NAP Regional Training Workshop for Asia on" Mainstreaming Climate Change Adaptation into Water Resources"

Case Study

(Mone Chaung Multipurpose Dam)

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General Information of Myanmar

Location:

- Located in South-East Asia
- Situated Between

  9° 32' & 28° 31' North Latitude

  92°10' & 101°10' East Longitude
- Borders with

  China ~ North

  India & Bangladesh ~ West

  Thailand & Laos ~ East

  Thailand ~ South

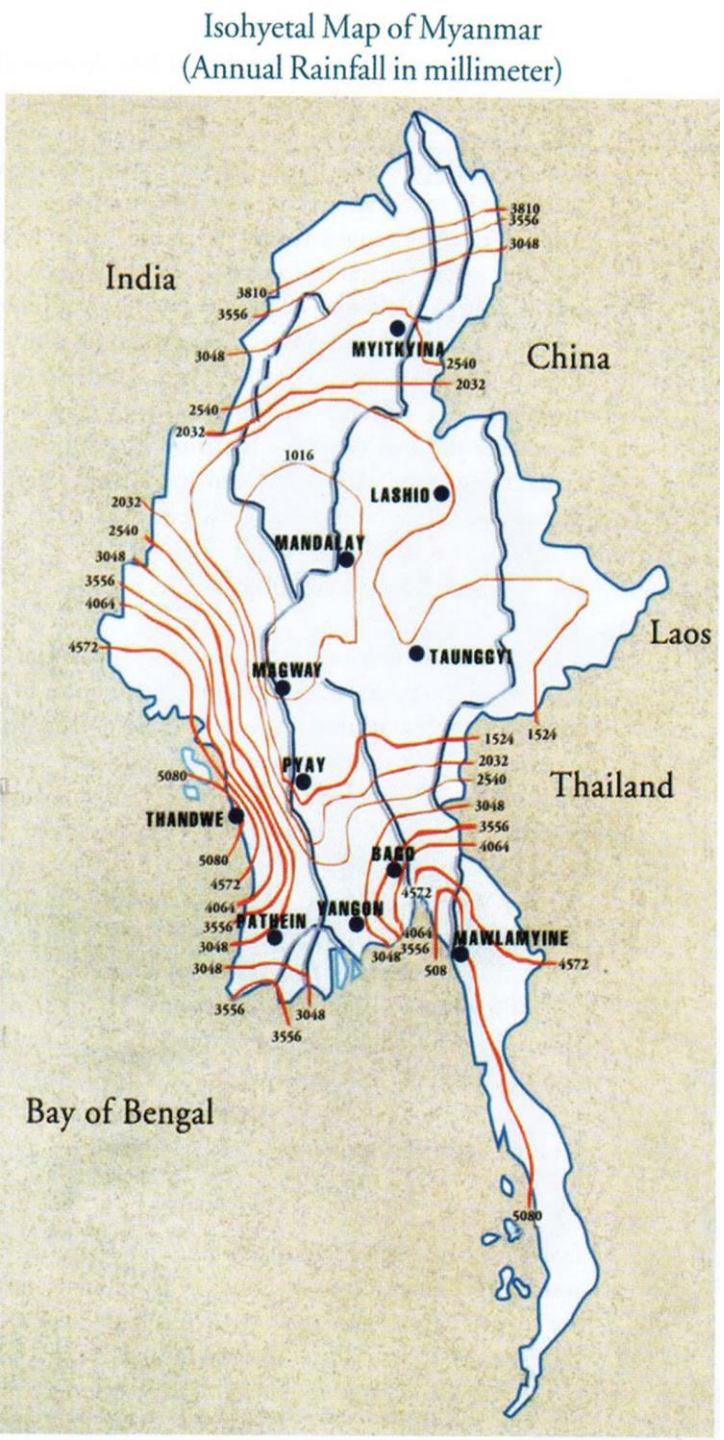
Population:

Population growth ~ 0.89 % (2016-2017)

Population ~ 52.92 Million (2016-2017)

Rural Population ~ 37.45 Million

Urban Population ~ 15.47 Million



Climatic Condition

- **Dry season - March to May**

  (Summer) - Temperature 40°C - 43°C

- **Wet season - June to October** (rainy)
  - South-West monsoon wind
  - 2030 mm to 3050 mm- deltaic area
  - -1520 mm - in the Shan state
  - 2030 mm to 3810 mm -in the north
  - 5080 mm -South,Southeast and South west
  - 750 mm - in the Central Dry zone

- **Cold season - November to February**

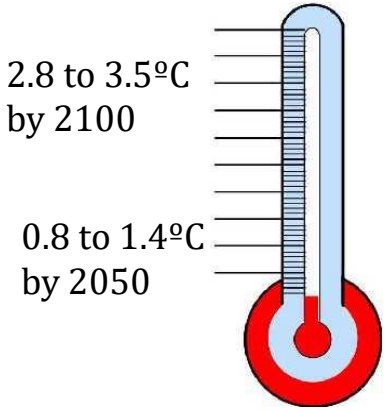
  (Winter) - Temperature : 16°C - 10°C

1. Climate Change Challenges

Projections of future changes in climate for Myanmar* 2050 and beyond

*NAPA; DMH/RIMES; CCSR

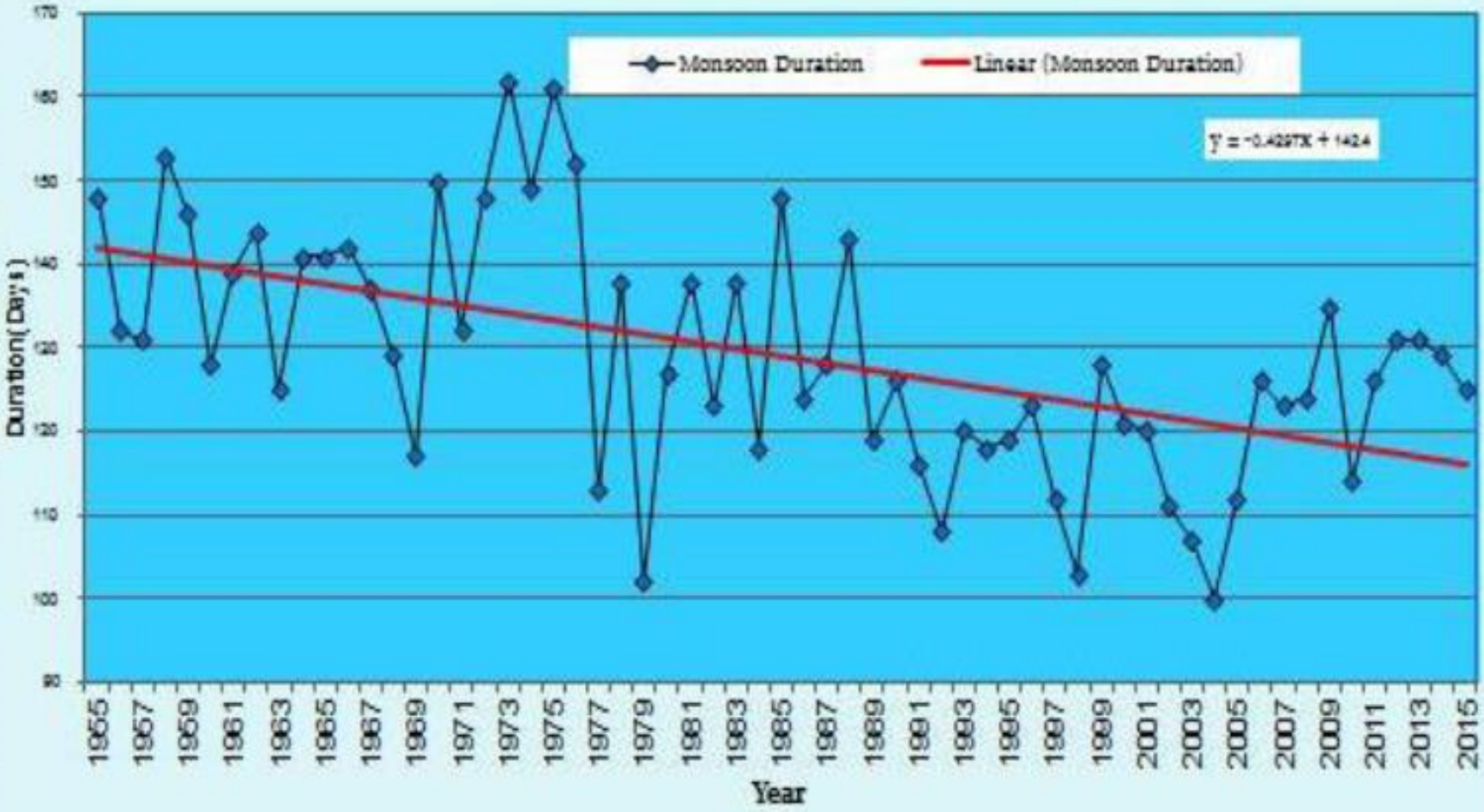
- **Increase in temperatures** by mid-Century (~1.4 degrees Celsius –low estimate)
- **Increased numbers of hot days** (extreme temperatures)
- **Increased rainfall with regional differences i.e.** wetter rainy seasons in-land
- **More extreme rains, storms/cyclones and flood events**
- **Shorter Monsoon season** (late on-set/early withdraw) and **droughts**
- **Sea-level rise** (up to 40cm by 2050)
- **Storm-surge**



Increase ~1582 mm by 2100

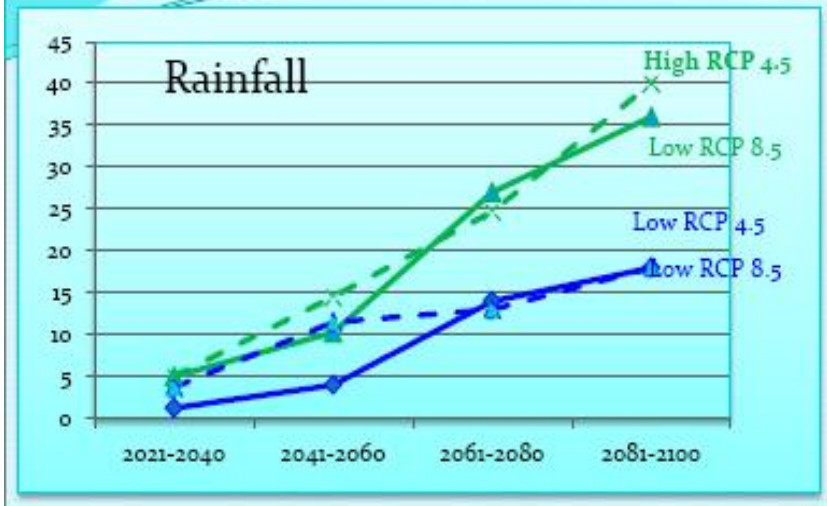
Increase ~661 mm by 2050

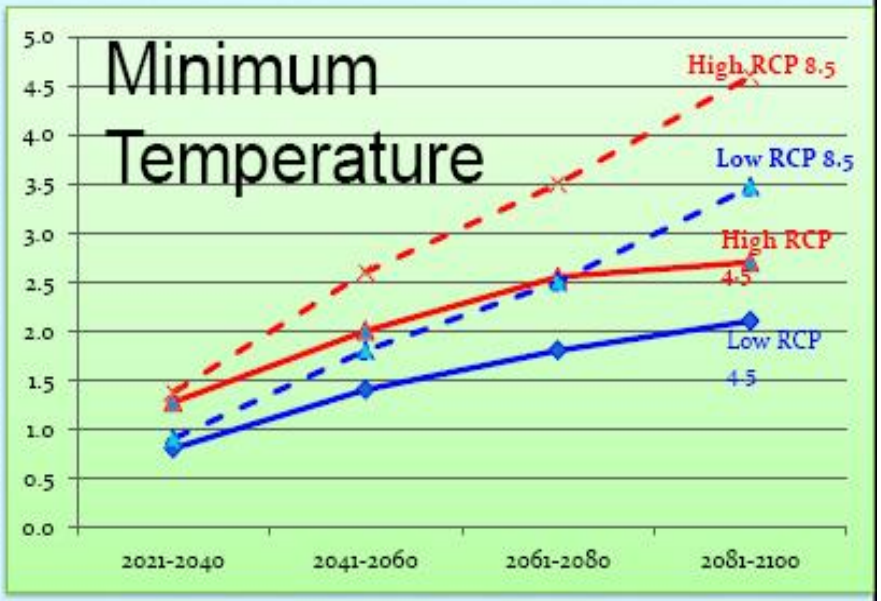
Monsoon Duration

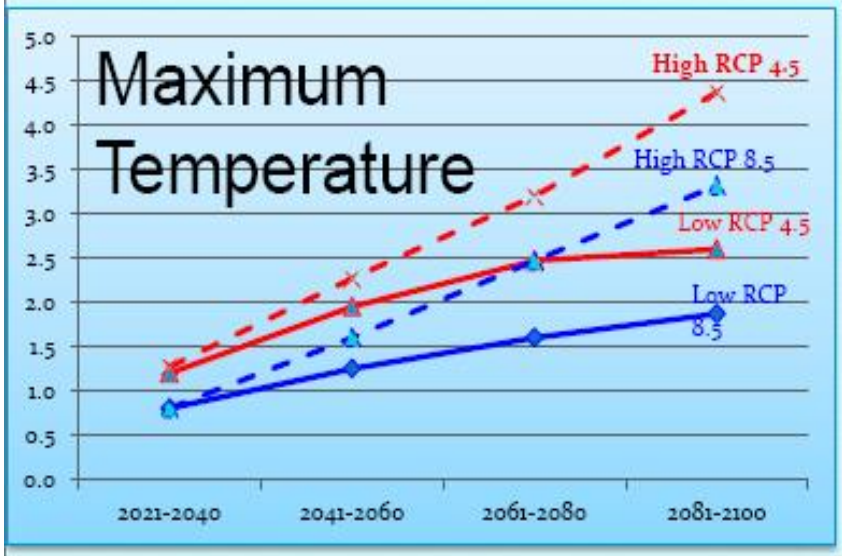


Source - DMH

Projection for MYANMAR







Source - DMH

Water Resources
(Annual Surface and Groundwater Potential in Myanmar)

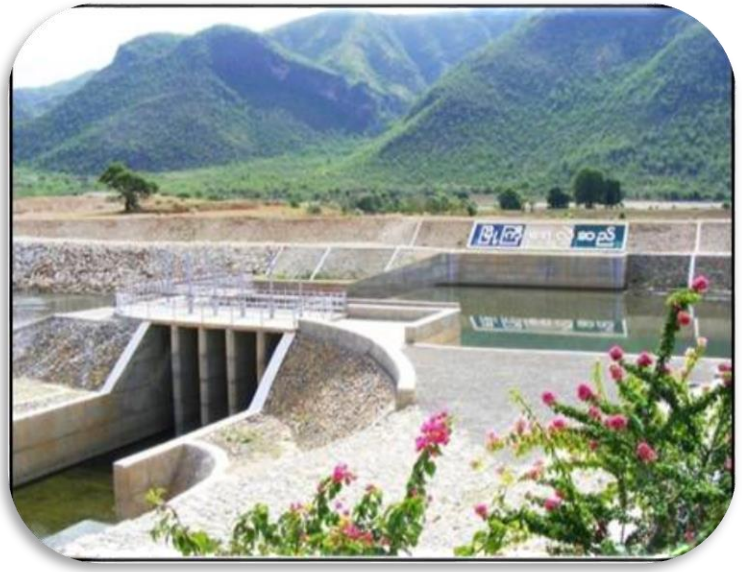
Sr No	Name of Principal River Basin	Catchment Area (000'sq-km)	Annual Surface Water (km^3)	Estimated Groundwater Potential (km^3)
1	Chindwin River	115.30	141.293	57.578
2	Upper Ayeyarwady River	193.30	227.920	92.599
3	Lower Ayeyarwady River	95.60	85.800	153.249
4	Sittaung River	48.10	81.148	28.402
5	Rivers in Rakhine State	58.30	139.245	41.774
6	Rivers in Tanintharyi Division	40.60	130.927	39.278
7	Thanlwin River (from Myanmar boundary to its mouth)	158.00	257.918	74.779
8	Mekong River (within Myanmar territory)	28.60	17.634	7.054
	Total	**737.80**	**1081.885**	**494.713**

Summary Table of Dams, Reservoirs, Weir, Tanks and Sluice Gates Constructed and Maintained by Irrigation and Water Utilization Management Department

Sr. No.	State / Region	Dam/ Reservoir	Weir	Tank	Sluice Gate	Total
1.	Kachin State	-	5	-	-	5
2.	Kayar State	5	10	17	-	32
3.	Kayin State	2	1	2	7	12
4.	Chin State	1	-	-	-	1
5.	Sagaing Region	28	10	2	1	42
6.	Tanintharyi Region	-	1	-	20	21
7.	Bago Region	39	13	-	14	66
8.	Magway Region	56	10	2	1	68
9.	Mandalay Region	48	15	36	-	99
10.	Mon State	6	-	-	11	17
11.	Rakhine State	14	-	-	-	14
12.	Yangon Region	9	1	-	35	45
13.	Shan State	9	28	4	-	41
14.	Ayeyarwady Region	6	1	-	79	86
15.	Naypyitaw	12	12	8	-	32
	Total	235	107	71	168	581
					Source – DG (ID)	

Summary Table of Full Tank Storage Capacity and Water Spread Area of Dams and Reservoirs, Maintained by Irrigation and Water Utilization Management Department

Sr. No.	State / Region	Dam/ Reservoir	Full Tank Storage Capacity (Ac –ft)	Water Spread Area (Ac)
1.	Kachin State	-	-	-
2.	Kayar State	5	12314	886
3.	Kayin State	2	29024	2571
4.	Chin State	1	1954	67
5.	Sagaing Region	28	3220027	151059
6.	Tanintharyi Region	-	-	-
7.	Bago Region	39	5547355	173205
8.	Magway Region	56	2066384	52046
9.	Mandalay Region	48	1825486	53739
10.	Mon State	6	132034	2723
11.	Rakhine State	14	56951	1853
12.	Yangon Region	9	730491	33572
13.	Shan State	9	915212	13458.50
14.	Ayeyarwady Region	6	356722	7195
15.	Naypyitaw	12	1007378	24045
	Total	235	15901332	516419.50
			Source – IWUMD	



Storage dam, one of the missions by ID

- To store water for various purposes
  - Irrigation, hydropower, domestic water supply, recreation
- Not only to care for seasonal variations in rainfall in river flows, but also for drought and flood control

River Pumping and Tube Well

Maintained by Irrigation and Water Utilization Management Department

No. of Irrigation Facilities by River Pumping and Tube Well - 205

Irrigation Area by River Pumping and Tube Well - 0.254 Million ha

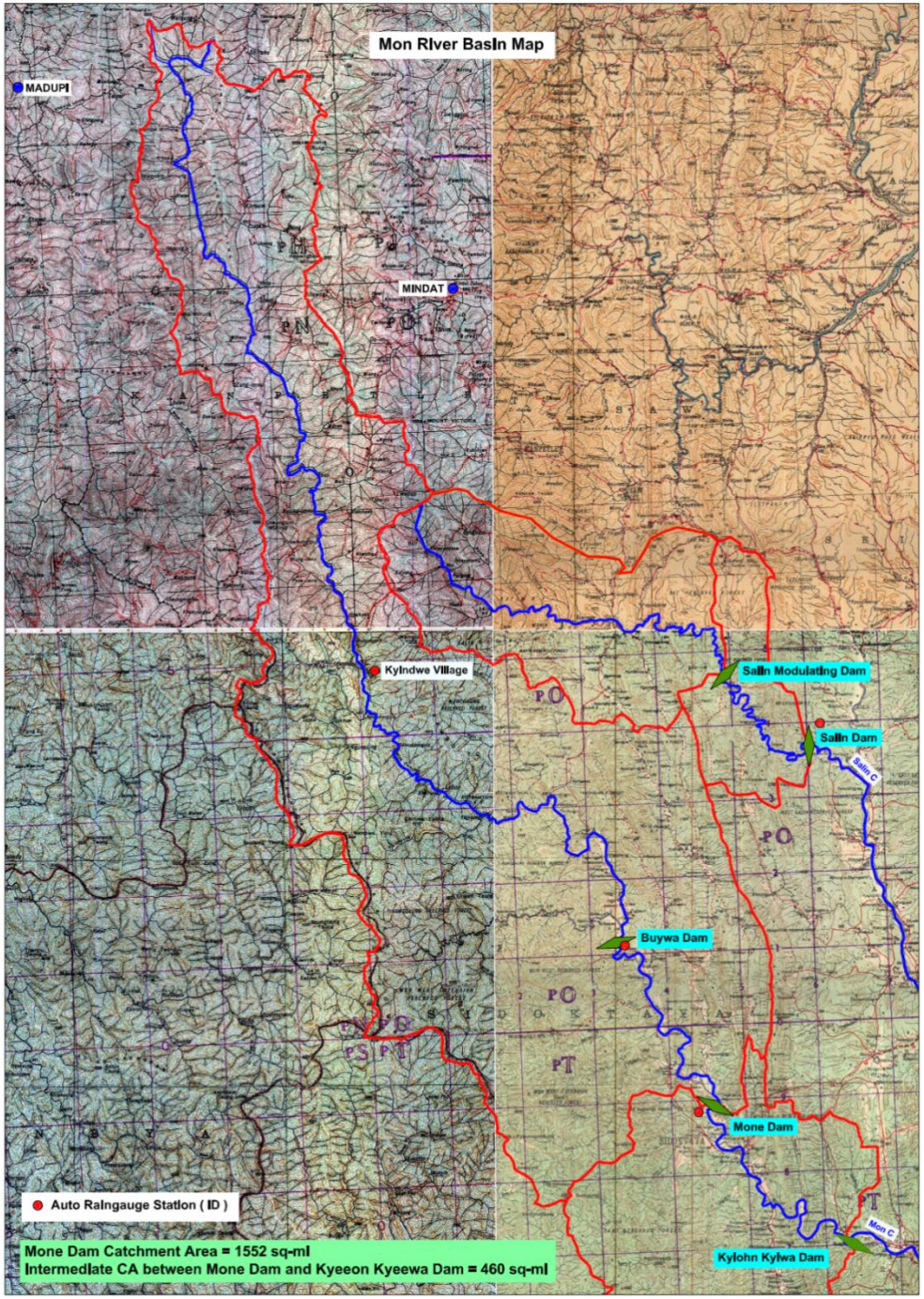
Meteorological Stations at Dam/ Weir/ Sluice Gate Sites Maintained by Irrigation Department

Region	No. of Rainfall Stations	State	No. of Rainfall Stations
Yangon	13	Kayar	2
Bago	43	Kayin	3
Magwe	32	Chin	1
Mandalay	46	Mon	8
Sagaing	23	Rakhine	4
Ayeyarwady	6	Shan(North)	3
Nay Pyi Taw	6	Shan(South)	11
	Total	**201**	

Case Study and practice of Adaptation Action Plan in Myanmar

MONE CHAUNG DAM

1.	Location	-	Magway Region
			Saytoktayar Township
2.	Map Reference	-	1 inch = 1 mile Scale
			(84L/7 T 462891)
3.	Name of Chaung	-	Mone Chaung
4.	Catchment Area	-	1468 Square Miles
5.	Avg: Annual Rain Fall	-	44 inches
6.	Avg: Annual Inflow	-	3500000 Acre-ft
7.	Type of Dam	-	Earth Filled Dam(Zone Type)
8.	Length of Dam(Including 2 saddles)	-	6490 ft
9.	Height of Dam	-	200 ft
10.	Storage Capacity	-	674400 Acre-ft
11.	Dead Storage Capacity	-	110000 Acre-ft
12.	Water Spread Area at F.T.L	-	10620 Acres
13.	Length of Diaphrgam Cut-off wall	-	2120 ft
14.	Width of Diaphragm Cut -off wall	-	1.97 ft
15.	Depth Diaphragm Cut-off wall	-	46.3 ft
16.	Length of Diversion Tunnel	-	3625 ft
17.	Diameter of Diversion Tunnel	-	37.4 ft
18.	Diversion Tunnel Design Discharge		34120 cuft/sec
19.	Type of Spillway	-	Reinforced Concrete
			(Ogee Type
20.	Width of Spillway	-	350 ft
21.	Spillway Design Discharge	-	149130 Cu.ft/sec
22.	Hydropower installed Capacity	-	25x3 Mega Watt
23.	Annual power Output	-	330 Million KW/hour
24.	Irrigable Area	-	96777 Acre
25.	Project Started	-	1995-1996 Year
26.	Completed year (Dam)	-	2006-2007 Year



Name of Dam - Mone

State & Division - Magway Region

Irrigation Area - 108000 Acres

Location - Setoktaya Township

Catchment Area - 1552 Sq mile

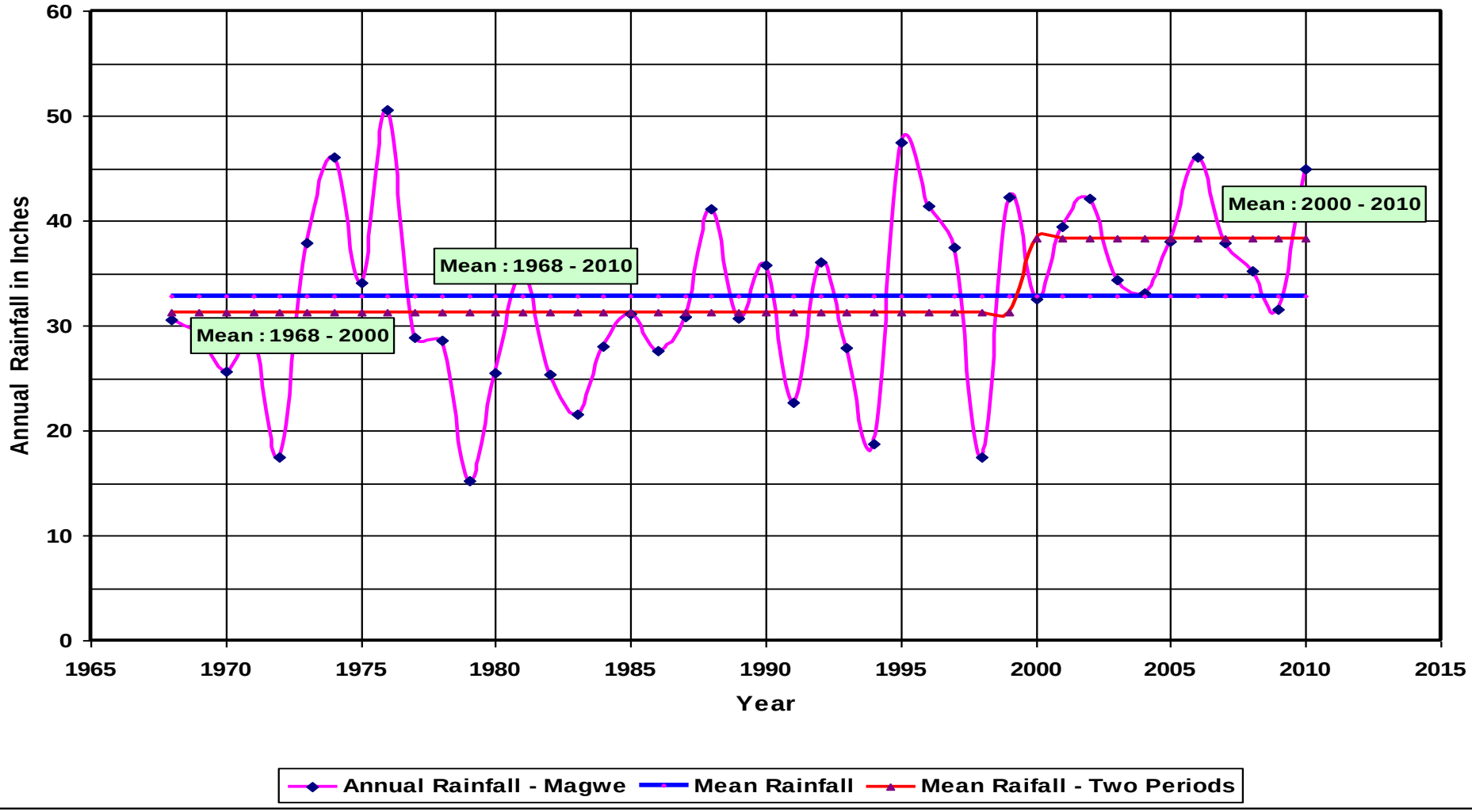
F.T.L Capacity - **674407** Ac- ft

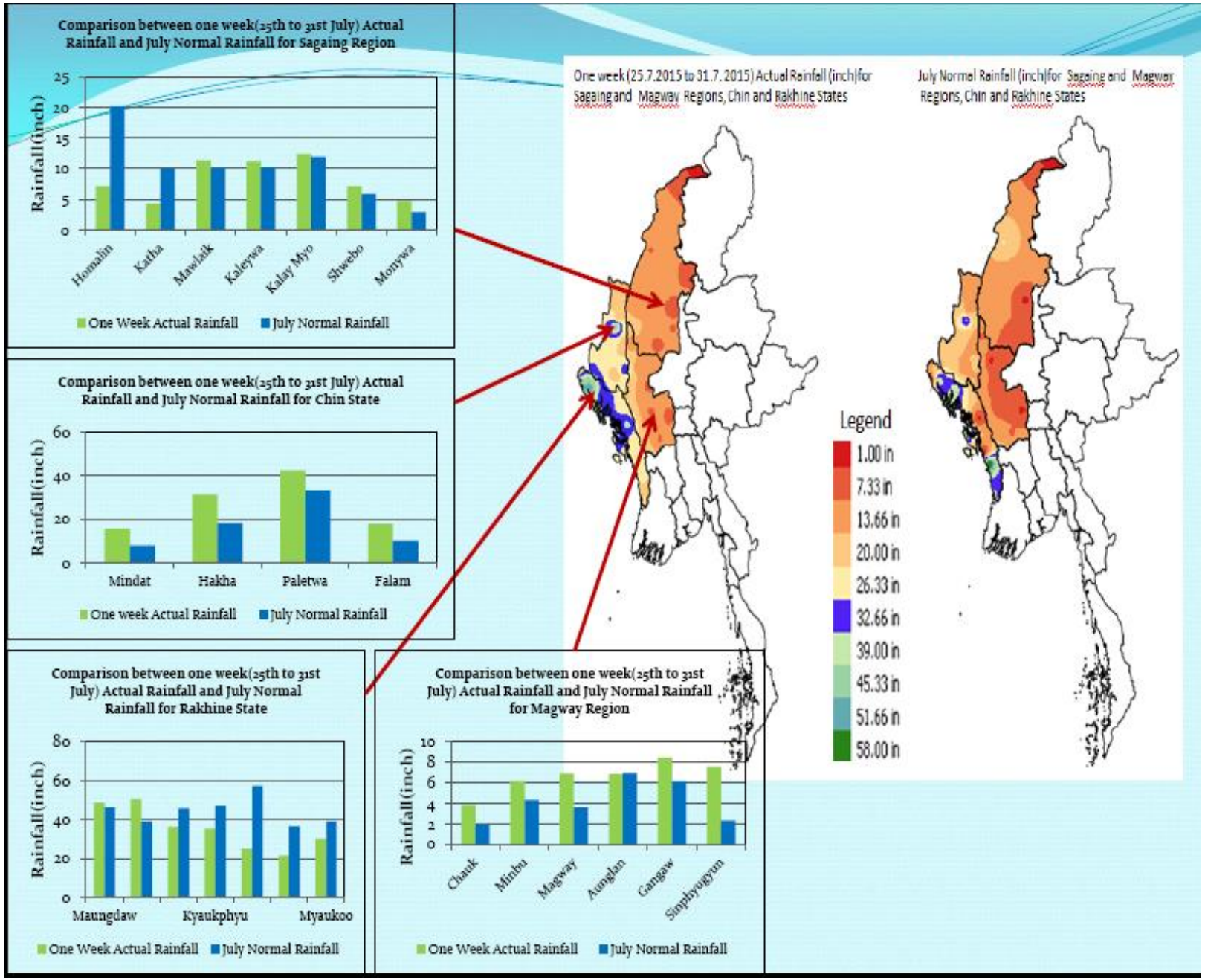
Year	Inflow	Hydro Power	Dam Site Rainfall	Spilled Volume	Remark
	Ac-ft	Ac-ft	Inch	Ac-ft	
2006	3901969	2611653	51.31	1369021	
2007	5155106	2684298	67.51	2456881	
2008	2609823	2402541	41.26	242250	
2009	2956867	2213345	44.97	640829	
2010	2421994	1995573	74.52	1334722	
2011	4938641	2171783	65.34	2735761	
2012	3020628	1816027	38.86	1048213	
2013	3268385	2027161	57.84	1185646	
2014	1842046	1732559	37.92	141290	
2015	**4941520**	1403986	57.48	**3410986**	
2016	4005385	2020169	61.55	1954122	

* Average Annual Inflow (2006 to 2015) = 3505698 Ac-ft
* Due to Cyclone Komen, Spill volume amount for 7 days (29.7.2015 to 4.8.2015) is **1719909** Ac-ft and it is **2.55** times of the Full tank Capacity.
* Dam Site Rainfall at (31.7.2015) is **4.27** inches. But Matupi Rainfall at (31.7.2015) is **9.20** inches. Dam site RF between 27 to 31 July is **14.43** inches.

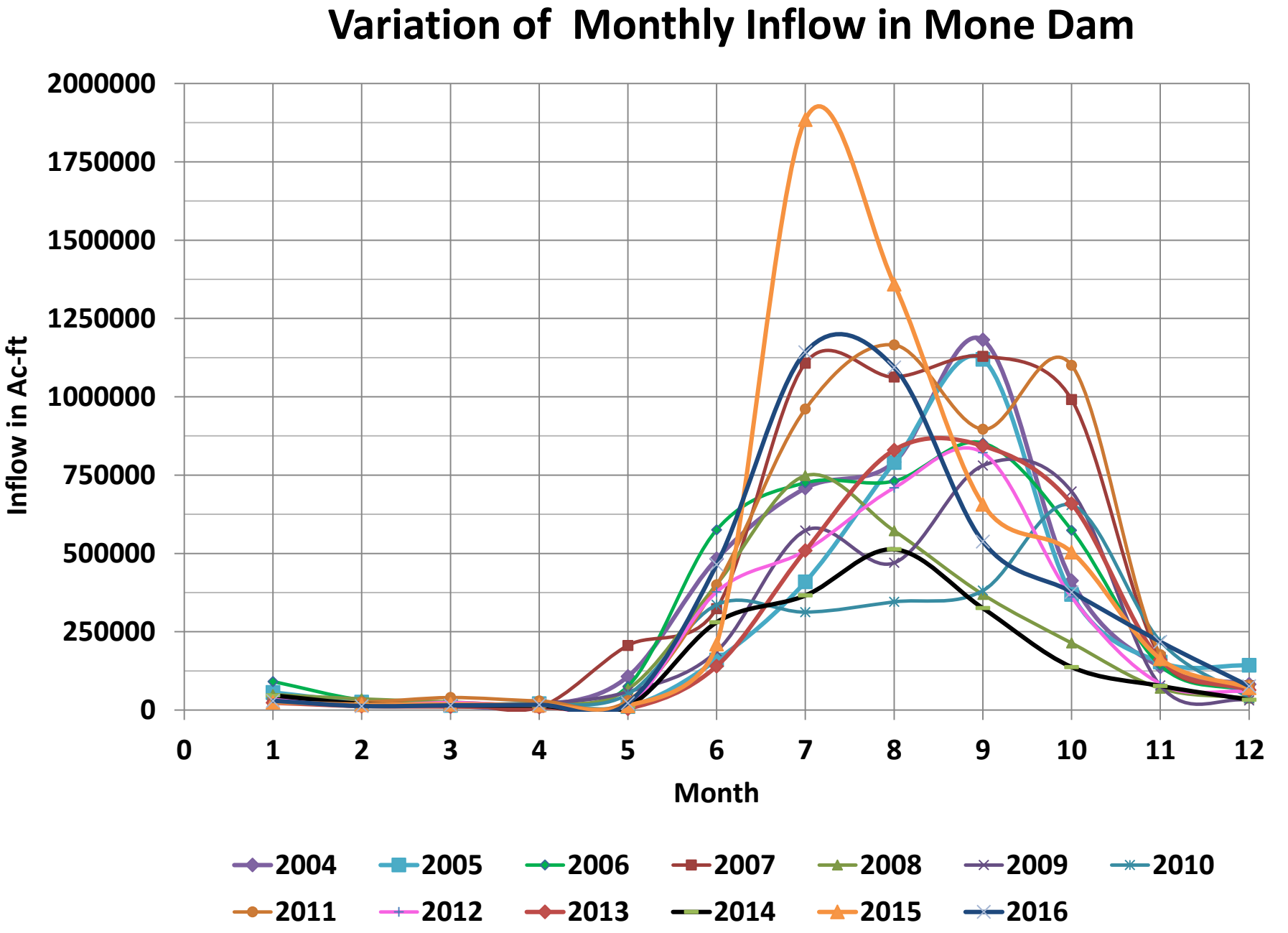
STUDY OF ANNUAL RAINFALL AT MAGWE

Variation of Annual Rainfall at Magwe

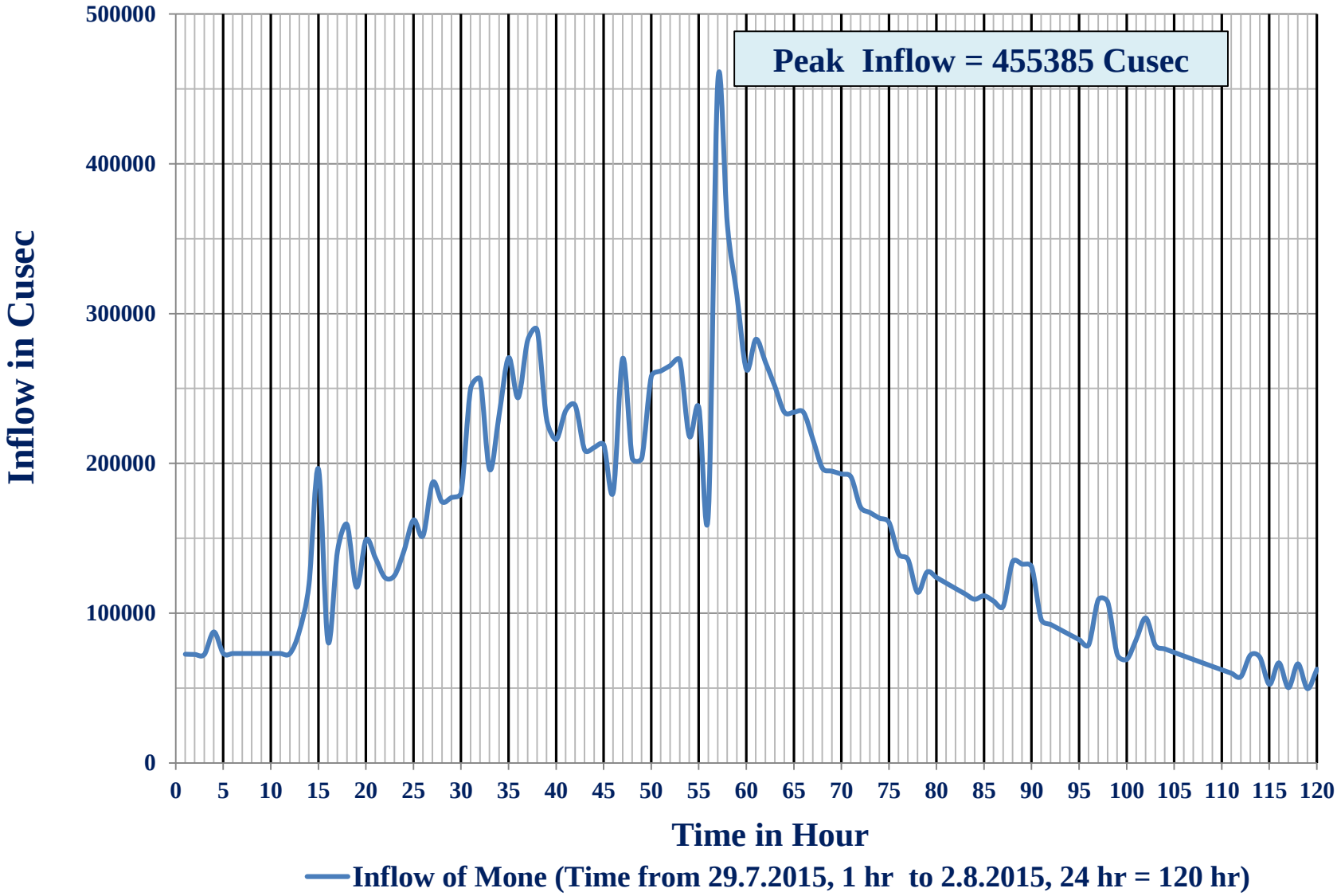



Comparison between one week(25th to 31st July) Actual Rainfall and July Normal Rainfall for Sagaing Region
Rainfall(inch)
25
20
15
10
5
0
Homalin
Katha
Mawlaik
Kaleywa
Kalay Myo
Shwebo
Monywa
One Week Actual Rainfall
July Normal Rainfall
Comparison between one week(25th to 31st July) Actual Rainfall and July Normal Rainfall for Chin State
Rainfall(inch)
60
40
20
0
Mindat
Hakha
Paletwa
Falam
One week Actual Rainfall
July Normal Rainfall
Comparison between one week(25th to 31st July) Actual Rainfall and July Normal Rainfall for Rakhine State
Rainfall(inch)
80
60
40
20
0
Maungdaw
Kyaukphyu
Myaukoo
One Week Actual Rainfall
July Normal Rainfall
Comparison between one week(25th to 31st July) Actual Rainfall and July Normal Rainfall for Magway Region
Rainfall(inch)
10
8
6
4
2
0
Chauk
Minbu
Magway
Aunglan
Gangaw
Sinphyugyun
One Week Actual Rainfall
July Normal Rainfall
One week (25.7.2015 to 31.7.2015) Actual Rainfall (inch)for Sagaing and Magway Regions, Chin and Rakhine States
July Normal Rainfall (inch)for Sagaing and Magway Regions, Chin and Rakhine States
Legend
1.00 in
7.33 in
13.66 in
20.00 in
26.33 in
32.66 in
39.00 in
45.33 in
51.66 in
58.00 in

Source - DMH


Variation of Monthly Inflow in Mone Dam
Inflow in Ac-ft
2000000
1750000
1500000
1250000
1000000
750000
500000
250000
0
0
1
2
3
4
5
6
7
8
9
10
11
12
Month
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016

Peak Inflow of Mone Multipurpose Dam
(Using Old Area-Capacity Table)



Review the Original Storage Capacity by Doing Bathymetric Survey for Dam

(Garmin 80x Echo-sounder with SP80 Differential GPS)

Original Design Storage Capacity	-	674407 Ac-ft
New Design Storage Capacity	-	**620900** Ac-ft
Difference	-	53507 Ac-ft

Hydrological Assessment of the Design Flood for Mone Dam

Original Design Flood for 1000 Yr RP - 405435 Cusec

Peak Inflow Discharge due to Cyclone Komen - 455385 Cusec

Review Design Flood for P.M.F - 716687 Cusec

Retrofitting Spillway Capacity to Mone Dam

Main Service Spillway, Width, B - 350 ft (Crest Level – 520ft)

Auxiliary Spillway , Width, B - 220 ft (Crest Level – 530ft)

Mone Chaung Multipurpose Dam

Water Storage Condition @ Mone Dam (30.7.2015)

Auto Raingauge Station at Mone Chaung Multipurpose Dam,

(Latitude 20º 18' 15" N, longitude 94º 15' 14" E)

National Water policy
CHAPTER (5)

Adapation To Climate Change

5.5 Planning and management of water resources structures, such as, dams, flood embankments, tidal embankments, etc, should **incorporate coping strategies for possible climate changes**. The acceptability criteria in regard to new water resources projects need to be re-worked in view of the likely climate changes.

5.6 During some studies on the existing dams under the Irrigation Department (ID), irregular performances of many reservoirs influenced by impending climate change were observed yielding huge volume of water to the waste. Up to now, more than hundred of reservoirs have been constructed at the cost of thousands of billion kyats from the public fund. **Upgrading of the existing reservoirs after rigorous studies** would optimize the water use for apprehending more irrigated lands to enhance the livelihood of the grassroots level farmers and to meet the nation's goal of poverty alleviation.

5.7 Most water resources projects are designed and operated based on the **historical pattern of hydrological parameters to estimate water availability**, based on the historical records by assuming that same cyclical order or constant climatic behavior may occur. This assumption is no more applicable under the climate change impacts. **The present and future trends of hydrological and meteorological parameters under new climate conditions can be investigated and appropriate adaptation strategies have to be implemented**

National Adaptation Program Action (2012)

Priority Adaptation Projects for implementation in Myanmar to address immediate needs for building climate change resilience of vulnerable communities.

Sector/Theme	Priority Adaptation Project Title	
WATER RESOURCES	**First priority: Assessing the status of dams for providing sustainable water supplies and withstanding flood risks under future climate change.**	
	Second priority: Constructing small-scale water impoundments in Naypyidaw for flood control and increasing water supplies for local communities.	
	Third priority: Protecting human life and property against climate extremes in the Ayeyarwady river system through channel improvement and adaptation structures.	
	Fourth priority: Estimating regional rainfall-runoff relationships for supporting the development of flood early warning systems and ensuring sustainable water management.	

Agriculture Policy

J. Environmental Conservation and Climate Change Resilience Policy

1. To collaborate with internal and external organizations to acquire needed technology, construct basic infrastructures and uplift the capacity of concerned departments and organizations – aiming at mitigation losses and damages caused by natural disasters; and implementing resilient agriculture, livestock and fishery activities.

2. To support the empowerment of socioeconomic responsiveness of farmers, livestock keepers and fisher folks when they are facing the adverse effects of climate change and natural disaster.

3. To conserve natural ecological system so as to sustain increased utilization, to mitigate land degradation, soil and biodiversity losses, and to ameliorate soil fertility.

Constraints

- Flood hydrograph for spillway design is applied with much care because rainfall input is very much limited and not representative for the entire catchment.
- Current observation system is manual. Rainfall intensity is not available.
- Hourly water level data of dams are not reliable because of manual reading, except in case of high flood over spillway.
- Catchment rainfall is not available for analyzing accurate runoff.
- Real-time data are not available for flood forecasting.
- Budget allocation is very limited for hydrological investigation work.
- Limited forecasting in Spatial and Temporal scale.

Needs for Flood Management

- Upgrade Current Meteorological and Hydrological observation system and Extend to establish in CA
- Install advanced hydro-meteorological monitoring & flood warning system (Real time)
- Establish data bank to upgrade and access data information
- Build up the capacity in Hydrological , Hydraulic Modeling and usage of Satellite rainfall
- Comprehensive study for extreme events
- Check and modify the Reservoir Operation
- Strengthen the forecasting system (Spatial &Temporal)
- Carry out monitoring for bathymetric Survey
- Weather data with finer spatial and temporal scales .

Way Forward

1.Improve Observation Net work
2. Hydrologic design parameter development (e.g. IDF, DDF)
3. Development of regionalized PMP for different hydrographic regions
4. Development of criteria for PMP as a national standard
5. Dam safety guidelines and reservoir operation rules
6. Application of IWRM concept
7. Dam breach scenarios for large dams in Myanmar
8. Application of climate risk information in water resources planning and management
9. Sediment control and watershed management
10. Development of hydro-meteorological database center for data sharing
11. Using spatial technology (GIS, RS) in hydrological assessment (e.g. flood mapping)

Thank You Very Much
For Your Attention