Enhanced Water Security Through IWRM
Mahaweli Experience

27th November – 4th December 2013 Sri Lanka

MAHAWELI BULK WATER ALLOCATION -Planning and Monitoring

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Rainfall

- ***Rainfall patterns*** in Sri Lanka are dominated by two Monsoons AND two Inter-monsoons
  - South-West monsoon (May to September)
  - North-East monsoon (November to February)
  - First Inter-monsoon (March to April)
  - Second Inter-monsoon (October)

Hydrological Regions of Sri Lanka

The associated air movement patterns in combination with strong orographic influence of the central hills produce three ***Hydrologic Regions*** *or Zones*

- ***The Wet Zone***

  Receive rainfall during both monsoons, SW & NE monsoons. Average annual rainfall ranges between 2,000 and 5,500 mm

- ***Intermediate Zone***

  Receives rainfall from NE monsoon and it's around 2,000 mm

- ***The Dry Zone***

  Rainfall occurs during N-E monsoon period . Average annual rainfall is 1,000-2,000 mm

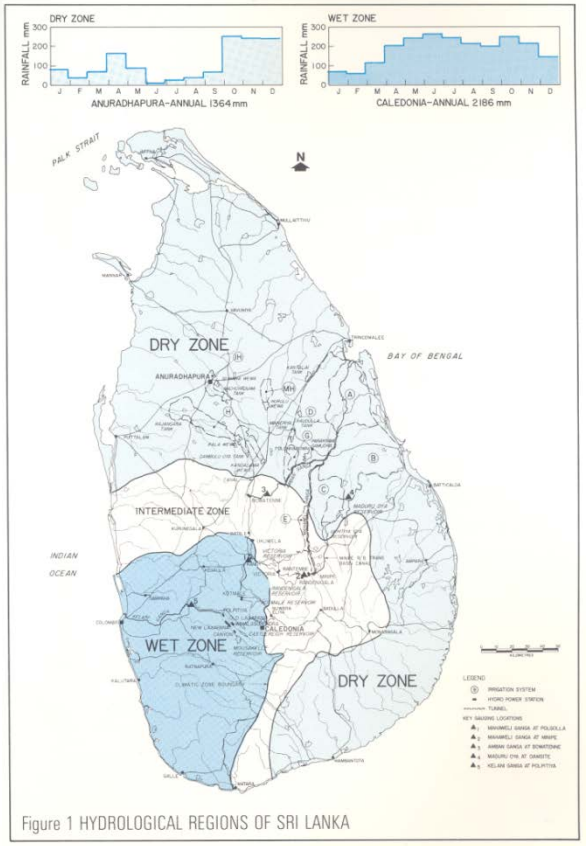

Figure 1 HYDROLOGICAL REGIONS OF SRI LANKA

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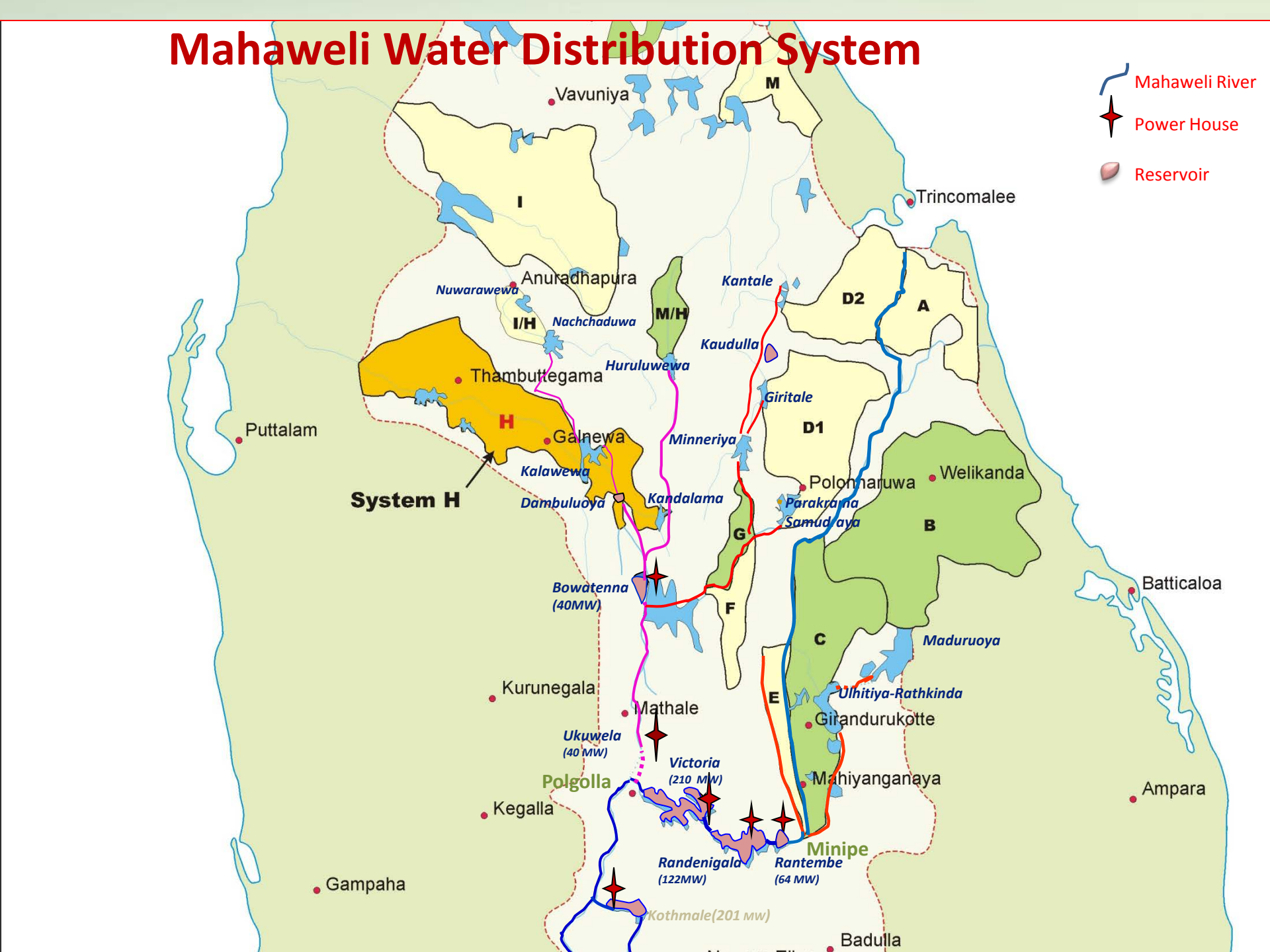
Mahaweli Water Distribution System



Storages Available

Within Mahaweli Basin

Reservoir	Storage (MCM)
Kotmale	173
Polgolla	4
Victoria	721
Randenigala	861
Rantambe	7
Total	**1766**

Adjacent Basins

Reservoir	Storage (MCM)
Ulhitiya Rathkinda	145
Maduru Oya	596
Bowatenna	23
Total	**764**

TOTAL 2530 MCM

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Demand for Water-2010

System	Area (Ha)	Demand (MCM)
System H	40,059	871
System C	24,771	687
System B	21,013	592
System E	7,530	275
Polonnaruwa (D1)	27,245	431
Polonnaruwa (D2)	10,365	268
System G	6,700	221
System A (Allai)	7,050	280
Anuradhapura (IH,MH)	11,060	237
	155,793	**3862**

Annual Requirement = 3862 MCM

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Average Annual Inflows

Irrigation Area	Storage (MCM)	Avg. Annual Inflow (MCM)
Dambulu Oya	11.7	9.3
Kandalama	33.8	26.4
Kalawewa	123.7	117.3
Rajanganaya	100.7	109.6
Nachchaduwa	55.7	92.7
Nuwarawewa	44.5	11.1
Tissawewa	4.3	1.6
Huruluwewa	67.8	33.8
Giritale	24.4	8.8
Minneriya	135.7	85.5
Kantale	140.6	75.9
Vendrasan	24.7	5.7
Kaudulla	128.3	115.7
PSS	136	28.4
Total	***1031.9***	***721.8***

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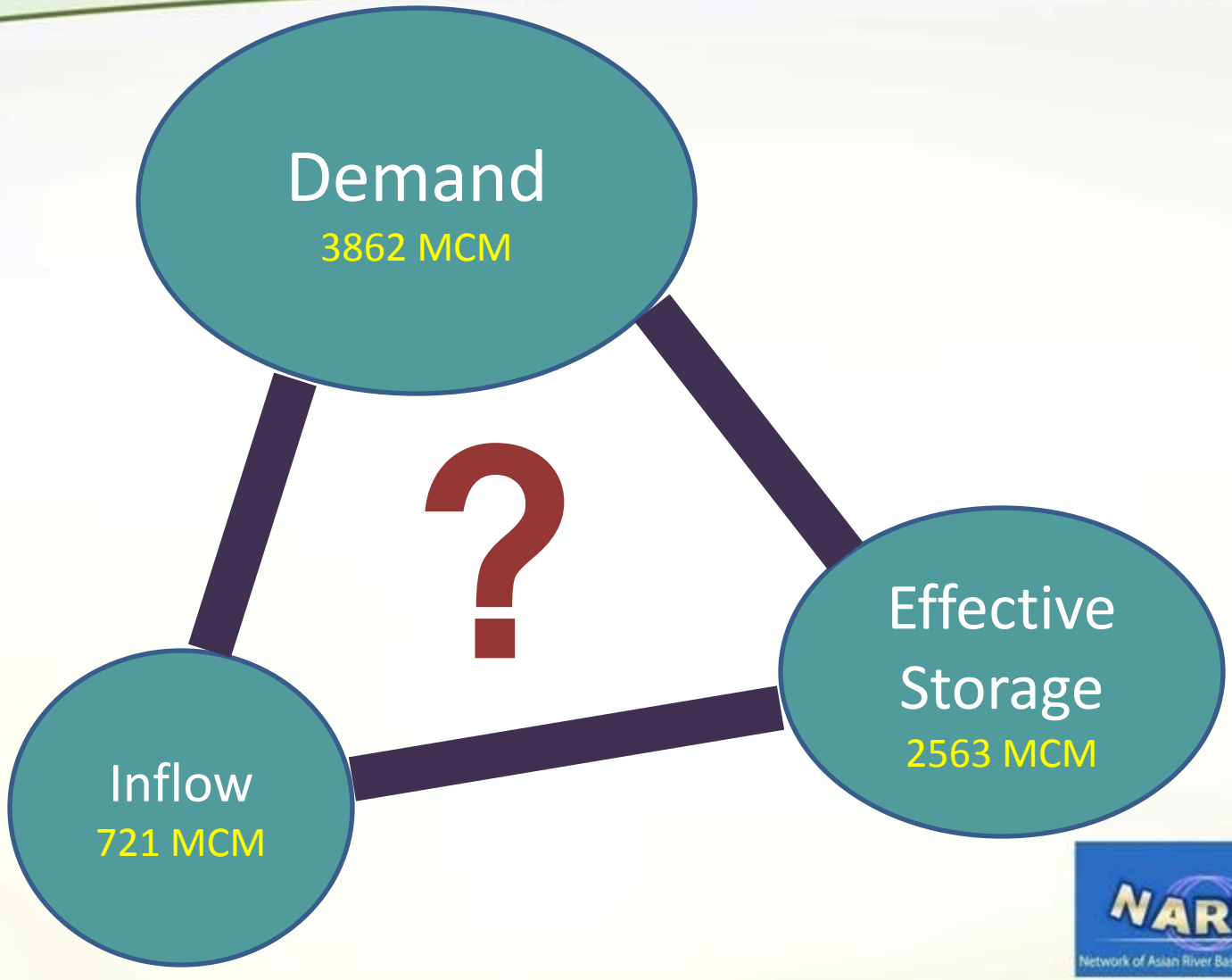
Challenge



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Water Management Panel (WMP) & Water Management Secretariat (WMS)

- WMP is the decision making body responsible for setting water management policies in the Mahaweli System

- WMS is to provide technical advice to WMP, and to plan, coordinate and monitor operations throughout all reservoirs receive Mahaweli water.

Computer Model

- ACRES Irrigation Demand Model (AIDM) -

  This model computes a monthly demand series for various irrigation systems using past 30 years of hydrologic data

- ACRES Reservoir Simulation Program (ARSP) -

  This general multipurpose multi-reservoir simulation program is the main analytical tool used to produce the water balance statement

- Data Entry Retrieval System (DERS)

  Thos generates the complete Seasonal operating Plan for stake holders.

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Seasonal Operating Plan (SOP)

- WMS prepares two SOPs per annum through a consultative process.
  - Maha Season (Oct – Mar) – Wet Season
  - Yala Season (Apr – Sep) – Dry Season

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Contents of Seasonal Operating Plan

1. Monthly diversion volumes at,
   - Macro diversion points
   - Sub System Diversion Points

2. Spill flows, Power flows, Energy generation , plant availability, end of the monthly storages of the hydro power reservoirs

3. Cropping calendar

4. Reservoir releases, Duty of water, end of the monthly storages, average rainfall over the area for Irrigation reservoirs

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Data Requirement for SOP

Historic Data

1. Initial storages of the reservoirs
2. Past 30 years of hydrologic data
3. Type of soil in each irrigation area
4. Duty of water in irrigation systems during past 5 years

Field Data

1. Type of crops & cropping extents collected from the irrigation systems [Field offices of Mahaweli Authority of Sri Lanka (MASL) & Irrigation Department (ID)]
2. Maintenance schedules for
   I. Main canal - from ID & MASL
   II. Reservoirs - from ID, MASL & Ceylon Electricity Board (CEB)
   III. Power plants - from CEB
3. Peak power & Energy demand forecast - from CEB
4. Drinking water requirement – from Water Supply Board

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Field Level Data Collection

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Suggested Type of crops & cropping extents

Irrig. System	River Basin	Principal Reservoir	Active Storage (10^3 m^3)	Net Irrigated Area (ha)
System A	Mahaweli	-	-	7,000
System B	Maduru Oya	Maduru Oya	478	16,580
System C	Mahaweli	Ulhitiya Oya	98	21,920
System D1	Amban Ganga	Minneriya	136	9,460
		Giritale	23	3,500
		Kaudulla	114	5,400
		Kantale	157	8,200
Sub Total D1			430	26,560
System D2	Amban Ganga	Parakrama Samudra	116	10,350
System E	Mahaweli	-	-	7,200
System G	Amban Ganga	-	-	5,670
System H	Kala Oya	Dambulu Oya	9	2,240
		KHFC	-	2,250
		Kandalama	32	4,480
		Kalawewa	123	25,330
		Rajanganaya	94	7,000
System IH	Malwatu Oya	Nachchaduwa	56	2,970
		Nuwarawewa	45	1,020
		Tissawewa	3.3	520
System MH	Yan Oya	Huruluwewa	65	4,210
Sub Total H, IH, MH			427.3	50,020
Grand Total			**1,549.3**	**145,300**

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Maintenance Schedule

- Availability of Power Plants
- Suggested maintenance periods of Reservoirs and Major Canals

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Maintenance Schedule

Closure Periods of Main Canals and Power Houses for Maintenance

	Item	Station	2011				2012			
			Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr
1	KHF Canal	MASL	--XX	XX--	----	----	----	----	----	XX--
2	Minipe Right Bank	MASL	XXXX	XX--	----	----	----	----	----	----
3	EMYE Canal	ID	--XX	XX--	----	----	----	----	----	----
4	Bowathenne Reservior	ID	---X	XX--	----	----	----	----	----	----
5	Minipe Left Bank	ID	XXXX	XXX-	----	----	----	----	----	----
6	Ukuwela Power House Unit 1	CEB	----	-XX---	----	----	----	----	----	----
7	Kotmale Power House	CEB	-XXX	-------	----	----	----	----	----	----

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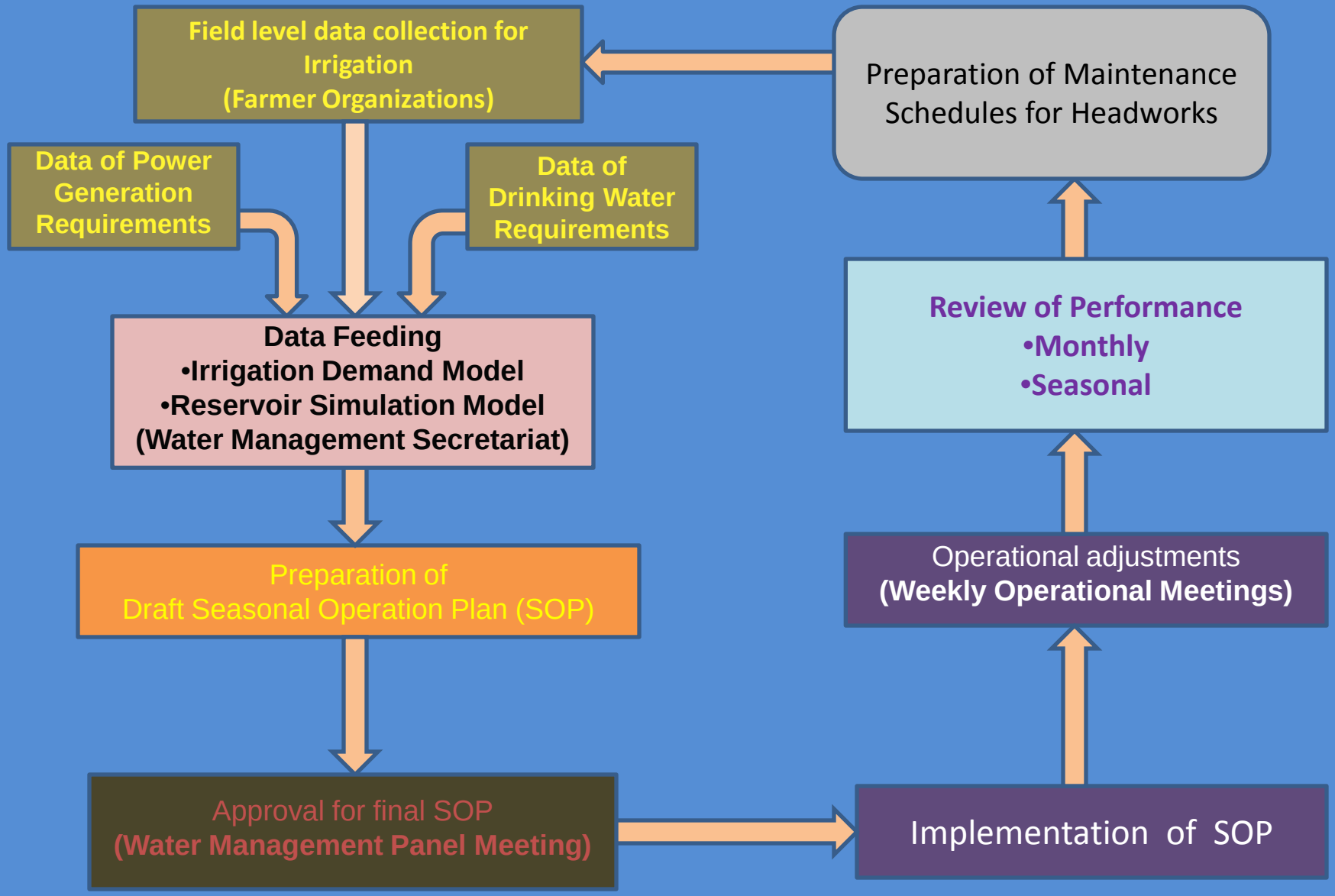
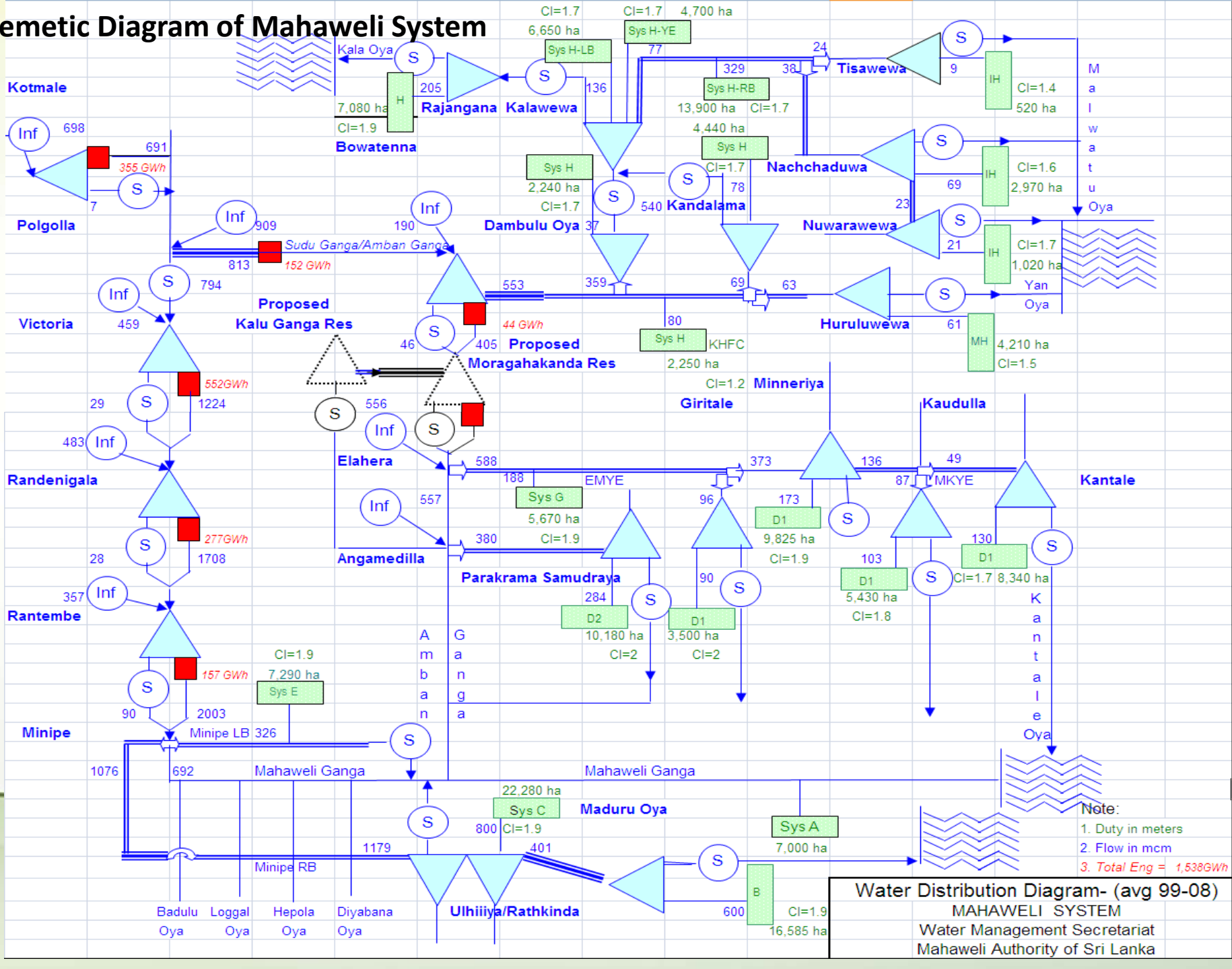
Peak Power and Energy Demands - CEB

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Peak Power Demand (MW)	1947	1903	1937	1971	2007	2050	2034	2117	2026	2013	2043	2054
Energy Demand (GWh)	878	844	867	875	809	932	848	929	903	928	937	908
Energy Demand (MW cont.)	1180	1172	1165	1176	1162	1253	1178	1249	1254	1247	1259	1261

PREPARATION OF SEASONAL OPERATING PLAN



Schemetic Diagram of Mahaweli System



Weekly Operational Planning Meetings

- Once the SOP is approved the diversions and distribution of water and monitoring of the total program is directed by the WMS.
  - A representatives from ID, CEB, Headworks division of MASL, Technical Services division of MASL, Water Supply Board, Director & WMS staff are meeting at WMS on **every Friday at 11 am** to discuss the current performance of the system and releases for next weeks.
  - Decisions of the meeting (Weekly Operation Plan) are displayed on Mahaweli web site
  - In crisis situations farmer organization representatives also participate this meeting

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WMS – Weekly Operational Meeting

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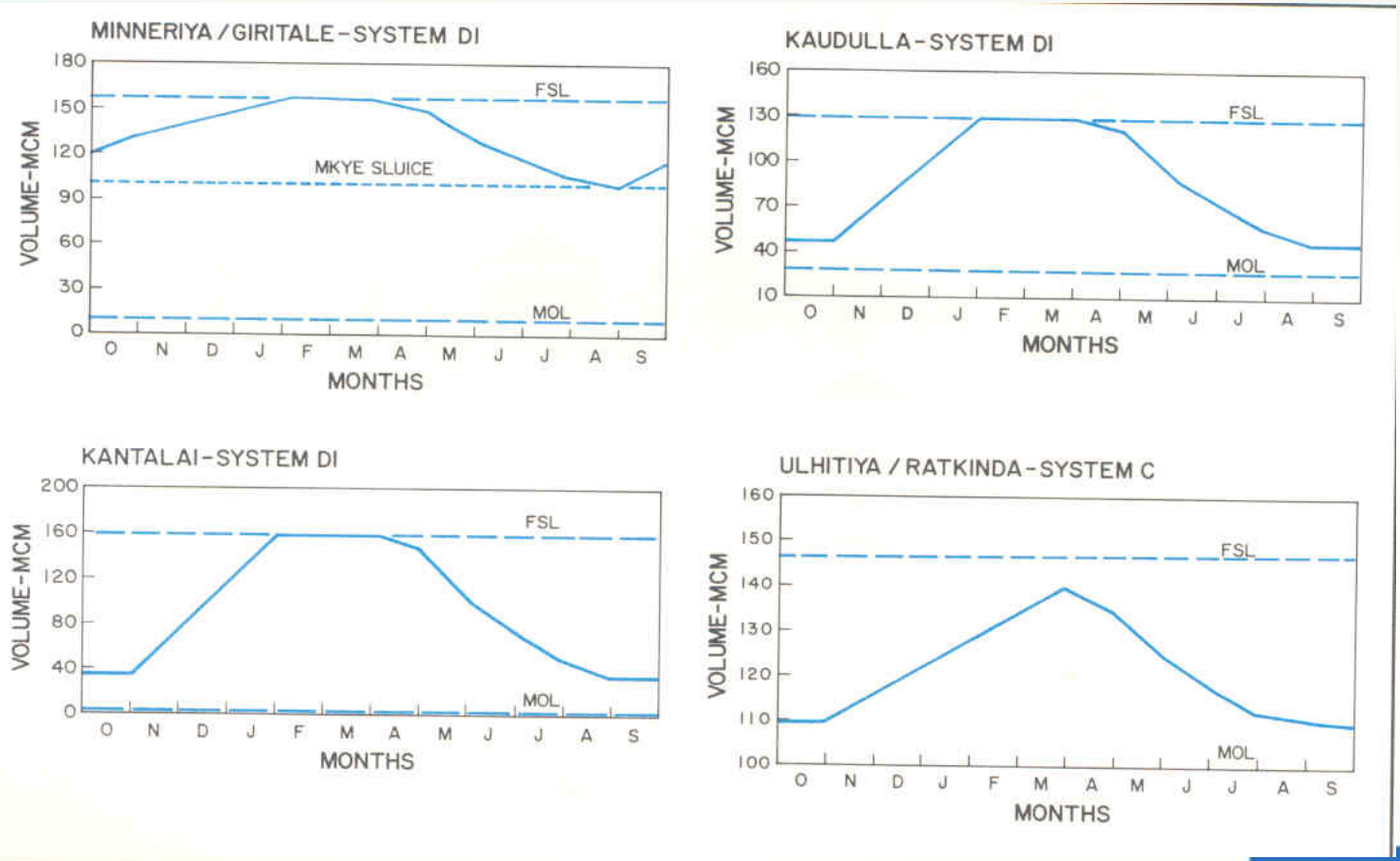
Reservoir Operation Rules

- Step 1: In an Irrigation Reservoir above the Rule Curve (*RC)* no diversion demand is placed on main system reservoirs. These *RCs* are adjusted to minimize demand on main system reservoirs while maintaining the irrigation reliability

Irrigation reservoirs



Multipurpose Reservoirs

- Step 2: In a multipurpose reservoir power demand could be satisfied when water level is above the *Rule Curve (RC)* and below which irrigation demand would dictate release volume. These *RCs* are adjusted to maximize average hydroelectric energy generation.

- Step 3: In a power generating reservoir *RCs* are adjusted to maximize average hydroelectric energy generation.

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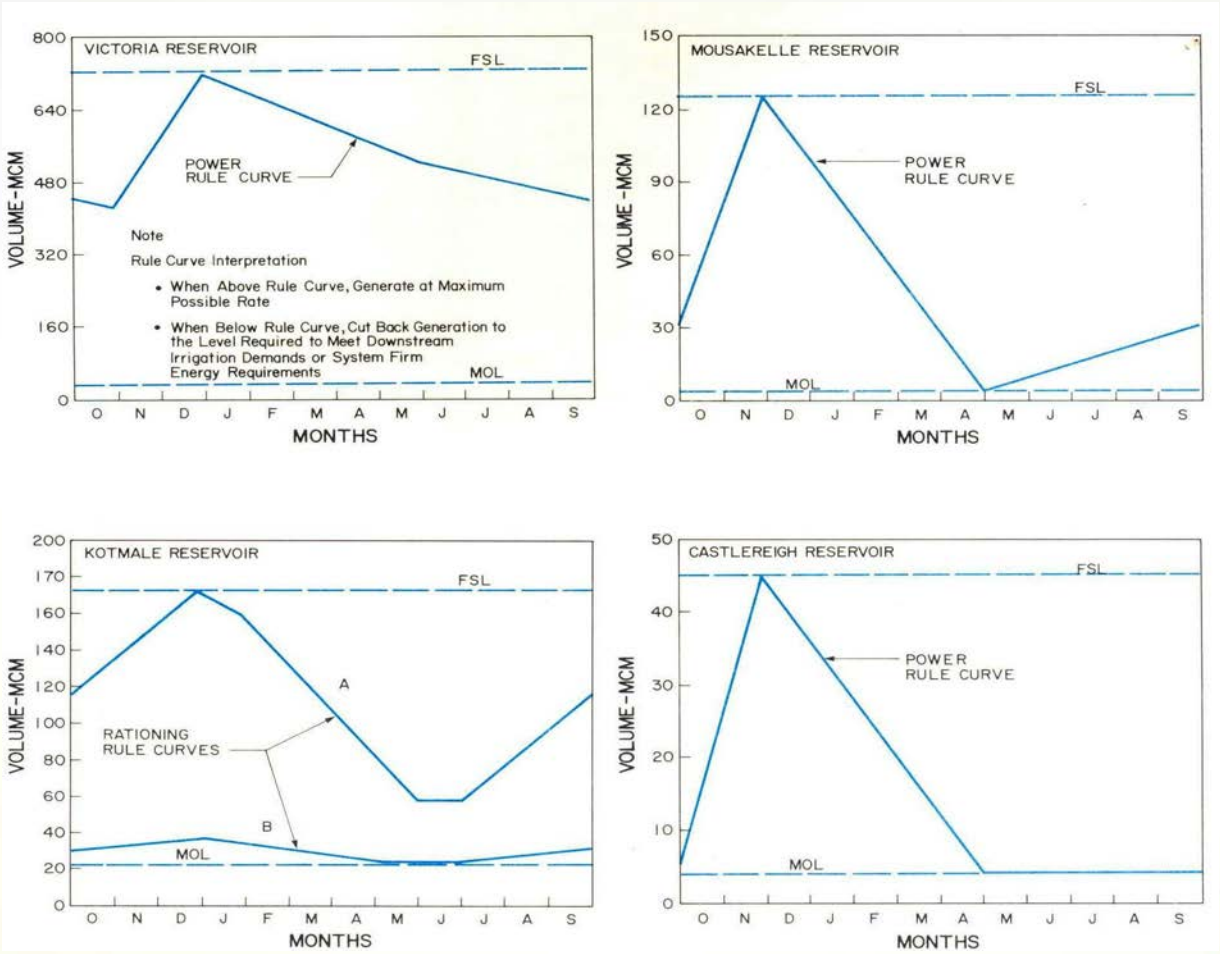
Multipurpose Reservoirs



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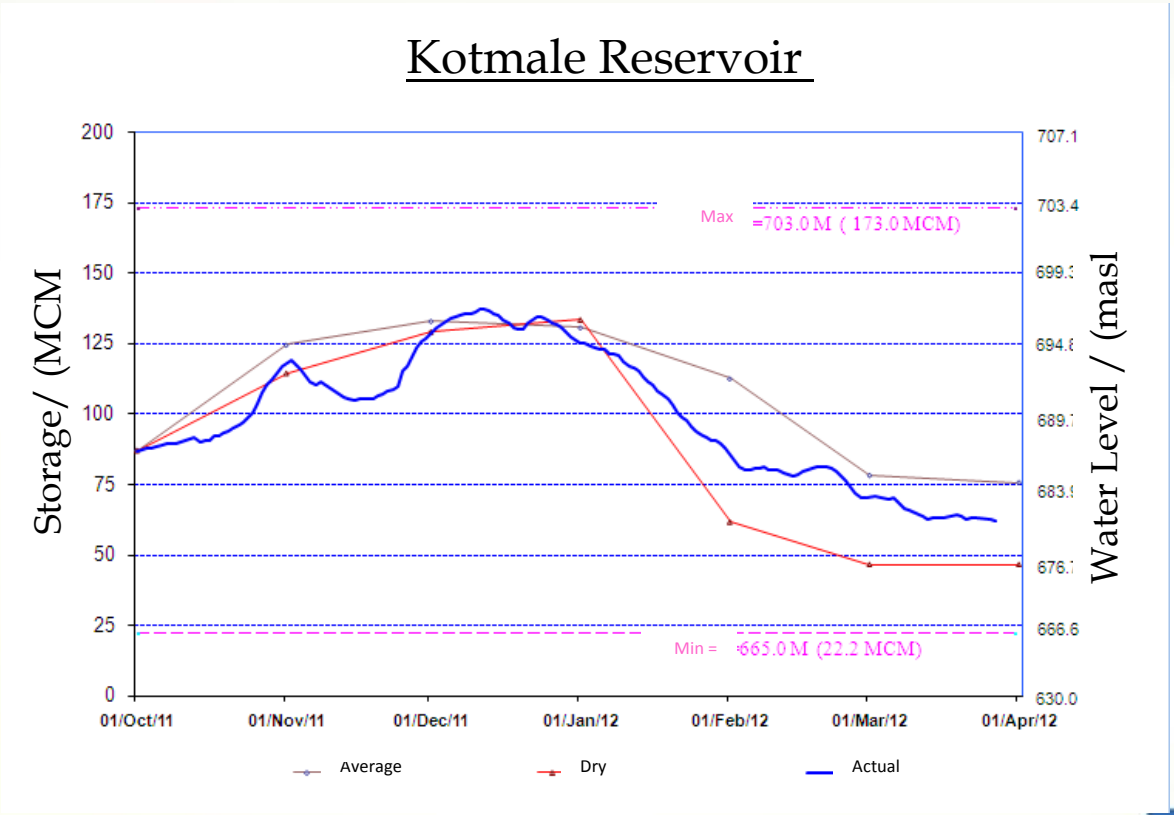
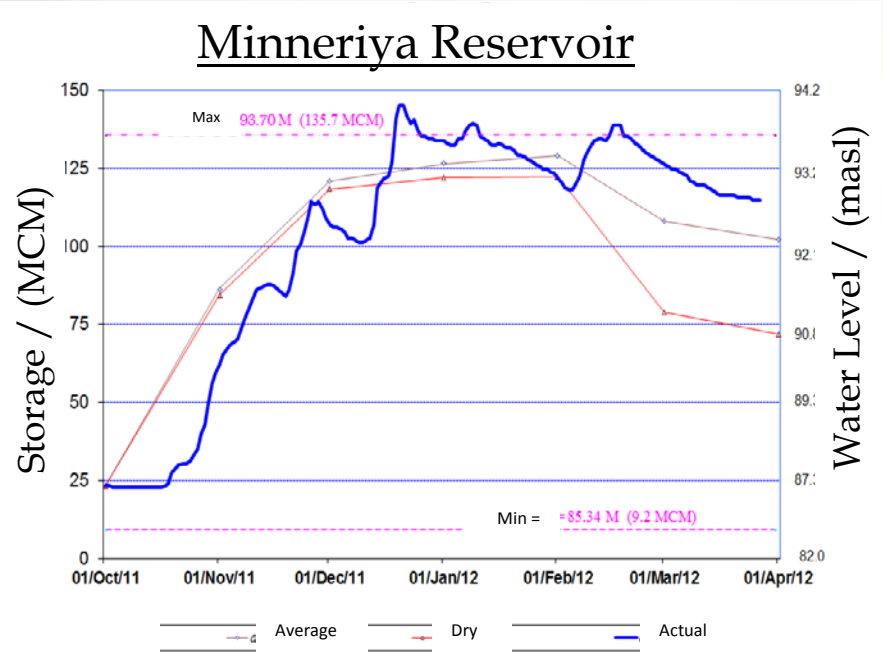
Average Situation - 2011/12 MAHA

Reservoir Behavior

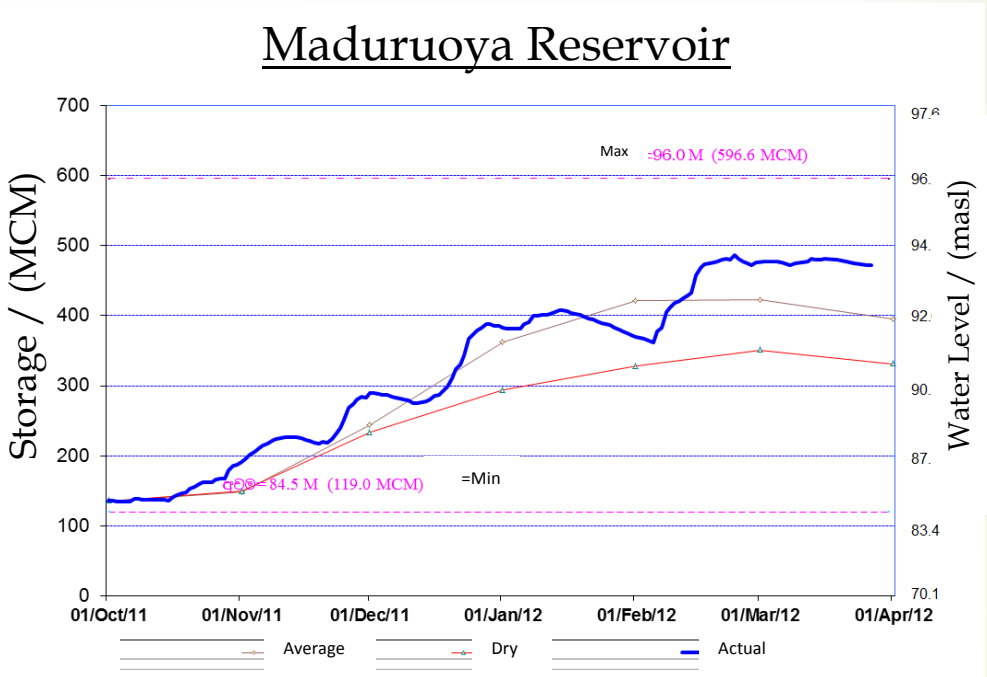


Average Situation – Sufficient Inflows & Storage



Minneriya Reservoir behavior

Maduruoya Reservoir behavior



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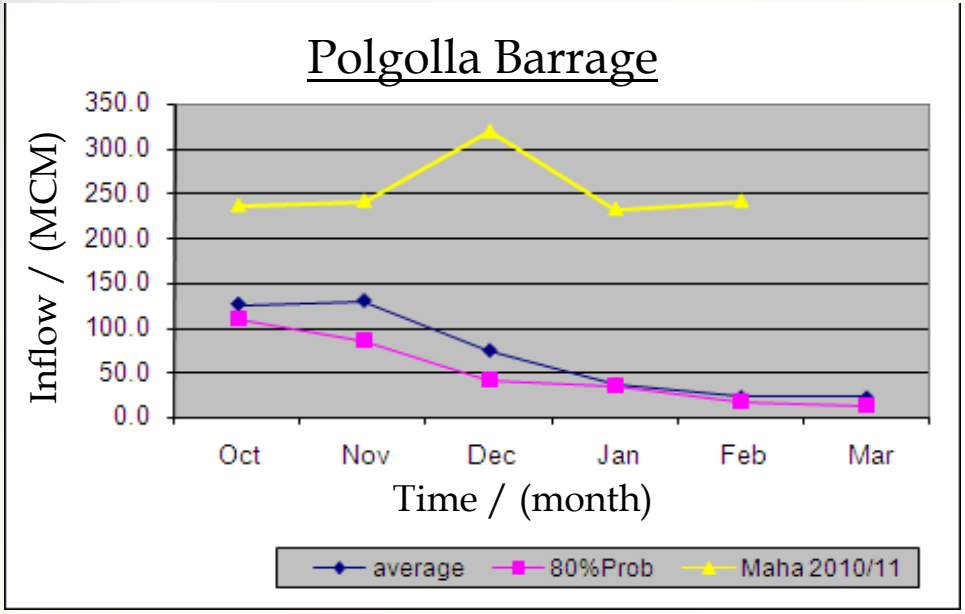
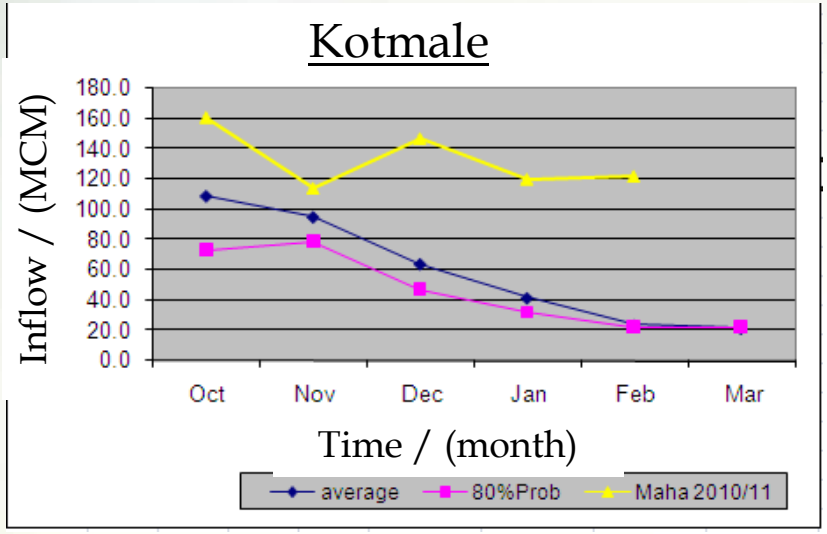
Wet situation - 2010/11 Maha



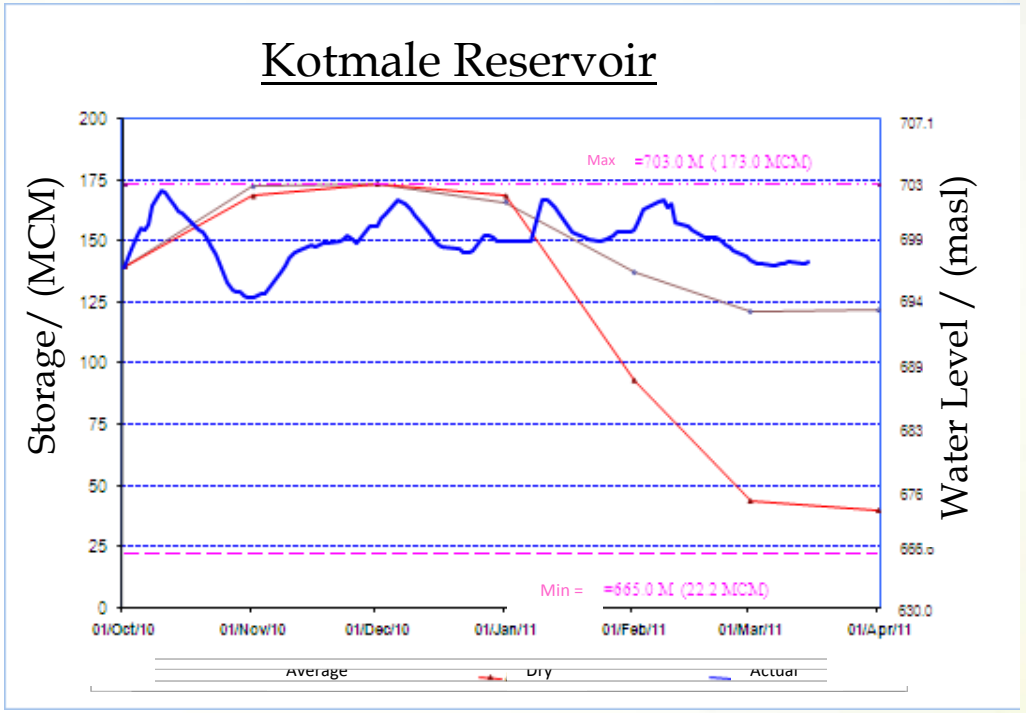
Inflow to Polgolla Barrage

Reservoir Behavior

Reservoir Behavior

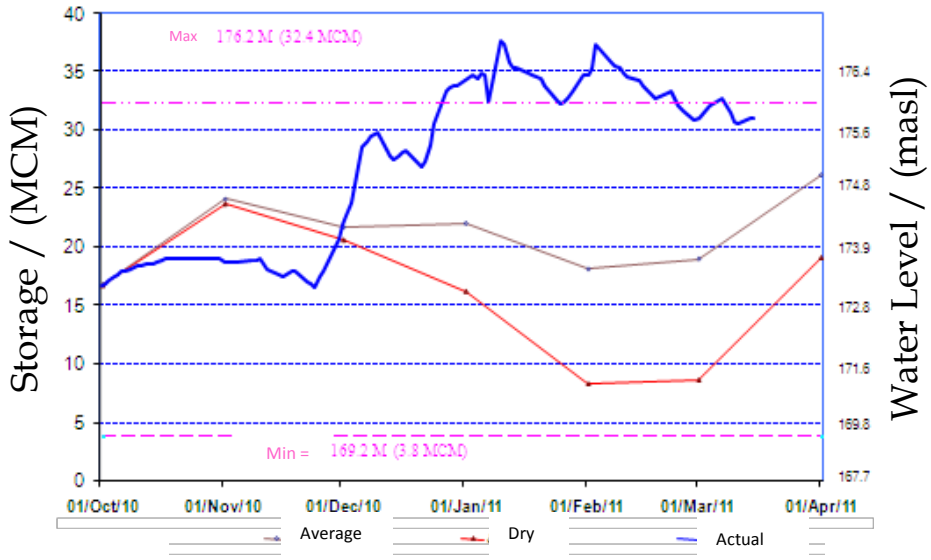


Inflow to Kotmale reservoir -2010/11

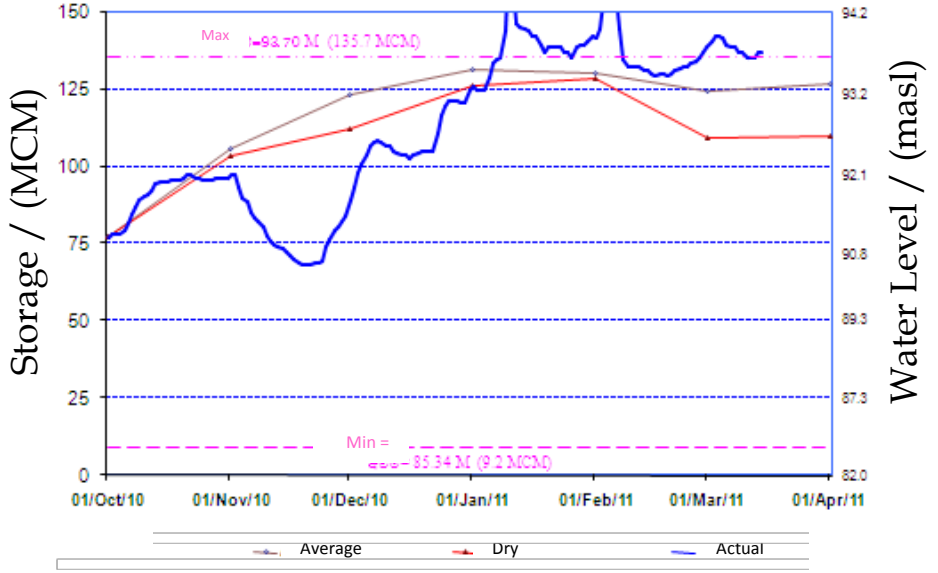


Irrigation Reservoir Behaviour

Kandalama Reservoir



Minneriya Reservoir



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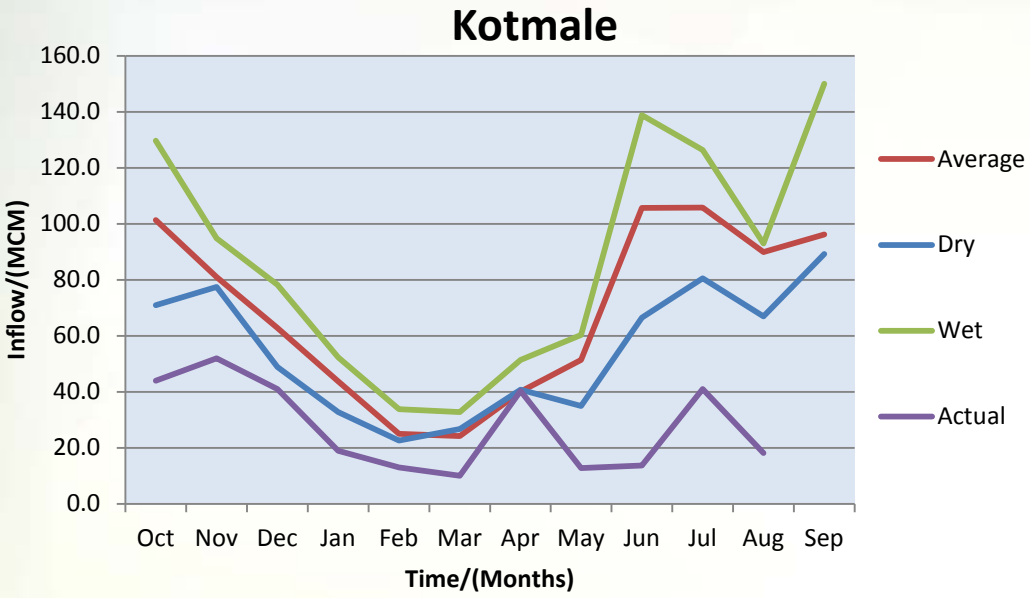
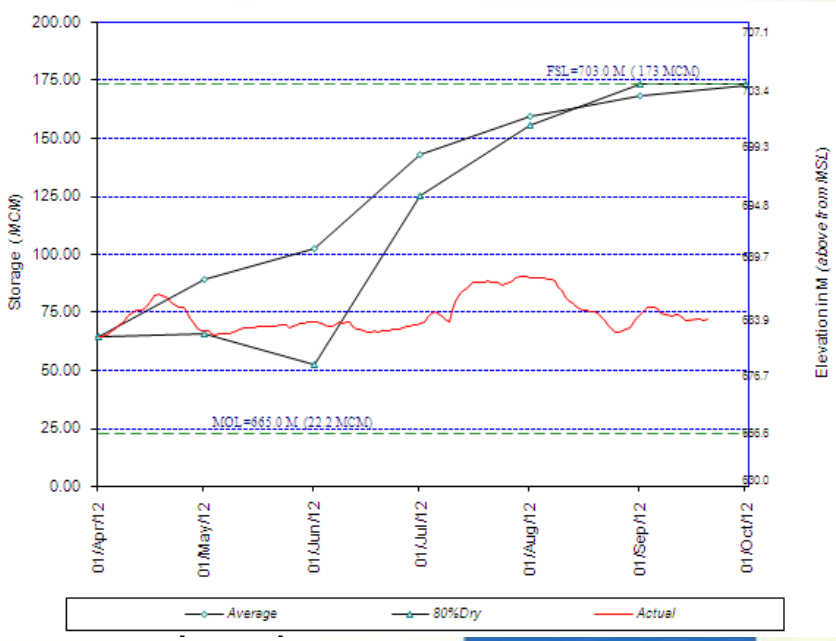
Dry situation - 2012 Yala

Reservoir Behavior





Inflow To Kotmale Reservoir

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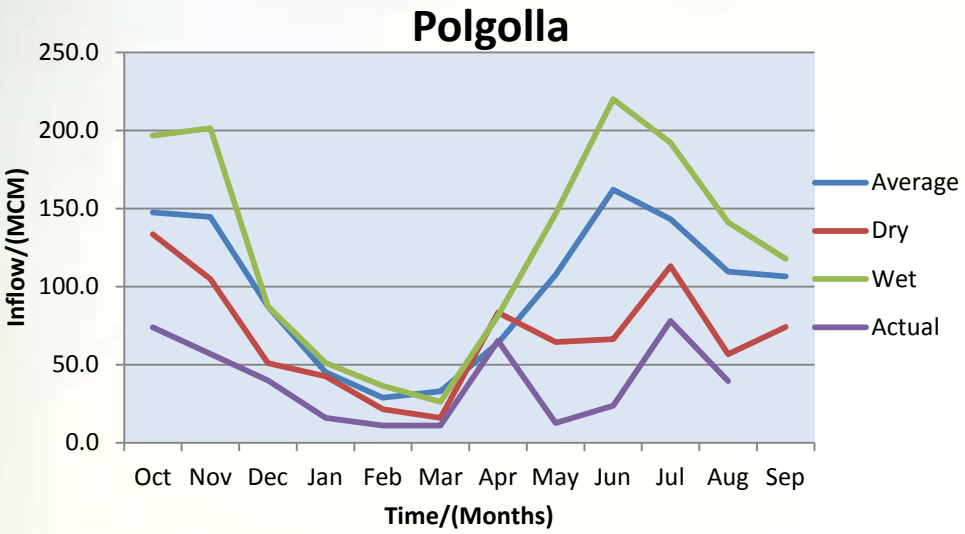
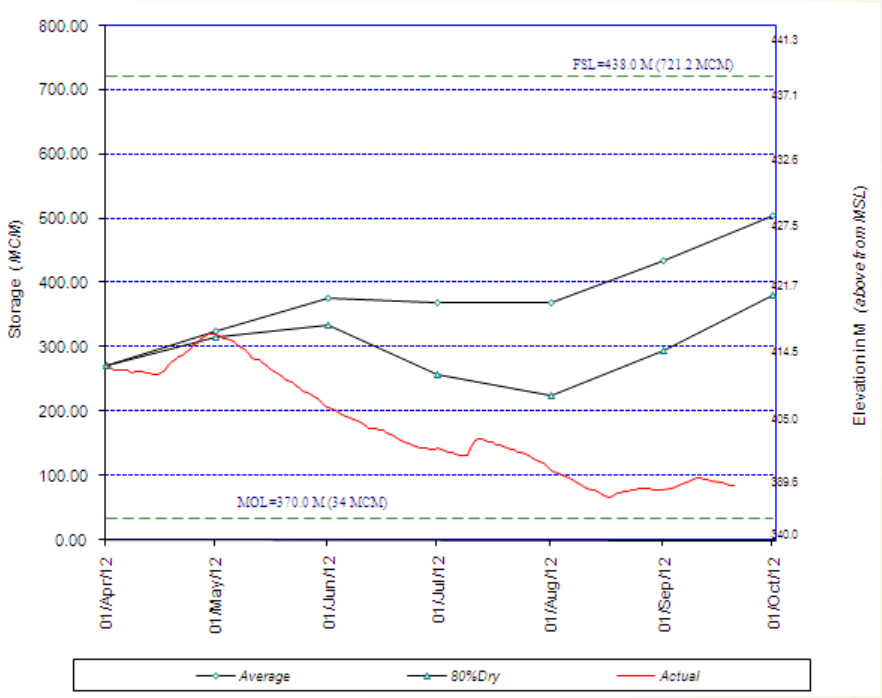
Victoria Reservior Behavour





Inflow To Polgolla Barrage

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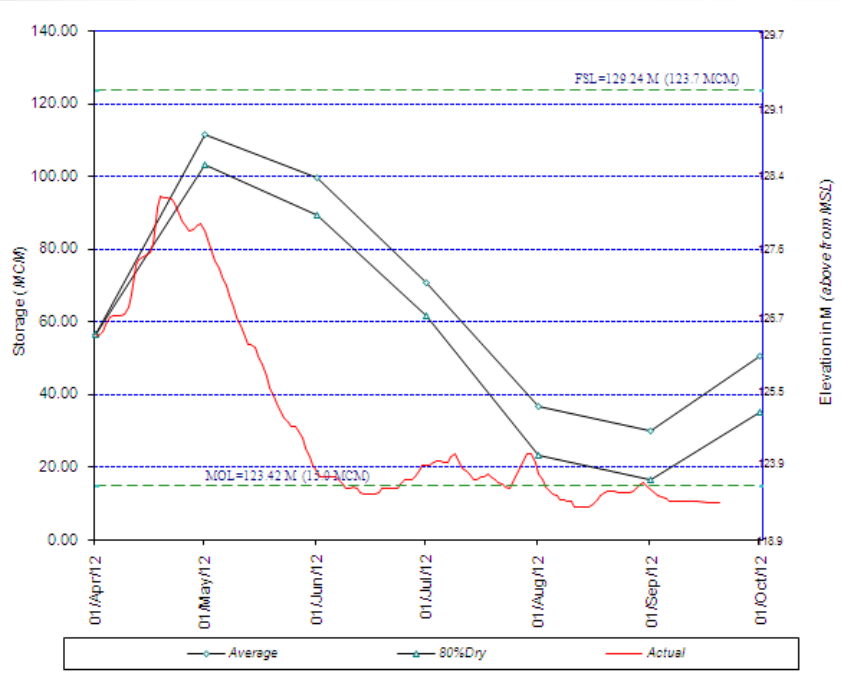
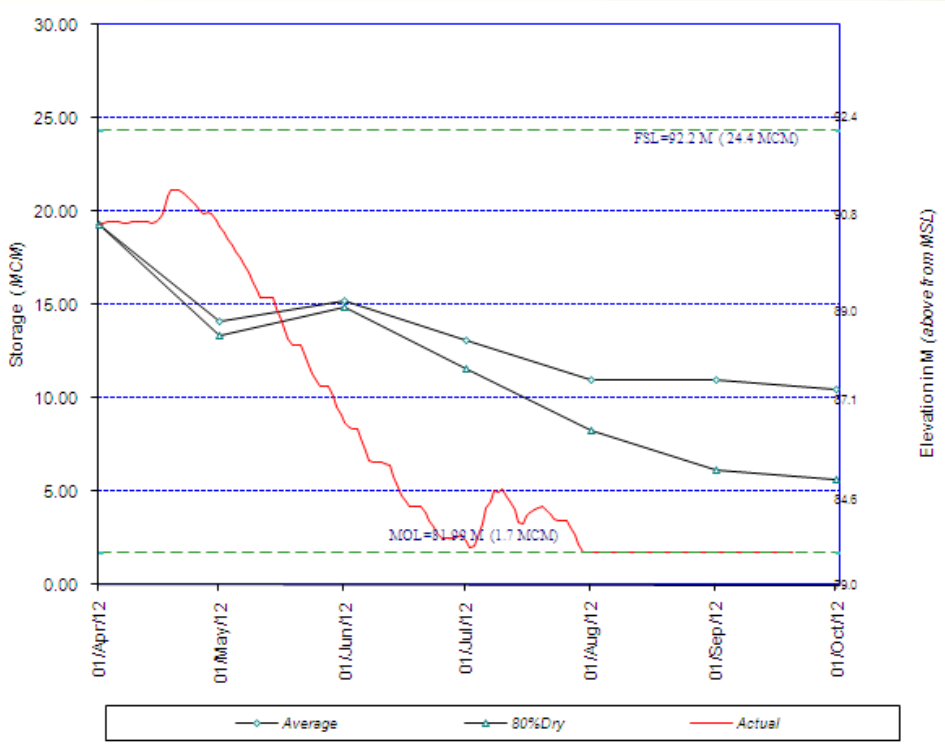
Irrigation Reservoir Behaviour

Giritale Reservoir





Kalawewa Reservoir

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Process used for Seasonal Management

- Seasonal operation Plan
- Weekly review of Inflows, Storages & water allocations
- Operation Directives
- Monitoring of Implementation of directives.

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Crisis Situations

- Delay of monsoon rains.
- Insufficient water availability at Irrigation reservoirs due to over cultivation.
- Droughts
- Land sharing in case of reduced cropping extent in an irrigation system
- Sudden break down of a power plant
- Breaching of a trans basin diversion canal.
- Request for extensions for last date of water issues due to delayed cultivation of a few.

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Our Achievements in Water Management

- Consultation of water users at planning and implementation stages of each season
- Identification of crisis situations through close monitoring and analysis , and resolving at early stages as possible .
- No crisis has gone above WMP level.
- It's proved that multipurpose, multi-user water resources management system could be managed successfully even without a legal framework

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"Water is the Driving Force of Nature"

Thank you