The FLOOD 2018 - an analysis based on data analytics

It was a tough time for Keralites and departments in the previous year due to flood. The most wanted people for this tragedy was KSEBL in the view of press and media. So I thought of having an analysis based on analytics tools(Microsoft POWER BI is used for analysis). The software is having basic reporting and analytics techniques. Since it's a free version it has some limited functions compared to the full version. The first thing which we have to understand is that some places of kerala used to have flood during monsoon, especially in the low line area of Kuttanad and aluva Manapuram. I still recollect the situation in 2013 where my colleagues house at Aluva was under water. So its not a new thing for us. Then what happened now?? Why everyone blame us?? I worked most of the time in Generating stations and having a very good understanding of Kerala DAMs and Hydrology. The data collected from WRIS , NLDC, SRLDC, SLDC are presented here for an academic purpose.

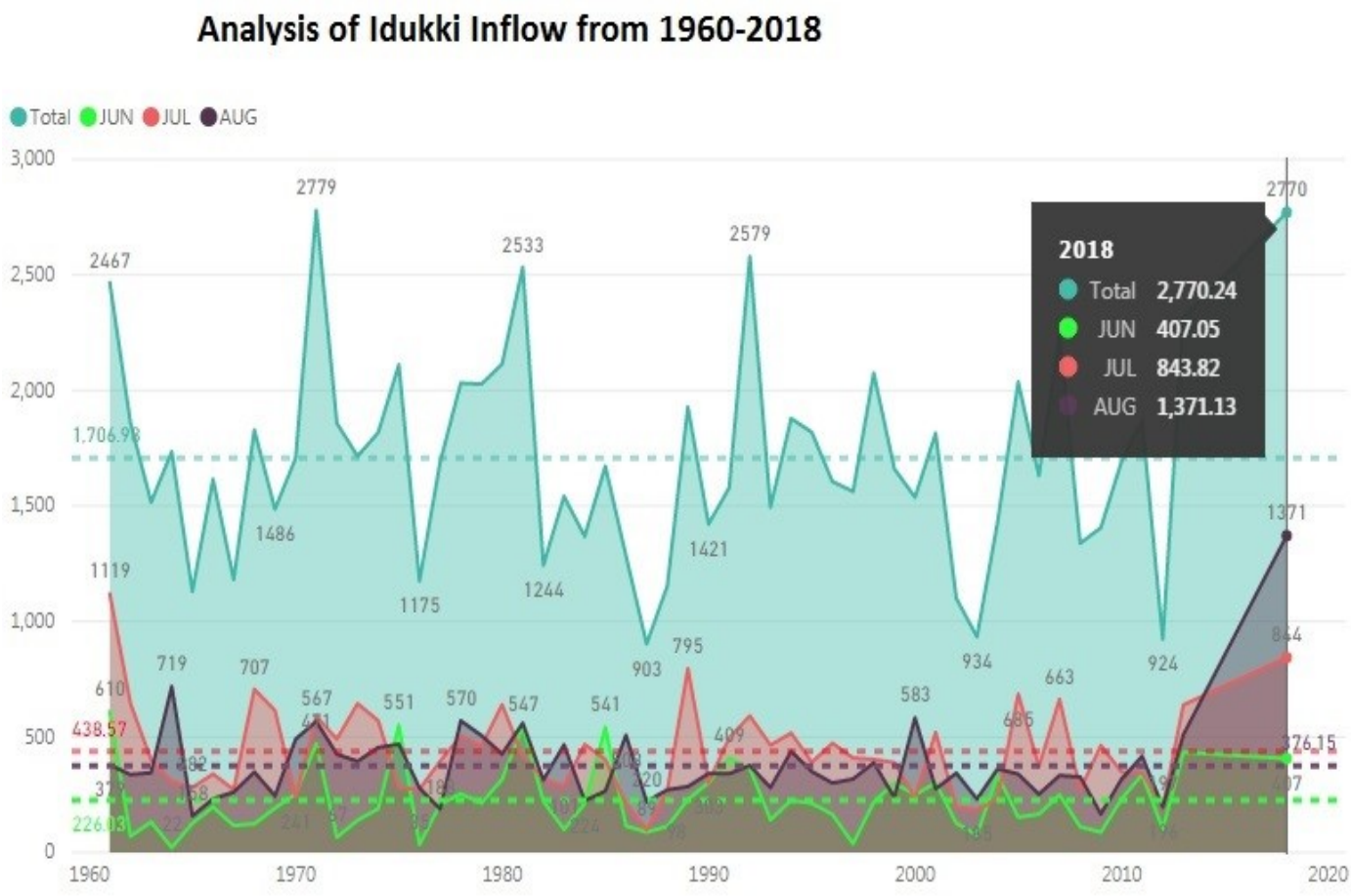
The analytics will give us the answers for our questions. Even the google sheets provide a lot of options to explore. You can also run various scripts to get accurate results. The reporting tool requires historical data. This technique is known as data warehousing. Nothing but a warehouse of data. The most important thing is that no data in this will be deleted and usually has a time stamp. The data analytics and reporting is need of the hour and India is the best in this. I have seen that WR-IS has good collection of data and hence these sites are used for academic purpose.

If we study the data of Idukki reservoir for the past few years we can understand what happened during flood 2018.

For Eg: what is the average inflow of water in to Idukki reservoir during various months of monsoon (The dotted lines)?

Analysis:

This is been shown in the picture 1 and it is For June - 226MCM, July- 438MCM, August - 376MCM. Now if we compare these values with inflow received in 2018, the results will give us what happened during flood???



Picture (1)

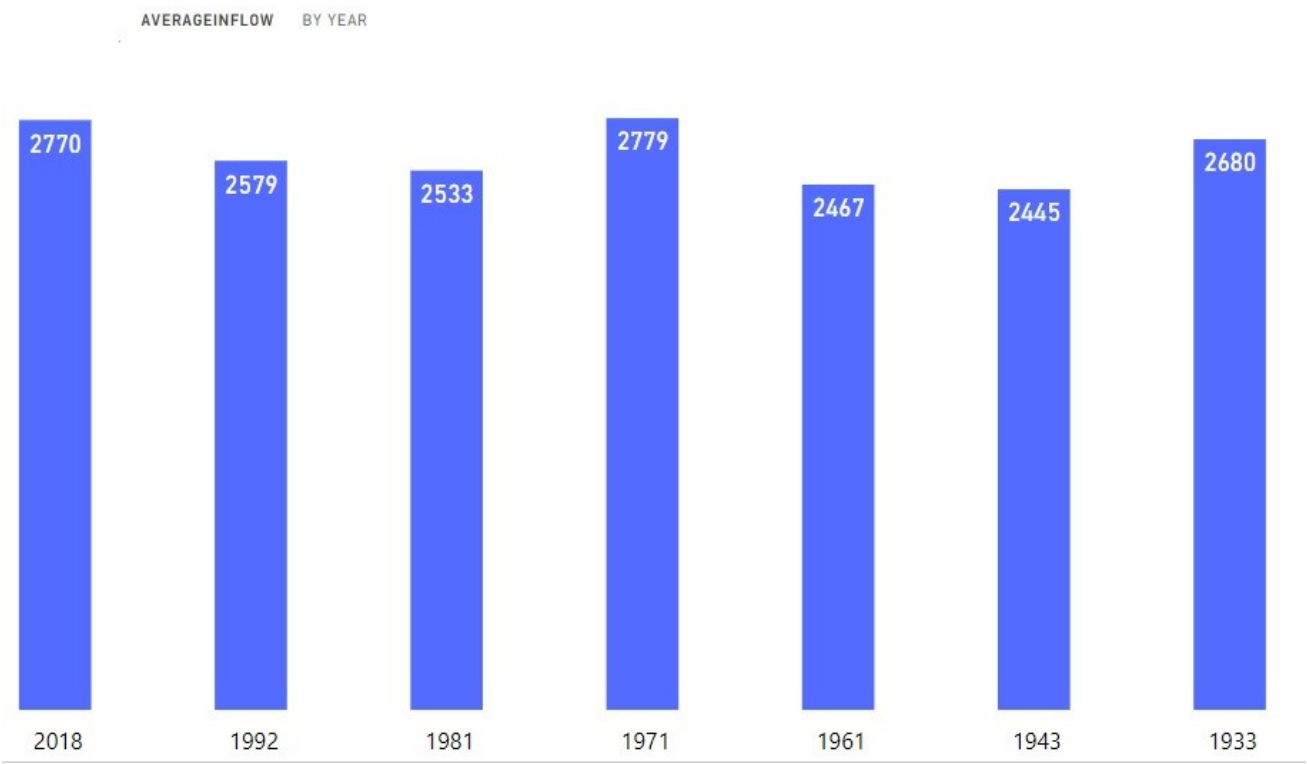
In which year we have received the maximum inflow for August month?

Analysis:

We can see during 2018 we have received maximum inflow in the august month. So the graphical representation will always help us to have a clear picture on various issues.

Heaviest Inflow

Now the average inflow in to idukki for the period of 1960 to 2019(Data up to September) is calculated and drilled down to see the top few years.(Picture 2)



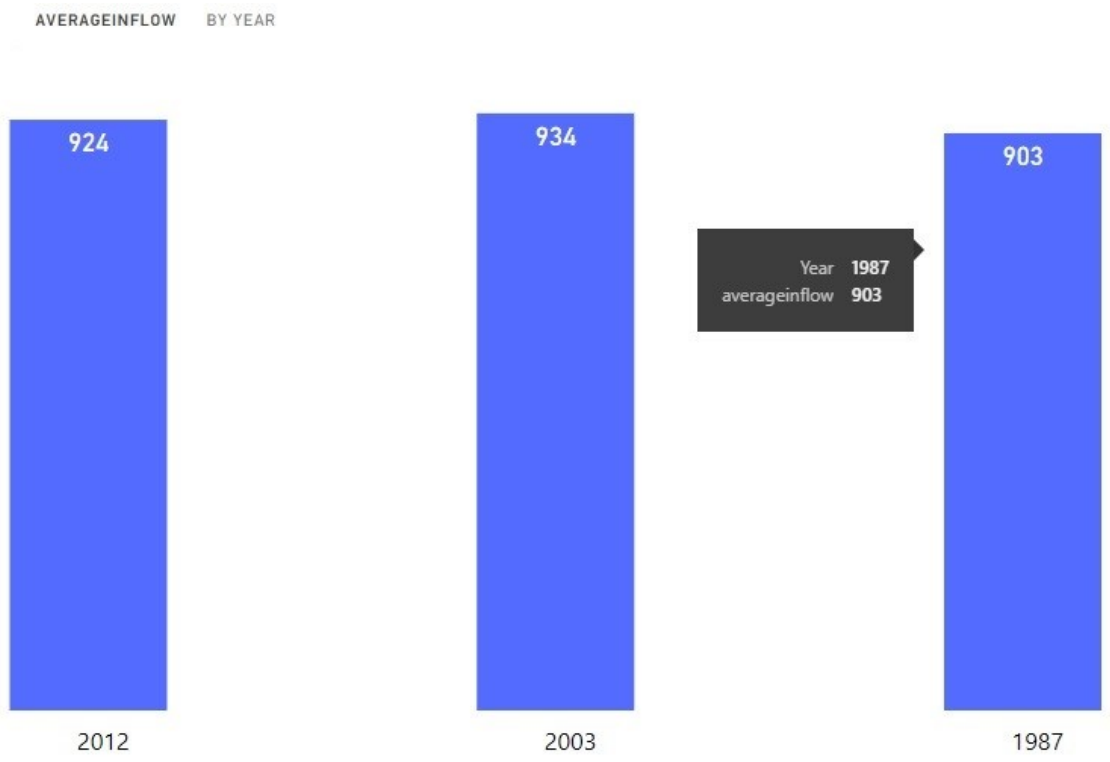
Picture(2)

Analysis:

It is seen that strong inflow (2500MCM and above) in to the dam used to occur in a period of 10 years between 1933 and 1943 and 1961,1971 and 1981 etc.

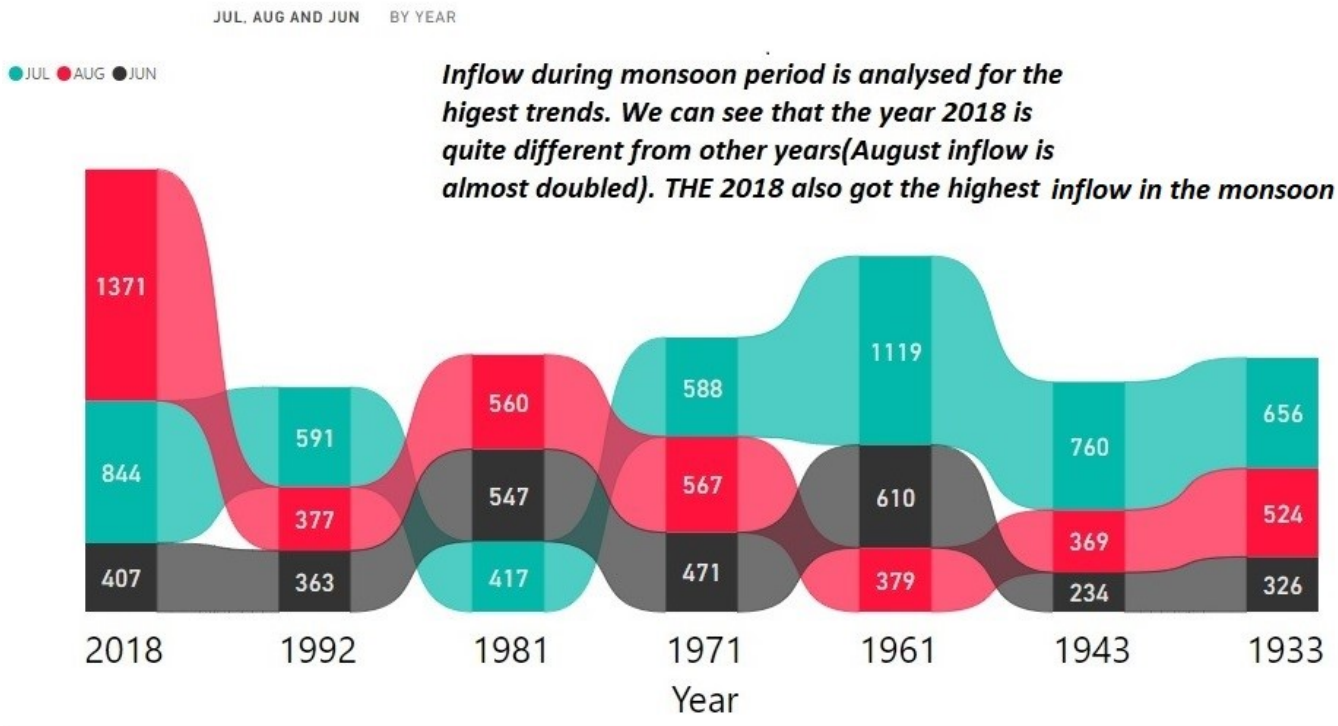
Worst Inflow

Moreover the worst inflow in to idukki reservoir happened in the year 2012,2003 and 1987(around 900 MCM) as shown below.



Picture (3)

Considering these aspects we will go back to our previous analysis**- 'What happened in 2018?'**. So I have taken a new graph which is known as 'Ribbon'



Picture (4)

Inflow for each month is shown in the picture(4). It clearly says what happened during the peak of monsoon. **The reason for heavy inflow during 2018 is due to heavy rains and no dams in kerala generated floods. Here the discussion is for constructing more reservoirs like IDUKKI**. This is only the second time (first being 1981) we received heavy inflow during august month. **If this happened in July or June then we would have had the cushion for accommodating this massive in flow. But dangerously it happened in the month of august. That too 360 percentage above the average inflow (376 MCM).**

Rule Curve

So coming to the next level of analysis to handle such a situation, we need to consider rule curve. Rule curve shall be there for all dams and this curve will have information about its operational capability.

After the derivation of initial rule curves for different purposes, the operation analysis is carried out for the reservoir and the rule curves are fine-tuned till the performance of the system could be improved. Finally derived rule curves are the operation rule curves which will be used to guide the operation of reservoir in actual field

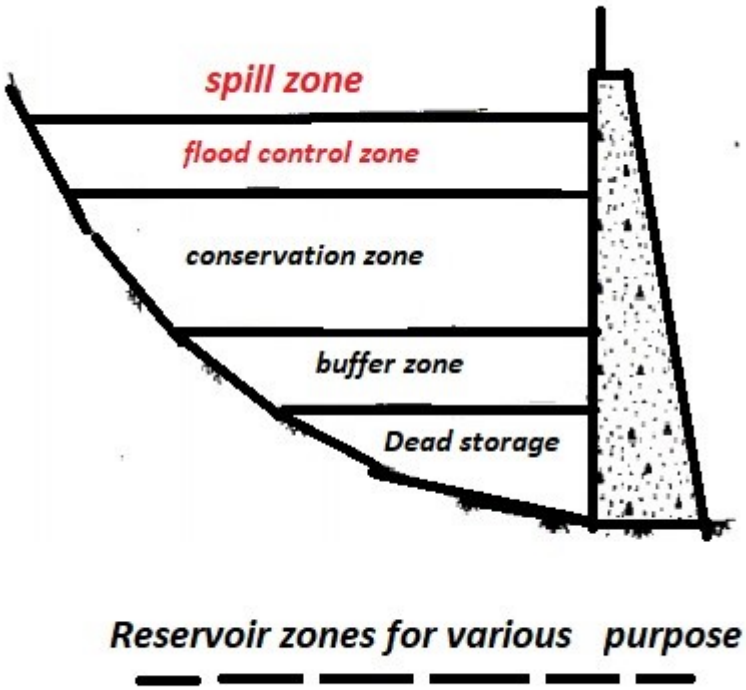
conditions. At any time, the reservoir is operated according to the prevalent water level and the elevation of different rule curve levels for the corresponding time. Let us assume that a reservoir is meant to serve for water supply (highest priority), irrigation (next priority), and hydropower (least priority). For these purposes, three operating rule curves are prepared, say curve 'W' for water supply, Curve 'I' for irrigation, and curve 'H' for hydropower. In addition to these, one upper rule curve, say curve 'U' is prepared.

The typical procedure for rule curve based operation is given in following steps:

- At any time step, if the present water level in the reservoir exceeds level 'U', then spill is made from the reservoir and the water level is brought to Level 'U'.
- If the present reservoir level falls below level 'U' but exceeds level 'H', full supply is made for meeting all demands from the reservoir but no spill is made.
- If the present reservoir level falls below level 'H' but exceeds level 'I', then supply for the hydropower generation is curtailed (say, by 25%) while full demands of irrigation and water supply are made from the reservoir.
- If the present reservoir level falls below level 'I' but exceeds level 'W', then supply for the irrigation is curtailed (say, by 25%) while minimum demands for hydropower (if any) and full water supply demands are made from the reservoir.
- If the present reservoir level falls below level 'W', then release (full or partial) is made only for water supply demands and no release is made for irrigation or hydropower demands.

I have seen this typical pattern in all our dams and especially in Irrigation purpose dams like Chimmony Peechi etc. Here in peechi there is a different penstock for drinking water purpose alone, this level is much below the irrigation and hydro outlets. So our interest is basically for fixing the upper level for flood absorption i.e flood control zone.

Flood Control Zone



Picture (5)

The normal operation policy is to release as much as possible when the reservoir is in the spill zone, to release as much as possible without causing flood damages to downstream when the reservoir is in flood control zone, and to bring the reservoir to the top of the conservation zone at the earliest possible time. The release from the conservation zone is governed by the requirements of water for various purposes intended to be met by the stored water and the day-to-day releases may be adjusted based on the inflow anticipated and future requirements up to the end of operating horizons. When the amount of water is anticipated to be short compared to demand, releases may be curtailed. Limits of various zones may vary with time. **So the time is the most important thing. As I said earlier if this inflow happened in June then the situation would have been normal.**

Let's see what is the level of Idukki on 1st of august 2018.

Level on 01-08-2018					
Reservoir Name	FRL (m)	Current Reservoir Level (m)	Live Capacity at FRL (BCM)	Current Live Storage (BCM)	CURRENT YEAR
Idukki Reservoir	732.43	730.246	1.46	1.338	**91.64**
STORAGE AS % OF LIVE CAPACITY AT FRL					
LAST YEAR			LAST 10 YEARS AVERAGE		
23.84			**41.3**		

As on august 1st 2018 the reservoir had 91.64% water compared to the last year average of 23.84 and last 10 year average of 41.3%. This data was taken from WRIS.

Here in 2018 we received the heaviest inflow in the month of august for the first time after the commissioning of idukki. That means our reservoir was supposed to have a cushion to meet the flood control zone. At least this could have been decided if we have some of the analytical tools so that the trend of inflow will decide the operational rule curve. If we look at the inflow vs average inflow during similar years, we can see that 2018 almost match with 1961 and 1971(picture 4). Moreover the inflow received during 2018 is almost the double of average inflow for these month(This is been shown in the picture 1 and it is For June - 226MCM, July- 438MCM, August - 376MCM). **So what we could have done is that , to create flood cushion to meet double of average inflow for august month i.e 2*376=752 MCM**. If the dam was lowered by 752MCM or half the live storage then we could have easily absorb 725 MCM of 1371 MCM (total inflow for august) and the impact in the periyar region could have been set to NULL**. This would have made keralites to build 10 more idukki dams to protect kerala from floods**.

But unfortunately we missed this opportunity. But if we analyse the situation of 1961 with 2018 , I can surely say that Idukki HEP and this reservoir has saved People of Kerala. I have worked in Neriamangalam which is at panamkutty. The panamkutty is the confluence of Muthirapuzha and Periyar. During 1961 flood, the switch yard structures were damaged at neriamangalam. Even I heard fom then SEO, that during 1992 flood the bridge was water topped and he could hardly reach office. **But in 2018 year , we could run all the machine safely and that's just because of Idukki Reservoir. This is the only power house which has the best design to meet the flood discharge of both the rivers. Moreover we had managed 2018 better than 1961 and 1992**. So my point is that Idukki reservoir and idukki power house saved keralaites. Idukki Power house discharged close to 10 MCM daily in to moovatupuzha river and thus diverted some flood water in to the inter basin. This is a good concept and we could have done similar things in Chalakkudy and Idamalayar. But unfortunately we have no gates to control the flood water in to idamalyar. All we have is some pipes at wachumaram and it got stuck due to debris. So lets hope that we will have this inter-basin control to minimise the flood issues at chalakkudy.

CHALAKUDY THE WORST EFFECTED AREA IN FLOOD 2018

In my experience chalakkudy was devastated in flood 2018. The reason is pretty simple, poringalkuthu dam has no flood cushion. It has only 30 MCM storage and received almost 10 times of this water in 3 days as per CWC report. We had a proposal for Poringalkuthu Right bank dam with 500 MCM storage. If this dam was there then chalakudy would have been saved. Moreover Tamil Nadu has all their major dams in chalakuddy river(Nirar, lower nirar, parambikulam,thunacadavu, upper sholayar) in our area. All these dams were constructed after Poringalkuthu Dam and constructed with the support of PAP agreement. During flood 2018, water from Parambikulam ,thunacadavu and upper sholayar flood discharged in to our poringalkuthu and we end up with no option but to take all the surge. The dam was overtopped for more than 24 hours but still not seen any study report in this front. So flowing analysis is made after collecting data from WRIS.

- **Design flood discharge of Sholayar and Parambikulam is 1820 and 1687 cumecs respectively.Thunacadavu has a flood discharge of 500, means poringalkuthu shall have flood discharge capacity of 4007 cumecs and more to divert the flood water. But unfortunately the dam has only 2265 cumecs flood discharge capacity. The 1742 cumecs water will definitely has to take some other path and hence dam overtopped.**

- **The wachumaram diversion is supposed to carry the excess water from poringalkuthu reservoir in to Idamalayar**. But this diversion was blocked completely due to accumulation of logs and other debris. So the chance of diverting the flood water in to Idamalyar has ceased. There is no gates to control the flood water in this inter-basin project(**the best example is periayar and moovatupuzha using IHEP**).

- All the dams in the upstream of poringalkuthu(upper and lower Sholayar, Parambikukam and Thunacadavu) discharged flood water in to this gravity dam. The dam withstood a similar issues earlier too. The coordination with TAMIL NADU authorities is need of the hour since Right bank project is not yet envisaged.

- Also PRB Scheme will play a major role in the flood management since it will be the biggest single generating station recommended so far in Chalakudy River. Moreover this Dam can impound 523MCM water. The CWC recommended a new dam in the upstream of poringalkuthu for flood management. Hence this old proposal may be revisited rigorously for the people of KERALA.

- The report of CWC says that Parambikulam has released more water in to chalakuddy river(poringal dam) which is more than their inflow!! These issues can be mitigated only with integration of data.

Conclude:

The reason for heavy inflow during 2018 or flood in other terms is due to heavy rains and no dams in kerala generated floods. Here the discussion is for constructing more reservoirs like IDUKKI and use data analytics and other reporting techniques for better operations.