DAM BREAK REPORT CONFIRMS 35 LAKH DEATHS DUE TO COLLAPSE OF MULLAPERIYAR

Prof.T.Shivaji Rao,
Director, Center for Environmental Studies,
GITAM University, Visakhapatnam

http://tshivajirao.blogspot.com/2012/01/dam-safety-violations-of-mullaperiyar.html
http://tshivajirao.blogspot.com/2012/01/under-designed-dams-collapsedhydrologic.html
http://tshivajirao.blogspot.com/2011/12/scientific-solutions-for-resolving.html
http://blogs.ilocalbazaar.in/tag/mullaperiyar-dam-map/
(Videos on Dam collapses in the world)
http://sites.google.com/site/profshivajirao/polavaramdam-2 (Polavaram dam break analysis)
http://tshivajirao.blogspot.com/2012/01/dam-breach-flood-routing-for-rock-fill.html

There are serious violations on the safety aspects of the dam in terms of seismological safety, hydrological safety and environmental safety as discussed in detail under the above websites.

The dam has been under-designed because at the time of its construction cement was not available and hence neither a masonry dam in cement mortar nor a concrete dam with cement mortar could be built to ensure better safety standards. The old methods of construction followed about a century ago enabled the engineers to use only surkhi mortor with lime, sand and rubble stone was used for the construction of the dam. Since the dam was underdesigned and with poor materials of construction it is bound to collapse due to aging also. Moreover the magnitude of peak floods to be used for the spillway design was based upon rough estimates which do not confirm to the modern estimates of extreme floods as recommended by experts of the International committee on large dams Even the seismic potential was under- estimated Hence there are abundant chances for the dam to collapse and such an accident will result in economic bankruptcy to the states that depend upon Periyar river water. Consequently the people of Kerala living downstream of the dam are vociferously demanding for the implementation of dam review policies followed for evaluation of safety of the existing dams and take remedial actions to protect the lives of the people and their properties. But there is no unanimous agreement on this subject of dam safety between Kerala, Tamil Nadu and the Union Government and this as resulted in a controversy on the safety of the dam.

A serious controversy on the safety of Mullaperiyar dam is raised by the people in Tamil Nadu and Kerala. While Kerala is demanding for the removal of the existing aged and decaying dam on the plea that its inevitable collapse within the near future will result in an avoidable man-made disaster like the Bhopal tragedy in India and the Fukushima nuclear accident in Japan. Due to this disaster waiting in the wings more than a lakh of people between the dam and the Iddukki reservoir 40km below the dam more than 35 lakhs of people in the lower reaches of Periyar river upto Ernakulam-Cochin belt will be drowned causing not only loss of millions of lives of human and animal population but also precious housing properties and agriculture fields placing a total loss amounting to more than one lakh crores of rupees. This economic burden will have to be borne directly or indirectly by all the people of various states in the country. Tamil Nadu Government is insisting that the existing dam is safe and that it should not be decommissioned at any rate because the Tamilians may lose their rights over irrigation water

transfer from Periyar river in Kerala to Vaigai river in Tamil Nadu. This problem can be simply solved if Kerala state is genuinely concerned about saving the lives of 35 lakhs of Keralites by constructing 2 or 3 smaller dams in between the Mullaperiyar dam and Iddukki dams. But the urge to construct these dams cannot be perceived by the people of Kerala and its elected representatives in the state legislature unless they are presented with a Mullaperiyar dam break scenario with its damaging impacts on hundreds of villages, towns and cities in the Iddukki, Ernakulam and Kottayam districts. For this purpose a dam break analysis for Mullaperiyar dam is carried out by using the popular national weather service dam break flood forecasting model (NWS DAMBRK) for assessing the likely maximum flood discharge and elevation to be attained by the flood inundation for several habitations down steam in the eventuality of a dam failure.

NWS – DAMBRK MODEL DESCRIPTION:

The U. S National Weather Service (NWS) initially developed DAMBRK program (Fread, 1984) in 1977. Research has been ongoing in developing improvements in the DAMBRK model allowing it to have an increasing range of application (Fread, 1989). The model has wide applicability, it can function with various levels of input data ranging from rough estimates to complete data specification, the required data is readily accessible and it is economically feasible to use with minimal computational effort on microcomputers.

DAMBRK model can be used to develop the outflow hydrograph from a dam breach and hypothetically route the flood through the downstream valley. The governing equations of the model are the complete one-dimensional Saint-Venant equations of unsteady flow which are coupled with internal boundary equations representing the rapidly varied flow through structures such as dams and embankments which may develop a time dependent breach. Also, appropriate external boundary equations at the upstream and downstream ends of the routing reach are utilized. The system of equations is solved by a nonlinear weighted four-point implicit finite difference method. The flow may be either subcritical or supercritical.

The hydrograph to be routed may be specified as an input time series or it can be developed by model using specified breach parameters (size, shape, time of development). The possible presence of downstream dams which may be breached by the flood, bridge / embankment flow constrictions, tributary inflows, river sinuosity, levees located along the downstream river, and tidal effects are each properly considered during the downstream propagation of the flood. DAMBRK may also be used to route mud and debris flows using specified upstream hydrographs. High water profiles along the downstream valley, flood arrival times, and hydrographs at user selected locations are the standard DAMBRK model output.

DATA REQUIREMNTS FOR NWS – DAMBRK MODEL

The DAMBRK model was developed by National Weather Service (NWS) so as to require data that was accessible to the forecaster. The input data requirement are flexible in so far as much of the data may be ignored (left blank on the input data cards or omitted altogether) where a detailed analysis of a dam break flood inundation event is not feasible due to lack of data or insufficient data preparation time. Nonetheless the resulting approximate analysis is more accurate and convenient to obtain than that which could be computed by other techniques. The input can be categorized into two groups.

The first data group pertains to the dam: (the breach, spillways, and reservoir storage volume). The breach data consists of the following parameters: T (failure time of breach, in hours), b (final bottom width of breach), Z (side slope of breach), h_{bm} (final elevation of breach bottom), h_o (initial elevation of water in reservoir), h_f (elevation of water when breach begins to

form), and h_d (elevation of dam). The spillway data consists of the following : h_s (elevation of uncontrolled spillway), C_g (coefficient of discharge of gated spillway), C_d (coefficient of discharge of crest of dam), Q_t (constant head independent discharge from dam). The storage parameters consists of the following: a table of surface area (A_s) in acres or volume in acre-ft. and the corresponding elevations within the reservoir. The forecaster must estimate the values of T,B,Z,H_{bm} , and H_f . The remaining values are obtained from the physical description of the dam, spillways, and reservoir. In some cases H_s, C_s, H_g and C_g and C_d maybe ignored and Q_t used in their place.

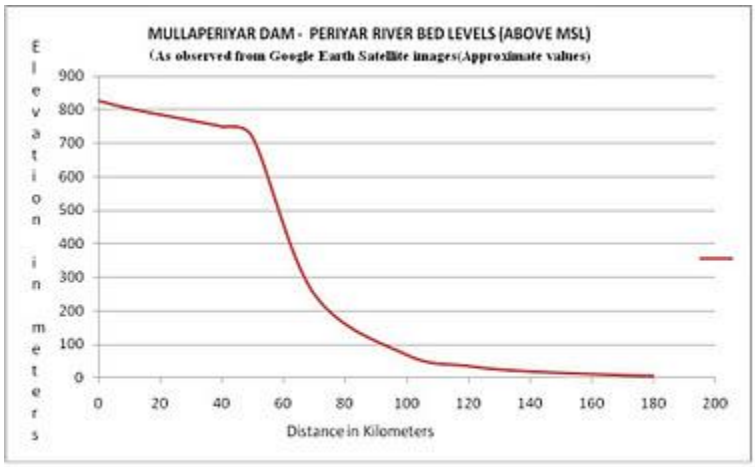
The second group pertains to the routing of the outflow hydrograph through the downstream valley. This consists of a description of the cross-sections, hydraulic resistance coefficients, and expansion coefficients. The cross-sections are specified by location mileage, and tables of top widths (active and inactive) and corresponding elevation. The active top widths may be total widths as for a composite section, or they may be left floodplain, right flood plain, and channel widths. The channel widths are usually not as significant for an accurate analysis as the over bank widths. The number of cross-sections used to describe the downstream valley depends on the variability of the valley widths. They also depend on the availability of cross-section measurements. However, a minimum of two must be used. Additional cross-sectional data to be input by the forecaster according to such criteria as data availability, variation, preparation time etc. The number of interpolated cross-sections created by the model is controlled by the parameter DXM which is input for each reach between specified cross-sections. The expansion-contraction coefficients (FKC) are specified as non-zero values at sections where significant expansion of contradictions occur. But they may be left blank in most analyses.

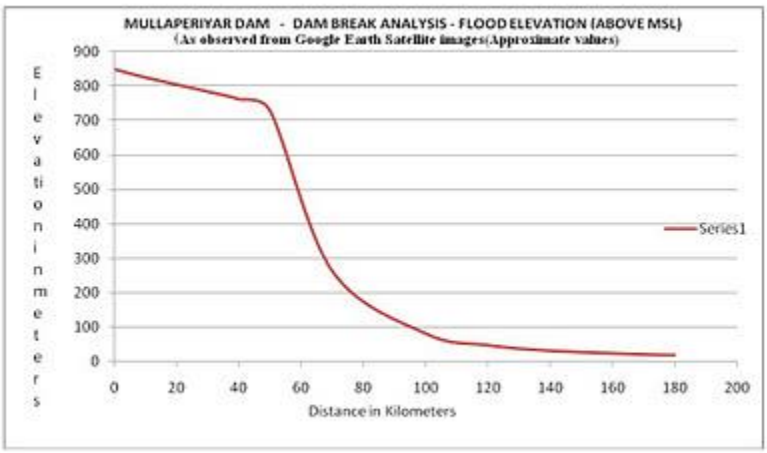
In the present case of Mullaperiyar dam due to non availability of detailed topographical sheets of the Periyar river basin the Google Earth satellite pictures have been used for measurement of distances, bed level elevations, location of dams and reservoirs and human habitations upto Cochin. It is found that the river slope for different river stretches with several water falls vary from an average of 10m per km, 5m per km and 1m per km. Since the super critical flows below the water falls are some extent to modified by a few dams and reservoirs in lower Periyar basin and Bhutantankkettu reservoirs a gradient 1m per km has been considered and the input data has been incorporated in the DAMBRK computer model to obtain the flood depth elevations and the human habitations that will be submerged under a wall of flood arising due to the Mullaperiyar dam burst under the worst conditions of cloud burst which results in overtopping of the dam including the Earth dam on the left side. The details of the output data on bed levels flood elevation levels and flood depths are presented in the tables and graphs furnished below.

MULLAPERIYAR DAM – DAM BREAK ANALYSIS
Table indicating distances from the dam,
Bed levels , Flood Elevation levels and Flood depths

Distance from Dam(Km)	Bed levels (m)	Flood Elevation (m)	Flood Depth (m)
0	827	850	23
10	804	826	22
30	768	785	17

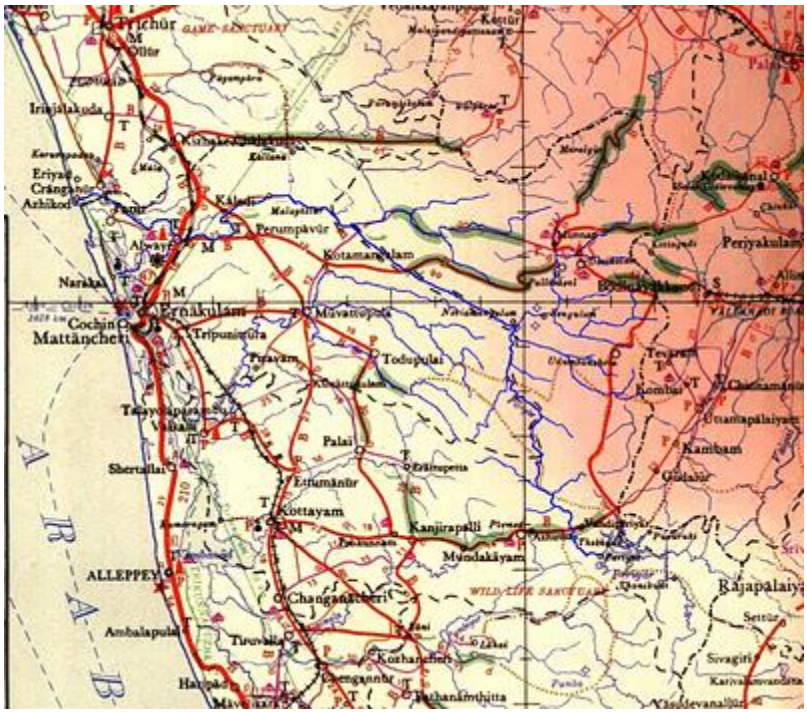
40	750	763	13
50	720	730	10
70	252	264	12
100	70	82	12
120	36	48	12
140	20	32	12
170	9	21	12
180	7	19	12



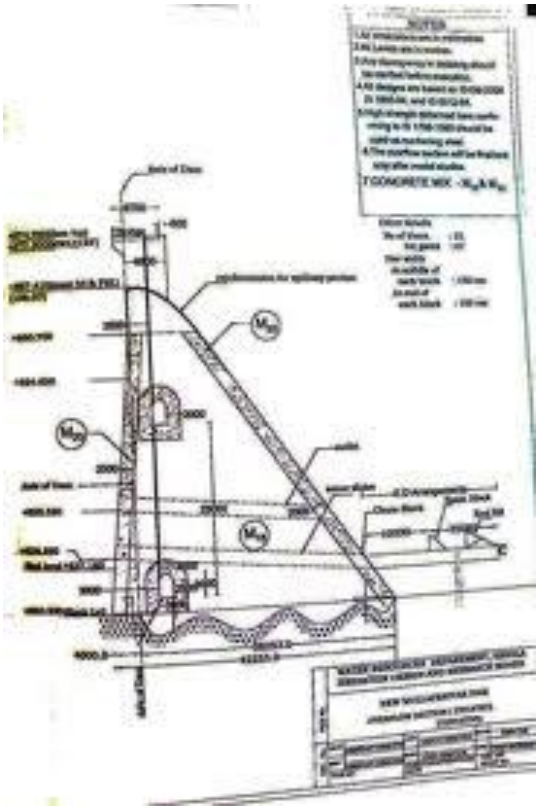


Hundreds and thousands of people in several villages and lakhs of people in major towns and urban settlements will be drowned under flood depths varying from about 72ft. (23m) below the dam, 66ft (20m) at Vandiperiyar, 50ft at Upputhara, 40ft at Iddukki cluster of villages, 38ft. at Kaladyand its neighbouring villages and more than 38ft over hundreds of villages and towns including Cheranalloor, Kanzoor, Chowara, Aluva, Ernakulam and Cochin. The dam break model was run by assuming that the disaster will occur during a rainy season when all the tributaries of Periyar and the dams over them will be completely full and this additional flood

due to Mullaperiyar dam break will cause the flood havoc, killing about 35 lakhs of people in the zone of influence of the floods. While some of the dams at Iddukki may over flow and cause flood havoc in the intermediate zones of Todupula and Muvvattupula there will be additional water inflow from several tributaries like Idamalayar that add fuel to the fire and consequently the flood depths presented here are bounded to be under estimated to some extent. Mullaperiyar dam is bound to collapse for several reasons including deterioration of construction materials, frequent earthquakes, emerging extreme floods due to global warming and climate change impact, poor construction, mechanical or human failures. Hence Kerala people must visualize this emerging scenario and exert pressure over their Government to save their lives and properties by taking timely action because a stitch in time saves nine.




PERIYAR RIVER BASIN
Irinjalakuda
Kizhake Chalakudi
Poringalkuthu
Malayattur
Paper
Periyar
Kuttampuzha
Alwaye
Munnar
Neriamangalam
Cochin
Muvattupula
Periyar
Tripunittura
Kannadi
K E R A L A
Idukki
Kallar
TAMIL NADU
Vandamettu
Erattupetta
Gudalur
Periyar
Vandiperiyar
TAMIL NADU
0 4 8 12 16 20 Km
Scale
LEGEND
Basin Boundary
International Boundary
State Boundary
River and Dam
Important Place
Map by www.sandrp.in
REFERENCE
1 Idamalyar
2 Idukki
3 Kuthungal
4 Lower Periyar
5 Malankara
6 Narimangalam
7 Pallivasal
8 Panniar
9 Periyar
10 Sengulam



SALIENT FEATURES OF PERIYAR PROJECT – PERIYAR DAM

GENERAL:

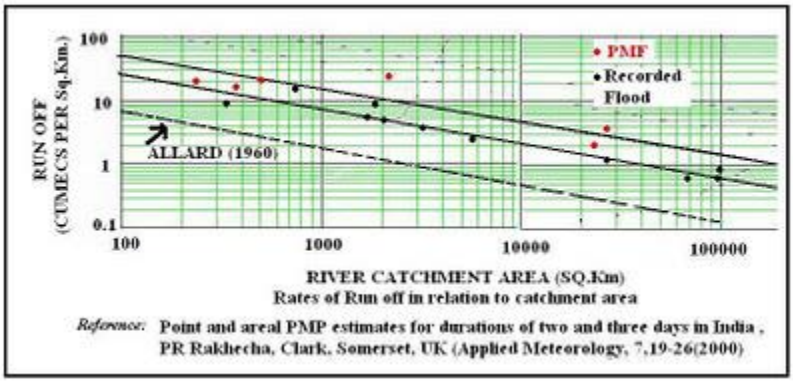
River & Basin	**: MullaiPeriyar River & Periyar Basin**
Location	**: Lat 9^{o} 03' 20" Long: 77^{o} 08' 45"**
Construction Period	**: 1887-1895**
Cost	**: 43.00 lakhs (18 crores for strengthening work)**

RESERVOIR:

Catchment area	**: 232.60 sq.miles (602.4 sq.km)**
Water spread area	**:10.21 sq.miles (28.44 sq.km)**
Design Flood	**: 1.22 lakh cusescs (3454 cumecs)**
FRL	**: 152' (+2861' {(or) +872.285 m}**
MWL	**: 155' {+2864' (or) +873.20m}**
Dead Storage Level	**: 104' {+2831' {(or) +857.65m}**
Capacity of Reservoir at FRL	**: Gross 15,682mcft (444.06 mcum)**

REGULATORS:

Vents	**: Old : 10 Nos (36x16) or (10.97x4.88m)**
Additional	**:New : 2 Nos (40'x16') or (12.19x4.88m)**
Type	**:Old : Vertical Lift Shutter**
	: New: Radial Shutter
Crest Level	**: 136' (+2845ft) or 867.405m**
Platform Top Level	**:177.65' (+2886.75') or 880.105m**
Max.discharge	**Old : 86,000 cusecs (2483.54 cumecs)**
	New: 36,000 cusecs(991.08 cumecs)
	Total : 1.22 lakh cusecs



<u>Warning:</u> If the maximum design flood for the dam is placed at 1.22 lakh cusecs by Tamilnadu when the International experts predict PMF of about 4 lakh cusecs how can anybody assusre safety of dam on the basis of scientific and technical considerations?