and to ensure public safety"[65]

13.1.3. CWC Report on Kerala Floods concluded that rainfall in Kerala between 01-06-2018 and 19-08-2018 was above 42% of the normal

[58] Paragraph 31 of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[59] Paragraph 32, Ibid
[60] Paragraph 218(iii), Ibid
[61] Ibid
[62] Paragraph 222(iii), Ibid
[63] Page 31, Counter Affidavit of KSEB in WPC 28954/2018
[64] Page 33, Ibid
[65] Pages 33-34, Ibid

rainfall.[66] Rainfall between 15-18 August, 2018 created severe flooding in the State[67] and 2.19 BCM downpour during these three days are comparable to the 1924 rainfall.[68] This fact is scientifically tested and ascertained in various articles / reports[69] also. It is seen that **Kerala received above normal rain between 01-06-2018 and 19-08-2018. It was above 42% of the normal rainfall and that the rainfall between 15th and 17th August, 2018 was extremely heavy / torrential in nature**. This is the main reason for deluge.

13.2. However there are **other reasons** also that lead to aggravation of floods and they are as follows:

13.3. Dams in Kerala and its role in moderating floods:

13.3.1. National Water Policy, while addressing aspects pertaining to Flood Control and Management, has declared that '*...adequate flood cushion should be provided in water storage projects to facilitate better flood management and that flood control should be given overriding consideration in reservoir regulation policy, even at the cost of sacrificing some irrigation or power benefits*'.[70] This recommendation was reiterated[71] in NDMA Guidelines on Floods and '*concluded that reservoirs do moderate floods*'[72] and that the '*extent of moderation depends on the available space in the reservoir for storage of water during floods*'[73]. Reservoir is the most important component of a water resources development scheme and empty space in a reservoir enables to store flood water.[74] Thus, control / moderation of flood ought to be one of the important functions of any dam / reservoir. Even if a dam / reservoir was originally conceived for a single purpose (i.e., irrigation or power generation etc.); in view of the stipulations under

---

[66] Paragraph 6.0(ii), CWC Report
[67] Paragraph 6.0(vi), Ibid
[68] Paragraphs 6.0(vii) and (xiv), Ibid
[69] See *'Role of dams on the floods of August 2018 in Periyar River Basin, Kerala'* by Sudhir KP & Others [Current Science, Vol 116, No. 5 page 780]; *'The Kerala Flood of 2018: combined impact of extreme rainfall and reservoir storage'* by Vimal Mishra (IIT Gandhinagar) & Others – Accessible at <https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-480/hess-2018-480.pdf>
[70] Paragraph 17.2, National Water Policy (2002)
[71] Paragraph 5.3, NDMA Guidelines on Floods (2008)
[72] Paragraph 5.4, Ibid
[73] Paragraph 5.4, Ibid
[74] Chapter 2, RTIOR

National Water Policy, NDMA Guidelines on Floods, RTIOR and other similar directive mandates, the State and dam managers shall utilize dams / reservoirs for flood control purpose also.

13.3.2. In Kerala, there are 79 (seventy nine)[75] dams/ reservoirs/ barrages under the control of Kerala State Electricity Board and Irrigation Department, Government of Kerala. However, it is candidly admitted by the State in its Counter Affidavit that purpose of dams in Kerala is either power generation or irrigation[76] and "not to contain the flood."[77] Affidavit further says "the reservoirs are commonly built in India for conservation of water and flood control purposes. In our State, there are no dams exclusively for flood control".[78]

13.3.3. The CWC Report,[79] Counter affidavits filed by State of Kerala,[80] KSEB[81] and DSA[82] averred that rainfall and consequent floods that happened in 2018 are comparable to the historic floods of 1924 and imply such an event is uncontrollable and unmanageable. However it may not be safe and prudent to draw analogy to that event which occurred about a century back to justify flood havoc that occurred in 2018. First of all it is to be noted that in 1924 only Mullaperiyar dam was there in Kerala and now there are 79 dams.[83] It is also relevant to note that there are significant development in the field of science, technology and various aspects relating to flood management and reservoir operations in modern days. Similarly we are having specialized institutions such as CWC, DSO, NDMA / SDMA etc. that could deal with diverse aspects of dam / flood management. Real question to be asked is whether we failed in utilizing large number of

[75] KSEB has 59 dams (27 large dams, 30 small dams and 2 mini dams) and Irrigation Department has 20 dams (16 dams and 4 major barrages) [See paragraphs 36 and 103 of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018].
[76] Paragraph 35 of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[77] Paragraphs 106 and 218(iv), Ibid
[78] Paragraph 105 of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[79] Paragraph xiv, CWC Report
[80] Paragraph 222(iii) and (v) of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[81] Page 34 of the Counter Affidavit filed on behalf of KSEB in WPC 28954 of 2018
[82] Paragraph 9 of the Counter Affidavit filed on behalf of Kerala Dam Safety Authority in WPC 28502 of 2018
[83] See <*http://www.india-wris.nrsc.gov.in/wrpinfo/index.php?title=Dams_in_Kerala*> for list and details of dams in Kerala (accessed on 02-03-2019)

dams to manage extreme rainfall that resulted in floods and in tapping modern scientific and technological developments for flood management?

13.3.4. As such, it is a matter of concern that none of these dams / reservoirs could be utilized for the purpose of flood control despite specific stipulations under National Water Policy, NDMA Guidelines on Floods, RTIOR and other similar directive mandates. **Thus it is clear that, none of the 79 dams in Kerala were operated or used for the purpose of flood control / moderation despite the obligation to utilize dams for the purpose of flood control / moderation also as per stipulations under National Water Policy, NDMA Guidelines on Floods, RTIOR and other similar directives**.

13.4. Flood Control Zone as stipulated in relevant guidelines:

13.4.1. Flood cushion or Flood Control Zone is '*the storage space earmarked as temporary storage for absorbing high flows for alleviating downstream flood damages. This space should be emptied as soon as possible to negotiate next flood event.*'[84]

13.4.2. Counter affidavit filed by State of Kerala and KSEB would show that "even though the dams in the State are not flood control dams, flood cushions (difference between FRL and Final warning level) are provided to regulate flood water in the reservoir."[85] However, for eg: in KSEB dams such as Idamalayar FRL is 169m, Red Alert level is 168.5 m, MWL is 171.2m[86] and actual release of water was made on 09-08-2018 when water level reached 171.2m / MWL[87]; in Kakki reservoir FRL is 981.46m, Red alert level is 980.90m, MWL is 982.16m[88] and actual release of water was made of 09-08-2018 when water level reached on 981.25m; in Pampa reservoir FRL and MWL was fixed as 986.33m, Red alert level is 986m and actual release was made on 10-08-2018 when water level reaches 986.20m.[89] Similarly in Irrigation

[84] Paragraph 3.2(b)RTIOR and Paragraph 2.8, BIS Report
[85] Paragraphs 106 and 218(iv) of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[86] Paragraph 56, Ibid
[87] Paragraph 58, Ibid
[88] Paragraph 62, Ibid
[89] Paragraphs 66 and 67, Ibid

Department dams such as Malampuzha also FRL is 115.06 m and Red alert stage is 114.45m and actual release of water was made on 01-08-2018 when water level reaches 114.86m;[90] in Neyyar FRL is 84.75, 3rd / Red alert level is 84.4m and water was released when the level reached 84m.[91] Almost all dams in Kerala released water only after the water level crossed FRL or reaches near MWL.[92]

13.4.3. Dam Safety Report, as back as in 1986, clearly stipulated that "*in case of gated reservoirs, while it is desirable to fill the reservoir early, it should not be brought to near FRL...*'.[93] It further stipulated that the '*reservoir operation should be carefully coordinated between flood disposal and the building up of conservation storage*'[94] and this is achieved *inter alia* by guide curves / rule curves. According to RTIOR 'Flood Control Zone' is to be earmarked as temporary storage and this space should be emptied as soon as possible to negotiate next flood event.[95] BIS Report[96], RTIOR[97] and O&M Manual[98] specifically mandates to provide Flood cushion or Flood Control Zone below FRL and above Conservation Zone.

13.4.4. Details provided in the counter affidavit would show that (i). water was simultaneously allowed to be filled close to FRL in all the dams even before floods, (ii). release of water from most dams were made when the water level crossed FRL or reached near to MWL and thus the flood cushion is not maintained and (iii). no empty space was maintained in anticipation of floods. Thus it appears that **dams in Kerala had not maintained effective Flood Control Zone and the flood cushion said to have maintained is not as mandated by the BIS Report, RTIOR and O&M Manual**. Had proper flood cushion or Flood Control Zone been maintained, to what extent floods could have been contained and to what extent damage could have been mitigated

---

[90] Paragraph 112, Ibid
[91] Ibid
[92] See generally Paragraphs 50 to 96 and 112 of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[93] Paragraph 7.3.3, Dam Safety Report
[94] Paragraph 7.3.4, Ibid
[95] Paragraph 3.2(b), RTIOR
[96] Paragraph 4.1.2.2 and Fig 1, BIS Report
[97] Paragraph 3.2 and Fig 3.1, RTIOR
[98] Page 18, O&M Manual

or whether water release could not have avoided the flood event[99] etc. is a matter of further enquiry.

13.5. High Reservoir Storage and sudden release of water:

13.5.1. Conclusion drawn in CWC Report to the effect that '*dams in Kerala neither added to the flood nor helped in reduction of flood, as most of the dams were already at FRL or very close to FRL on 14 August 2018 due to more than normal rainfall in the months of June to July 2018*'[100] is an aspect that requires deep analysis. It is an admitted fact that 'State was already reeling under floods with extremely heavy rains when prediction of IMD was received by 15-08-2018.'[101] KSEB affidavit also says that "...most of the reservoir systems of Kerala swelled during first heavy spell during the third week of July itself, and the water level in several major reservoirs started to rise above normal levels."[102] Even CWC Report says "*the water level in several reservoirs were almost near their Full Reservoir Level(FRL) due to continuous rainfall from 1st June. Another severe spell of rainfall started from 14th of August and continued till the 19th of August, resulted in disastrous flooding in 13 out of 14 districts in Kerala*".[103] Similarly, scientific journal also found that 'reservoirs storage before flooding was anomalously high in most of (the seven) reservoirs (under study).[104] Therefore it could be inferred that **most of the major reservoirs were almost full before the extreme rainfall occurred on 14-16 August, 2018 and they did not have the capacity to accommodate the additional flow generated by extreme rainfall.**[105] And as such, authorities were compelled to release substantial amount of water from reservoirs in a short span of time, at the peak of the rainfall period.

13.5.2. Connection between high reservoir storage, sudden release of water and resultant floods in downstream is succinctly detailed in

---

River Basin, Kerala' by Sudhir

NDMA Guidelines on Floods as "...*Reservoirs can, however also, accentuate the flood problem in the downstream areas if the rules for the regulation are not prepared considering the flow carrying capacity of the rivers and the safety of the dams. Similarly, if the reservoirs are not operated according to the operation manual and reservoir is filled at the beginning of the monsoon season for meeting water demands for irrigation, hydropower, drinking and industrial water supply, a large quantity of water may suddenly have to be released to prevent the crossing of Maximum Water Level (MWL) and for ensuring the safety of dam which may lead to flooding downstream. The inability on the part of the agency in charge of operating reservoirs to anticipate intense rainfall in the catchment, and consequently large inflows into the reservoirs, may also necessitate the release of a larger quantity of water resulting in large-scale flooding*".[106] Even according to the CWC, "floods may also get aggravated due to release of water from reservoirs when the rivers are already in floods"[107]

13.5.3. It is also relevant to note that floods in the downstream area, caused due to opening of a dam are very different from the normal flood as[108] (i). During normal floods, water will only rise gradually and whereas floods from water released by dams come much more suddenly, leaving little time to respond; (ii) the potential damage from water suddenly released from the dam is much greater than that of a gradually rising flood in the river (iii) the water released from dam is either relatively silt free or carrying too much silt if released from the bottom sluices. In either case, it is different from normal rain-induced flood water, and has a different damage potential. Peak of Kerala flood was between 14-19 August, 2018 and most of the towns and places were suddenly inundated and there was abnormal rise of water. Hence, it is seen that sudden release of large quantity of water has accelerated the flood event.

---

[106] Paragraph 5.4, NDMA Guidelines on Floods

[107] Paragraph 1.1.3 of 'Manual on Flood Forecasting' by Central Water Commission accessible at -<http://www.cwc.gov.in/file/1716/download?token=zVFUDOyn> (accessed on 22-03-2019)

[108] See '*Role of Dams in Kerala's Flood Disaster*' by Himanshu Thakkar; Vol LIII No. 38 Economic and Political Weekly page 20

13.5.4. Thus it is seen that **high reservoir storage and sudden release of water has resulted in worsening the floods in Kerala**.

13.6. De-Silting:

13.6.1. Along with the fact that almost all reservoirs in Kerala were holding water to the maximum of its holding capacity even during the first week of August, 2018, it is also necessary to note that, according to Dam Safety Authority "several dams have reduced storage capacity as a result of silting."[109] According to CWC, 'handling of sediments is found to be a major challenge in the operation of reservoir' and that sedimentation will result in 'loss of active storage volume'[110]

13.6.2. Dam Safety Report specifically mandates to carryout reservoir silt survey at regular intervals.[111] Similarly O&M Manual points out that 'reservoir capacity may change because of sedimentation that reduces available storage volume over time.'[112] As such, it is obligatory on dam managers to carry out periodic silt survey and to take steps to maintain maximum water storage capacity in reservoirs. However the CWC Report and counter affidavits are silent on this aspect. As such it is seen that, **water storage capacity of reservoirs in Kerala was reduced due to siltation and sedimentation and this might have contributed for aggravation of flood event.** This is also a very significant aspect for enquiry.

13.7. Rule Curves:

13.7.1. Rule Curve is the target level planned to be achieved in a reservoir under different conditions of probabilities of inflows and / or demands, during various time periods in a year.[113] Every dam is supposed to have a dam specific rule curve.

---

[109] Paragraph 7 of the Counter Affidavit filed on behalf of Kerala Dam Safety Authority in WPC 28502 of 2018

[110] Paragraph 1 of 'Guidelines for Sediment Management in Hydropower & WR Projects', published in September, 2018 accessible at <http://www.cwc.gov.in/file/5781/download?token=m8gZPNnb> (accessed on 22-03-2019). This document provides details of sedimentation and siltation of reservoirs.

[111] Paragraph 7.5.1, Dam Safety Report

[112] Paragraph 2.2.5, O&M Manual

[113] See generally Paragraph 4, BIS Report; Chapter 4, RTIOR; Paragraph 2.2, O&M Manual

13.7.2. Counter affidavits filed by State of Kerala, KSEB and DSA are silent about the existence or operation of dams in Kerala in accordance with dam specific rule curves. Even the CWC Report is also silent on the aspect regarding compliance of rule curves and also does not say whether Kerala dams were operated as per standard rule curves during floods. However the first recommendation of the CWC Report is to 'review the rule curves of all the reservoirs in Kerala' and to 'formulate rule curves for both conservation as well operations during the flood'.[114] Thus it is seen that **none of the dams in Kerala had updated rule curves based on which the same were operated during the floods**.

13.8. Emergency Action Plans:

13.8.1. Emergency Action Plan (EAP) is a written document prepared by the dam owner, or the dam operator, describing a detailed plan to prevent or lessen the effects of a failure of the dam or appurtenant structure.[115] Dam Safety Report (1986) says 'the aim of (Dam) management cannot be handling of the natural phenomena itself, but rather to lessen or mitigate its impact upon human beings and natural environment. In order to carry out such measures it is necessary to have a proper plan and well defined measures which would help to reduce the risk of disaster.'[116] Significance of EAP was highlighted by the NDMA in its Guidelines on Floods (2008) wherein it is said that "*...Reservoirs can, however also, accentuate the flood problem in the downstream areas if the rules for the regulation are not prepared considering the flow carrying capacity of the rivers and the safety of the dams.*"[117]

13.8.2. In this context, NDMA directed the State Government / SDMA to (i). draw up an action plan by June 2008 for completing review / modification of rule curves and operation manuals within a period of three years (ii). to set up expert committees by September 2008 with the CWC's representatives for review of rule curves / operation manuals for each of the major reservoirs;[118]

rules of all existing reservoirs by December, 2009 etc. It further says that State Governments / SDMA will be assisted by CWC and IMD in implementation of these and other steps.[118] Specific Action Plan with 2009 as deadline was given.[119] Need for an EAP and detailed procedure for its preparation was highlighted in EAP Guidelines.[120] Notification flowcharts[121] (notifying levels of emergency i.e., Blue/Orange/Red); Inundation Maps[122] that includes detailed Maps; Emergency classification[123] so as to reduce under / over reaction to an emergency etc. are to be specifically included in the EAP.

13.8.3. CAG Report No. 10 (2017) finds that no EAPs were prepared for any of the 61 dams in Kerala.[124] KSEB affidavit stated that they had "started preparation" or "initiated action"[125] for preparing EAPs. State of Kerala in its affidavit submits that EAPs for dams in Kerala is "in the process of developing" and adds "although Emergency Action Plan (EAP) is in making, the State Dam owners have followed all the 5 steps of process outlined in the Guidelines for Developing EAP for Dams published by CWC".[126] Developing the 'Five-Step response process'[127] in an EAP is a scientific and technical procedure involving different elements.[128] Facts provided in paragraph 220 of the counter affidavit filed by the Government of Kerala, do not seen to comply with the details stipulated in the EAP Guidelines. However, CWC Report also does not address this issue.

13.8.4. Thus it seems that **none of the dams in Kerala had an EAP, despite NDMA mandate to have the same by 2009 and that the dams in Kerala were not operated as per the stipulations in EAP Guidelines**. It also not known how the elaborate steps mentioned in EAP Guidelines could be followed in the absence of an 'approved

[118] Paragraph 5.4, Ibid
[119] Paragraph 5.6, Ibid
[120] See EAP Guidelines
[121] Paragraph 3.3, Ibid
[122] Paragraph 3.4, Ibid
[123] Paragraph 3.5, Ibid
[124] Paragraph 5.3.1, CAG Report No. 10, 2017
[125] Page 37 of the Counter Affidavit filed on behalf of KSEB in WPC 28954 of 2018
[126] Paragraph 222(1) of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[127] Chapter 2, EAP Guidelines
[128] Chapter 3, Ibid

EAP'[129] and whether such steps were actually followed as stated in paragraph 220 of the counter affidavit filed by the State of Kerala need to be technically verified and confirmed by an expert body.

13.9. Alerts issued and precautionary steps taken:

13.9.1. In the affidavit filed on behalf of the State of Kerala it is stated that on 25-07-2018, a meeting was convened by the CMD of KSEB and had fixed "3 stage alert levels" for various dams under the KSEB.[130] Minutes of the said meeting is on record as Exhibit R7(h) in WPC 28594 of 2018 wherein it is stated that "due to the continuous downpour for the last few days, the water level in the dams under the KSEBL reached alarming levels". Levels fixed by KSEB[131] for issuance of various alerts (Blue/ Orange/ Red) and details regarding issuance of actual alerts as well as that of dams under irrigation department[132] were detailed in the counter affidavit.

13.9.2. Affidavit filed on behalf of Government of Kerala and KSEB shows that 'alert levels' were fixed and in case of almost all dams all alerts including 'Red alert' was issued. However EAP Guidelines says "a Red emergency level is triggered when dam failure is about to occur or is already in progress" and once a decision is made to issue Red alert "*an order of evacuation of residents in potential inundation areas will be issued immediately*".[133] Here it is to be noted that for almost all dams, Red alert was issued. It seems that **various alerts (Blue / Orange/ Red) were issued not in accordance with EAP Guidelines**.

13.9.3. Even if it is assumed that Red alert is correctly issued for each of the dams, still the question whether all precautionary steps (especially for evacuation of people) and follow up actions as per EAP Guidelines, after issuance of Red alert, was made or not is required to be ascertained. Paragraphs 85 and 86 of the counter affidavit filed by State of Kerala in WPC 26269 of 2018 detailed steps taken in Idukki

[129] Approved by Central or State Dam Safety Organization as the case may be as per Paragraph 3.8 of EAP Guidelines
[130] Paragraph 43 of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[131] Paragraph 219, Ibid
[132] Paragraph 112, Ibid
[133] Paragraph 2.2.3, EAP Guidelines

district prior to and after the opening of shutters in Cheruthoni dam. However, no such details are provided in respect of the other dams / areas in the State.

13.9.4. For eg: Red alert was issued for Idukki dam on 09-08-2018;[134] for Kakki-Anathode on 08-08-2018;[135] for Pamba on 09-08-2018[136] and so on. However, actual flood and inundation happened on several downstream areas after 14-08-2018. In fact in many places (such as Chalakkudi, Paravoor, Ranny, Chenganoor etc) people were clueless about sudden rise of water and possible level of inundation. Thus it is seen that **no proper follow-up action and effective precautionary steps (especially for evacuating people and accommodating them in safe locations) were taken after issuance of Red alert**. This is also a matter of enquiry.

13.10. IMD Forecasting:

13.10.1. KSEB in its affidavit states "KSEBL relies on the periodical data and forecast provided by the IMD;"[137] "it is based on the predictions from IMD that the KSEBL was maintaining the levels in the reservoir so as to accommodate the rainfall"; "dam levels as on 09-08-2018 were capable of accommodating the rainfall as predicted by the IMD vide Ext. R7(f)" and that "KSEBL could not have pre-emptied the water in the dams based on data / forecast provided by IMD."[138] Similarly, State of Kerala has also stated that 'extremely heavy rains were not predicted by IMD' and such prediction was received only on 15-08-2018.[139] From these averments, it seems that variation in IMD prediction is cited as one of the main reasons for not releasing water.

13.10.2. However it is to be noted that in Opening web page of India Metrological Department, Ministry of Earth Sciences, Government of India <http://www.imd.gov.in/pages/disclaimer.php> contains a

---

[134] Paragraph 53 of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018
[135] Paragraph 63, Ibid
[136] Paragraph 67, Ibid
[137] Page 4 of the Counter Affidavit of KSEB in WPC 28954/2018
[138] Page 5, Ibid
[139] Paragraphs 32 and 218(iii) of the Counter Affidavit filed on behalf of State of Kerala in WPC 29296 of 2018

disclaimer which reads that "*the India metrological Department website contains some derived products based on real-time data with only limited quality control. The Department does not guarantee the currency, correctness, accuracy, reliability, or any other aspect regarding characteristics or use of information presented. Timely delivery of data and products from the server through the Intgov is not guaranteed. The user accepts sole responsibility and risk associated with the use of the data provided through India metrological Department's website. Department is providing this data "as is" and disclaims any and all warranties, whether express or implied, including (without limitation) any implied warranties of merchantability or fitness for a particular purpose....*"

13.10.3. Thus the **dam managers ought not to have 'solely' relied on IMD predictions for dam management and variation in IMD forecast or prediction cannot be counted as a justification for delayed release of water from dams.**

13.10.4. However, according to RTIOR 'hydrologic forecast plays a dominant role in reservoir operation'[140] and 'estimation of empty storage requirements during various time periods forms part of flood moderation operation and forecast plays a vital role in increasing flood moderation efficiency'.[141] 'Flood Forecasting enables us to be forewarned.'[142] Chapter 4 on Flood Forecasting in NDMA Guidelines on Floods elaborates the procedures and role of different stakeholders in this regard.

13.10.5. At the same time, Union of India's affidavit states that 'no proposal was received from State of Kerala and therefore no Flood Forecasting Stations in Kerala are maintained by CWC.'[143] Hence **it is imperative to put proper Flood Forecasting system in place for effective flood management.**

---

[140] Paragraph 2.4, RTIOR
[141] Paragraph 2.4.1, Ibid
[142] Para 4.1, NDMA Guidelines on Floods
[143] Paragraph 36.3 of the Counter Affidavit filed by Union of India in WPC 28502 of 2018

13.11. Reduction in water carrying capacity of rivers and encroachment of flood plains:

13.11.1. Reduction in water carrying capacity of rivers and encroachment of flood plains has also resulted in increased flood damage. However, strategies to solve these issues are also matters to be addressed and for this also, detailed studies are required.

Other Aspects:

13.12. Real time integrated operation of dams / reservoirs and bringing reservoir operations under one umbrella:

13.12.1. According to RTIOR, any project in a river has to be integrated with other projects in the basin[144] and their operation has to be in 'real time'. According to National Water Policy[145] there should be basin based flood control and management policy. However, even now dams / reservoirs in Kerala are treated as separate entities.

13.12.2. Hence it is recommended to implement real time integrated operation of dams / reservoirs after bringing reservoir operations under one umbrella. Operational control or at least, decision regarding release of water has to be taken in a scientific manner by specialized agencies such as Dam Safety Authority / Disaster Management Authorities after taking all dams / reservoirs in a river basin as an integral unit. Niceties and other aspects are required to be decided by experts.

13.13. Climate Change and Extreme Events:

13.13.1. Link of extreme weather conditions / events with climate change is also an issue of great concern. Experts[146] have recommended further studies in this regard. In the absence of authentic reports or materials no conclusions are drawn on the effect of climate change on floods in this Report. However, experts could suggest[147] strategies as to

---

[144] Page 4, RTIOR
[145] See generally National Water Policy (2002) and (2012)
[146] See *'Role of dams on the floods of August 2018 in Periyar River Basin, Kerala'* by Sudhir KP & Others [Current Science, Vol 116, No. 5 page 780]
[147] See generally https://www.floods.org/ace-files/Projects/DamRiskReductionStrategy_20130722_FINAL.pdf (accessed on 09-03-2019) and https://blogs.ei.columbia.edu/2011/06/07/making-room-for-rivers-a-different-approach-to-flood-control/ (accessed on 09-03-2019)

how Kerala can prepare itself against the risk of floods based on extreme events and the solutions that could be implemented beyond traditional steps such as increasing dam storage, or area under dams?

14. SUMMARY OF CONCLUSIONS:

Main cause of deluge:

i. Kerala received above normal rain between 01-06-2018 and 19-08-2018. It was above 42% of the normal rainfall and that the rainfall between 15th and 17th August, 2018 was extremely heavy / torrential in nature;

Other causes that has contributed for worsening Kerala Floods, 2018:

ii. None of the 79 dams in Kerala were operated or used for the purpose of flood control / moderation, despite the obligation to utilize dams for the purpose of flood control / moderation also as per stipulations under National Water Policy, NDMA Guidelines on Floods, RTIOR and other similar directives;

iii. Dams in Kerala had not maintained effective Flood Control Zone and the Flood Cushion said to have been maintained was not as mandated by the BIS Report, RTIOR and O&M Manual;

iv. Most of the major reservoirs were almost full before the extreme rainfall that occurred on 14-16 August, 2018 and they did not have the capacity to accommodate the additional flow generated by extreme rainfall;

v. Sudden release of water simultaneously from different reservoirs during extreme rainfall aggravated the damage;

vi. None of the dams in Kerala had updated *Rule Curves* based on which the same were operated during the floods;

vii. None of the dams in Kerala had an EAP, despite NDMA mandate to have the same by 2009 and that the dams in Kerala were not operated as per the stipulations in EAP Guidelines;

viii. Various alerts (Blue / Orange/ Red) were issued not in accordance with EAP Guidelines;

ix. No proper follow-up action and effective precautionary steps (especially for evacuating people and accommodating them in safe locations) were taken after issuance of Red alert;

x. Dam managers ought not to have 'solely' relied on IMD predictions for dam management and variation in IMD forecast or prediction

cannot be counted as a justification for delayed release of water from dams;

xi. Water storage capacity of reservoirs in Kerala was reduced due to siltation and sedimentation;

xii. Reduction in water carrying capacity of rivers and encroachment of flood plains.

Other Aspects:

xiii. Various Guidelines / Manuals etc issued by Government / Authorities (especially CWC and NDMA) on diverse aspects pertaining to Dam Safety and Flood Management were not implemented;

xiv. Flood Plain Zoning, preparation of Inundation Maps, finalization of Emergency Action Plans, updating of *Rule Curves*, evolving dam specific Operation and Maintenance Manual, put proper Flood Forecasting system in place, etc., are to be carried out and implemented in a time bound manner;

xv. There should be basin based real time integrated operation of reservoirs and dams; at least decision regarding release of water, has to be taken by specialized agencies like Dam Safety Authority / Disaster Management Authority.

15. Whether a further enquiry by an independent expert committee is required to identify the causes of Kerala Floods 2018 and to make suggestion for improving flood / dam management system?

15.1. In response to prayers in various writ petitions seeking for a judicial / expert enquiry, Government of Kerala in its affidavit states that no further study on Kerala Floods is required as CWC already analyzed the causes of floods and concluded in Exhibit R1(ba) CWC Report that "*dams in Kerala did not contribute to floods, 2018.*"[148] According to CWC Report floods caused due to '*severe storm occurrences during 8-9 August, 2018 and 15-17 August, 2018*' and that '*rainfall during 15-17 August, 2018 is comparable to historical rainfall of 1924*'.

15.2. However, conclusions in paragraphs 13.3 to 13.11 (Summary of conclusions ii to xv) were not specifically addressed / inquired in the CWC Report. Aspects relating to implementation of various Policy directions / Guidelines / Reports etc. issued by various Authorities (detailed in paragraph 10 above) were not addressed in the Report. Similarly, aspects pertaining to Dam Management, Flood Forecasting, finalization of EAPs etc., where CWC is having stakes and say, were not discussed. It also does not contain details regarding various steps that are to be taken in future in the light of lessons learned. Moreover CWC Report is only a rapid assessment report. Hence a more detailed enquiry by an independent body is required for the purpose of identifying causes that worsened Kerala Floods, 2018 and future steps that are to be taken.

15.3. As per section 62 of the Kerala Irrigation and Water Conservation Act, 2003; the Kerala Dam Safety Authority is having a duty to advise the Government or other agencies on aspects including "operation and maintenance" of dams. However, recommendation made on aspects relating to implementation of various mandatory Policies / Guidelines / Reports etc. issued by various Authorities (detailed in paragraph 10 above) relating to operation and maintenance of dams are not seen mentioned in the counter affidavit by DSA. Moreover, DSA appears to have already taken a view fully endorsing the CWC Report and has unequivocally averred that "*Ext. R5(d) report of the Central Water Commission is a complete answer to the baseless allegation that the August, 2018 flood was on account of improper management of dams*".[149]

15.4. It may be recalled that the Kerala Floods / Landslides caused loss of 433 human lives, affected 5.4 million people and displaced 1.4 million people; resulted in total damage of Rs. 26,720 crore and total recovery needs are estimated at Rs. 31,000 crore.[150] Considering the huge scale and severe magnitude of Kerala Floods / Landslides, 2018,

---

[149] Paragraph 11 of the Counter Affidavit filed on behalf of Kerala Dam Safety Authority in WPC 28502 of 2018

[150] Kerala Post Disaster Need Assessment Report on Floods and Landslides, 2018 (PDNA) Prepared by United Nations, Asian Development Bank, World Bank, Government of Kerala etc.

which is the worst natural disaster that the State had witnessed in its history, a more detailed enquiry by an independent expert authority is imperative. This is essential to strengthen our dam / disaster management system and to ensure a better response to such events in future.

15.5. Conclusions drawn in this report are based on the materials on record.

15.6. In the circumstances, a **more detailed enquiry on Kerala Floods, 2018 by an independent expert inquiry committee headed by former judge of a superior Court and preferably consisting of reputed Hydrologist, experts in dam management, engineers' etc.** is highly recommended.

15.7. Report of such committee will significantly assist this Hon'ble Court[151] to issue final directions in the above Batch of PILs.

15.8. Such expert committee needs to obtain / ascertain more factual details, if necessary by conducting local visits and after providing opportunity to all interested persons to give inputs. Progress of various steps taken for flood control and dam management (such as Flood Plain Zoning, preparation of Inundation Maps, finalization of Emergency Action Plans, aspects pertaining to Flood Forecasting etc), post Kerala Floods, 2018, could be monitored and suggestions could be made. Such monitoring and suggestions are required as deadline fixed for various measures were not complied by stakeholders so far. This will further enable this Hon'ble Court to issue directions in that regard too.

Therefore, after careful evaluation of the factual scenario and the relevant provisions of law, I seek to put before this Hon'ble Court the following:

---

[151] In *Indian Bank v. Godhara Nagrick Coop Credit Society* (2008) 12 SCC 541, paragraph 41-3, the appointment of fact finding committee by High Court is approved by Supreme Court. Several such committees / experts were appointed in various environmental related issues. *See generally* Mihika Poddar and Bhavya Nahar 'Continuing Mandamus and Innovation to Bridge the Right

SUGGESTIONS:

I. An independent expert Enquiry Committee headed by former judge of a superior Court and preferably consisting of reputed Hydrologist, experts in dam management, engineers and other experts, may be appointed to enquire into the various causes of Kerala Floods, 2018 and to make suggestions for strengthening the flood / dam management aspects in future;

II. The said Enquiry Committee may be directed to enquire and file report *inter alia* on:

Re: Causes that worsened the Floods:

a. Causes of Kerala floods, 2018 and factors that had lead to or aggravated the damages;

b. Whether high reservoir storage and sudden release of water during extreme rainfall has worsened the floods?

c. Whether Flood Control Zones in each dams were maintained as per stipulations under National Water Policy, NDMA Guidelines on Floods, RTIOR and other similar directives;

d. Whether dams in Kerala were operated in accordance with *Rule Curves* properly fixed?

e. Whether high reservoir storage and sudden release of water has worsened the floods?

f. Whether siltation and sedimentation have contributed for aggravation of flood event?

g. Whether dams in Kerala were operated in accordance with the EAP Five Steps Response Process as per EAP Guidelines during Kerala Floods, 2018?

h. Whether proper and effective warning was issued? And if so, whether it has timely reached the people?

i. Whether proper follow-up action and effective precautionary steps were taken after issuance of Red alert in accordance with EAP Guidelines / standard practice;

Re: Steps that are required to be taken in Future:

j. Identify the lessons to be learned from the Kerala Floods, 2018 and steps that are required to be taken to manage similar future flood events?

k. Ascertain the stage of implementation of various Policy directions / Guidelines / Reports etc. issued by various Authorities (detailed in paragraph 10 above) and steps, if any, required to be taken in future.

l. Monitor the progress and various steps taken by the stakeholders in aspects related to Flood marking, Flood Plain Zoning, preparation of Inundation Maps, updating *Rule Curve*; preparing Emergency Action Plans, Flood Forecasting and other similar precautions in accordance with relevant stipulations and mandates;

m. Steps that are required to be taken to improve water carrying capacity of rivers and removal of encroachment of flood plains;

n. Steps that are required to be taken for enhancing the reservoir storage capacity of dams in Kerala;

o. Whether operational control or authority to take final decision regarding release of water from various dams / reservoirs has to be taken away from KSEB/ Irrigation Department and given to Dam Safety Authority and / or Disaster Management Authority?

p. Steps those are required to be taken to further strengthen Dam Safety Authority and Disaster Management Authorities?

q. How Kerala can prepare itself against the risk of future extreme flood events? What are the solutions that may be implemented beyond traditional steps such as increasing dam storage, or area under dams? And

r. Such other aspects that are deemed necessary by this Hon'ble Court.

III. Monitor the implementation of various recommendations and suggestions that are going to be made by the Expert Enquiry Committee.

This Hon'ble Court may, as it pleases, give kind consideration to the above suggestions and issue appropriate directions in this regard.

Dated this the 27th day of March, 2019

Adv. Jacob P Alex

Amicus Curiae

k. Ascertain the stage of implementation of various Policy directions / Guidelines / Reports etc. issued by various Authorities (detailed in paragraph 10 above) and steps, if any, required to be taken in future.

l. Monitor the progress and various steps taken by the stakeholders in aspects related to Flood marking, Flood Plain Zoning, preparation of Inundation Maps, updating *Rule Curve*; preparing Emergency Action Plans, Flood Forecasting and other similar precautions in accordance with relevant stipulations and mandates;

m. Steps that are required to be taken to improve water carrying capacity of rivers and removal of encroachment of flood plains;

n. Steps that are required to be taken for enhancing the reservoir storage capacity of dams in Kerala;

o. Whether operational control or authority to take final decision regarding release of water from various dams / reservoirs has to be taken away from KSEB/ Irrigation Department and given to Dam Safety Authority and / or Disaster Management Authority?

p. Steps those are required to be taken to further strengthen Dam Safety Authority and Disaster Management Authorities?

q. How Kerala can prepare itself against the risk of future extreme flood events? What are the solutions that may be implemented beyond traditional steps such as increasing dam storage, or area under dams? And

r. Such other aspects that are deemed necessary by this Hon'ble Court.

III. Monitor the implementation of various recommendations and suggestions that are going to be made by the Expert Enquiry Committee.

This Hon'ble Court may, as it pleases, give kind consideration to the above suggestions and issue appropriate directions in this regard.

Dated this the 27th day of March, 2019

Adv. Jacob P Alex
Amicus Curiae