

Water Quality Monitoring in the Chindwin River Basin:
Capacity building, State, and Challenge

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Content

1. Why water quality monitoring in Chindwin Basin?
2. Capacity building and monitoring methodology
3. Current status and key findings
4. Challenges and recommendations

Why water quality monitoring in Chindwin Basin?

- Critical concern from the stakeholder engagement and consultation meetings
- Rapid development in the region, particularly
  - Mining expansion
  - Deforestation
- Sharing river water use by different sectors
- Lack of capacity in monitoring health of river

Consultation meeting in Nov 2014

Mining activities

Riverbed dredging for gold mining in Uru River

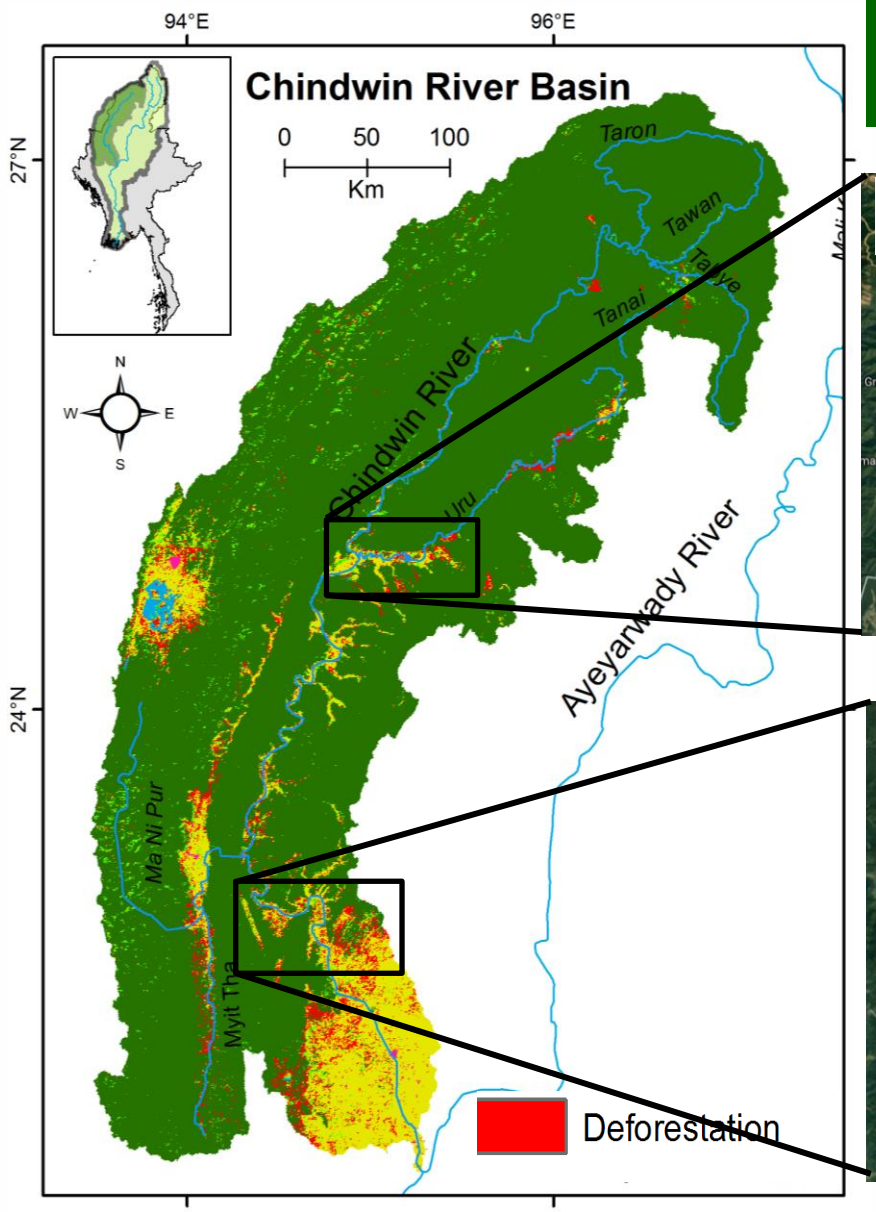
Gold Mining Type	Potential impact on water quality and sedimentation
River bed dredging	Highest
Riverbank mining	High
Hillside mining	High, if the runoff reaches the river
Pit mining (inland)	Lower

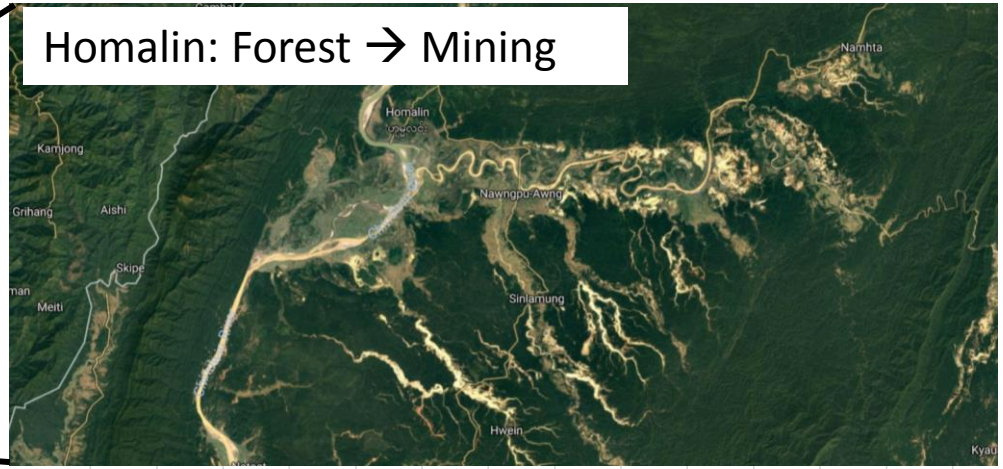
Riverbank mining in Uru River

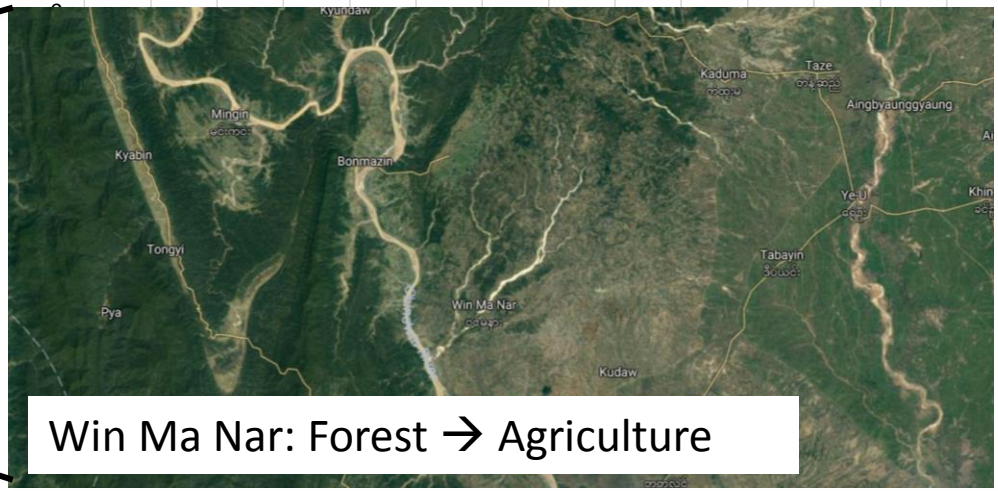
Hillside mining in Uru River

Pit mining near Chindwin River, Homalin township

Deforestation







Institutional involvement in water quality

Institution	Main Role in Water Quality
DWIR – Directorate of Water Resources in Improvement of River Systems	Water quality in the river channel
ID – Irrigation Department	Water quality for irrigation Water quality in reservoirs
WRUD – Water Resources Utilization Department	Water quality (river or well) for rural villages Water quality for groundwater irrigation projects
ECD – Environmental Conservation Department and Department of Occupational Health	Industrial and domestic sewage contamination
City development council	Quality of water supply
DMH	Water quality of rainfall (acidity)

Objective of the study

- To build capacity of local NGOs and local government agencies
- To understand current situation of water quality in Chindwin river basin
- To support developing water quality management and monitoring strategy in Chindwin river basin

Capacity building (1/3)

Approach

- Training
- On field coaching
- Knowledge exchange with Pollution Control Department (PCD) in Thailand

Target groups

- Local NGO (MEI)
- Local government agencies (i.e. DWIR, ECD, IWUMD)

Capacity building (2/3)

- Knowledge exchange between MEI and Pollution Control Department (PCD) in Thailand, May 2016

- PCD conducted hands-on training for MEI on water sampling at Klong Prapa canal about basic water analysis in Thailand, May 2016

Capacity building (3/3)

- PCD and SEI staffs supervised MEI team on sampling and preservation techniques in the Chindwin River in Myanmar, May 2016

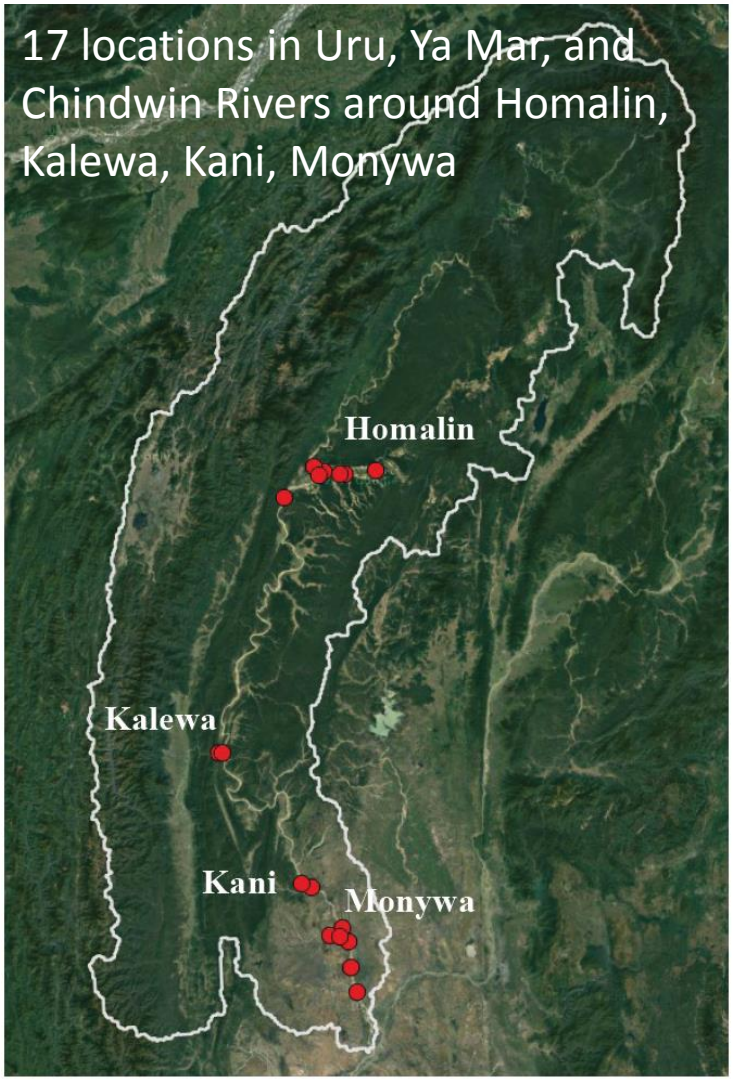
- MEI, PCD and SEI staffs provided training to Myanmar agencies on water quality monitoring and sampling in Monywa, Myanmar, September 2016

Methodology of the study

1. Literature review
2. Stakeholders consultations (Nov 2014, May 2015)
3. Data collection from government departments
4. Household survey: 600 households in Homalin, Kani, Monywa
5. Focus group Interviews
6. **4 times for field monitoring during dry and wet season in 2015 and 2016 (23 parameters)**
   - **In-situ measurements**
   - **Laboratory tests**
   - **Portable test kits**

Monitoring parameters and locations

Testing Methods	Measuring parameters
In situ measurement (8 parameters)	• Water Temperature
	• Air Temperature
	• Rapid Dissolved Oxygen (RDO)
	• Oxidation Reduction Potential (ORP)
	• Electrical Conductivity (EC)
	• Salinity
	• Total Dissolved Solid (TDS)
Laboratory measurement (14 parameters)	• Oil and grease
	• Total Nitrogen (TN)
	• Total Phosphorus (TP)
	• Chemical Oxygen Demand (COD)
	• Total Suspended Solid (TSS)
	• Turbidity
	• Total hardness
	• Total Dissolved Solid (TDS)
	• Arsenic (As)
	• Cyanide (CN)
	• Lead (Pb)
	• Mercury (Hg)
	• Copper (Cu)
	• Iron (Fe)
Portable test kits (5 parameters)	• Bacteria
	• Lead (Pb)
	• Mercury (Hg)
	• Copper (Cu)
	• Iron (Fe)



Steps : Water quality sampling & test

1. Planning
2. Equipment preparation
3. Water sampling
4. Field testing
5. Sampling preservation
6. Packing and transportation
7. Laboratory test
8. Result analysis

Step 1: Planning

Research/ Project

- ✓Methods
- ✓Periods
- ✓Sample Numbers
- ✓Parameters
- ✓Containers
- ✓Locations

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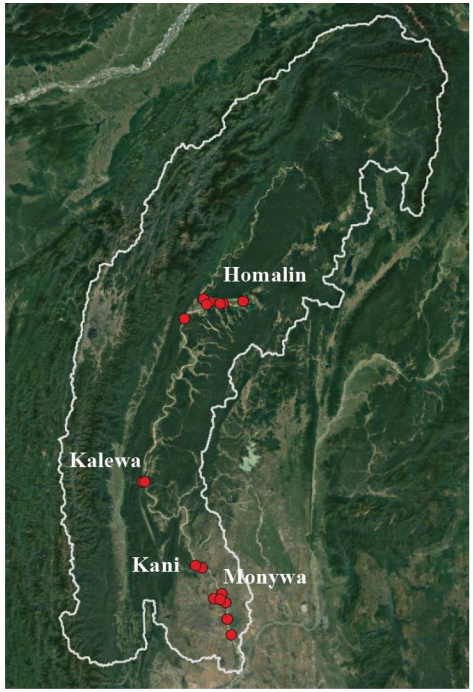


Step 2: Equipment preparation (1)

General equipment

- ☐ Map
- ☐ GPS/Battery
- ☐ Camera/Battery
- ☐ Voice recorder/Battery
- ☐ Record pen
- ☐ Adhesive tape
- ☐ Plastic rope
- ☐ Tissue
- ☐ A4 Paper
- ☐ Glove
- ☐ Life jacket/Cap
- ☐ Cutter
- ☐ Scissors

Step 2: Equipment preparation (2)

Field datasheet

Water sampling field data sheet

A. Site details

1. Site number:_____
2. Site Name:_____
3. Date:_____Time: _____
4. Recorded by: _____

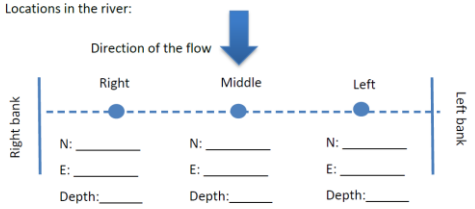
B. Site conditions

1. Water color:_____ River width: _____(m) River depth : _____(m)
2. Weather condition: No rain Rain Windy
3. Human activities nearby: Rural Urban Agriculture Industry Others:_____

Upstream river condition	Downstream upstream condition

C. Water Sampling

1. Location: ( ) Right bank ( ) Middle ( ) Left bank ( ) Bridge
2. Method:
   ( ) Grab sample Number of points for water sampling:_____
   ( ) Composite sample Number of points for water sampling:_____
3. Locations in the river:



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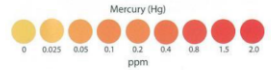
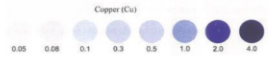
C. In situ measurements:

Grab sample	Composite sample
1. Water Temperature (°C): _____	1. Water Temperature (°C): _____
2. pH (Insitu):_____ pH (meter):_____	2. pH (Insitu):_____ pH (meter):_____
3. EC (microSiemens/cm2): _____	3. EC (microSiemens/cm2): _____
4. ORP (mV): _____	4. ORP (mV): _____
5. Dissolved Oxygen (mg/l):_____	5. Dissolved Oxygen (mg/l):_____
6. Salinity (psu): _____	6. Salinity (psu): _____
7. TDS (ppm): _____	7. TDS (ppm): _____
8. Air temperature (°C): _____	8. Air temperature (°C): _____
9. Turbidity (NTU):_____	9. Turbidity (NTU):_____

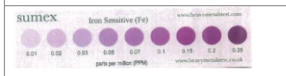
D. Test kits Testing time: _____ **Photo/Note**



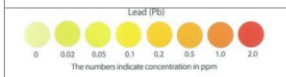
Mercury value:_____



Copper value:_____



Iron value:_____



Lead value:_____

Bacteria: Color of test kit after 48 hrs

Purple or blue: _____

2

Detail of containers for laboratory test for each site

HDPE	Label	Acid	Parameter	Lab
1	White	No	Hardness, TDS	ISOTECH
2	White	No	TSS	SGS
3	Yellow	HNO3	Arsenic, Mercury, Lead	ID
4	Yellow	HNO3	Iron	ISOTECH
5	Blue	NaOH	Cyanide	ISOTECH
Glass	**Label**	**Acid**	**Parameter**	**Lab**
1	Pink	H2SO4	TN, TP, COD	SGS
2	Pink	H2SO4	Oil & grease	SGS
3	Yellow	HNO3	Copper	SGS

Lab	No of bottles	No of parameters	Parameters	Color
ID	1 (HDPE)	3	Arsenic, Mercury, Lead	1 Yellow
ISOTECH	3 (HDPE)	4	Hardness, TDS, Iron, Cyanide	1 White, 1 Yellow, 1 Blue
SGS	1 (HDPE) + 3 (Glass)	6	TN, TP, COD, Oil & grease, Copper, TSS	1 White, 2 Pink, 1 Yellow

Locations

No	Site	City	Abbreviation	Lon	Lat
1	Homalin	Homalin	HL	94.90803	24.86083
2	Nam Taw	Homalin	NT	95.29567	24.83639
3	Uru downstream at confluence	Homalin	UD	94.96922	24.83236
4	Naung Po Aung	Homalin	NPA	95.06944	24.81329
5	Nansakar	Homalin	NSK	95.09961	24.81250
6	Mokekalae	Homalin	MKKL	94.93389	24.81194
7	Shwe Pyi Aye Town	Homalin	SPAT	94.72061	24.68245
8	Kalewa Town_upstream	Kalewa	KLWU	94.30474	23.20572
9	Kalewa Town_downstream	Kalewa	KLWD	94.32642	23.20568
10	Kani_upstream	Kani	KNU	94.82934	22.44609
11	Kani_downstream	Kani	KND	94.88638	22.42408
12	Upstream Monywa_ChindwinBridge	Monywa	UMB	95.08022	22.18878
13	Ya Mar River - Bridge	Monywa	YMB	95.00736	22.13997
14	Ya Mar River - Downstream	Monywa	YMD	95.06868	22.13716
15	Monywa	Monywa	MW	95.12147	22.10900
16	CHR_down2	Monywa	CHRD	95.13992	21.95325
17	Bridge - Chindwin confluence	Monywa	BCC	95.17758	21.80900

Step 2: Equipment preparation (3)

Field measurement and test kits

In Situ measurement

- ☐ smar TROLL Multiparameter
- ☐ Battery for smar TROLL
- ☐ Mobile phone/battery
- ☐ KNOW water for calibration

Turbidity measurement

- ☐ Turbidity meter

pH measurement

- ☐ pH meter
- ☐ pH paper

Test kits

- ☐ Mercury
- ☐ Lead
- ☐ Copper
- ☐ Iron
- ☐ Bacteria

Step 2: Equipment preparation (4)

Lab measurement

Sampling

- ☐ Sampler
- ☐ Plastic bucket (4 litter)
- ☐ Ladle rope
- ☐ Funnel
- ☐ Bowl

Sample containers

- ☐ 1000 ml HDPE bottle
- ☐ 1000 ml Glass bottle
- ☐ Spare glass bottle cap
- ☐ 1000 ml Drinking bottle

Bottle labels

- ☐ White label for unpreserved samples
- ☐ Pink label for preserved with Sulfuric acid (H_2SO_4)
- ☐ Yellow label for preserved with Nitric acid (HNO_3)
- ☐ Blue label for preserved with others
- ☐ Label pen (permanent)

Step 2: Equipment preparation (5)

Preservation acids

- ☐ Sulfuric acid (H2SO4)
- ☐ Nitric acid (HNO3)
- ☐ Sodium hydroxide (NaOH)
- ☐ Acid box
- ☐ Distilled water
- ☐ Rubble pipette bulb/tube
- ☐ Groves

Ice boxes

- ☐ Large ice box for 24 bottles
- ☐ Plastic box (green color)
- ☐ Ice bucket
- ☐ Big plastic bag
- ☐ Hammer
- ☐ Label for ice boxes to send samples to Yangon

Step 2: Equipment preparation (6)

Transportation

Step 3: Water Sampling

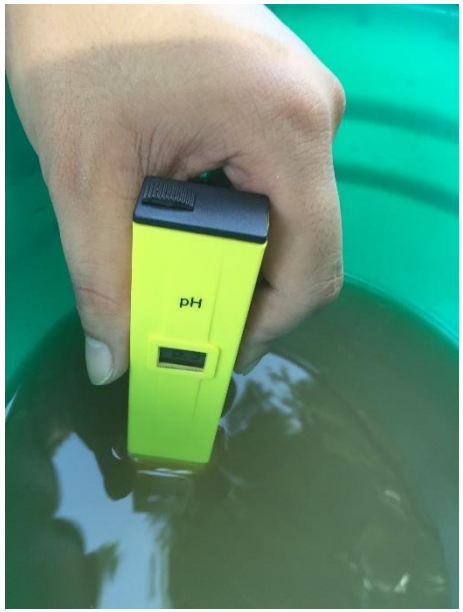
Before Sampling

- General safety inspection of the sampling locations
- Use equipment with good conditions with regular maintenance
- CLEAN sample containers
- Prepare ice or cool packs, cooler or container to store samples in cold condition
- Label sample containers: plastic/glass bottles
- Using water proof and sturdy labels
- Write information on the sample bottle using waterproof pen

Step 4: Field testing

In Situ test

Turbidity test



pH test

Test kits

Step 5: Samples preservation

Preservation Method and Holding time Preservation

No	Parameters	Examination method	Laboratory	Preservation time	Preservation	
					Chemical	Size (ml)
2	Oil and grease	APHA	SGS	28 day	add H2SO4 or HCl to p H <2	1000
3	Total Suspended Solid (TSS)	APHA	SGS	no limit time	Refrigerate	1000
4	Copper	APHA	SGS	6 months	add HNO3 to p H <2	100
5	Total Nitrogen (organic)	APHA	SGS	7 day	add H_2SO_4 to p H <2	1000
6	Total Phosphorus	APHA	SGS	28 day		
7	Chemical Oxygen Demand (COD)	APHA	SGS	7 day		
9	Hardness	EDTA Titrimetric	ISO Tech	3 day	Refrigerate	1000
10	Cyanide	Colorimertic	ISO Tech	3 day	Add NaOH, to pH>10	
11	Iron	Phenanthroline	ISO Tech	3 day	Add HNO3 to p H <2	
12	Total Dissolved Solid (TDS)	sens ion5 Conductivity Meter (HACH)	ISO Tech	3 day	Refrigerate	
16	Arsenic	AAS	Irrigation Dept	3 day	Add HNO3 to p H <2	1000
17	Mecury	AAS	Irrigation Dept	3 day		
18	Lead	AAS	Irrigation Dept	3 day		

Step 5: Samples preservation




Samples preservation for laboratory test

Step 6: Packing and transportation

- Always keep temperature < 4C with ice in ice boxes
- Avoid leakage with plastic bags
- Label the ice boxes

Step 7: Laboratory test

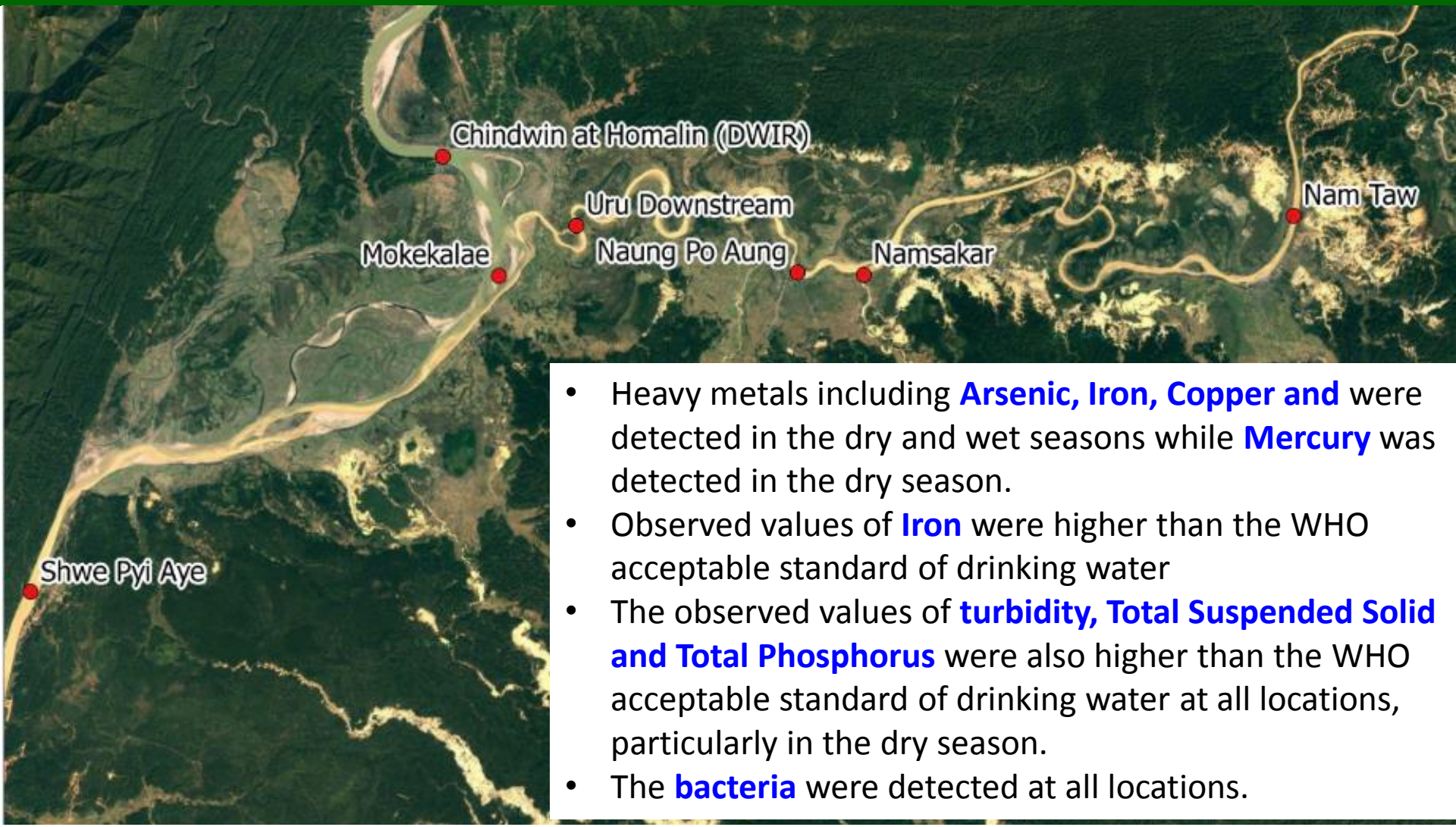
Thailand

State of water quality in 2016

Homalin

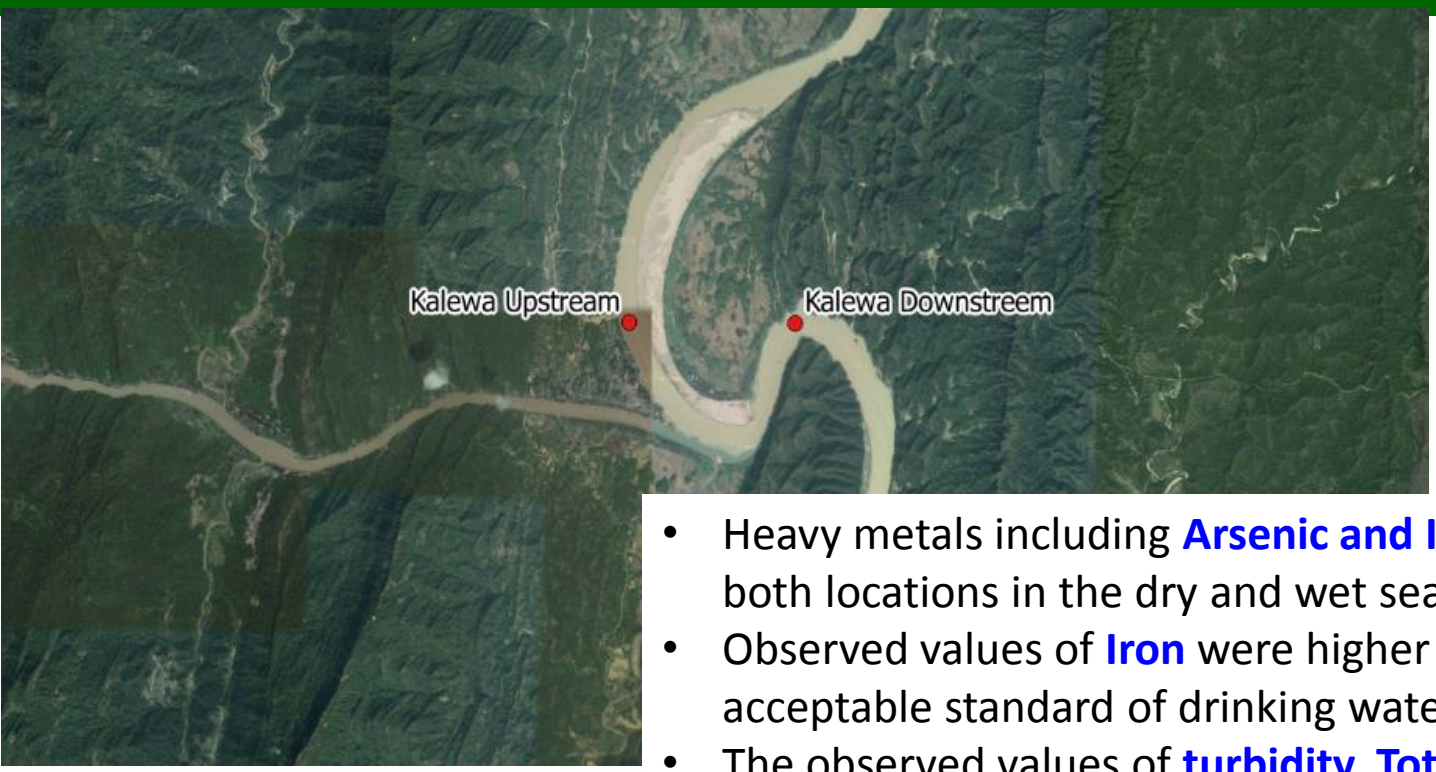
Monywa

Key findings: Homalin



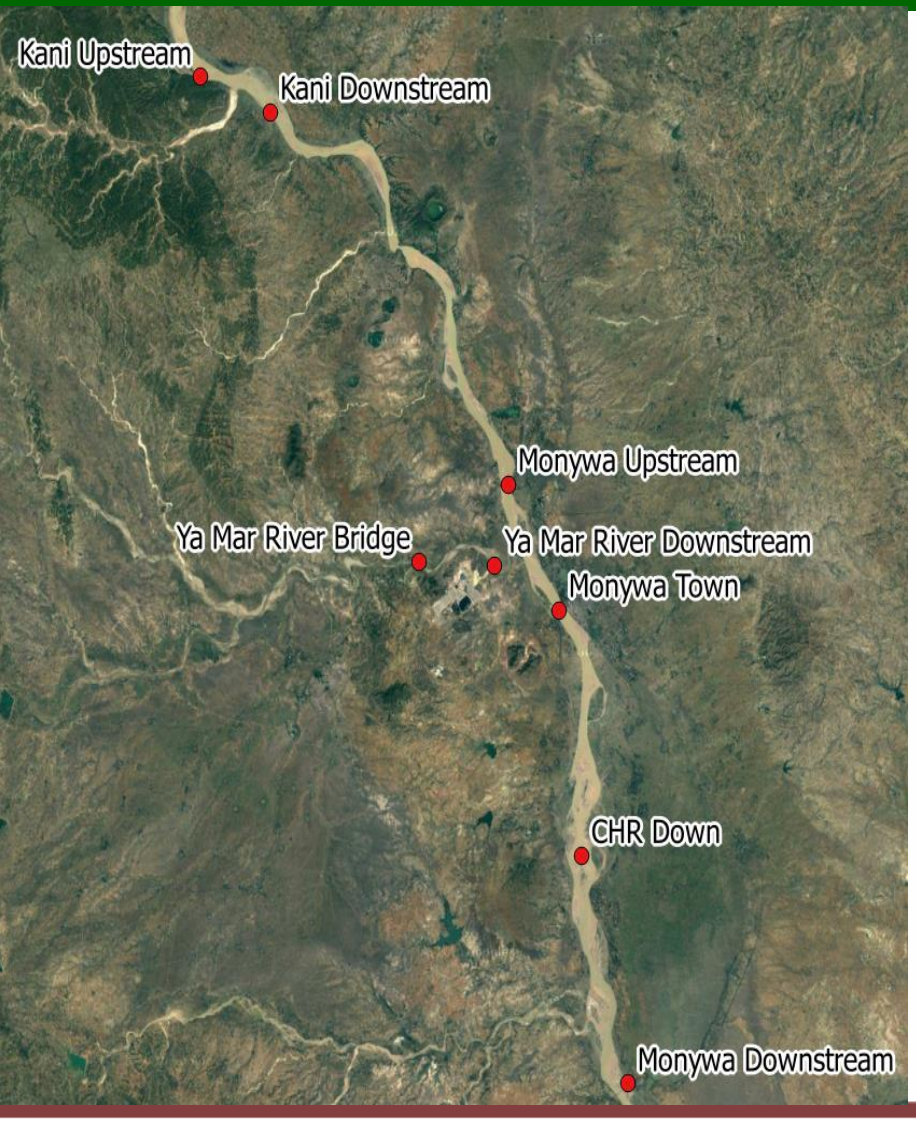
- Heavy metals including **Arsenic, Iron, Copper and** were detected in the dry and wet seasons while **Mercury** was detected in the dry season.
- Observed values of **Iron** were higher than the WHO acceptable standard of drinking water
- The observed values of **turbidity, Total Suspended Solid and Total Phosphorus** were also higher than the WHO acceptable standard of drinking water at all locations, particularly in the dry season.
- The **bacteria** were detected at all locations.

Key findings: Kalewa



- Heavy metals including **Arsenic and Iron** were detected at both locations in the dry and wet seasons.
- Observed values of **Iron** were higher than the WHO acceptable standard of drinking water at both locations.
- The observed values of **turbidity, Total Suspended Solid and Total Phosphorus** were also higher than the WHO acceptable standard of drinking water at all locations, particularly in the dry season..
- The **bacteria** were detected at all locations.

Key findings: Monywa and Kani



- Heavy metals including **Arsenic, Copper, Iron and Mercury** were detected at all locations and **Lead** was detected at Kani downstream and Ya Mar River and Monywa town.
- Observed values of **Iron** were higher than the WHO acceptable standard of drinking water at all location in the dry and wet seasons
- The observed values of **turbidity and Total Suspended Solid** were also higher than the WHO acceptable standard of drinking water at all locations, particularly in the dry season.
- **In Ya Mar River,** observed values of **Electric Conductivity** in the dry season were higher than the WHO acceptable standard of drinking water .
- The **bacteria** were detected at all locations.

Key challenges

1) Resources and capacity: Limited
2) Logistic: Take long time
3) Measurement techniques, tools and laboratories: Increase more parameters for heavy metals and improve water samples preservation and laboratory standards
4) Data reliability: Using different techniques and methods
5) Water quality standard/classification for surface and groundwater: No standard
6) Institution: Need more coordination and data sharing

Recommendations (1/3)

1) **Water quality monitoring should continue** at strategic locations, particularly for
   1) detected heavy metals including **Arsenic, Iron, Mercury, Copper,** and **Lead**
   2) other parameters such as **turbidity, Total Suspended Solid and Total Phosphorus** which have values higher than the WHO acceptable standard of drinking water

2) **Water treatment systems for drinking water are required** at all locations to remove turbidity, total suspended solid, total phosphorus, iron and mercury from raw water sources in Chindwin, Uru and Ya Mar Rivers.

3) **Further studies** and investigations are recommended on **sources of water pollutions and consequence impacts on human and environmental health.**

Recommendations (2/3)

4) **Awareness raising to relevant stakeholders** (local people, farmers, private sectors, etc.) is necessary since many people living in Chindwin Basin are using water directly from the rivers and other sources without any treatment. It is important that they know the state of water quality in the basin for proper water uses and also basic household-level water treatment methods.

5) **Engagement with and building relevant capacities of local agencies and communities in water quality monitoring** will help increase number of water samplings and thus improve the accuracy of future water quality study in Chindwin River Basin.

6) **Chindwind RBO can help to coordinate water quality issues** among different institutions in Chindwin River Basin

Recommendations (3/3)

Stakeholders	Issues	Action needs
Central and Regional Government	Many institutions working on water quality, sometimes overlapping work	Coordination and data sharing between institutions Improvement of water quality monitoring system
Local government and local communities	Need to understand the risk faced by the villages, and how to deal with these risks	Capacity and campaigns to raise awareness about water quality issues
Private sectors	Need to decrease pollution and avoid contact with contaminated waters	Water treatment systems Pollution control systems Regulations
Universities	Need to understand status, pollution sources and potential impacts	Detail studies and providing evident information to decision makers

Way forwards

Empowering Civil Society and Governmental Agencies to Mainstream Biodiversity and Ecosystem Service Values into Development Plans for the Chindwin River Basin, Myanmar

Apr 2017- Mar 2019 (2 years)

under Critical Ecosystem Partnership Fund (CEPF)

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THANK YOU