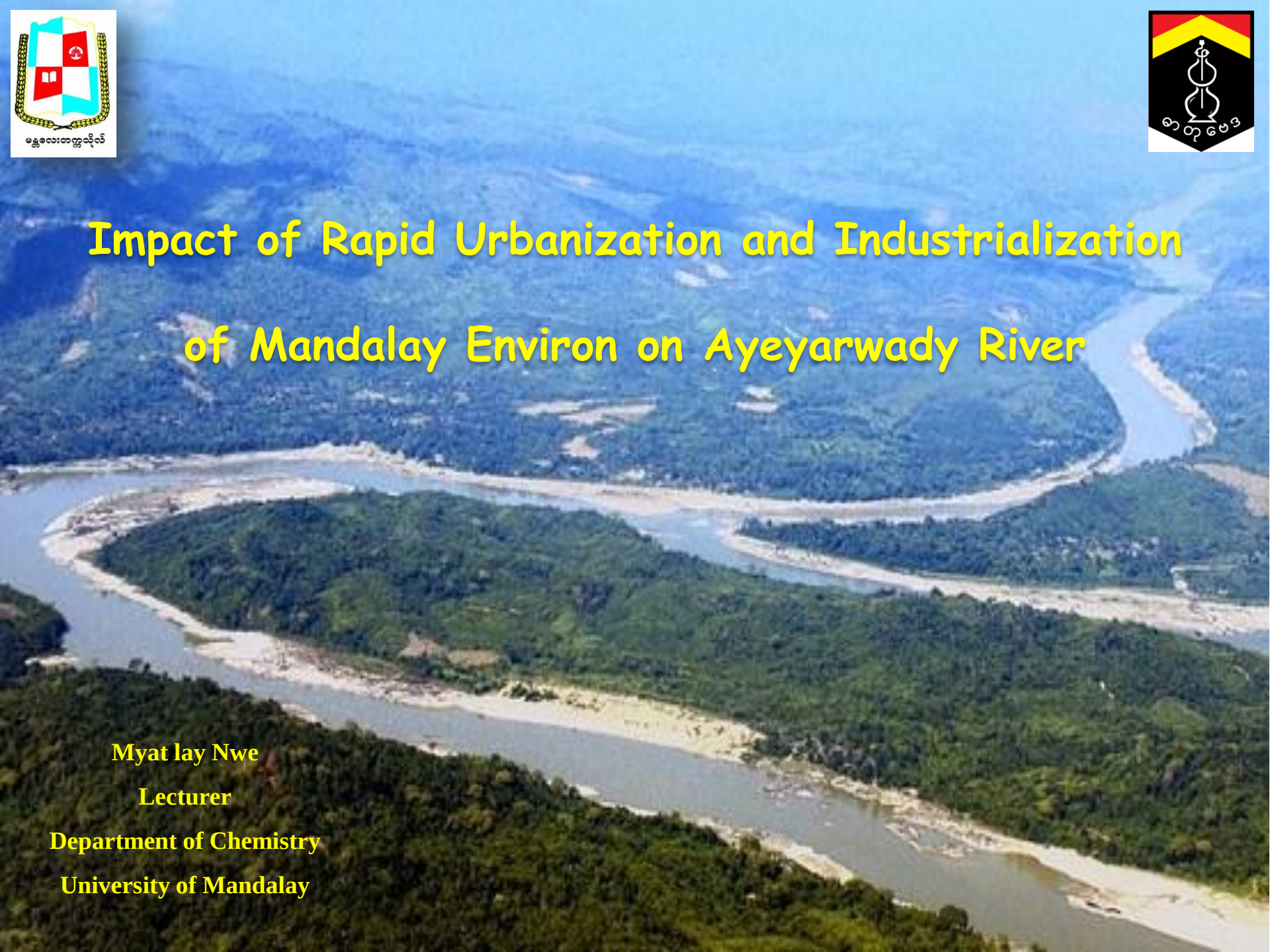

Impact of Rapid Urbanization and Industrialization of Mandalay Environ on Ayeyarwady River

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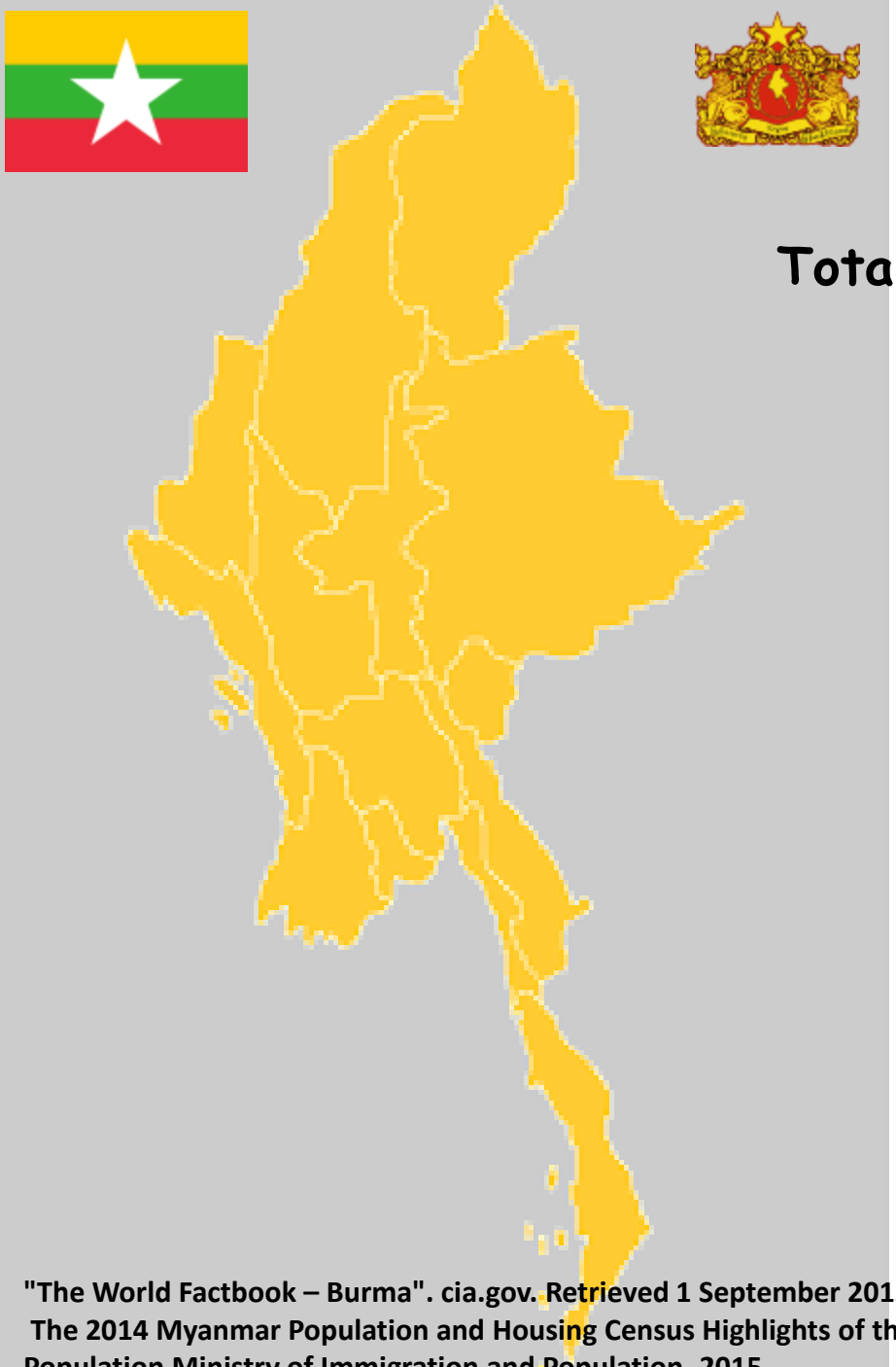
Outlines

- Abstract
- Information
  - Myanmar
  - Ayeyarwady River
  - Mandalay
- Sample Collected Area
  - River water from Ayeyarwaddy river
- Result and Discussion
- Conclusion

Abstract

Analysis of water quality is required for pollution control, the assessment of long-term trends and environmental impacts for human beings. In this paper, it is pointed out that how the effect of urbanization and industrialization of Mandalay Environ impacts on Ayeyarwady River, the main blood of our land. Water samples of river were collected from six different localities of Mandalay environ; namely Nyaungkwe, Mayangyan Jetty, Gawwein Jetty, near Kantawgyi, near Yadanabon Bridge and junction of Ayeyarwady and Dohkhtawaddy river on August 2013, 2014 and 2015, 2016 respectively. Physicochemical parameters of water samples were monitored. The amount of calcium, hardness, magnesium, iron, manganese, chloride, sulphate and total alkalinity were measured with the aids of sophisticated instruments. Heavy metal contamination in water samples were detected by using Atomic Absorption Spectroscopic method. The obtained data were studied and compared with the previously collected data of 1981, 1982 and 1995. The results showed that the water of Ayeyarwady was contaminated with some heavy metals. The chloride percent is obviously increased. According to these data survey, it is found that heavy metals contents are increasing year by year. Due to the long-term trend research, Ayeyarwaddy River is being threatening by heavy metals especially lead. Judging from these, it is seriously needed to save our blood vein, Ayeyarwady River.

Keywords; Urbanization, Industrialization, Mandalay Environ, Ayeyarwady



Republic of the Union of Myanmar

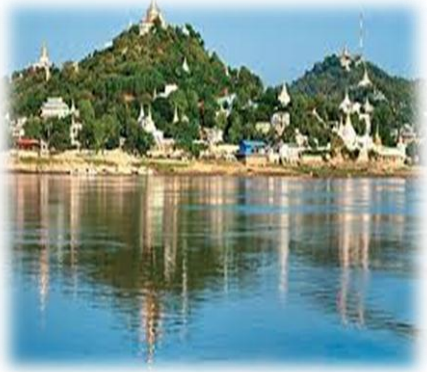
Total area - 676,578 square kilometer

"The World Factbook – Burma". cia.gov. Retrieved 1 September 2012.
The 2014 Myanmar Population and Housing Census Highlights of the Main Results Census Report Volume 2 – A. Department of Population Ministry of Immigration and Population. 2015.

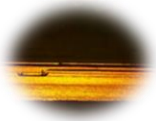

How lucky we are!

Source	Mali River
- coordinates	28°22′0″N 97°23′0″E
Secondary source	N'Mai River
- coordinates	28°4′0″N 98°8′0″E
Source confluence	
- location	Damphet, Kachin State
- elevation	147 m (482 ft)
- coordinates	25°42′0″N 97°30′0″E
Mouth	Andaman Sea
- location	Ale-ywa, Ayeyarwady Region, Myanmar
- elevation	0 m (0 ft)
- coordinates	15°51′19″N 95°14′27″E
Length	2,170 km (1,348 mi)
Basin	413,710 km^2(159,734 sq mi)

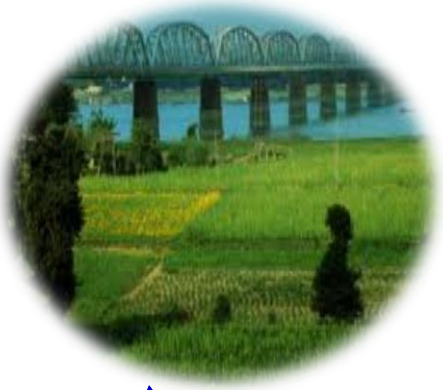





- running through the centre of the country
- Myanmar's most important commercial waterway
- about 1,350 miles (2,170 km) long
- flows wholly within the territory of Myanmar
- total drainage area is about 158,700 square miles (411,000 square km)







Agricultural

Industrial

Domestic

Fishing

Transportation

Pulling teak logs,
made into large rafts and
floated down the Irrawaddy River

Mandalay Region

- an administrative division of Myanmar.
- located in the center of the country
- Mandalay (regional capital)

Historical population

Year	Pop.
1973	3,668,493
1983	4,577,762
2014	6,165,723

Source: 2014 Myanmar Census

*Census Report. The 2014 Myanmar Population and Housing Census **2**. Naypyitaw: Ministry of Immigration and Population. May 2015. p. 17.*

UNIVERSITY OF MANDALAY

Mandalay

- the second-largest city and the last royal capital of Myanmar
- Located on the east bank of the Ayeyarwaddy River
- the economic hub of Upper Myanmar
- the centre of Myanmar' culture

Total population and annual growth rate of Mandalay City

Year	Number of People	Growth Rate %
1857	90000	
1891	188815	2.2
1901	183816	-0.3
1911	138299	-2.8
1921	148917	0.3
1931	147932	-0.1
1941	163243	1
1953	185867	1.1
1963	232571	2.3
1973	417938	6
1983	532949	2.5
1993	710027	2.9
2007	921741	1.9
2014	6145588	30.43

Source: Census Department

Urbanization of Rate of Mandalay Region

Year	Number of People	Growth Rate %
1983	532,948	2.5
1993	710,027	2.9
2007	921,741	1.9
2014	6,145,588	30.43

- Within 10 year, just 200,000 of people increased
- Within 7 year, unbelievable increased about 5 million

- In 1992, Mandalay was reformed into five townships and 86 wards by an announcement of Ministry of Home Affairs and the Urban area becomes 41.35 square miles.

- In 2014, Mandalay was reformed into seven townships.
  - Amarapura
  - Aungmyethazan
  - Chanayethazan (city centre)
  - Chanmyathazi
  - Maha Aungmye
  - Patheingyi
  - Pyigyidagun

Population is the main consideration factor of Urbanization.

Homeless

Jobless

hopeless

Which way can we use to solve these problems

???

Homeless
Jobless
hopeless

Two more industrial zones in Mandalay Region

Industrial Zone	Region	Name of Zone	Year of Establishment	Area (acre)	No. of Industries
Mandalay	Mandalay	Industrial Zone-1	1990	809.510	661
		Industrial Zone-2	1997	137.000	333

With more industrial zones,

job creation will be realized.

http://myanmargeneva.org/e-com/MOI-2/MOI-2/myanmar.com/Ministry/moi2/zone.htm

Industrial Zone

- The industrial zone of Mandalay City were established due to the government policy for a market oriented economy.

- As the local population were employed in the industries, the job opportunities they have provided changed their living standard and economic condition.

Principle Industries in Myanmar

- Agro-based industry
- Wood-based industry
- Textiles & garment industry
- Food stuff industry
- Pharmaceutical industry
- Machine – tools & spare parts industry
- Porcelain & chemical industry

- Therefore many people also migrate from rural area for their better life and income.

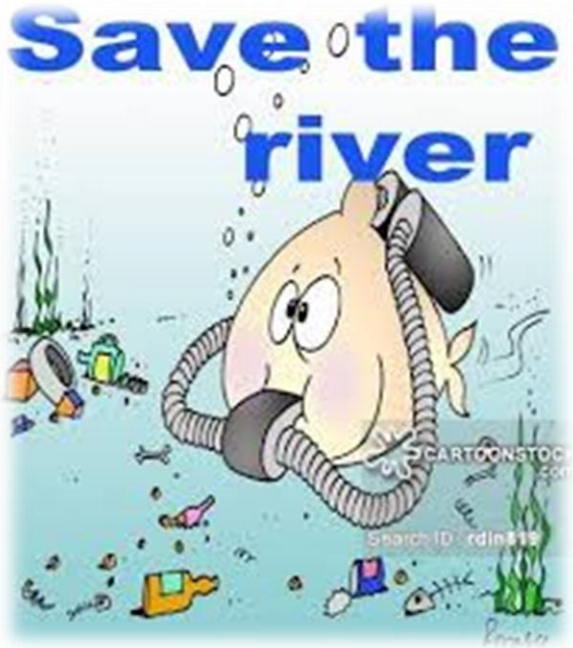
- Job opportunities due to industrial zones and other trade with international and local economic conditions, it is assumed that Mandalay urban development is pronounced in Myanmar.

- It is interested thing that how about pollution appears on Ayeyarwaddy river year after year by our second most populated region, Mandalay.

Water is a key element of life for everyone on Earth.

We should maintain the main blood of Our land,

Ayeyarwaddy River very well.



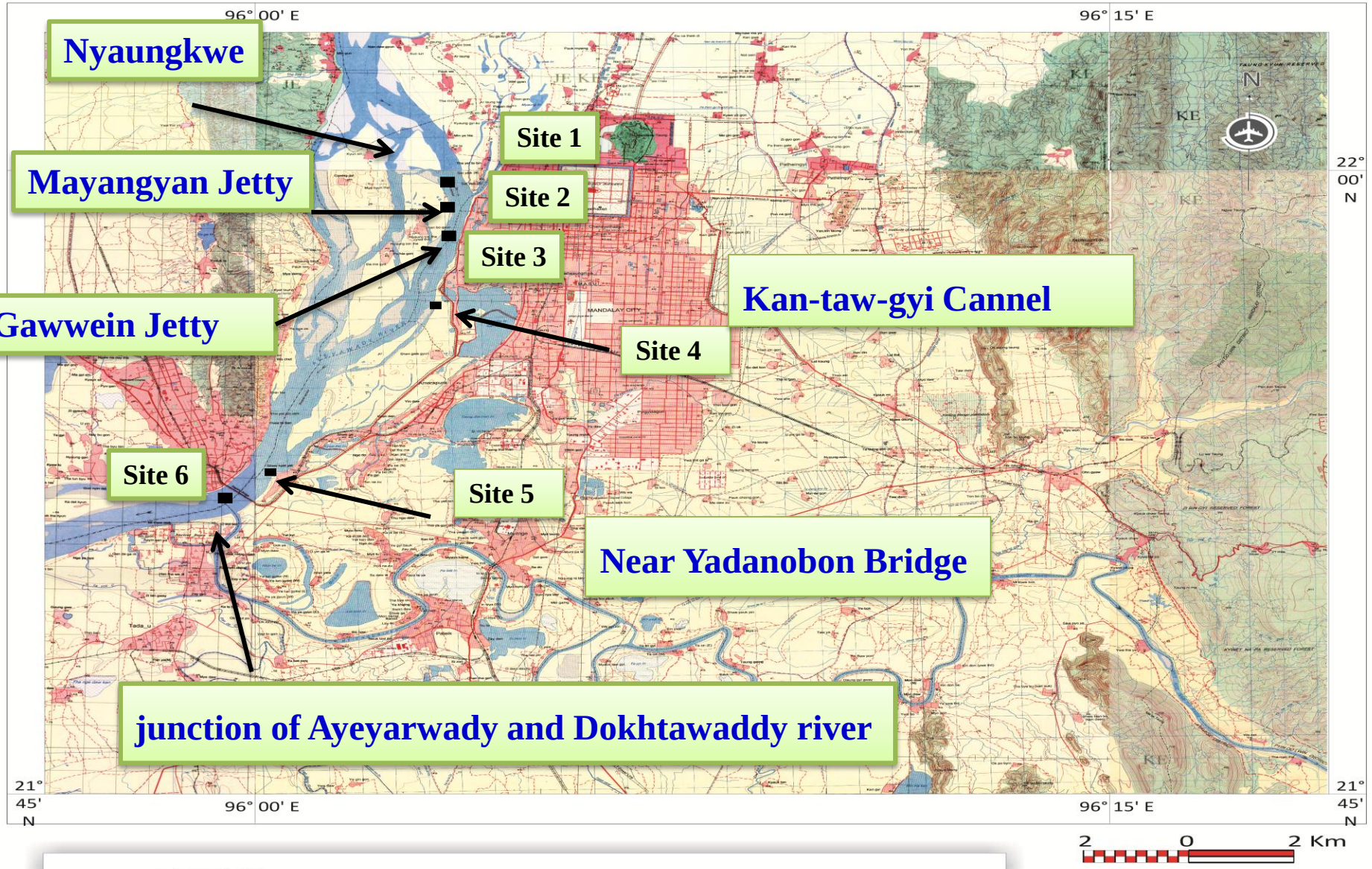
Long term trend research on water resources in Mandalay environ

- determine the water quality year by year
- search the way to reduce impact of urbanization and industrialization
- share the knowledge to save our environ

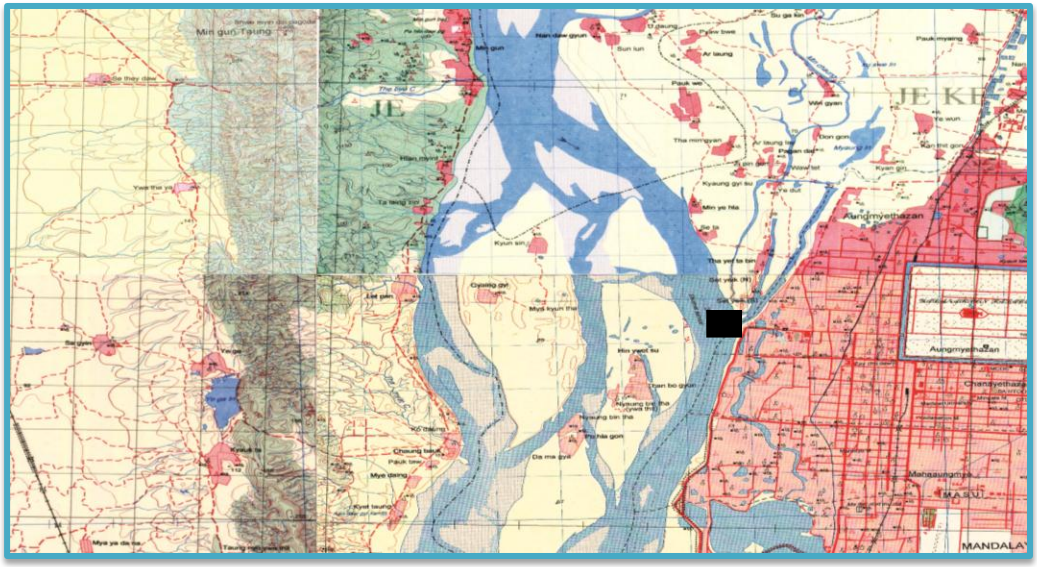
Source of Water of Sample

(Surface water)

Along Ayeyarwaddy river near Mandalay Urban

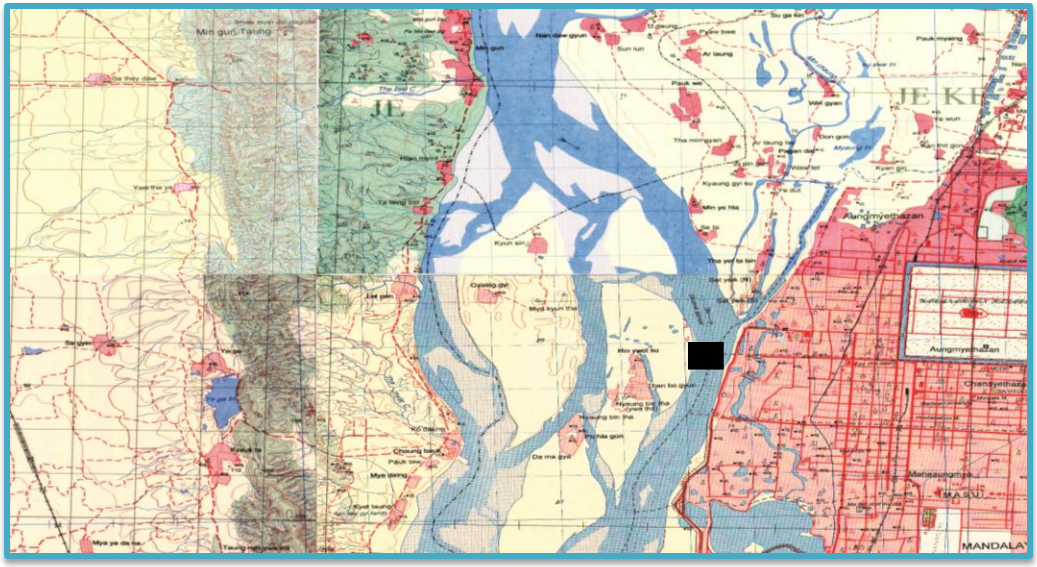

Nyaungkwe
Mayangyan Jetty
Gawwein Jetty
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
Kan-taw-gyi Cannel
Near Yadanobon Bridge
junction of Ayeyarwady and Dokhtawaddy river
96° 00' E
96° 15' E
22° 00' N
21° 45' N
2 0 2 Km
LEGEND
Road
Rail Road
River and Stream
Lake
Residential Area
Sample Collected Area

Near Nyaungkwe (site I)



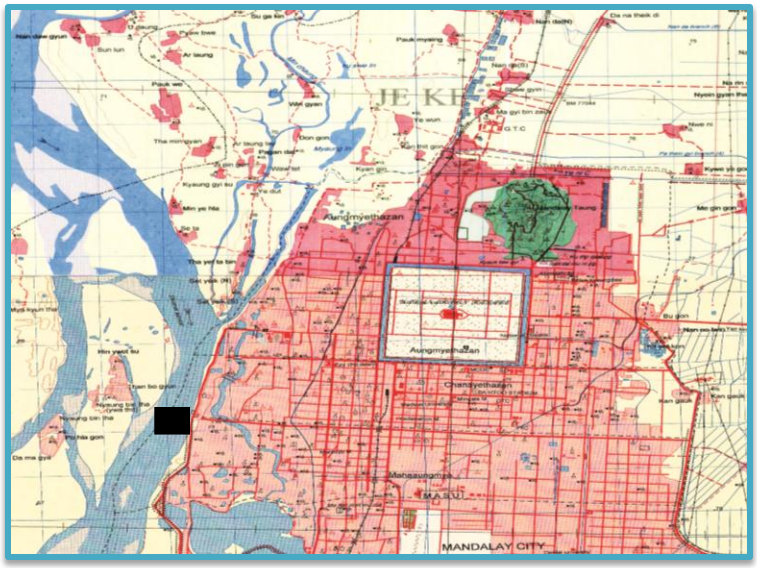
- begin in Mandalay Urban
- the stream begin in Sagyin area flow into Ayeyarwady river near Nyaungkwe quarter
- Many marble quires and gold mines
- most slum are living Nyaungkwe quarter

Mayangyan Jetty (Site II)



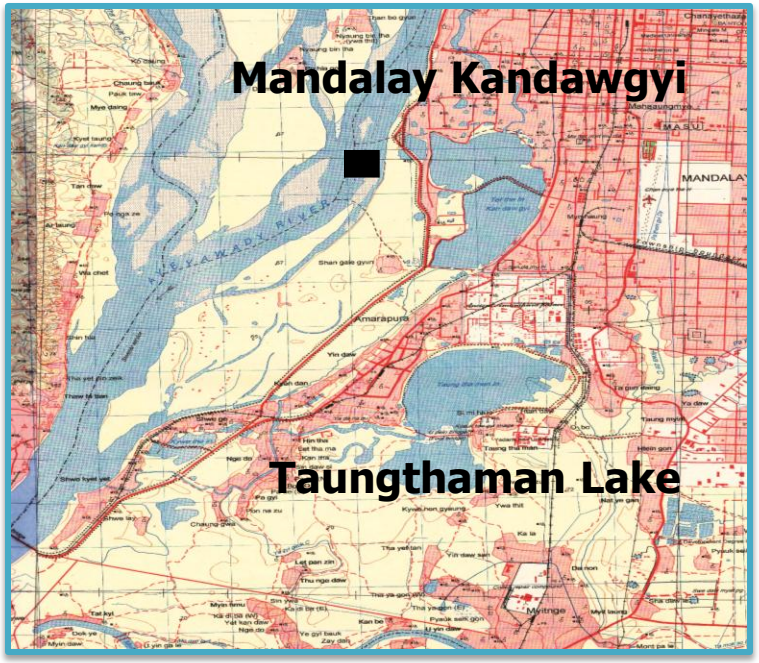
- about 1.6 km from Gawwein Jetty
- used as transit Jetty
- Tourist water way transport association are formed with about 50 motorboats

Gawwein Jetty (Site III)



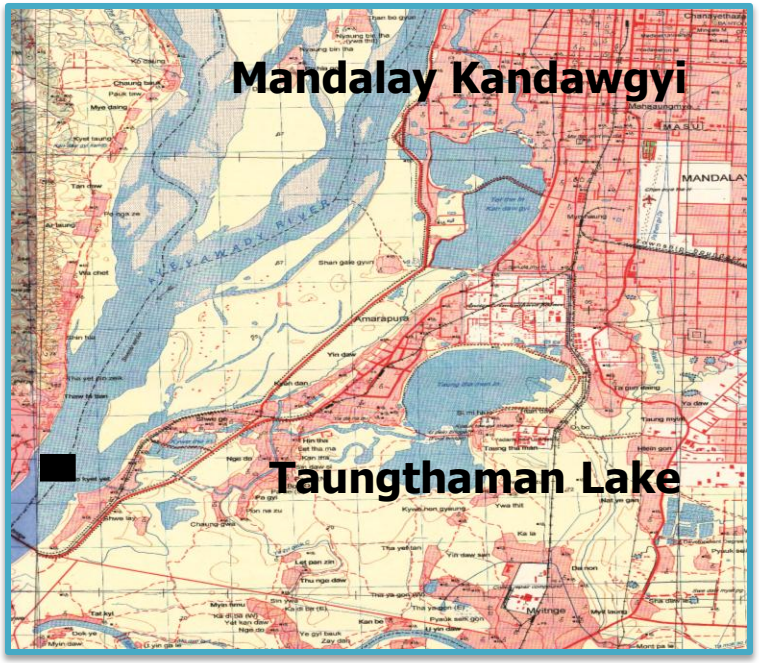
- Mandalay's main pier
- transport construction material, food and other products around the country along Ayeyarwady river's shipping channel
- at the Conner of 35th street and strand road in Mandalay

Kan-taw-gyi (Site IV)

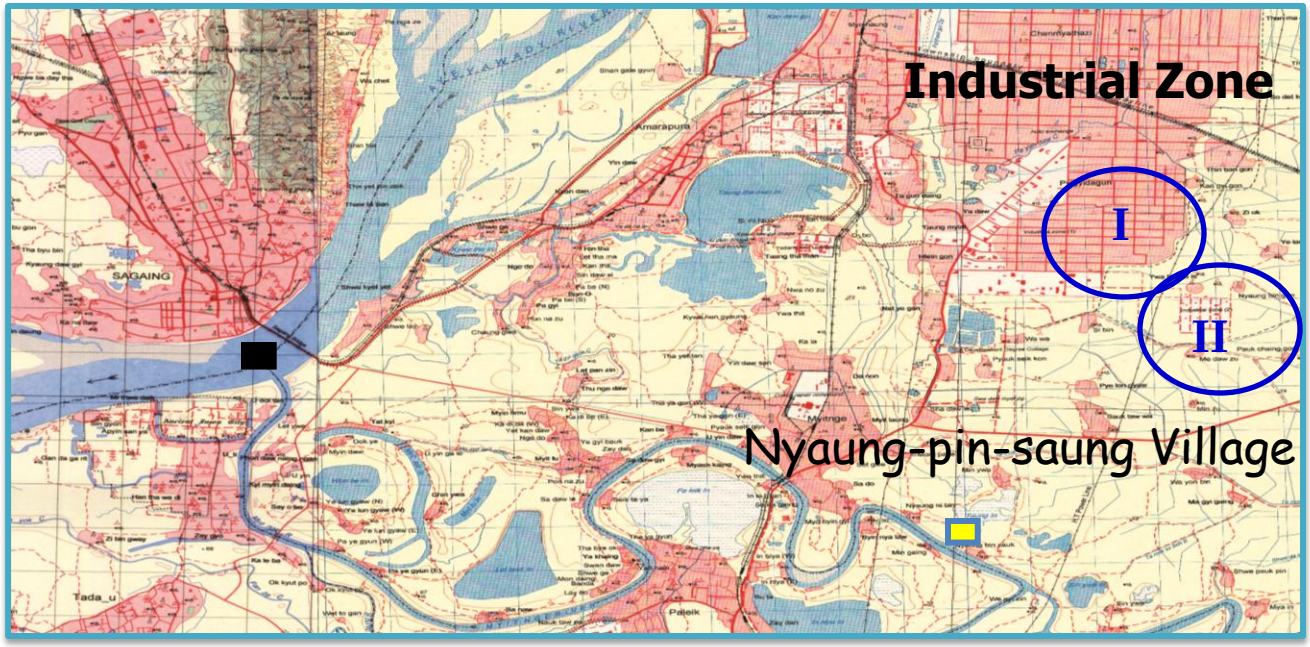


- the municipal waste water from some quarter of Mandalay city drain directly into Mandalay Kandawgyi and Taungthaman Lake
- the water from Kandawgyi flow directly into Ayeyarwady River at this site

Near Yadanabon Bridge (site V)



- near Petrol Jetty
- near Boat Jetty
- the water from the Taungthaman lake enter Ayeyarwady river at that site



Junction of the Ayeyarwady and Dokhtawaddy Rivers (Site VI)

- most factories from Mandalay industrial zones drain their wastewater directly into Dohktawaddy river at West of Nyaung-pin-saung Village
- Dohktawaddy river flow into Ayeyarwady river

Physical Parameter	-	**color**
	-	**Turbidity**
	-	**pH**
	-	**Total Solid**
Chemical Parameter	-	**Total Hardness**
	-	**Total Alkalinity**
	-	**Calcium Content**
	-	**Magnesium Content**
	-	**Sulphate**
	-	**Chloride**
	-	**Iron**
	-	**Manganese**
	-	**Dissolved Oxygen**
Heavy Metal	-	**Lead (Pb)**
	-	**Cadmium (Cd)**

Methods used in the analysis of water

No	parameter	Method	Determination (by)
1	Color	Pt. Co standard	Spectrophotometer
2	Turbidity	Absorptometric	Spectrophotometer
3	Total solid	Direct Measurement	Spectrophotometer
4	pH	Direct Measurement	pH meter
5	Hardness	EDTA Titrimetric	Titration
6	Calcium	EDTA Titrimetric	Titration
7	Magnesium	Calculation	Magnesium

Methods used in the analysis of water

No	parameter	Method	Determination (by)
8	Chloride	Argentometric	Titration
9	alkalinity	Titrimetric	Titration
10	Total iron	Atomic Absorption Spectrometric	Atomic Absorption Spectrophotometer
11	Manganese	Persulphate	Spectrophotometer
12	Sulfate	Gravimetric	precipitation
13	DO	Winkler	Titration
14	Lead	Atomic Absorption Spectrometric	Atomic Absorption Spectrophotometer
15	Cadmium	Atomic Absorption Spectrometric	Atomic Absorption Spectrophotometer

Results and Discussion

year

- 1982, Aug
- 1995, Aug
- 2013, Aug
- **2014, Aug**
- **2015, Aug**
- **2016, Aug**

Site 1 = Ayarwaddy River that is 15 feet from Nyaungkwe

Site 2 = Ayarwaddy River that is 15 feet from Mayangyan Jetty

Site 3 = Ayarwaddy River that is 15 feet from Gawwein Jetty

Site 4 = Ayarwaddy River that is 15 feet from near Kan-taw-gyi

Site 5 = Ayeyarwaddy River that is 15 feet from near Yadanabon Bridge

Site 6 = Ayarwaddy River that is junction of Ayarwaddy and Dkhtawaddy river

Physical Parameter

color

Turbidity

pH

Total Solid

Color Analysis (Platinum, Cobalt Scale)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1				7	9	6		
2				6	7	10		
3			5	6	7	8	5	50
4						7		
5				5	7	7		
6				5	7	12		

August 2013 - reach highest desirable level

August 2014, 2015, 2016 - overcome highest desirable level

Turbidity Analysis (FAU Unit)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	18			30	51	148		
2	18	18		12	18	131		
3	18		18	20	42	136	5	25
4						183		
5				15	24	134		
6				22	35	189		

2015 - Site 1, 3, and 5 overcome maximum permissible level

- very busy river
- Used for commercial transportation
- turbid and turbid and turbid

August 2016, significantly increase because of 2016 is flash flood year.

Total Solid (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	95.3			650	1030	1000		
2	94.4	96		338	462	900		
3	95.2		102.5	218	318	1000	500	1500
4						1200		
5				190	310	900		
6				610	500	1500		

- main reason for why the river water is turbid

pH Analysis

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	7.1			6.6	6.9	7.9		
2	7.2			7.9	7.4	7.8		
3	7.2		6.8	8.1	7.5	7.8	7.0 to 8.5	6.5 to 9.2
4						7.8		
5				8.2	7.6	7.6		
6				8.3	7	8.3		

- satisfactory data

Physical Parameter of River Water

- Polluted in more extend comparing to previous report data
- pollution rate increased rapidly year after year
- Site (1), (3), (4) and (6) are most polluted than other year by year.

Site 1, Site 3, Site 4

Industry Pollution

Site 6

- many factors such as Urbanization and Industrialization
- cause and affect
- pollution of surface water, Ayeyarwaddy river water

Chemical Parameter

- Total Hardness
- Total Alkalinity
- Calcium
- Magnesium
- Sulphate
- Chloride
- Iron
- Manganese

Total Hardness Analysis (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	32.43			120	160	124		
2	30.52	44		40	100	80		
3	30.52		40	40	60	56	100	500
4						68		
5				40	40	52		
6				240	160	120		

Total Hardness (mg/L as $CaCO_3$)	
• Soft:	0-30
• Moderately soft:	30-60
• Moderately hard:	60-120
• Hard:	120-180
• Very hard:	> 180

- ❑ Site (1) and (6) reach hard water level
- ❑ no significant change year after year

Diersing, Nancy (2009). "Water Quality: Frequently Asked Questions." Florida Brooks National Marine Sanctuary, Key West, FL.

Total Alkalinity Analysis (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	32.43			390	780	312		
2	66.0	52		195	260	88		
3	66.0		88	130	130	84	600	950
4						60		
5				130	130	56		
6				390	260	276		

- significant change in 2014
- site (1) overcome highest desirable level in 2015

Calcium as Ca Analysis (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	4.97			32	24	20		
2	4.58	11.2		8	24	16		
3	4.58		8	8	8	14		
4						14	75	200
5				8	16	12		
6				40	40	41		

Year

no significant change until 2014

sharply started change in 2015 except site 3

Magnesium as Mg Analysis (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	4.80			12	10	10		
2	4.57	3.9		2.4	10	10		
3	4.57		5	2.4	2.4	8	30	150
4						8		
5				2.4	5	8		
				14	12	10		

- solve why high alkalinity of river water

Sulphate as SO_4 Analysis (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	2.68			98	127	98		
2	1.92	7.68		69	79	70		
3	1.62		70	78	98	98	200	400
4						98		
5				59	69	78		
6				88	102	127		

- With two years - Quite increased
- compared with 1982 - seriously increased
- One problem for river water

Chloride Analysis (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016	Highest desirable level	Maximum permissible level
1	1.27			25	40	35		
2	1.37	5.67		25	40	35		
3	1.17		8	25	40	35		
4						35	30	150
5				25	40	35		
				25	40	40		

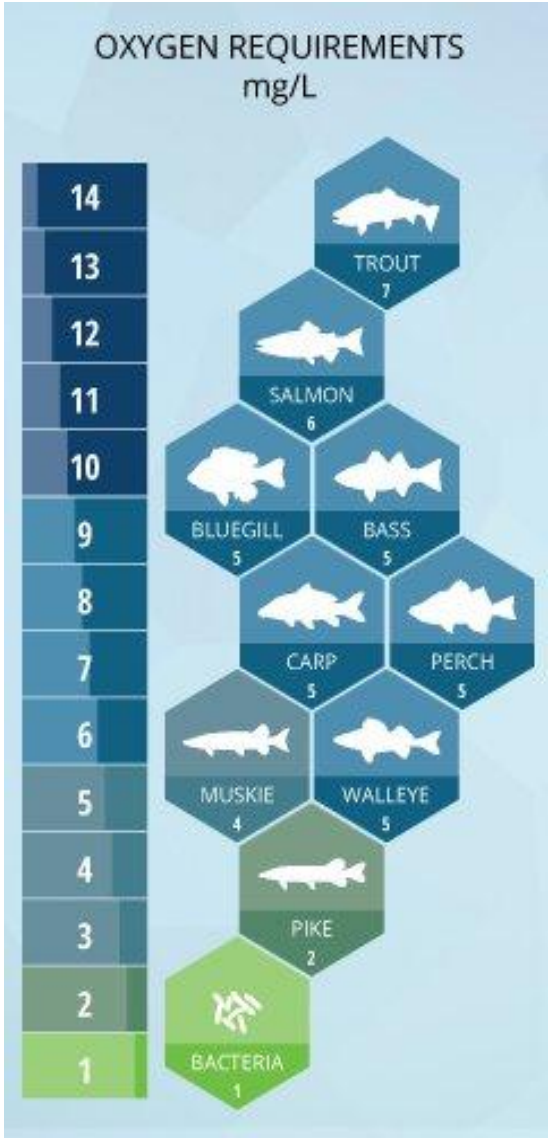
- one of Serious factor , chloride percent
- the increasing rate of chloride level
- In 2015, exceed the highest desirable level
- Rapid rate

Total Iron and Magnese Analysis (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016
1	Nil			Nil	Nil	Nil
2	Nil	Nil		Nil	Nil	Nil
3	Nil		Nil	Nil	Nil	Nil
4				Nil	Nil	Nil
5				Nil	Nil	Nil
6				Nil	Nil	Nil

not detectable (ppm level) in all sites

Dissolved Oxygen Analysis (mg/L)



Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016
1				5.10	6.4	5.44
2		6.8		5.10	6.4	5.6
3			5.90	5.80	6.4	6.72
4						6.24
5				5.30	6.4	5.29
6				6.42	7.4	6.4

Satisfactory data

Chemical Parameter of River Water

- Polluted in more extend comparing to previous report data
- pollution rate increased rapidly year after year
- Site (1), (3) and (5) are most polluted than other year by year.

All sites

- Chloride
- overcome highest desirable level

- many factors such as Urbanization and Industrialization
- cause and affect the pollution of surface water, Ayeyarwaddy river water
- lead Ayeyarwaddy river water will become salty

Heavy Metal Determination

Lead (Pb)

Cadmium (Cd)

Heavy Metal Analysis (Lead) (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016
1	Nil			0.0112	0.0270	0.0124
2	Nil	Nil		0.0203	0.0473	0.0316
3	Nil		0.0183	0.0406	0.0541	0.0441
4						0.0468
5				0.0270	0.0338	0.0215
6				0.0338	0.0473	0.0312

- **Beginning to detect at Gawwein Jetty in August, 2013**
- **Increasing year by year**
- **rate of trade in Gawwein Jetty increase significantly**

Heavy Metal Analysis (Cadmium) (mg/L)

Site	Aug, 1982	Aug, 1995	Aug, 2013	Aug, 2014	Aug 2015	Aug 2016
1	Nil			Nil	Nil	Nil
2	Nil	Nil		Nil	Nil	Nil
3	Nil		Nil	Nil	Nil	Nil
4				Nil	Nil	Nil
5				Nil	Nil	Nil

- can not be detected (ppm level) until August, 2016

Heavy Metal Determination

- Lead content of site (2), (3) , (4) and (6) are higher
- Lead percent of Ayeyarwaddy river are going increasing rate year after year

Conclusion

- Site (I), near Nyaungkwe is most pollutant.
- It is because near slum area and the stream from Sagyin flows into Ayeyarwaddy river near Nyaungkwe quarter.
- Thus, total hardness, total alkalinity, total solid and sulphate levels of river water were found to be highest level.

- Site (III), Gawwein Jetty is increasing the pollutant rate year by year.
- The rate of trade in Gawwein Jetty significantly increase due to the population growth increase.

- Heavy metal (lead) content increase year by year.
- Consequently, the pollutant level of Ayeyarwaddy river water at Gawwein Jetty have become serious level.

- Site (VI), Junction of Ayeyarwaddy river and Dokhthawady river
- All water quality parameter are increasing rapid rate.
- During 10 years, if the pollution rate continuously increase, the pollution level of this site will reach toxic level.

- Chloride level of ground water is near equal to the chloride level of river water.
- In this way, all of our soft water will become salty.

- Urbanization and industrialization have negative effects on the coastal ecosystem and environment in general.

Industry Pollution

Urban Pollution

- Due to population
- Due to Urbanization
- Due to Industrial zone

-

reduce the water quality

Heavy metal contaminant appear

- not exceed WHO standard
  - Physical Parameter
  - Chemical Parameter
  - Heavy metal content

Surface water and Ground water are polluted

By

Urbanization and

Industrialization

All of We are **researchers**

- Search the way to reduce environmental impact
- give awareness
- Share our knowledge

Save our earth as mush as we can

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- Thanks for your time and kind attention